Risk Management in Toll Road Concessions

by

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Submitted to the Department of Civil and Environmental Engineering
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE in CIVIL ENGINEERING

at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

February 2003

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ABSTRACT

With a degrading road infrastructure and dwindling public funds, governments are turning towards the private sector to develop roads and finance them though toll revenues. However, these high stakes endeavors were not always successful; in other words, they were not able to provide a fair return to the sponsors and investors while guaranteeing the public welfare and satisfying the government interests. A review of the international experience of toll roads, with a focus on developing countries, suggests that if a thorough and pertinent risk management program is implemented by private concessionaires, with the support of the government, then many risks could be mitigated, thus reducing the exposure of both the private sponsor and the government.

Thus, in this study, we suggest a three-step risk management process. This first step of this process consists of identifying and classifying the risks in toll roads, according to the milieu from which they stem (project, market, country); the second step is an investigation in an array of risk mitigation strategies that are relevant to one or more risk categories; finally, the third step is risk analysis which consists of accounting for risks when evaluating a project. In the last two chapters, we will embody major issues in risk management in two case studies: In the first case study, New Batinah Highway project, we focus on the value of flexibility in toll roads and in the second case study, Melbourne City Link project, we focus mainly on the role of project organization and financial structure in risk management.

Finally, in the conclusion, we emphasize that the private sponsor cannot be the only player in the risk management process but government support and commitment are vital. Thus we redefine the role of the government and the role of the private concessionaire in the provision of toll roads.

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ACKNOWLEDGMENTS

I dedicate this thesis to my mother for her invaluable support, to my two sisters for their encouragement and to the soul of my father, my indelible source of strength and faith. May God bless all of them.

I would like to express my gratitude to Professor Fred Moavenzadeh, for his guidance and his constructive comments.

I would like also to thank my professors at MIT and at AUB for their generosity in transmitting knowledge.

Special thanks to all my friends here at MIT, with whom I spent memorable moments, to my old friends who always kept in touch, in spite of the distances that separate us, and to my beloved family, abroad and in my home country.

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Introduction

The experience of toll roads started many decades ago and gained momentum recently with the privatization of infrastructure projects in the road sector. It was initiated in developed countries, mainly Europe and the United States of America, and widespread to developing countries in Asia, Africa and Latin America with the Public-Private Partnerships (PPP) initiative of the World Bank. Many failures in private toll roads, especially in Asia and Latin America, outweigh the successes achieved in this field, which leads us to bring up the high stakes private investors are committed to and the way these investors should approach and manage risks.

Indeed, the failure in these toll roads triggered different studies which tried to question the ability of the private sector to deliver viable toll roads, as well as its efficiency, as compared to the public sector. Few of these studies adopted the standpoint of the private investor and developed strategies that allow the latter to cope with the high stakes involved. Thus, the idea of this thesis was incepted with the premise that the question to raise is not anymore whether the private investor is able or not to deliver public infrastructure projects, but rather how the private sector can make use of instruments available in the capital market, in combination with the support from the government and the multilateral agencies, in order to cope with these high stakes. The approach adopted consists of reviewing different case studies on toll roads, included mainly in the World Bank database, and uncovering the commonalities in these toll roads to be able to derive a more general scheme.

Thus we start chapter one with a general overview of the international experience of toll roads and then we briefly explain how these projects are commonly procured under a Build-Operate-Transfer (BOT) arrangement, with an emphasis on the shift of the concessionaires from being network operators to being Ad hoc alliances and international developers, which affects the nature of risks they are facing. We will also try to justify the interest of the public sector in private toll roads and some of the initiatives taken by public authorities to encourage the participation in such projects. After having a clear vision of the risky environment of private road concessions, we will suggest a three-stage risk management framework as a template that can be followed by a private concessionaire. The three stages are: risk identification and classification, development of risk mitigation strategies and risk analysis in investment decision. These three stages correspond consecutively to chapters two, three and four.

In chapter two, we propose a classification for the risks according to the environment from which they stem; thus we divide risks into project risks, country risks and market risks, and we elaborate on the different subcategories.

In chapter three, we suggest the major risk mitigation strategies with a focus on externalities rather than on how to control the construction process and estimates and predict cost and schedule overruns, because we believe that the viability of these large scale projects is more sensitive to these externalities than to the ritual project management processes commonly adopted.

In chapter four, we suggest and compare different risk analysis techniques which allow the investor to account for the risks in his investment decision.

In chapters five and six, we present two short case studies: In the first case study, the New Batinah Highway, we conduct a valuation for the modularity that can be sometimes implemented in the construction of toll roads; We try to assess the value of the option to start building a two-lane highway and to expand this highway if the expected demand materializes. As to the second case study, Melbourne City Link project, it represents the first hundred percent electronically tolled road, and in spite of the challenges it has faced, it was a big achievement for the State of Victoria. Thus, we will present this project, with an emphasis on the risks involved as well as the risk management strategies that were deployed.

Finally, in the conclusion, we highlight the complementary roles of both, the private concessionaire as well as the government in implementing a risk management framework for toll road projects.

Chapter 1 General Overview of Toll Road Concessions

The International Experience in Toll Road Concessions

The experience in delivering toll roads did not start in our century; In fact, in the 19th century, there were at least two thousand private companies operating toll roads in the United States of America, mainly the private turnpikes companies of the northeastern states. These were business corporations raising money by private stock subscription and paying dividends to the stockholders. However, in the US, road privatization gained momentum in Virginia, in 1988, with Virginia's private tollway law. Legislation for private toll roads was subsequently adopted in different states and Puerto Rico[1]. In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) allowed private capital to match Federal Highway Funds to increase investment in highway systems, which fostered private toll road development. Subsequently, different legislative and policy changes were included to foster private participation in toll roads; For example, in 1994, the Federal Highway Administration (FHWA) launched a demonstration program (Test and Evaluation program TE-045) to allow the states to leverage federal dollars in innovative finance strategies in order to increase private participation in infrastructure investments[2].

The pioneering initiatives in the US found followers in Europe, with the European Union stimulus, mainly in Anglo-Saxon, Nordic and Southern countries where deregulation generated new private toll road projects. These initiatives started to gain momentum early, in the 1980s, mainly in Great Britain with Thatcher's reforms and in France with Mitterrand's government, after an important nationalization trend in the cold war period, such as the nationalization of the Suez Canal Company and the grant of France's motorway concessions to public and semi-public companies[3].

As for Latin America and Asia, developing toll roads is relatively a recent practice promoted by the World Bank under the initiative of developing Public-Private Partnerships in infrastructure delivery; Mexico for example launched a very ambitious toll road development program between

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[1] Klein, D. and Fielding, G (1992) "Private Toll Roads: Learning from the 19th Century". The University of California Transportation Center.
[2] Giglio, J. (1996) "Fast Lane to the Future: The Privatization Route". Hudson Institute.
[3] Gomez-Ibanez, J. and Meyer, J. (1993) "Going Private: The International Experience with Transport Privatization." The Brookings Institution, Washington, D.C

1989 and 1994, aiming at building 5,000 km of new roads. However, the majority of these roads did not meet the projections and their financing had to be restructured, with a substantial contribution from the government. Table 1-1 shows the actual investments in roads that the private sector has committed by contract to deliver, between 1990 and 1997, in developing and transition economies. Investments in roads constitute 60% of the total investments in the transport sector, which shows the interest of the private investors in such projects, as well as the need for investing in an aging road infrastructure.

	Africa	East Asia	Eastern Europe	Latin America	Middle East	South Asia	Total
Number of transactions	5	102	2	93	0	6	208
Value in millions of $	426	18,567	1,086	18,794.8	0	63.5	38,937.3
% of total value of investments in transport[4]	88%	55%	61%	69%	0%	6%	**60%**

Table 1-1 Investment commitments of the private sector in the road sector, in developing and transition economies, between 1990 and 1997[5]

The interest of the public sector in involving private stakes in road delivery stems primarily from the insufficiency of the public funds and the increase in road capacity needs; In fact, even though the government collects gasoline taxes and other miscellaneous fees on vehicles, these revenues are being siphoned-off, almost in every country, towards other public expenses, leaving the road sector in atrophy. According to Maurits Westerhuis, Director-General of the International Road Federation (IRF[6]), two thirds of road-related taxes in Europe are diverted to the general budget, instead of being spent primarily on road infrastructure[7]. Moreover, the private sector is believed to be more cost conscious, efficient, technology and customer-oriented, which fosters its participation in toll roads. In fact, several reasons were suggested to justify why the private sector can deliver services at a lower cost in the case of the United States; The most commonly

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[4] Investments in transport include airport, port, rail and road projects.
[5] Estache, A. (1999) "Privatization and regulation of transport infrastructure in the 1990s: successes...and bugs to fix for the next millennium". The World Bank.
[6] The International Road Federation (IRF) is a non-governmental, not-for-profit organization with public and private sector members in some 70 countries. Its mission is to encourage and promote development and maintenance of better and safer roads and road networks.
[7] European Economic Summit 2001

proposed reasons are: (1) higher private sector salaries and incentives that attract effective management personnel, (2) absence of cumbersome regulations that impede procurement, (3) potential economies of scale that can be achieved by the private sector for example, by providing the same services in different cities, (4) less restrictive labor rules,(5) the ability to deduct capital depreciation and interest payments from taxes. However, these arguments (about the efficiency of the private sector) are still controversial and not always persuasive. Furthermore, new laws and regulations stemming from environmental concerns ("Clean Urban Transport"[8] actions in Europe and "Clean Air Act"[9] in the US) are putting more emphasis on the construction of capital intensive congestion relief toll tunnels[10], which provides more opportunities for private developers. These tunnels shift traffic off congested streets, reduce ground-level air pollution due to the electrostatic cleaning system embodied in the ventilation towers of the tunnels and lessen overall emissions by creating a nonstop traffic pattern. Finally, we can see that governments now, especially in European Union countries, are promoting toll roads as conforming to the globalization trend and the principle of territoriality, since it seems fairer for the users of the facility to pay for it, instead of charging the citizens high taxes for a facility they are not the exclusive users of.

In spite of the increasing interest of the public sector in private toll roads, private investors often consider these as risky endeavors; In fact, a recent research on the Asian infrastructure privatization market[11] was conducted, analyzing eighty-seven concession projects awarded between 1985 and 1998 and covering twelve Asian countries. Out of these eighty-seven concessions, fourteen were identified with major problems, six of which were private toll roads; knowing that twenty five out of the eighty seven concessions were toll roads, this gives a percentage of twenty four percent of partial or complete failure. Table 1-2 shows the major road concession projects in Asia with various problems. This high failure percentage coincides in fact with the Asian economic crisis in the 1990's, which had a big repercussion on toll road

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[8] "Clean Urban Transport" actions promote efficient, safe, environment friendly accessible and competitive transport systems which are essential to growth, employment and European Union competitiveness.
[9] The Clean Air Act is a federal law established in 1990, imposing pollution controls on all the states in America.
[10] Poole, R. and Sugimoto, Y. (1993) "Congestion Relief Toll Tunnels". Reason Policy Institute. Policy Study No 164.
[11] Kwak, Y. (2002) "Analyzing Asian Infrastructure Development Privatization Market". Journal of Construction Engineering and Management. March/April 2002

development in Asia. The risks involved in toll road projects will be thoroughly identified and classified in the following chapter.

Project	Value (US $ millions)	Major concessionaires	Country	Status	Problems
Second Stage Expressway	1,000	Kumagai Gumi	Thailand	Expropriated	Legal
Elevated Rail/Road Project	3,200	Hopewell	Thailand	Suspended	Financial
Don Muang Tollway	416	Dyckerhoff & Widman	Thailand	In Operation	Economic
Second Crossing Road	570	Renong	Malaysia	In Operation	Political
Pantai Expressway	240	Renong	Malaysia	Suspended	Managerial
Guangzhou-Zhuhai Highway	1,200	Hopewell	China	In Operation	Managerial

Table 1-2 Major Asian toll road concessions with various problems

In sum, development of private toll roads saw the light in the nineteenth century but gained momentum with the recent privatization trend in the infrastructure sector. The public authorities have many incentives to promote private toll roads but the latter are risky endeavors for the investors and many failures were depicted, especially during the Asian crisis. Thus, a proper risk management system should be implemented by every private concessionaire involved in toll roads.

We will look in the following part at toll road categories, the organization of toll road projects and the stakeholders involved, which will be a keystone in the study of risk management and allocation between major players.

Toll Road Categories

We identify four major toll roads categories: Congestion relievers, inter-city arterial roads, development roads and bridges and tunnels.

Congestion relievers are relatively short roads built to relieve traffic on existing urban routes. In general, they are expensive to build because of the high land costs in urban areas and the expensive amenities designed to ameliorate the objections of the built-up communities through which they pass. These congestion relievers face competition from the existing expressway network, thus they can count on heavy traffic mostly during the peak hours, when the untolled alternatives are normally congested. Moreover, the least-cost alignments through these areas usually have been exploited by public authorities, leaving the private concessionaire with a difficult and costly alternative. In general, tolls are not fixed on these roads but rather follow a variable pricing scheme, charging for example higher tolls during peak periods. In this way, tolling is becoming a mechanism to manage traffic demand on congested highways in big cities, besides being a financing mean.

Inter-city arterial roads are built to improve access between major cities and access to airport or port terminal complexes. These roads are generally long, high-capacity and serve heavy truck traffic, thus might be expensive and in consideration of the different types of users, different tolls might be charged.

Development roads are generally links between remote areas with urban centers or links between major transport routes. Their development can be viewed as an economic growth stimulus for the region but in general, these roads cannot be financed exclusively by tolls because the traffic volumes generated in the early operation phase are insufficient. Thus, many times, the government gives the concessionaire ancillary rights to develop the properties along the road and earn profits.

Finally, bridges and tunnels are also a category of toll roads and are most of the time built as congestion relievers. They are typically short, with high traffic volumes but they are very expensive to build, per kilometer, as compared to the other road categories.

Thus we can conclude that toll roads, with their different categories, should involve different commitments and risks from the part of the concessionaire as well as the government.

Organization of Toll Roads Concessions

The private sector is brought into the transport market through different ways: outsourcing, management contracts, leases, franchises, concessions, divestitures by license or sale and private

supply and operation[12]. Figure 1-1 shows the spectrum of options for ownership and operation of infrastructure, ranging from public supply and operation to full private supply and operation. According to this classification which is suggested by the World Bank, concessions include leasing, franchising and Build-Operate-Transfer (BOT) arrangements. However, within the scope of this study, we limit our definition of concessions to Build-Operate-Transfer arrangements, the most widely used delivery system in toll roads. The most common organization of BOT projects is shown in Figure 1-2.
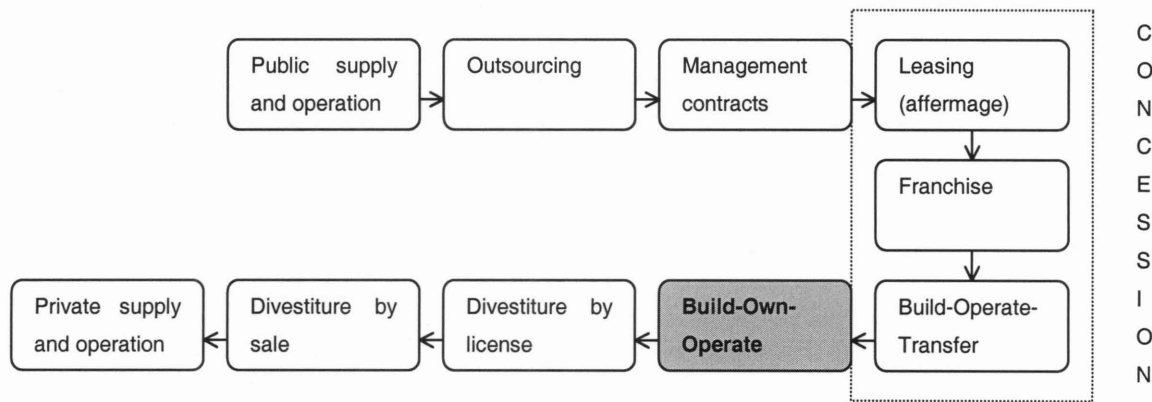
Figure 1-1 The spectrum of options for ownership and operation of infrastructure

(Adapted from "Concessions in Transport", TWU paper27, the World Bank, 1996)

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[12] Shaw, N., Gwilliam, K. and Thompson, L. (1996) "Concessions in Transport"-TWU paper-27. The World Bank.

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┌─────────────────────┐         ┌─────────────────────┐
│   International      │─────────│  Public Authorities  │
│   Organizations     │         │                      │
└─────────────────────┘         └─────────────────────┘
           Guarantees                    ▲ │
                                         │ │ Concession
                                         │ ▼ Contract
┌─────────────────────┐         ┌─────────────────────┐         ┌─────────────────────┐
│  Operator Company    │─────────│   Concessionaire     │─────────│   Public Works       │
│                      │         │                      │         │   Contractors        │
└─────────────────────┘         └─────────────────────┘         └─────────────────────┘
                ↖                         ▲ │
                 ↘  Insurance             │ │ Loans
                    Contract              │ ▼
┌─────────────────────┐         ┌─────────────────────┐
│  Insurance Companies │         │       Banks          │
│                      │         │                      │
└─────────────────────┘         └─────────────────────┘
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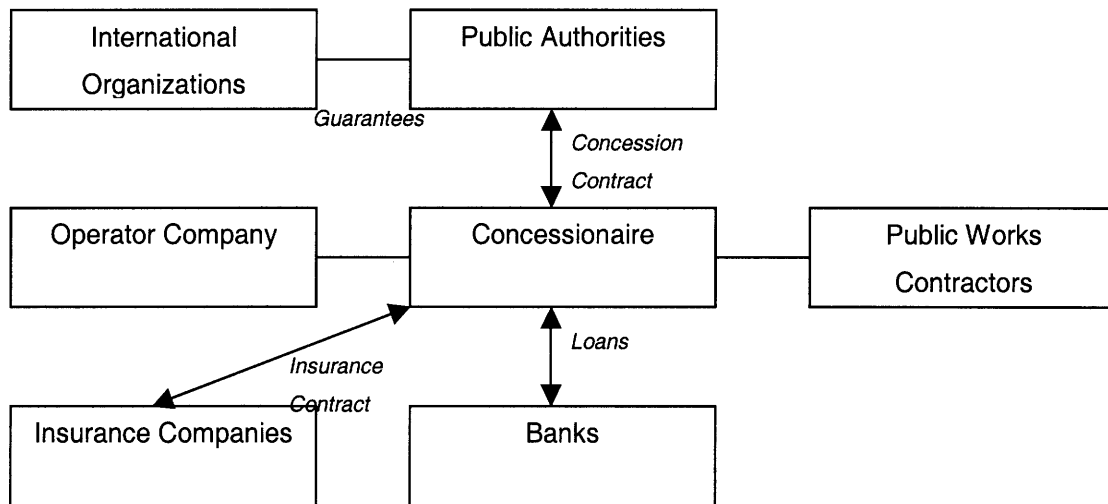
Figure 1-2 Organization of BOT projects

We define a "concession" or a BOT project, in the road sector, as a delivery system by which a public authority grants a private company specific rights to design, finance, construct, operate and maintain a road section, incorporating it within the existing network. The concessionaires cover investment costs and carry commercial risks since they rely on operation revenues to be remunerated. At the end of the concession period, the ownership of the road is transferred at no charge to the government and the initial capital investment is thus considered as a sunk cost. In most projects, the design responsibility is shared between the concessionaire and the government, with the latter taking the lead in corridor identification and preliminary design, leaving specific details to the private concessionaire, subject to the subsequent government approval. In general, the government preserves the right to expropriate the facility any time prior to the end of the concession period. However, in the termination clause provided in the contract agreement, the government should provide a formula by which the concessionaire will be compensated if he rescinds the concession, otherwise, the private concessionaire won't be encouraged to be involved in such endeavors. On the other hand, the private concessionaire can negotiate the franchise period with the public authority if the anticipated revenues cannot be realized in the set period.

In Europe, the majority of the concessionaires are semi-public and public companies[13], while in the United States, where capitalism and political liberalism are more accentuated, private concessionaires are increasingly participating in the provision of public infrastructure. In the United States, public infrastructure projects are open to competition to guarantee value for money, the fact that encourages private companies to participate in the sustainable development of infrastructure. In Europe, the government can award a particular concession contract to a local concession company without any competition. For example, in France, the road network covering the territory is shared by six semi-public and two private companies, represented by ASFA (Association des Sociétés Françaises d'Autoroute). Each company has a monopoly over the network development in a specific region of the territory[14]. However, the European Commission is currently promoting a fair competition in infrastructure projects, a competition open to all European concessionaires. In the EC Treaty and directive 93/37/EC, the EC recommends the application of rules of fair competition to public work projects exceeding 5 million ECU, excluding Value Added Tax (VAT), with some exceptions; this directive proposes opening the contract to competition at the European level, by publishing the concession announcement in the Official Journal of the European Community (OJEC), including the criteria of the award of the concession. Every European concession company can submit a bid and the concession authority can engage in a negotiation procedure to award the contract. This initiative encourages private companies to organize themselves into consortia and bid competitively on projects. Thus we can notice that road concessionaires are shifting from being network operators to being international concessionaires/developers and Ad hoc alliances with the unbundling trend Network operators take advantage of economies of scale, scope and network; an example of network operators is given the French motorway concessionaires. However, these network operators are being substituted by international concessionaire-developers who are specialized in a specific domain, which gives them a competitive advantage and allows them to build high entry barriers to the road construction industry. For example, Cofiroute, the French company, is shifting from being a network operator to being an international concessionaire-developer with many subsidiaries. It started road construction in the French territory and extended it to the

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[13] Bousquet, F. and Fayard, A. (2001) "Road Infrastructure Concession Practice in Europe", French Highway Directorate.
[14] Fayard, A. (1999). "The French Experience in Motorway Concession". World Bank.

American continent with SR91 project. Finally, Ad hoc alliances are alliances between entrepreneurs or engineering firms that wish to respond to bids and develop opportunities. These are very common in road infrastructure projects in the United States, Asia and Latin America.

As we have seen, there is a major interest in a competitive tendering process for equity issues and public welfare. However, the experience in toll roads shows that many times, the franchise duration has been renegotiated because the expected revenues did not materialize within the franchise term agreed upon in the initial concession contract. As a matter of fact, an innovative contract award process has been devised and was mainly applied in South America. It is called the Least-Present-Value of Revenue (LPVR) auction mechanism[15]. Under this mechanism, the public authority fixes the toll level and asks, in the bids, for the net present value of revenues (the discount rate is known to all bidders before the auction) that the private concessionaire will accept in order to build, finance, operate and maintain the road. The winner is the one who asks for the smallest net present value and the franchise ends when the present value of revenue equals the winning bid. Table 1-3summarizes the pros and cons of this innovative auction mechanism for infrastructure franchises.

Pros	Cons
1. The franchise holder does not have to make accurate demand forecasts.	1. The franchise holder does not have any incentive to increase traffic demand.
2. The post-contract renegotiations by the franchise holder are reduced.	2. The franchise duration is not accurately known by the participants.
3. The "fair" compensation, in case of contract termination, is easily determined.	
4. Changes in user fees have no effect on the revenues of the franchise holder.	

Table 1-3 Pros and Cons of Least-present-Value Auction mechanism for toll roads

On the other hand, another variation in the remuneration of toll roads is shadow tolls. This system is mainly implemented in Design-Build-Finance-Operate projects in the United Kingdom and aims at sharing the traffic risk between the concessionaire and the public authority;

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[15] Engel, E, Fisher, R and Galetovic, A (1997) " Revenue Based Auctions and Unbundling Infrastructure Franchises"- December, 1997, No.IFM-112

According to this system, the concessionaire does not collect tolls from the users but is remunerated by the public authority, based on the degree of the utilization of the road. Thus, this involves counting the number of users and paying the concessionaire on a pro rata basis according to this number. The payment to the concessionaire takes also into account the performance of the concessionaire, in terms of for example, the level of traffic disruption during repair work or the measures taken to increase road safety.[16]

As to the return to the investor in case of "conventional" tolling, the public authority regulates sometimes either toll levels or the rate of return in order to limit the profits of the private company. In toll level regulation, the public authority sets the toll level, which is function of the rate of inflation and the internal efficiency of the company. However, internal information about the company may not be truly disclosed to the public authority, which may lead to asymmetry in the information and consequently, erroneous estimation of tolls. We will come back to this principal-agent problem in subsequent parts. In rate of return regulation, the public authority sets the rate of return of the private company, which determines the tolls to be applied by the concessionaire. In case the rate of return is not achieved by the company, then the public authority keeps the right to change toll levels, which provides little incentive for the concessionaire to improve the service in order to increase the demand and consequently, the revenue. In many cases, concessionaires are not only remunerated through tolls but they may benefit from real estate development from the fact that real estate development creates demand for transport and conversely, the development of transport infrastructure increases the value of real estate assets. Therefore, in many instances, land and development rights are included in the concessions. However, this right might lead to little incentive for efficient operation after development profits have been realized, difficulty in determining the length of the concession and monopoly rents over the commercial operations, such as filling stations on highways. Moreover, sometimes, there can be commercial services agreements between the concessionaires and the public authority, and these agreements may last even after the concession period ends. For example, in California, toll road concession agreements allow commercial ventures such as service stations along the toll highways to operate for 99 years after the end of the concession, which was supposed to last 35 years.

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[16] www.fhwa.dot.gov/innovativefinance/stchapt1/html

In sum, we have seen that toll road projects are commonly delivered today as Build-Operate-Transfer projects to Ad hoc alliances and international developers rather than network operators. Many stakeholders are involved, such as the concessionaire, the public authority, the operator company, the contractors, the lenders, the insurance companies and the institutional organizations. Moreover, in an attempt to reduce commercial risks associated with toll revenues, a new auction mechanism called Least-Present-Value of Revenue Auction mechanism was implemented, and the government sometimes assumes part of this revenue risk through shadow tolls.

Indeed, many stakeholders are involved in toll roads and the risks are immense if not addressed conveniently. Thus, in the following part, we emphasize on the risk concept and we propose a framework for risk management in toll road concessions.

A Proposed Framework for Risk Management in Toll Road Concessions

The environment within which each construction project takes place is divided into three parts: certainty, uncertainty and risk. Certainty exists when the decision maker can accurately predict what will happen during project lifecycle. This does not happen very often in the construction industry. The opposite is uncertainty, and refers to situation where potential outcomes cannot be easily understood because there is no previous "history" relating to the situation being considered. As to risk, it is differentiated from uncertainty by the fact that it can be described in statistical terms. One way to measure risk is through the standard deviation of the distribution of expected outcomes. We will deal with risk analysis in subsequent parts. Thus, we limit ourselves now to the simple definition of risk as the chance of having an undesirable outcome that might deter some or all parts of a project.

Risk management is a system which aims to identify and quantify the risks to which the project is exposed so that a conscious decision can be taken on how to manage risks. It is not a pure quantitative analysis, but it is more a matter of common sense, analysis, judgment, intuition, experience and willingness to operate a disciplined approach to critical situations which threaten the success of a project.

Based on the conclusions drawn from IMEC[17] (International Program in the Management of Engineering and Construction) research program, two approaches for risk management were delineated: The "decisioneering" approach and the "managerial" approach. The decisioneering approach assumes that the future is probabilistic and focuses on projecting project's most likely future, after adjusting the outcomes for the level of risks. This approach is at the core of the Expected Value theory, the Expected Utility Theory and the Real Option theory and flexibility valuation. The managerial approach assumes that the future is indeterminate and focuses on the proactive responses and strategies of managers to shape the outcome of the project. This approach uses four different techniques for different risk categories: shape and mitigate, shift and allocate, influence and transform, and diversify. We will see in chapter three how the risk management strategies we will propose effectively focus on these four techniques.

Miller and Lessard divided risk categories according to two axes: specific / broad (or systemic) and high control/ low control; Specific risks affect only the project while broad risks affect a large number of participants. On the other hand, high control risks can be managed by one or more parties while low control risks are outside the control of any of the potential participants. Figure 1-3 illustrates theses different managerial approaches to risk management.

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[17] IMEC program studied the performance of sixty Large Engineering Projects, ten of which are in the road sector. The results of this research program are presented in (Lessard, D and Miller, R, 2001)
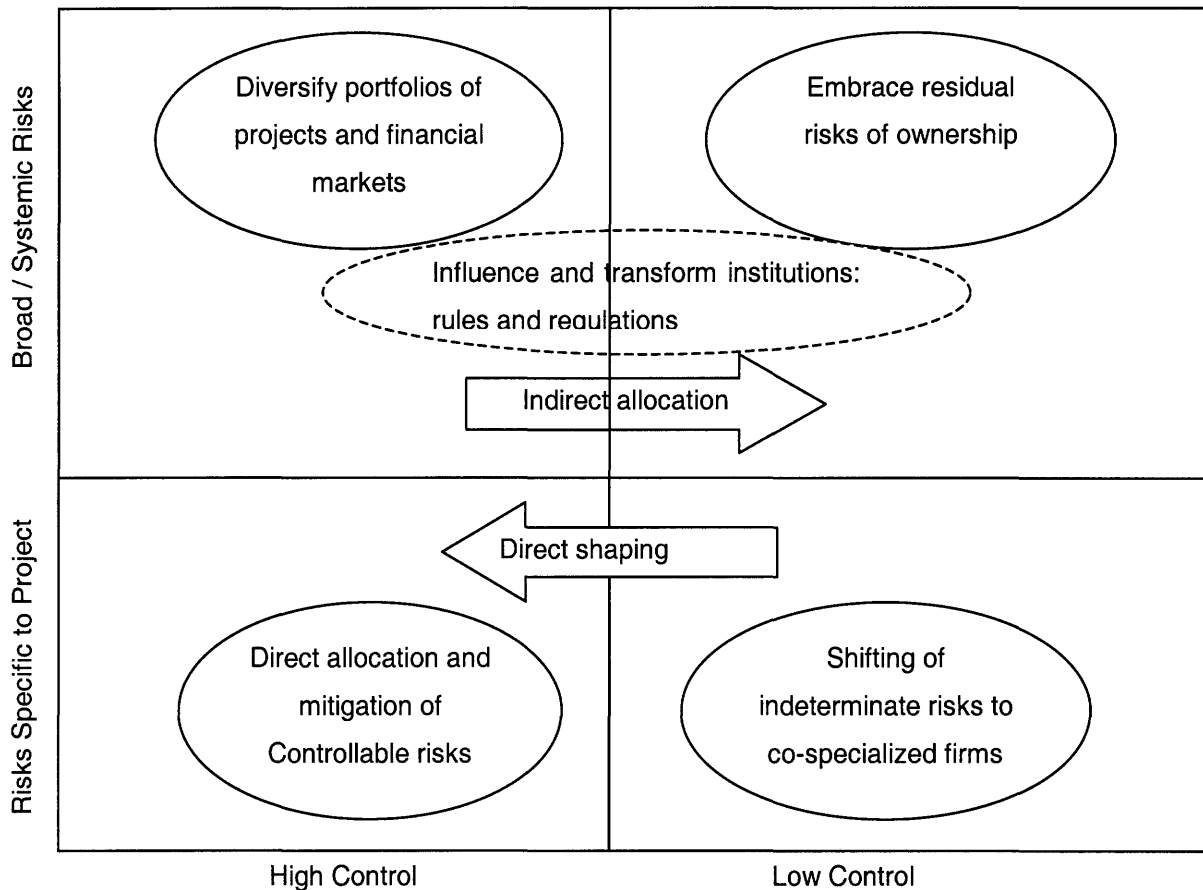
Figure 1-3 Managerial approaches to risk management

(Source: Lessard, D and Miller, R, 2001)

In our study, we adapted the previous risk management approaches, with other decisoneering approaches, in order to emphasize the most critical aspects in toll road projects, after having considered the strengths and weaknesses of different projects undergone in Europe, the United States, Latin America and Asia. Thus, we suggest the risk management framework in Figure 1-4, which we will be building, block by block, in the following chapters. The three main building blocks are risk identification and classification, the development of risk mitigation strategies and the accounting for risk in investment decision analysis. These three blocks are presented sequentially; however, we can identify feedbacks between the different phases of the management process. Thus risk management can be visualized as a dynamic rather than static and sequential process.

Risk identification and Classification	Risk Mitigation Strategies	Risk Analysis
– Project Risks	– Financial structure	– Expected Value Theory
– Market Risks	– Diversification	– Expected Utility Theory
– Country Risks	– Financial instruments	– Other approached
	– Incentives and contractual arrangements	dealing with uncertainty and complexity
	– Support from the Government	(sensitivity analysis and simulations)
	– Support from Global Multilateral institutions	– Decision Tree Analysis
	– Joint Ventures and Unbundling	– Real Options and Valuation of flexibilities
	– Options and Flexibilities	

Figure 1-4 Proposed Risk management framework

Chapter 2 Risk Identification and Classification

Risk identification constitutes the first stage in risk management and can be considered the keystone because once risks are identified, they cease to be real threats and they become more of management challenges. Risk identification involves identifying and classifying the types and sources of risks. Different classifications have been proposed: unique (diversifiable) or market (non diversifiable), controllable or uncontrollable, upside and downside, dependent or independent, inherent or external, corporation or project-related, management-related or technical. In particular, in this study, we classify risks according to the environment from which they stem; thus, we divide risks into three categorie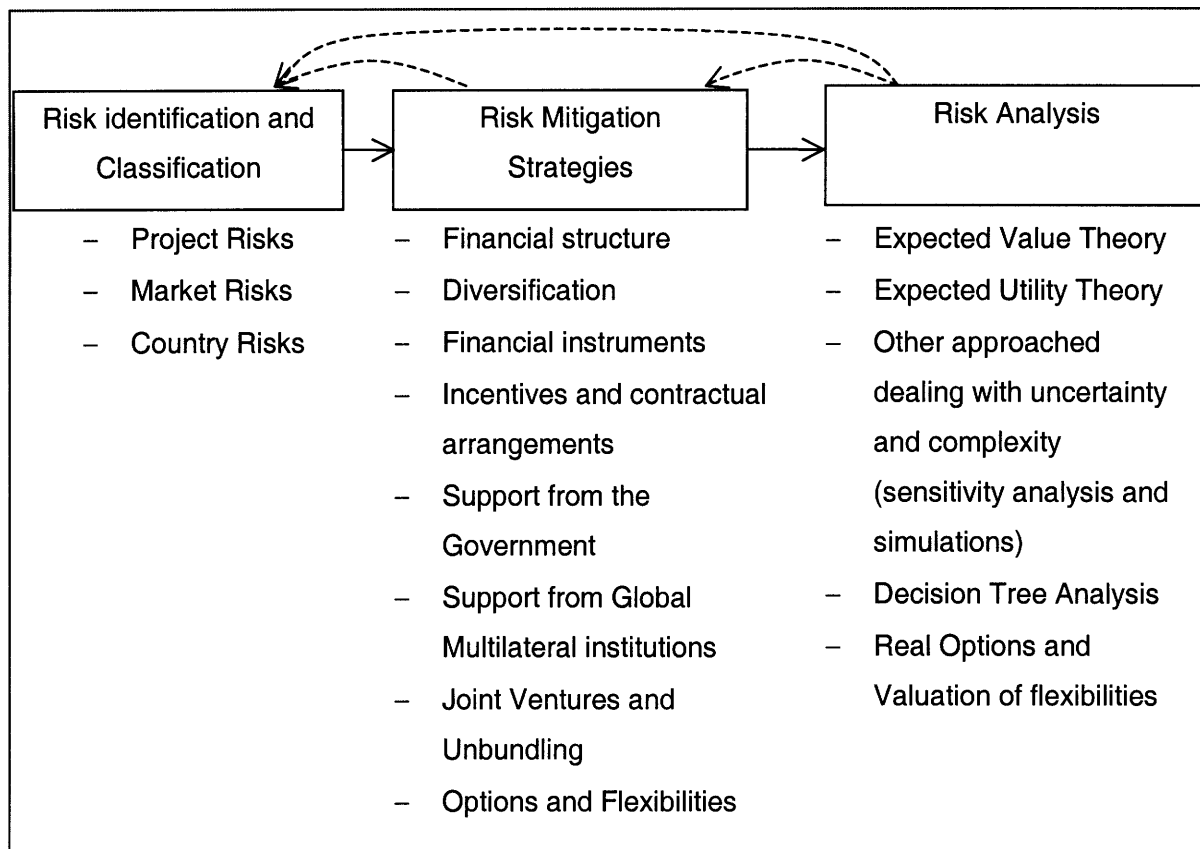s: Project risks, market risks and country risks. However, in the subsequent chapters, we will refer to the other classifications in order to emphasize a very specific feature. Throughout the following sections, we will make use of different examples for the sake of illustration of the risk categories. These examples are derived from the World Bank case studies database.[18]

Project Risks

Project risks are risks specific to the project itself or to the industry which the project relates to; In other words, an investor undertaking a project in the same country, under the same market conditions but with different characteristics (location, scope, organization, duration, and industry) is not necessarily subject to these specific risks. Project risks can be divided into three categories, according to the different stages in the project lifecycle: development risks, construction risks and operation risks.

Development Risks

Development risks are encountered by the concessionaire after the award of the concession contract and before the initiation of construction. At this stage, most of the risks are assumed by the sponsors who provide venture capital as seed money to launch the project. The three major risk factors in toll road experience facing concessionaires are the difficulties in the acquisition of the right-of-way, the environmental clearance and the creditworthiness of the project sponsor.

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[18] Review of Recent Toll Road Experience in Selected Countries and Preliminary Tool Kit for Toll Road Development. 1999. Study prepared by Padeco Ltd. for the World Bank and Ministry of Construction of Japan (MOCJ) as part of the Asian Toll Road Development Program.

Acquisition of the Right of Way

The acquisition of the right-of-way for a road can be provided by the government or it can be delegated to the private concessionaire; each government has his own provisions and regulations. Typically, governments own the land and lease it to concessionaires because they have the power of eminent domain, which gives them the right to acquire property.

For example, in the Colombian toll roads concessions signed in the 1990's, the National Road Institute, a governmental authority, agrees with the private concessionaire to supply the land by a certain date and the latter pays the owners through a trust fund established to develop the project. The governmental authority and the private concessionaire jointly establish the costs of land appropriation but the former has the authority to negotiate the land price with the owner, as long as the final payment is not more than twenty percent above the initial cost estimate agreed upon by the governmental authority and the concessionaire. In case negotiation between the governmental authority and the land owner fails, the former has the right to sequester the land. Whenever land costs exceed the sums in the agreement, the private concessionaire has the obligation to pay the incremental amounts, keeping the right to claim for reimbursement later, so that the project initiation is not delayed.

From the practice followed in the acquisition of the right-of-way in Colombia, we can conclude that the acquisition is a complex process and even if the government has stake in it, a substantial land cost increase may be enforced on the concessionaire, which should be considered prior to any involvement in such endeavors.

This issue has been adequately addressed in Chile where, in the concessions that took place since 1993, any increase in land costs is covered by the government. In fact, before the concession is bid out, consultants are hired to identify the necessary lots and appraise their value. Once this value is determined, the amount is included in the bid specifications for the concession and the concessionaire is supposed to include this amount in his bid. If the costs of expropriation are higher than estimated, than the Chilean Ministry of Public Works will assume the difference and fund the amount out of their operating budget. Moreover, the public agency bears the risk of delivering the expropriated properties as scheduled within the concession agreement. Thus, if the properties are delivered late, then the concessionaire is compensated for the delay.

Environmental Clearance

The second source of risk encountered at the development stage is the environmental clearance. This clearance is awarded when the project is judged conforming to the environmental statutes. Most of the environmental concerns are related to air quality, visual and aesthetic impacts, noise and vibration impacts, interference with ecosystems and parkland, construction waste disposal, hazards and risks (flooding, health and safety, accidents) as well as archaeological and cultural impacts. On one hand, environmental issues are addressed by governments, seeking the welfare of the community, but on the other hand, they are also addressed by financial institutions such as the European Bank for Reconstruction and Development (EBRD). The latter is committed "to promote, in the full range of activities, environmentally sound and sustainable development". Thus, it conducts very serious environmental assessments and audits in order to approve on funding a project in any of the 27 European countries in which it operates. As a matter of fact, we can associate with environmental clearance two major threats: A delay in the initiation of the construction due to holdups in the governmental approval process and a fund shortcoming due to the opposition of financial institutions such as the EBRD or the World Bank for example.

Creditworthiness

As to the sponsor's creditworthiness, it refers to the ability of the project sponsors to raise debt and equity in the capital market. Credit rate of projects and sponsors are provided by credit rating agencies such as Standard & Poor. In fact, due to major changes in the investments in the European toll road sector, Standard & Poor published its first special report on European toll roads in December 2001[19]. It provides credit analysis of publicly rated toll road companies and project-financed toll road transactions, incorporating valuable information for project sponsors and lending agencies. The credit of the sponsor can be enhanced through the provision of letters of credit from commercial banks. As to the project credit, it can be enhanced through an active and substantive stake to be taken by governments, through minimum annual guarantees that reduce traffic risks or through shadow tolling. We will look into these issues more in details in the risk mitigation strategies section. However, we need to bear in mind that the sponsor and the project creditworthiness are extremely important because they can substantially impact the financing cost of the project and consequently its viability.

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[19] Standards & Poor's. (2001). "Infrastructure Finance: European Toll Roads". Standards & Poor's Publications.

Construction Risks

Construction risks are encountered by the concessionaire during the construction of the road or the tunnel or the bridge. The main sources of construction risks are: differing site conditions, poor performance of the contractors and the suppliers, engineering difficulties and technical novelties. Differing site conditions stem from the fact that both sponsors and contractors base their cost estimates, schedules, designs and choice of construction techniques based on limited amount of information, just to meet contract obligations. Then, subsequently, in the course of construction, the site conditions might differ from the ones predicted, which will end up being very problematic, in particular in fixed cost contracts. Moreover, the performance of the contractors and suppliers might not meet the expectations of the sponsor, especially when the latter is a foreign investor who relies on the local manpower which might not have the required level of experience and expertise. We will add to this the threat of the engineering difficulties and technical novelties, mainly in bridges and tunnels. The major engineering challenges that have been encountered in tunnels are mainly associated with the geology of the site, the health risks of compressed air and the stability of the water level in submerged tunnels. The first tunnel project that comes to our mind is certainly the Big Dig in Boston and the major challenging bridge is the Northumberland Strait Crossing project. The latter faced the challenge of building the major spans offsite and then transporting them on-site with barges, in an estuary with high currents.

The resulting cost overruns in BOT projects are primarily assumed by the sponsor in case of fixed price concession contract, but renegotiation provisions can also be included in the contract terms. For example, in the Guangzhou-Shenzhen road project in China, where cost overruns were encountered, the private investor had to contribute additional $700 million in equity but the government approved on an increase in the profit sharing during the first ten years of operation. At this stage, equity provision was vital because lenders are unwilling to provide loans that have claims on nonexistent assets.

Operation Risks

Operation risks are encountered when the road is operated and tolls are collected. The three main risk areas are traffic demand, toll levels and toll collection technology.

Traffic Demand and Toll Level

Demand uncertainty and toll levels uncertainty can lead to inaccuracies in the estimation of the revenues which are supposed to cover construction, operation and maintenance. The risks resulting from these uncertainties are fully assumed by the sponsor or shared by the government when the latter provides minimum traffic and revenues guarantees. In fact, these risks are substantial due to the lack of credible forecasting methodologies; Even though the forecasting methodologies are more and more sophisticated, the error in the output is still important because of the poor quality of input parameters. Moreover, traffic volumes are very sensitive to income and economic growth. In particular, in toll roads that serve export activities, traffic volumes are very sensitive to exchange rate changes, which shows the extensive number of parameters that shape traffic levels.

To give an idea about the errors in traffic forecasts, out of fourteen toll roads considered in the states, according to an analysis conducted by Morgan[20], two experienced traffic levels greater than predicted while the traffic on the remaining twelve roads was between 20 to 75 percent less than predicted. In Hungary, the M1 Motorway attracted only fifty percent of its expected volume in its first year of operation and in the Mexican toll road concessions, traffic volumes were only one fifth of the forecasted levels.

The four major consideration areas that affect the quality of projections are: Data collection and modeling, traffic forecasting process, trip maker and travel behavior and external considerations. While the first three areas relate to the limitations of the forecasting tools, the last area, external considerations, considers issues generally outside the realm of the toll traffic and revenue forecaster, in particular, the development of competing facilities and the development of access facilities. These two issues raised many concerns in the toll road experience. For example, the development of the tolled road network in Bangkok provides a concrete example of the risks of competing facilities and access facilities encountered by a private toll road provider in a country with poor network planning. In fact, Thailand has three road development plans provided by three different public authorities:

> 1- A national intercity motorway network master plan implemented by the Department of Highways (DOH) under the Ministry of Transport and Communications (MOTC);

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[20] Muller, R.H. (1996). "Examining toll road feasibility studies". J.P Morgan Municipal Rd. Res. Rep., J.P. Morgan Securities, New York

2- A Bangkok-centered plan of the Expressway and Rapid Transit Authority (ETA) of Thailand, a state enterprise under the Ministry of Interior (MOI);

3- A combined road and railway scheme of the State Railway of Thailand (SRT), a state enterprise under MOTC.

Two roads, Don Muang Tollway developed between 1994 and 1998 under the national intercity motorway network master plan and the Bang Pa-in-Pakkret expressway developed between 1998 and 2000 under the Bangkok-centered plan of the Expressway and Rapid Transit Authority, run parallel and compete with each other. Consequently, in November 2001, Northern Expressway Co Ltd (NECL) claimed more than a billion baht in compensation for losses on its Bang Pa-in-Pakkret expressway[21]. It argued that its contract allowed it to demand compensation if a state project damaged its operation. Moreover, the concession agreement between Don Muang Tollway Public Company Limited and the Department of Highways specified that the government would construct new flyovers to allow radial movement of the traffic toward the new road. However, the government did not deliver for more than two years and prevented any toll road increase prior to the provision of the flyovers, which lead to toll revenues thirty percent less than expected and the sponsor went bankrupt.[22]

Toll Collection

As to the toll collection technology, it presents two major challenges: the technical challenge and the managerial challenge. The technical challenge refers to the reliability of the technology used to collect tolls. Two main state-of-art technologies are being used in Electronic Toll Collection Systems: The short-range systems where on-board units communicate with equipments installed on the roadsides and the satellite positioning and navigation systems and Global System Mobile, where the on-board unit communicates with a satellite. The reliability of these technologies is measured by the processing speed that they can exhibit, without any traffic disturbance, as well as the ability to equip vehicles with the necessary transponders and sensors. As to the managerial challenge, it concerns toll payment techniques and acceptance of the system by the users. In toll roads, the concessionaire normally assumes the responsibilities if the technology deployed for

[21] "Expressway company wants compensation". Bangkok Post. November 8, 2001.
[22] Ogunlana, S.O. (1997). "Build-Operate-Transfer procurement traps: Examples from transportation projects in Thailand". Proc., CIB W 92. Symp. on Procurement-A key to innovation, International Council for building Reasearch, Studies and Documentation, Rotterdam, The Netherlands, 585-594

toll collection fails. However, on the management side, the government can play a vital role in the enforcement of toll payments and the prosecution of drivers caught in an illegal situation.

Market Risks

Market risks or more precisely financial risks are associated with the factors that increase price volatility in the capital market. They do not affect a particular project only but rather affect all the industries in general. In this context, price refers to the price of traded goods, price of currency and price of loans. Thus, the financial risks we will be considering are: foreign exchange rate risks, interest rate risks and inflation risks.

Foreign Exchange Rate Risks

Foreign exchange rates started to be very volatile during the early 1970s, with the breakdown of the Bretton Woods system of fixed exchange rates. Under the Bretton Woods system, traders (importers and exporters) for example knew exactly how much they would receive in their local currency before concluding a deal. However, after the breakdown of Bretton Woods system, the rules changed and the real return on domestic versus foreign financial assets is substantially affected. In particular, adverse exchange rate movements may affect interest payments or other income streams received on a foreign currency-denominated asset[23].

Two major areas of concerns related to exchange rate risks were raised in toll road experience: currency devaluation and currency inconvertibility.

Currency Devaluation

The problem of currency devaluation affected toll road projects in Asian countries during the Asian crisis in the late 1990's. For the sponsors of these projects, debt servicing becomes very expensive if loans are issued in the home country and the currency of the host country, where the revenues are collected, is devaluated with respect to the currency of the home country. No adjustment for currency devaluation was provided in toll road calculation formulas, which drastically impeded many projects in Asia. However, the gravity of the issue was adequately

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[23] Smith, C., Smithson, C. and Wilford, D. (1989) "Managing financial risk". The institutional Investor Series in Finance.

addressed in Peru for example since concession contract terms provide a devaluation adjustment formula given by the following[24]:

$$P_t = P_{t-1} \times (1 - CPI_{t-1}) \times [1 + \beta(d_{t-1} - CPI_{t-1})] \, ;$$

Where P_t is the toll level adjusted for devaluation and inflation, in the national currency, for the period t; P_{t-1} is the toll level, in the national currency, for the previous year t-1; CPI $_{t-1}$ is the Consumer Price Index in the period t-1; d_{t-1} is the devaluation with respect to the sponsor foreign currency in the period t-1; β is a variable between 0 and 1, negotiated between the government and the concessionaire and representing the fraction of the difference between devaluation and inflation that should be passed through tolls. The toll level is thus adjusted for devaluation and inflation every six months using indices published by the National Statistics Office.

Currency Inconvertibility

On the other hand, currency inconvertibility controls are also a major issue to be addressed by private concessionaires investing in a foreign country. Those are controls imposed by the government of the host country on the free flow of funds in and out of the country. These controls manifest in the form of an active and/or passive blockage. An active blockage consists of an absolute ban to convert local funds for remittance and repatriation. A passive blockage consists of placing administrative obstructions in the bureaucratic approval and processing to convert local funds and repatriate them. A common form of passive blockage is the provision of tax disincentives, such as imposing progressive surcharges on an increasing amount of repatriated money. In fact, the issue of currency convertibility and profit repatriation was very critical in China, which prevented investors from securing long-term debts in the international market. As a matter of fact, in order to overcome the shortage in foreign debt due to high currency risks, the World Bank Group and China's State Development Planning Commission (SDPC) took the initiative to securitize the expressway system in order to finance new toll highways. In this respect, expressway development companies buy existing highway assets with mature traffic flow generating a stable income, then issue stocks through initial public offerings in the equity market in order to finance new projects. Thus, due to the discouragement of foreign investment through the legal and regulatory framework, we can see that toll highway

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[24] Estache, A., Romero, M, and Strong, J. (2000)."The Long and Winding Path to Private Financing and Regulation of Toll Roads". World Bank. Working Papers –Infrastructure, Telecoms, Power, Water

development was shared between three main local companies who tapped domestic capital to raise funds: Cheung Kong Infrastructure, New World Infrastructure and Road King Infrastructure[25].

Interest Rate Risks

Interest rate risks stem from the volatility of interest rates on bonds and loans. They result in two major effects:

First, financial institutions and their depositors become less willing to make long-term rate commitments, which impedes project financing through debt. In fact, when interest rates are highly volatile, savings banks may be stuck with long-term, low-rate loans to developers,that have to be financed with high-rate and volatile short-term funds. Thus, they are more reluctant to provide funds because a financial crisis might be generated.

Second, it becomes very difficult for the project sponsor to assess the expected real return of the project and the cost of transactions when the interest rates are volatile and when the sponsor is committed to floating interest rate loans.

Inflation Rate Risks

The inflation risks are the result of the volatility in the commodity markets. They affect both construction costs and toll revenues. In general, concessionaires account for inflation in the construction cost estimation and they are allowed to increase the toll levels in accordance with inflation. Thus, the exposure should not be drastic, unless an unexpectedly high inflation arises during the construction phase and then a decrease in inflation rate is observed during toll collection period.

In sum, financial risks can constitute a serious threat for the project, thus the sponsors should be able to identify them and draw a financial risk profile, which illustrates the impact of the financial price risk (foreign exchange rate risk, interest rate risk and inflation risk) on the project value. Thus simulation models can be used to examine the responsiveness of the project cash flow to changes in financial prices. For the sake of illustration, we give the example of the risk profiles of a US and a Japanese importer (Figure 2-1). As the price of the yen rises, the change in the US dollar price of the yen increases negatively and the dollar cost of the US importer's order

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[25] Nickesen, A. and Stanfield, M. (2000) "Toll road securitization in China". Roads & Highways Topic Note RH-3. The World Bank

increases, reducing the net cash flow. Conversely, the Yen cost of the Japanese importer's order decreases, increasing the net cash flow[26]
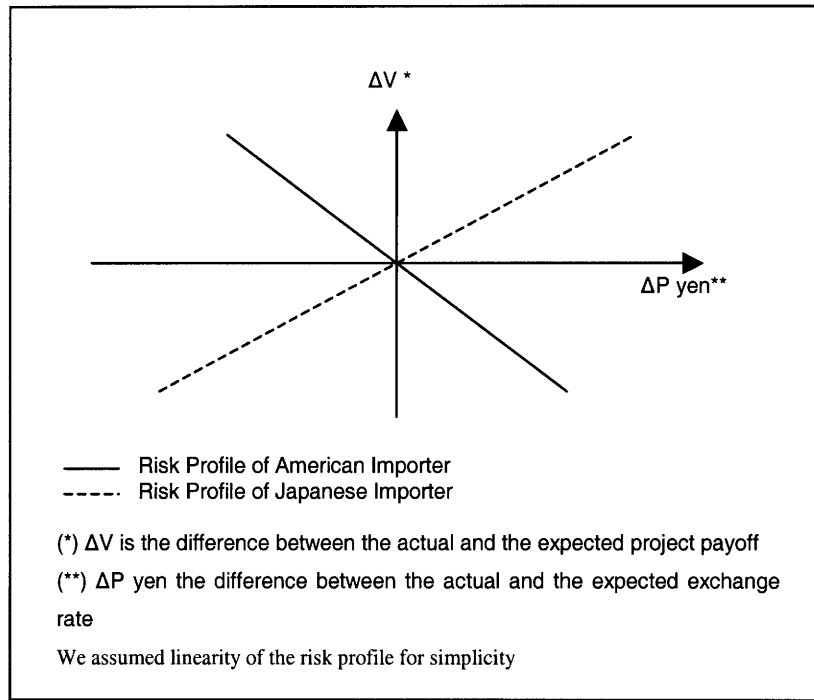
Figure 2-1 Sample of Financial Risk Profile

Country Risks

Country risks describe the risk of government actions that may endanger a project, as well as the risks of facing circumstances beyond the project developer's and government's control, such as natural disasters and wars. Country risks are divided into two categories: political risks and force majeure risks. Political risks can be divided into two subcategories: macrorisks and microrisks[27]. Macrorisks are general political events (such as regime changes, revolutions, warfare...) affecting most of country investments and business operations. On the other hand, microrisks hit specific fields of investment or business operations. We will focus in our analysis on microrisks characterizing toll road projects rather than macrorisks.

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[26] Smith, C., Smithson, C. and Wilford, D. (1989) "Managing financial risk". The institutional Investor Series in Finance
[27] Clark, E. and Marois, B. (1996) "Managing risk in international business". International Thomson Business Press.

Political Risks

Political risks are divided into five categories: Change in law, corruption, delay in approval, expropriation and local participants' reliability risk.

Change in law risk includes changes in the government's policies with respect to laws and regulations, methods of taxations, approvals and tariffs determination, after the date of signature of the concession agreement, which might sometimes render the performance of the project developer illegal.

As to the corruption risk, it is encountered when the government's officials and representatives solicit an unlawful consideration or commission, or utilize an unlawful influence. This will lead the concessionaire to either spend too much money on corrupt officials or to have the officials turn against the project.

The delay in approval risk refers to the fact that the public authorities do not process the approvals on time and often, they do not issue the approvals at all or even cancel the approved issues.

The expropriation risk occurs when the government expropriates the project without a fair compensation to the developer. The expropriation process can take the form of nationalization or "creeping" expropriation whereby the government imposes changes in taxes and tariffs to gradually takeover the facility and its generated operating revenues.

Finally, the local participants' reliability risks are most critical when the project sponsor is a foreign investor, not very familiar with the entities in the value chain such as the contractors, the suppliers, the operators, the lenders and others. The reliability and the creditworthiness of these participants are essential for the success of the project.

We recognize the Public Republic of China (PRC) as being on the top of the list of countries with high political risk profile, impeding the investments of many Engineering-Procurement-Construction (EPC) companies[28]. In PRC, political risks are mainly associated with difficulties and delays in the government licensing and approval process (especially the State Planning Commission in Beijing) , corruption at various levels of the government (frees passes to army sold on the black market, mafia-like labor brokers...) and expropriation of project assets (mostly creeping expropriation rather than full nationalization).

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[28] Wang, S., Tiong, R. Ting, S and Ashley, D. (2000) "Evaluation and management of political risks in China's BOT projects". Journal of Construction Engineering and Management. May-June 2000

Another Asian country with high political risks is Thailand. In fact, the political system in Thailand was very unstable in the 1990's: For the last seven governments (with 1997 as the reference date), the average life span was one year. Every government was a coalition of different parties, each with its own agenda. Thus, the new administration uses old contracts as soft targets for attack and the private concessionaires pay the price due to many problems such as those related to project agreement, right to operate the project, loan suspension, cost escalation and toll collection.[29]

Force Majeure

Force majeure risks are the risks related to natural catastrophes such as earthquakes or floods. These risks are beyond the control of the sponsor and the government.

In sum, country risks should be addressed by project sponsors before being involved in any project, in particular, in case of cross-border projects. However, it is hard to assess these risks on a quantitative scale; thus, many risk-rating services have established an index or scoring system. The major risk-rating services are Business International (BI) country-assessment service, Frost and Sullivan's world political risk services, International Reports International country-risk guide (ICRG), and the Business Environmental Risk Information's (BERI's) country-risk-rating service[30].

The inspection of different case studies on toll road concessions allowed us to identify and classify risks in three broad categories: project risks, market risks and country risks (Figure 2-2). If we refer to the classification proposed in figure Figure 1-3, we can see that the specific risks match with the project risks, while the broad risks match with market risks. This distinction will allow us to develop efficient risk management strategies in the following chapter.

[29] Ogunlana, S.O. (1997). " Build-Operate-Transfer procurement traps: Examples from transportation projects in Thailand." Proc., CIB W 92 Symp. on Procurement-A key to innovation , International Council for Building Research, Studies and Documentation, Rotterdam, the Netherlands, 585-594

[30] Ting, W. (1988) "Multinational Risk Assessment and Management". Quorum Books publishers

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                              │  Risks  │
                              └────┬────┘
        ┌──────────────────────────┼──────────────────────────┐
┌──────────────┐          ┌──────────────┐          ┌──────────────┐
│ Project Risks│          │ Market Risks │          │   Country    │
└──────┬───────┘          └──────┬───────┘          │    Risks     │
       │                         │                  └──────┬───────┘
  ┌────────────────────┐   ┌────────────────────┐    ┌────────────────────┐
  │ Development Risks   │   │ Foreign Exchange Rate│   │  Political Risks   │
  └────────────────────┘   │      Risks          │    └────────────────────┘
                           └────────────────────┘
  ┌────────────────────┐   ┌────────────────────┐    ┌────────────────────┐
  │ Construction Risks  │   │ Interest Rate Risks │    │   Force Majeure    │
  └────────────────────┘   └────────────────────┘    └────────────────────┘
  ┌────────────────────┐   ┌────────────────────┐
  │  Operation Risks    │   │  Inflation Risks    │
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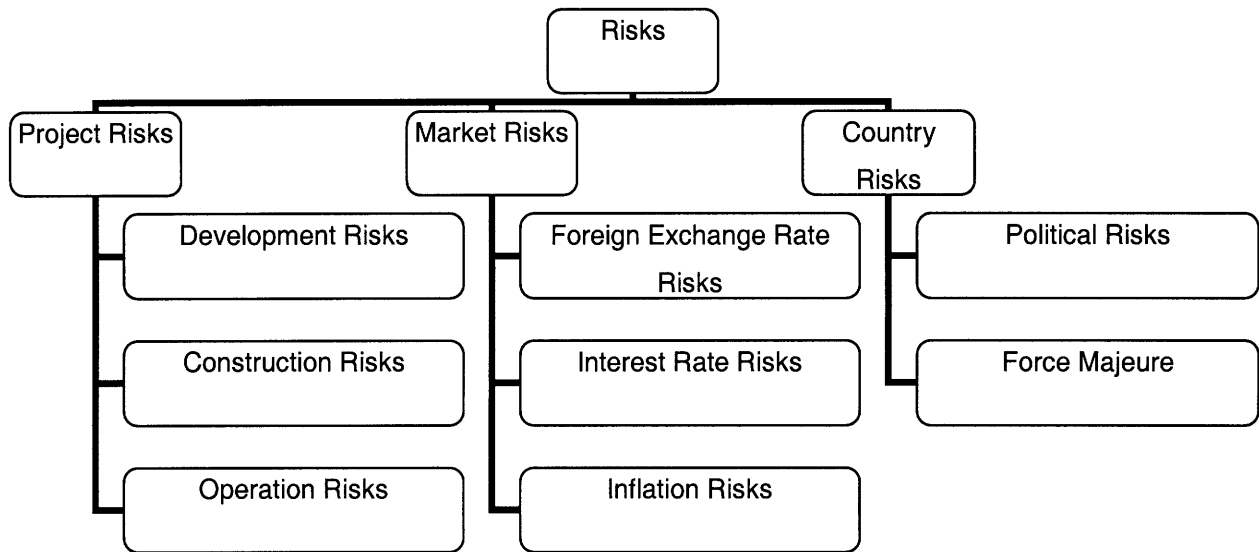
Figure 2-2 Risk Classification

Chapter 3 Risk Mitigation Strategies

Risk mitigation consists of developing tools and strategies to reduce risk exposure. We define four different response strategies that can be used alone or in combination in order to reduce this exposure: risk retention, risk reduction, risk transfer and risk avoidance. The risk response strategy depends on the severity of the risks and each stakeholder's objective, strength and attitude (risk seeker, risk neutral or risk averse). When designing a risk response strategy and shaping it according to the risk attitude, many hedging tools can be adopted. Thus, in this part, we focus on the important strategies already used or we suggest to be used in toll road projects.

Financial Structure

The financial structure of a project coincides with the repartition of the seed capital investment between investors, bondholders and equity holders, and the sharing of the revenues between them, with the gain proportions being function of the risks borne by each investor. According to the modern finance theory, the financial structure of a project does not change the return of a project. In other words, two projects with the same asset market risk (or total risk) have the same return, regardless of their capital structure. This asset market risk is measured by β, which is the ratio of the covariance between the project's return and the market return, and the variance of the market return. The Capital Asset Pricing Model (CAPM) allows us to obtain the return on asset with a specific risk level (β); it states that the return on any asset should be equal to the return on a risk free treasury bill, with equal maturity as the project economic life, plus a premium that accounts for the risk. The return on asset r_a is given by: $r_a = r_f + \beta\ (r_m - r_f)$; where r_f is the risk free interest rate and r_m is the market return. This return on asset can also be viewed as the weighted average return to investors:

$$r_a = \frac{E}{V} r_e + \frac{D}{V} r_d,$$ where r_e is the return on equity, r_d is the return on debt, E is the market value of equity, D the market value of Debt and V the total value of Equity and Debt. This formula emphasizes the fact that r_a is a given for a project but r_e and r_d change with the leverage. The assertion that the financial structure does not change the cost of capital is not in fact the complete truth; interest tax shields are considered gains because debts are tax deductible. Thus a more

accurate calculation of the cost of capital is provided by the following formula: $WACC = \dfrac{E}{V}r_e + \dfrac{D}{V}r_d(1-T)$ where T is the corporate tax rate.

Indeed, the financial structure does not affect the risks of the project; however, it allows allocating the risks to the parties most able to assume them. The core concept underlying the risk allocation through the financial structure is the seniority of debt to equity. In fact, equity can be viewed as a call option on project revenues with an exercise price equal to the debt. If the project revenues are not sufficient to pay back debt services, then the equity payoff is zero. And once the debt services are paid according to a preset formula, the remaining revenues will be all gained by the equity holders. This will allow us to match equity and debt with two types of risks, respectively: upside risks and downside risks.

Upside risks are risks, which, if properly controlled, can increase the value of the project. On the other hand, downside risks are risks, which, if properly controlled, prevent the value of the project from being less than the intrinsic value, however, do not increase the project value above its intrinsic value. Debt holders do not have an incentive to increase the project value above its intrinsic value because their gains are capped; on the other hand, equity holders gain from all the upside potentials, thus have incentives in controlling upside risks. As a matter of fact, in every project, upside and downside risks should be identified before deciding on the project financial structure. However, a clear-cut classification cannot be done and some risks are partly upside and partly downside. Moreover, many risks are hedged through contractual arrangements or financial instruments for example, thus will not be addressed in the financing structure.

In the context of toll roads, we can recognize some risk classes that can be hedged through the financial structure, such as construction risks, operation risks and risk of expropriation. Construction risks can be hedged by selling large equity stake to the contractor; the latter, not only is able to control the technical risks in construction, but will have also incentives to reduce the cost of the project because he will be entitled to part of the savings. Moreover, the operator company should also participate in equity provision if its performance affects the revenues of the project. On the other hand, selling a reasonable debt stake to a major commercial bank or a multilateral institution such as the World Bank serves to allocate much of the risk of expropriation of the facility and other country risks to the institution, which is going to resist any attempt, on the part of the government, to renegotiate the terms of the concessions to its own

advantage. In this way, not only the risks are reduced, but the incremental costs of renegotiation with the government are also trimmed. Furthermore, the governments do not have the slightest interest in defaulting to the World Bank loans because if the World Bank cuts off the government from any credit, it will be very difficult to get loans for the following infrastructure projects.

The project, however, is not always considered as dependable collateral for lenders; thus the latter either are reluctant to contribute or if they do so, they will request a very high rate of return. Thus, the government, when he is not allowed by law to share the debts of the project, he provides loan guarantees upon which he is committed to indemnify to bondholders in case of default. These guarantees are seen as a strong hedging tool against risks that cannot be controlled by parties in the concession consortium or lenders. We will deal more with other forms of government support in the following part.

Thus, we have so far discussed two major points:

First, the financial structure does reduce directly the risk of the project but rather allocates risk to the parties most able to assume it.

Second, equity holders have incentives to assume upside risks, while debt holders have incentives to assume downside risks.

The third point we will discuss now is the hierarchy in the claims on assets and its role in creating incentives and managing risks.[31]

Equity constitutes the risk capital and the basis for lenders or other investors providing more senior forms of capital to the project. Lenders look at equity investment as providing a margin or safety, thus encouraging them to have more stakes in the project. It is the last in priority for repayment, but as we mentioned earlier, it benefits from the upside potential of the project. Equity contribution takes the form of common stocks and preferred stocks. Preferred stocks are called so because they may be guaranteed by a sponsor willing to guarantee but unwilling to own the stock for some legal or other reason.

Subordinated debt (or mezzanine financing) is generally a fixed-rate, long-term and unsecured debt. It is senior to equity but junior to senior debt and other forms of secured loans. The providers of subordinated debt can be the concessionaire, the government[32], finance companies,

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[31] Frein, J. (1980) "Handbook of Construction Management and Organization". Van Nostrand Reinhold Company
[32] Under some regulations, a government agency sponsor often cannot take an equity position in a project for policy reasons. Thus, he may be able to provide subordinated debt to attract further senior debt.

risk capital companies or risk portfolio managers of insurance companies. Even though debt providers do not benefit from upside potentials, in many cases, the lenders are given stock warrants or stock conversion rights (often called sweeteners or equity kickers), which provide them with incentives for a better performance.

Senior debt is usually the first debt to be placed in the project because, at the early stages, the project is very risky and investors are not willing to tie large amounts of capital to a project unless they have the first claim on its assets. Senior debt is most commonly provided by commercial banks and falls in two categories, secured and unsecured loans; secured lenders have an advantage in liquidation over unsecured senior lenders.

Indeed, the previous risk management strategy can be implemented in case the project is incorporated as a separate, special purpose company. The opposite of this "project finance" is the "corporate finance" where projects are funded mainly from internal cash generation and the lenders look for repayment to the assets and the cash flow of the whole corporation which sponsors the project.

Diversification

The portfolio theory states that the expected return on a portfolio of assets is the weighted average return on individual investments, but the risk of the portfolio, measured by the standard deviation of the aggregated revenues, is smaller than the sum of the standard deviations of the investments considered individually. Thus, aggregating risky projects into one portfolio is a powerful strategy to reduce the risk of the aggregated projects.

This portfolio risk has two components: the unique or specific risk and the market risk. The unique risk is particular to a company and can be reduced by diversification, while the market risk is generated by economy wide perils that threaten all businesses and cannot be diversified. The unique risk can be diversified because of the correlation between individual investment risks: A correlation coefficient of +1 indicates that the risk of the portfolio will increase by one unit, while a zero correlation coefficient indicates that there is no overall correlation between individual investments in a portfolio and a correlation of -1 leads to a maximum diversification in a portfolio. In this last situation, the payoffs move in perfect lockstep and the unique risk becomes zero.

The concept of diversification in toll roads can be applied to franchise territories upon which the concessionaire is allowed to collect tolls on many roads or tunnels or bridges. The delivery of

concessions by packages was insinuated in many studies and was justified by the project economics of toll roads; in fact, on average, the traffic volumes must be in the range of 10,000-15,000 vehicles per day in order for toll revenues to be sufficient to cover construction, operating and financing costs. When corridors with these levels of traffic cannot be provided, the government should package different roads into one concession, which allows the sponsor to diversify his risk.

On the other hand, diversification can take place by investing in different types of investments or businesses. For example, Eurotunnel, the operator of the Channel Tunnel, is widening its operations to encompass retailing, property development and telecommunications; however, this diversification takes place at the expense of expertise, competitiveness, economies of scale and learning economies.

Finally, in the construction industry and in particular in infrastructure projects, there is no active management as in the investment world from which portfolio theory stems and where the investor can maintain a balance between return and risk of portfolio by buying and selling assets. In particular, infrastructure assets cannot be traded and the concessionaire is committed to build and operate the facility even if keeping the asset does not necessarily maximize the profit of the portfolio of investments. Thus, the advantages of diversification cannot be thoroughly captured in infrastructure projects, but reductions in risks can always be realized.

Financial Instruments

Financial instruments are off-balance-sheet instruments mainly used by project's sponsor or any other participants in order to hedge for the market risks. They are divided into four categories: Forward contracts, future contracts, swap contracts and option contracts.

Forward Contracts

A forward contract obligates its owner to buy a given asset on a specified date at a price specified at the origination of the contract. If, at maturity, the actual price is higher than the exercise price, the contract owner makes a profit; if the price is lower, the owner then suffers a loss. The major drawback of a forward contract is the fact that it exhibits performance risks or credit risks. In other terms, a party might default from paying. Thus, the performance risk should be addressed in contract terms. The default on a forward contract is similar to the default on a loan. A forward contract is thus considered as a credit instrument; it is suitable for parties who

have credit lines as a regular part of their business. However, the transaction costs of forward contracts are low, thus many people adopt these contract to hedge for market risks.

A forward contract can be a contract on foreign exchange rate, on interest rate and on a commodity.

In a foreign exchange forward contract, the buyer agrees to pay, at time t, a certain amount of money in currency x in order to receive a specific amount in currency y. The time path that the foreign exchange rate follows between the origination date and the maturity date is of no consequence. Foreign exchange forwards are traded in most major currencies with standard maturities. The extent to which a currency forward is available in a country depends on exchange controls, depth of alternative markets, and the monetary policy of the country. Moreover, because of regulatory differences among domestic markets, the reference market used to price a forward (i.e. to set a forward rate for a currency) is usually the Euromarket. The forward rate is given by the interest rate parity, a relationship based on arbitrage conditions between markets:

$\dfrac{F}{S} = \dfrac{1+i_2}{1+i_1}$ Where F and S are the forward and the spot exchange rates, respectively; i_2 is the

interest rate in country 2 and i_1 is the interest rate in country 1, taken most of the time as the United States. If country 2 is Japan, then F and S are given in ¥ per \$. Moreover, there is a bid-asks spread that compensates for the costs involved in providing the service of contracting (the major providers of such contracting services are banks); this bid-ask spread is measured by the difference in price quotes for a buyer and a seller.

Forward contracts on interest rates are also referred to as forward rate agreements or FRA. Although each institution that deals in FRA has its own terms and conditions, the British Bankers Association (BBA) terms and conditions have become the industry standard. Like a foreign exchange contract, it is essentially a credit instrument and no front-end cash transaction takes place; all value is conveyed at maturity. Whenever two parties enter in an FRA, the buyer will agree to pay to the seller on the settlement date if the contract rate exceeds the BBA interest settlement rate and the seller will agree to pay to the buyer on the settlement if BBA interest

settlement rate exceeds the contract rate; the amount to be paid is equal to: $\dfrac{|R-L| \times D \times A}{(B \times 100) + (L \times D)}$

Where L is BBA interest settlement rate (or LIBOR); R is the contract rate; D are the days in contract period; A is the contract amount; B =360 or 365, according to the market custom. L is

determined at the 11:00 AM London rate in the interbank market. The contract rate R is determined by the following: $(1+ {_0}R_j)^j (1+ {_j}R_k) = (1+ {_0}R_k)^k$, where: ${_0}R_j$ is the j-year interest rate today, ${_j}R_k$ is the forward rate from year j to year k, which is the contract rate and ${_0}R_k$ is the k-year interest rate today. Same as in foreign exchange forward contract, there is a deposit- borrow spread in the contract rate.

Futures Contracts

A futures contract, like a forward contract, obligates its owner to purchase a specified asset at a specified exercise price on the contract maturity date. The main difference between futures and forward contracts is the presence of four provisions that lower the credit risk: daily settlement, margin requirements, the clearinghouse and price limits. The daily settlement provision implies that the performance period of the contract is reduced to one business day and at the end of each day, the contract is marked to market, meaning that the two parties resettle the contract making the necessary payments. After the resettlement, the net present value of the contract is restored to zero. Thus, the futures contract can be viewed as an array of forward contracts; thus, with the reduced performance period, the default risk declines substantially. As to the remaining day-to-day credit risk, it is hedged through a surety bond, also called margin. At any point in time, the amount of the surety bond should be enough to cover the maximum change in the value of the contract that has occurred to date. In the futures market of the US, margins take the form of cash, bank line of credit or US treasury instruments; each party should have a separate margin account that should be kept above a limit called the maintenance margin. In this way, we can see that the credit risk is eliminated, however, two shortfalls remain: First, the parties still incur some costs associated with the evaluation of other traders' credit risk. Second, in case of default, if a contract is closed, then additional costs will be incurred to start sign another contract with another trader. To eliminate these two shortfalls, the clearinghouse intervenes in order to break apart and depersonalize the agreements. Finally, the default risk still persist only of the financial price moves so much in a single trading day. Thus, price limits are imposed; if the futures price moves beyond this limit, then the trading are halted on that contract for the remainder of the day.

Swap Contracts

A swap contract obligates two parties to exchange or swap specified cash flows at specified intervals. The most common form is interest rate swap, where one party pays a series of cash

flows determined by a fixed interest rate in return for a series of cash flows determined by a floating interest rate. The settlement date in a swap contract is the date at which the changes in values are transferred between the counterparties. The fact that this settlement date is less than the performance period means that the credit risk is reduced. However, it is still not eliminated and we can consider that this credit risk is greater than the risk in a forward contract but smaller than the risk in a futures contract. A swap contract can be viewed as a series of forward contracts stung together.

In sum, swaps and futures are portfolios of forward contracts. The payoff profiles for these three instruments are identical. The primary difference is the amount of default risk they impose on counterparties to the contract.

Option Contracts

The major difference between an option contract and the other contracts (forward, futures and swaps) is the fact that the owner of the contract does not have the obligation but the right to perform. Options are divided into two categories: call and put options. A call option gives its owner the right to buy an asset[33] at a specified future date, at a price agreed upon today. This priced is called the exercise price and reflects the expected price. A put option gives its owner the right to sell an asset at a specified future date and at a price agreed upon today. In fact Fisher Black and Myron Scholes demonstrated that a call option can be replicated by a continuously adjusting portfolio of two securities: forward contracts on the underlying asset and riskless securities. Thus options are thus not very different from the other financial contracts; in fact, selling a forward, future and swap contract is equivalent to buying a put option and selling a call option (put-call parity relationship). We can see in Figure 3-1the payoff of these contracts and the way they lead to a zero financial risk exposure

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[33] Here we mean by asset the financial price P which can be an interest rate, a foreign exchange rate or the price of a commodity.
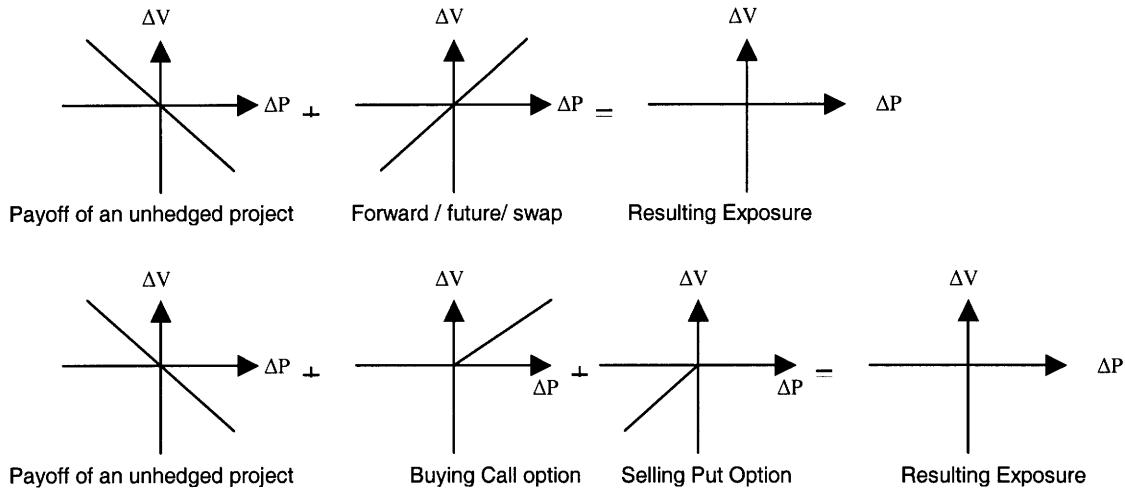
Figure 3-1 Building Blocks of Financial Instruments

Incentives and Contractual Arrangements

The contractual agreements between parties constitute a very important risk mitigation strategy because they rely on two concepts: incentives and legal accountability. Individuals are encouraged to perform if their performance is rewarded by a fee (and underperformance punished) and if they are subject to a legal prosecution in case of breach. These two concepts lie behind the principal-agent contract as well as the construction contracts in a concession.

Principal-agent contract

Corporations are structured in such a way that ownership and management are separated. This will allow share ownership to change without any interference with the operation of the business. It also allows the corporation to retain professional managers because shareholders may have the capabilities to provide the money without having deep knowledge of the business they are investing in.

Private infrastructure franchises are structured in the same manner: the owners or principals are the government, as well as the franchise board of directors which represents the shareholders, and both decide who the franchise Chief Executive Officer, or the agent, should be. The main objective of the government is economic efficiency and public welfare, while the main objective of the shareholders is financial return. However, the objective and risk attitude of the manager might not align with those of both principals, which create principal-agent conflicts. Moreover,

the discrepancy in the information between the agent and the principals will also aggravate these conflicts.

Thus, proper incentives schemes should be devised by the principals in order to make sure that the manager has the appropriate compensation when he acts in favor of both of them. However, the incentives provided by the government and the ones provided by the shareholders might conflict too, which will threaten the whole project and rises the question whether the project can be efficiently provided by the private sector.

Chiang[34] raised the previous concern and proposed an incentive framework for an infrastructure transport project where the principals are the government and the shareholders and the agent is charged of two tasks: transport service and property development. In the context of toll roads, this refers to cross-subsidizing the road with revenues from property development (residential or commercial). At the core of this framework was an explicit cooperation among the principals. Each principal should be restricted from basing his incentive scheme only on the dimension of the CEO's effort that is of primary concern to that principal; moreover, the principals should be prohibited any attempts to penalize the CEO for the efforts in other dimensions.

Thus, we can conclude that the governance of the franchise is of primary importance and a good franchise governance satisfies the interests of the principals, as well as the agents, and allows the concessionaire to attract investors and prevent any legal action between the manager and the shareholders, which might threaten the concession.

Construction Contracts

The main concern in these construction contracts is to apportion the risks between the sponsor, the designer, the operator, the contractors, the subcontractors and the suppliers using the liability (legal responsibility or accountability) as the main driver for performance.

The major risk mitigation components of such contracts are: positive and negative incentive clauses; surety bonds; and contract types.

We distinguish two types of incentive clauses: negative and positive incentive clauses. Negative incentive clauses, such as penalty and liquidated damages, decrease the contractor's fee (or subcontractor) when the actual performance is less than the expected performance. As to positive

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[34] Chiang, R. (2002) "Agency and incentive contract in private investment of transport project: An exploration of Fundamental relationships". Master's thesis. MIT

incentive clauses, they increase the contractor's (or subcontractor) fee when the actual performance is greater than that expected one.

As to surety bonds, they allow the transfer of some defaults risks to a surety company, which is normally an insurance company, a bank or a company specialized in providing sureties. The three types of surety bonds in use in the construction industry are: the bid bond, the performance bond and the labor and material payment bond. The bid bond ensures that the contractor will stand by his tender bid, while the performance bond ensures that the surety will manage to complete the project if the contractor defaults. The labor and material bonds protect employer for labour and material used on the project so that no liens are filed on the material or equipment by an unpaid party.

Finally, the choice of contract type is a major player is risk allocation: In cost reimbursable contracts, the contractor does not assume the risks associated with the stipulation of a fixed cost. As to fixed-price-contracts, they oblige the contractor to provide a certain amount of work at a fixed price, thus alleviating to a great extent the sponsor's risk. Moreover, contracts can be divided into traditional method-specification contracts and performance-based contracts. While the former specify for example the cubic meters of concrete cement to be used, the compacting method to be used in building the layers, the latter specify the road for example in terms of roughness, rutting or surface friction, vehicle processing speeds, which allow to transfer the risk to the party better able to decide on the most efficient way to direct a task in order to get a specific output.

In sum, adequate contracts should be tailored to each franchise in order to find the best combination of incentives in order to allocate the risk to the party most able to assume it. [35]

Government Support

The three categories of support tools provided by the government in toll road concessions are: Guarantees and insurances, subordinated loans and subsidies.

Equity guarantees are guarantees upon which the government provides the concessionaire with the option to buy out the franchise at a price that provides a minimum return on equity for the stockholders. However, the exercise of this guarantee should be triggered by very specific

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[35] "Impact of various construction contract types and clauses on project performance", Construction Industry Institute, Publication 5-1, July 1986

conditions agreed upon in the concession terms, otherwise, the private sector will not have enough incentives to perform.

As to debt guarantees, they commit the government to pay the lenders the principal as well as the interests in case of financial distress. They can also trigger government support in case of refinancing.

The government also provides guarantees to some financial risks, such as the exchange rate risks, and guarantees to support traffic revenues, such as minimum traffic and revenue guarantees or provision of shadow tolls. Moreover, some government agencies sell insurance policies to investors when private insurance is not available or prohibitively expensive. For example, the US government established The Overseas Private Investment Corporation (OPIC), an independent self-sustaining U.S. Government agency that sells risk insurance to encourage private investment by U.S. companies in some 140 emerging economies around the world. These risks include unanticipated political changes, economic downturns, the possibility that expected economic development in the region where the company invests may not materialize, or the risk that construction will not be successfully completed due to unforeseen circumstances.

The government can provide subordinated loans to fill the gap between senior debt and equity, increasing the leverage capacity of the project. From the public perspective, these loans will decrease the need for expensive private equity. From the sponsor perspective, these loans attract further senior loans. Moreover, to make the project less risky for the sponsor, the government may sometimes provide "reverse convertibles" which are equity, at the first stages of the project, but convert to loans when the project start to provide revenues.

Subsidies have no provision for repayment and are furnished by the government, either at the project inception, when the revenues are assessed insufficient to cover the total costs, or through negotiation with the sponsor, when the revenues are less than the expectations of the sponsor. In toll roads, which contain strong elements of natural monopoly, the variable cost is low and the fixed cost is high, leading to an average cost generally above the marginal cost,. However, for private investors to amortize their investment, they need to receive prices at least equal to the average cost. However, the optimal pricing should be marginal cost based to guarantee fairness and public welfare. Thus the difference between the marginal and the average cost is provided by the government as subsidies or shadow tolls.

Finally, we have mentioned the direct government support tools. Indeed, indirect support tools are vital. These include transparency and fairness, commitment and establishment of a mature and stable legal and regulatory framework.

Support from Global Multilateral Institutions

The International Monetary Fund (IMF) and the World Bank are two non profit, global multilateral institutions, established in the Bretton Woods conference in 1944 in order to provide direct support for financing and insuring infrastructure projects in developing countries. The two institutions played a vital role in providing support to toll road projects, mainly in Asia and Latin America.[36]

The World Bank's Partial Guarantees

Partial guarantees by the World Bank to private lenders have been triggered by many defaults in sovereign contractual obligations, which leads to the project sponsors' financial distress and consequently default on loans from commercial banks, in particular in private infrastructure projects in developing countries, during the debt crisis of 1980s and the Asian Financial crisis of the 1990s. The guarantees are called partial because they cover part of the risks, mainly country risks (political risks and force majeure). They can also extend to cover the risks in converting foreign exchange. These guarantees are issues to commercial lenders and can cover hundred percent of the principal and interest on the loan. In exchange of this guarantee, the World Bank requires a counterguarantee from the host government, as well as two fees to be paid either by the commercial bank (the lender) or by the sponsor (the borrower). These two fees are the standby fee and the guarantee fee. These partial risk guarantees are triggered by debt service default resulting from government non-compliance with one or more of its obligations as stipulated in the concession agreement with the concessionaire.

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[36] Philippe Benoit,(1996)"Project Finance at the World Bank" .World Bank Technical Paper 312, Washington, D.C.

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     Counter Guarantee          World Bank Guarantee
   ┌──────────────┐       ┌──────────────────┐       ┌────────────────────┐
   │  Government  │───────│  The World Bank  │───────│  Commercial Lenders │
   └──────────────┘       └──────────────────┘       └────────────────────┘
          │               ┌──────────────────┐                │
          │               │   Concessionaire │                │
   Concession             └──────────────────┘       Commercial Loans
                                   │
                          ╭────────────────────╮
                          │   Project Company   │
                          ╰────────────────────╯
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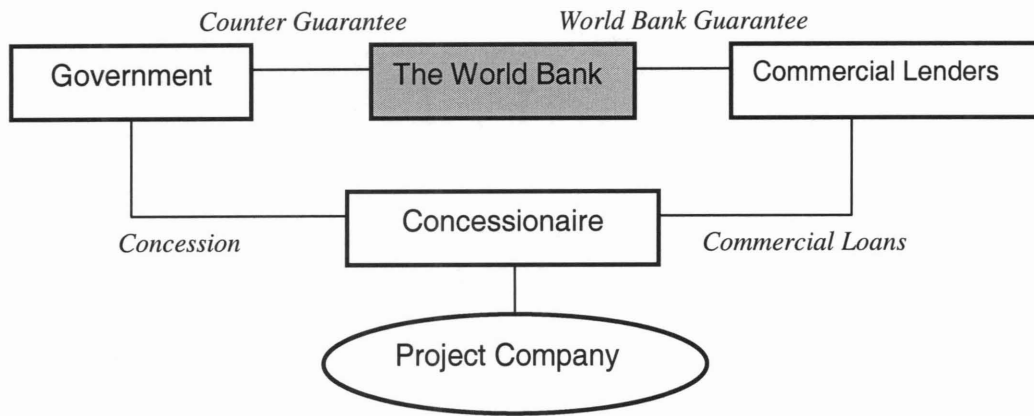
Figure 3-2 The World Bank's Partial Guarantees

MIGA's Political Risk Insurance

The Multilateral Investment Guarantee Agency (MIGA), an affiliate of the World Bank, provides investment guarantees against the risks of currency transfer, expropriation, war, civil disturbances and breach of contract by the host government. MIGA policies protect against losses arising from the investor's inability to convert local currency from the guaranteed investment into foreign exchange and to transfer it abroad. These policies also protect against losses due to actions depriving an investor of ownership or control of a project. These actions include nationalization as well as creeping expropriation. Finally, MIGA offers protection against losses from damage to tangible assets caused by politically motivated acts such as wars. MIGA can cover a wide range of investment vehicles such as equity, shareholder loans and management agreements. MIGA provides insurance with no host government counterguarantee.


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                          ┌──────────┐
                          │   MIGA   │
                          └──────────┘
   Insurance Coverage                      Insurance Coverage
   ┌──────────────┐                      ┌────────────────────┐
   │ Shareholders │                      │  Commercial Lenders │
   └──────────────┘                      └────────────────────┘
   Equity-bonds                           Commercial Loans
          ╭────────────────────────────────────╮
          │          Project Company            │
          ╰────────────────────────────────────╯
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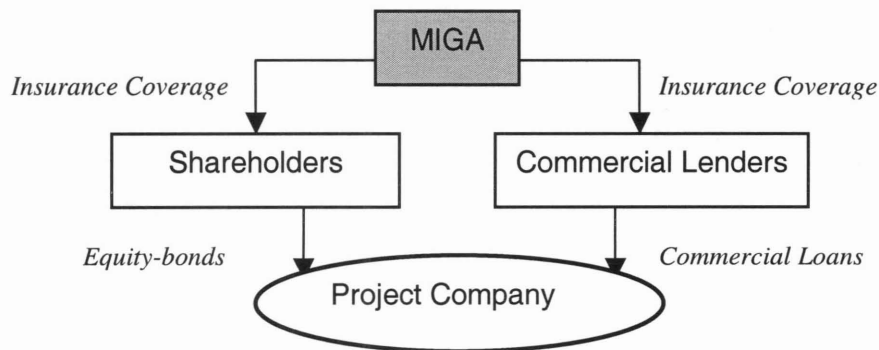
Figure 3-3 MIGA's political risk insurance

IMF'S Indirect Involvement

The International Monetary Fund (IMF) affects indirectly the environment in which private concessionaires operate in countries. During its regular consultations with government officials, it recommends policy changes to correct current problems such as inflation, unemployment, and balance-of-payments deficit, and it intervenes in the setting of taxes and tariffs. Thus IMF indirectly impacts the environment of a concession.

Joint Ventures and Unbundling

Joint ventures and other unbundled modes of market entry in the delivery of public infrastructure have frequently been cited as appropriate risk reduction strategies undertaken by sharing ownership, management and expertise with host-country nationals. We are here focusing on cross-border alliances, even though alliances can be considered between parties originated from the same country.

Unbundling in general refers to the separation and disaggregation of functional systems such as construction, operation, maintenance and technology from traditional ownership by foreign sponsors. Since these functional systems are not now exclusively held by the foreign sponsor, the latter is released from many liabilities.

In the case of joint ventures, however, the anticipated risk reduction may be short lived. In fact, at some point, the joint venture arrangement itself becomes a source of risk as differences in objectives and cross-cultural conflicts emerge. On the other hand, joint ventures may sometimes not be a choice but rather an obligation for the foreign sponsor; for example, Thailand restricts foreign ownership of construction companies up to 49% and Malaysia sets a target of 30% "Bumiputra" (people of Malaysian origin) share-holding in the public sector in the National Economic Policy. Similarly, in Vietnam and China, foreign construction companies tendering for projects must have at least one suitable local partner and are required to obtain a license on a project-by-project basis[37].

Appropriate strategies can be suggested to mitigate the risk factors in international construction joint ventures: First, the partner should be selected based mainly on its financial capability, relationship with the government, influence in local communities and reputation. Second, the joint venture agreement must cover the major critical areas such as the liabilities of the

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[37] Bing, L, Tiong, R, Fan, W and Chew, D. (1999). "Risk management in international construction joint ventures". Journal of construction engineering and management, vol. 125, No. 4

individual partners, the management structure, control and decision process, and the fair profit distribution policies. Third, the joint venture should choose experienced and familiar subcontractors and suppliers, and employ influential local organizations or individuals as logistic agents to strengthen the operations of the joint venture.

In sum, the unbundling trend in the delivery of private infrastructure project is noticeable, in particular, in road concessions where the contractor can be different from the operator, who can be different from the provider of the toll collection technology. This unbundling phenomenon allows the sponsor to package the work in such a way in order to delegate each package to a party able to face the major task challenges.

Introducing Options and Flexibilities

The value of options derives from the operating flexibilities and strategies embedded in a project. Different options can be identified: option to defer investment, option to default during staged construction, option to expand, option to contract, option to shut down and restart operations, option to abandon for salvage value, option to switch use and growth options. Options and flexibilities can be seen as risk hedging tools because they allow managers to stop the drainage of money on an investment that is going bad, to expand an investment that promises increased returns, to wait and acquire more information before getting involved in a project with high uncertainties and to switch use on a project. Even though we believe that options should be embedded and recognized in every project with uncertainties, the literature has not been generous in the provision of evaluations of options or flexibilities in the context of private toll roads. However, different options can be suggested: For example, sponsors can think of a modular investment in designing and building a highway to be easily expanded in the future. Moreover, a highway segment can be thought of as a growth option if the sponsor has the exclusive development right in the region. In an attempt to illustrate the value of flexibilities in toll roads, we will provide a case study analysis in chapter five.

In sum, we can summarize the risk mitigation strategies (we call them the four "s" strategies) in the following diagram.
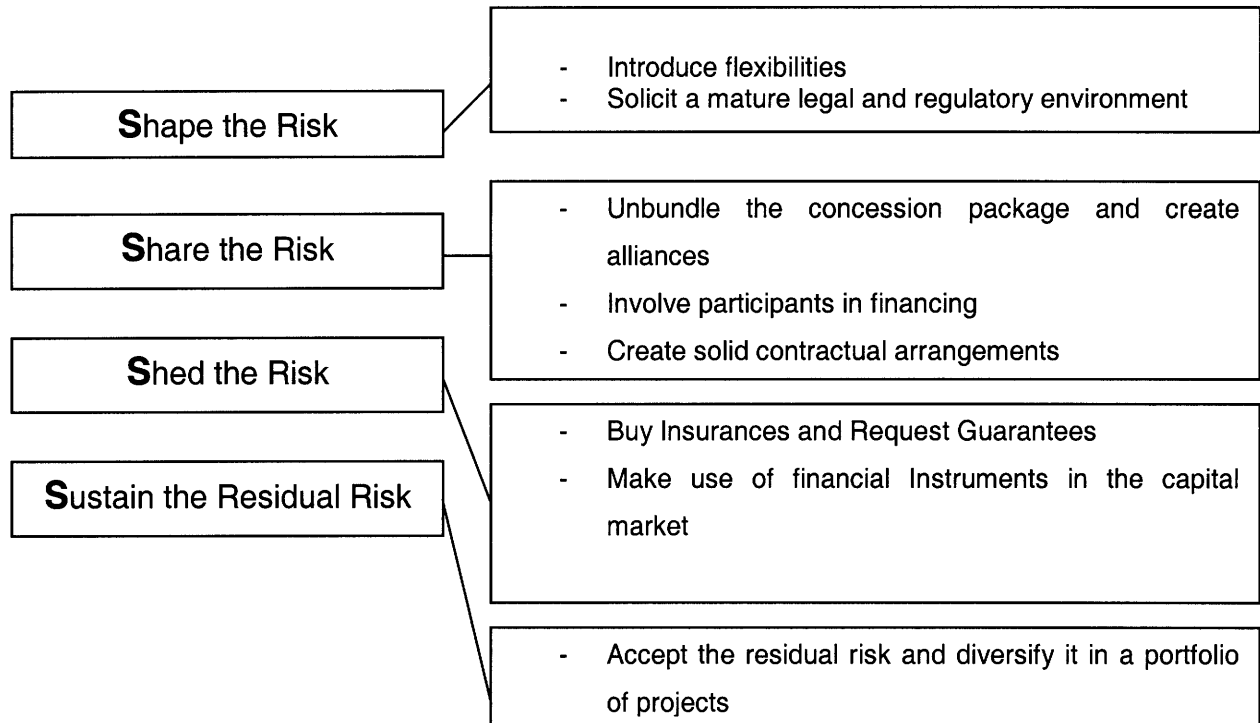
Figure 3-4 The four "S" strategies

Chapter 4 Risk Analysis

Risk analysis is an integral part in the risk management framework. It allows us to evaluate a project, knowing the cash flow as well as the return expected by the investors in exchange of assuming project risk. This is done through the Expected Net Present Value Approach. However, the cash flow cannot be accurately predicted, thus analysis tools were introduced such as sensitivity analysis, probability analysis (decision trees) and Monte Carlo simulations. However, the Net Present Value Approach does not account for the risk attitude. Thus the Utility approach can be used. Finally, The Expected Net Present value approach has a major drawback: Determining the exact discount rate that reflects the risk of the project and evaluating hidden flexibilities. Thus real options analysis can be used.

In the following sections, we will elaborate successively on the three approaches (Expected Net Present Value, Expected Utility and Real Options approach), pinpointing the advantages and disadvantages of each of these approaches.

Net Present Value Approach

The Net Present Value of a project is the sum of the cash flows generated by the project and discounted at the opportunity cost of capital. The opportunity cost of capital take into account three considerations:

First, a dollar today is worth more than a dollar tomorrow simply because today one can invest his money in the risk free treasury bonds and earn interest tomorrow. Thus, the project discount rate should be at least equal to the risk free interest rate.

Second, an investor expects higher returns from a risky investment than from a risk free one; otherwise, he would just limit his portfolio of investments to treasury bonds and not have stakes in any company. Therefore, a risk premium should be added to the risk free interest rate in order to account for the risk taking.

Third, the purchase power of a dollar today is greater than the purchase power of a dollar tomorrow. Thus, inflation rate should be added to the discount rate[38].

From these three observations, we conclude that the opportunity cost of capital for a project can be viewed as the sum of three components: the risk free interest rate, the risk premium and the

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[38] The real discount rate is <u>approximately</u> equal to the sum of the nominal discount rate and the inflation. The exact value is given by: 1+r nominal=(1+r real) (1+inflation rate)

inflation rate. Modern finance theory uses different approaches to evaluate the risk premium; the most widely used one is the Capital Asset Pricing Method we mentioned in a previous section. However, the risk-adjusted discount rate approach has many drawbacks in accounting for project risks:

First, it does not properly account for changes in project's own riskiness over its entire lifetime; by using a constant risk-adjusted discount rate, it assumes implicitly that the riskiness of the project cash flows is increasing at a constant rate over time. Even though this approach takes into account the decreasing reliability of cash flow forecasting, it overlooks the fact that risks change through project lifecycle.

Second, it assumes a risk premium that is in fact debatable and might not take into account the real risk level of the project; In fact, with all the risk categories we have identified previously in toll road projects, there is no doubt about the complexity and difficulty of estimating a risk premium.

Third, it predicts an expected scenario of cash flows and presumes that management is committed to a static investment strategy.

Fourth, it does not account for the attitude of the investor towards risk. It states that a project is worth undertaking if its net present value is positive, regardless of the willingness of the sponsor to assume risks.

One way to separate timing from risk adjustment in order to account for the changing project risk is through the Certainty-Equivalent value approach. At each year, the cash flow is adjusted in a way to account for the risk of that year and then all the cash flows will be discounted at the present using the risk free discount rate. In this case, risk adjustments are viewed more analytically. However, the remaining drawbacks of this approach still constitute major impediments that we will try to resolve through the remaining approaches.

Expected Utility Approach

The Expected Value Theory states that the investment decision to be taken should be the one with the maximum Expected Net Present Value. Thus, it ignores the sponsor's attitude to risk. However, decision-makers have different attitudes to risks; in other words, they make different decisions within the same risk environment. Some people are risk takers, willing to take additional risks on the expectation of a higher return. Others are risk neutral, indifferent to return,

except if it can be calculated to be worth the risk. Yet others are risk averse, willing to sacrifice the possibility of a higher return even for a relatively small risk. This risk attitude is concerned with the tradeoff that people will make between uncertain payoffs of known probability and sure payoffs, again with known probability. The tradeoffs are determined by asking the investors to specify how much sure money (the certainty equivalent) must be received to make them indifferent between the certainty equivalent and the expected value of a given amount that is not certain. Thus there is a relationship between money and utility where utility means the satisfaction the decision-maker receives from given quantities of money. The utility theory says that when individuals are faced with uncertainty, they make choices as if they are maximizing a given criterion, the expected utility. The utility function is a characteristic of an individual or a group, it is unique. It is illustrated in the form of a utility scale on the vertical axis and expected outcome on the horizontal axis. There are several methods applied to the assessment of a person's utility function such as the von Neumann-Morgenstern (NM), the Ramsey method and direct measurement. Utility curves can be divided into three broad categories, dependant on whether the decision-maker is a risk seeker, risk avoider or risk neutral (Figure 4-1). There are also mixed cases where for example the sponsor can be risk seeker over one range of monetary value and risk averse over another range.
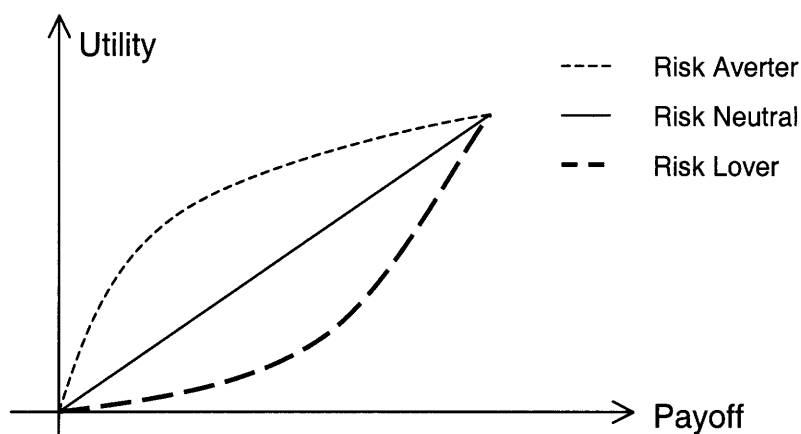

Figure 4-1 Utility function curves for different risk attitudes

Other Approaches Dealing With Uncertainty and Complexity

Sensitivity Analysis

Sensitivity analysis is useful in identifying the crucial variables that could contribute the most to the riskiness of the investment. Whether a variable is crucial or not would indicate whether it is

worth investing additional time and money to gather additional information that could reduce the uncertainty surrounding the variable. Sensitivity analysis also indicates how bad a misestimation of a variable can be before the project becomes unattractive.

Sensitivity analysis has its limitations: It considers the effect on the net present value of only one error in a variable at a time (or the effect on the expected utility of only one variable at a time), thus ignoring combinations of errors in many variables simultaneously. Moreover, examining the effect of each variable in isolation may be less meaningful when variables are interdependent. On the other hand, the effect of one variable may be serially dependant over time so that a forecast of one error in a year may propagate higher errors in subsequent years, causing a greater impact on Net Present Value.

These drawbacks can be reduced by combining variables and conducting scenario analyses and by simulations, which consider the impact of all possible combinations of variables.

Simulations

Simulations (the most widely used is Monte Carlo Simulation) overcome the shortfalls of sensitivity and scenario analyses by:

1- Considering all the crucial variables in a project;

2- Identifying the probability distribution of each variable;

3- setting a mathematical model to capture the important interdependencies between variables and the functional characteristics of a project as it evolves through time and encounters random events, conditional on a prespecified operating strategy;

4- Using repeated random sampling from the probability distributions of the crucial variables in order to arrive at the output probability distribution of the project Net Present Value or Utility for a given management strategy.

Simulations have many drawbacks too:

First, the mathematical model, in order for it to be comprehensive and reliable, ends up being very complex, thus, most of the time, is delegated to experts. This results in the poor management understanding of the whole simulation process, thus a lack of commitment to its results.

Second, many questions were raised in the adequacy of the discount rate used in discounting the cash flows. Thus many times, the aim of the simulation would be to get the cash flows

distribution rather than the net present value distribution and then the expected cash flows are discounted at an appropriate risk adjusted discount rate to get the expected net present value; Finally, simulations blindly follow a preset business operating strategy, without allowing to input the resolution of managers in adaptation to surprising events (for example, the resolution to abandon a project and its consequences).

Decision Tree Analysis

Decision Trees are tools that can also be used by sponsors in analyzing and accounting for the uncertainties in a project. Decision trees structure the problem in such a way that the major uncertainties and the decisions contingent on those uncertainties are represented in a tree. This tree is a sequence of nodes. A node may represent a decision, an uncertain event or an outcome. A decision node indicates a decision to be taken by the decision maker, a chance node represents an uncertain outcome and a terminal node denotes a final outcome. Once all the tree nodes and branches are laid out, the tree is folded backwards, determining the optimal decision at each time.

Decision tree analysis is well suited for analyzing sequential investment decisions and they correct some of the disadvantages of the Net Present Value approach because they do not commit the decision maker to present decisions but they propose the optimal path at every period in time, when more information is acquired. However, decision trees have many drawbacks: Since they rely on Net Present Values to compute the expected value of each outcome, they still share the major disadvantages of the risk-adjusted discount rate approach. In particular, we assume a constant discount rate along the decision tree, while, in reality, the riskiness of the outcomes changes based on their positions in the tree.

Real Options Thinking Approach

The valuation techniques exposed previously have many limitations because they do not capture the flexibilities embedded in investment decisions. As we have seen previously, these flexibilities are very valuable in risk management and their added value (benefits minus acquisition costs) should be aggregated with the net worth of the project. Thus, in any strategic investment, options should be identified and valued, then the investment should be redesigned to better use these options and the investment should be managed proactively through the options or flexibilities created. The valuation of these flexibilities or real options experienced a major

improvement with the breakthrough in modern finance brought by Black and Scholes in the pricing of financial options. However, even though we recognize that these the tools developed in real option valuation do not always capture the adequate real option value because we cannot always extend the techniques used for financial assets to non-financial (non traded) assets, we believe that what matters is the "real option way of thinking" rather than getting the right option value through sophisticated technical models. Our aim in this part is not to provide a thorough explanation of how to evaluate options. Our main purpose is to present a general overview of how we think in order to evaluate the option. Thus, we summarize the real option evaluation process in Figure 4-2. We will look into an application for a toll road in chapter five.

Frame the application

-What is the *contingent decision*?
-What *variable* triggers this contingent decision?
-Who has the *authority* to execute the decision?
-What *uncertainties* (private and market uncertainties) should be tracked to allow option valuation and what *stochastic process* do these uncertainties follow?
- What does the decision to *exercise* the option depend on? What does the *payoff diagram* look like?

Implement the option valuation model

-What is the *current value* of the *underlying asset*?
-What is the *volatility* of the underlying asset?
-Is there any *leakage* (value that accrues to the underlying asset before the exercise date of the option) in the asset value?
-What is the *risk-free rate of return*?
-What is the *option calculator* to be used? (Example, binomial approach or Black and Scholes formula)

Review the result and redesign

-What is the *option value*?
-Is the option greater than the *premium* paid to acquire it?
-Are there ways to create more options or to modify the option?
-Can the investment strategy be reconfigured or redesigned to increase value?
-Are there options that can be added by staging or modularity?

Figure 4-2 Real Option Evaluation Process

Chapter 5 Case Study: New Batinah Highway

Country and Project Background

The Sultanate of Oman is the second largest country in the Arabian Gulf. Its strategic geographic location and its natural resources make it a favorable business environment; with an approximate total area of 212,000,000 Km^2, it occupies the Southeastern corner of the Arabian Gulf. The sultanate borders with Saudi Arabia and the United Arab Emirates in the West, the Republic of Yemen in the South, the Straits of Hormuz in the North and the Arabian Sea in the East. Its coastline stretches for 1,700 kilometers from the Straits of Hormuz in the North to the borders of the Republic of Yemen in the South, overlooking the Arabian Gulf, the Gulf of Oman and the Arabian Sea. With proven oil reserves of 5.1 billion barrels (an average production of 800,000 barrels per day) and natural gas reserves of 25.2 trillion cubic feet in 1996, the developing country should not leave his poor infrastructure system, in particular his road network, hinder the economic prosperity of the region. Therefore, the government initiated in 1976 a development plan with a particular focus on the road network (Table 5.1). Consequently, the network of paved roads grew from a total length of 10 km in 1970 to a total length of 5,000 km of highways and 12,000 km of tracks in 1990. On the demand side, vehicle ownership has increased between 1990 and 1994 at an annual rate of 7.5%, a growth justified by increased accessibility, improved road facilities and a steady increase in population.

Period	Program Outline
1976-1980	-Promotion of agriculture and infrastructure development
1981-1985	-Development of Muscat area and road development in capital area
1986-1990	-Promotion of agriculture and under developed industries to avoid over-dependency on oil -Development of water resources and infrastructure
1991-1995	-Promotion of free competition by introduction of market economy system and protection of the private enterprise -Development of basic infrastructure
1996-2000	-Civil development including roads and other infrastructure -Human projects resource development

Table 5-1 Infrastructure development plan in Oman

However, the heavy reliance on a volatile source of revenues (70 to 80% of the total country revenues are provided by oil production) leads to an unstable budgetary expenditure on infrastructure, while the latter needs a constant development and maintenance. For example, in the fifth five-year plan (between 1996 and 2000), the budget allocated to civil development represented only 53% of what was allocated in the fourth year plan. Moreover, the ministry of communications (roads) receives in general only a small percentage of the total civil development expenditure. For example, in the fourth five year plan (between 1991 and 1995), the allocation for roads was equivalent to 4.68% of the total infrastructure sector development expenditure for the plan period. In the presence of this budgetary shortfall, highly feasible road projects are being executed by private sponsors under a **Build-Operate-Transfer (BOT)** scheme. The Existing **Batinah Highway (EBH)** is a major arterial serving the region and connecting the capital (Muscat) to the main cities of Batinah and to several neighboring cities of the United Arab Emirates , namely Al-Ain, Abu Dhabi, Dubai and Fujayrah. The importance of the subject road will increase in the near future in the presence of a master housing development plan. EBH is a dual carriageway with several roundabouts, at grade junctions, uncontrolled access and hazardous pedestrian crossings; it is an unsafe highway that causes dramatic accidents, especially with the presence of several speed limits that keep changing along it. A safe, free flowing and uninterrupted traffic flow along the corridor became a necessity and not a choice for the government; therefore, the question is not anymore "to invest or not invest", but rather to invest with the least cost that fulfills the demand. Different alternatives were suggested and the alternative that leads to the maximum economic benefit over cost ratio, taking into account direct and indirect costs and benefits, came out to be the construction of a dual carriageway parallel to the Existing Batinah Highway. We refer to this toll road by the **New Batinah Highway (NBH)**.

Traffic Estimation and Project Sensitivity to Traffic Uncertainty

In order to estimate the initial traffic on the NBH, an Origin-Destination (OD) table was developed for the 270 Km corridor. It associates a traffic flow to every segment of the highway between an origin and a destination. The initial OD table is the result of traffic counts and surveys and this initial estimate is enhanced through different traffic simulations and iterations. If we add up all the traffic volumes between origins and destinations along the new Batinah highway, we will have a rough estimate the total traffic volume along the highway.

In 1997, based on the current traffic volume in the whole corridor, the total traffic volume on the new highway is expected to be: 128,725 vehicles per day or approximately 47 million vehicles per year. Even though we dispose of sophisticated traffic modeling tools, we believe that this estimate is uncertain.

As to the traffic growth rate, it is more predictable and reasonable variations from the expected growth rate do not impede the feasibility of the project. According to The Feasibility Study, the traffic growth along various nationwide routes varies between 3% and 14% per year. We even expect more increase in traffic flow due to the realization of the five-year plan (1996-2000), a plan which includes civil development of roads and other infrastructure and human projects resource development. More recent data gathered from the Directorate General of Roads reports that nationwide average traffic growth varied between 4.7 and 7.9% annually between 1994 and 1997. In fact, the provision of the new highway will lead to future economic development which is expected to increase the traffic growth further by 2 to 3 %. Finally, by looking at the projected growth of economic indicators (fuel consumption, Gross Domestic Product) which are correlated to trip generation, we get two figures for the traffic growth: A low traffic growth rate of 3% and a high traffic growth rate of 17%. To be on the conservative side, we assume a traffic growth rate of 6% between year 0 (construction of the road) and year 10; In fact this figure was suggested by the government in the bid documents. After the 10th year, traffic growth will be smaller because the developing region would have reached saturation. Therefore, we assume a traffic growth of 3% after the 10th year.

In order to quantitatively foresee the effect of traffic uncertainty on the feasibility of the project from the sponsor standpoint, we perform a simple discounted cash flow analysis.

The initial capital investment cost of the dual carriageway at year 0 is estimated to be 137, 298, 246 RO (Omani Riyal). Since operation and maintenance costs are covered by the government, we exclude them from our analysis. The concession period is fixed by the concession terms: it is a period of 20 years, and we take it as the economic life of the project. As to the revenues, they are provided by toll collection. The level of tolls is determined by a survey performed in the region in order to find the fare that is acceptable by the majority. We use a value of 0.2 RO per vehicle. As to the initial traffic demand, we build our base case on the expected initial volume, which is 47,000,000 vehicles per year.

A discounted cash flow analysis results in a base case Net Present Value of 10,717,546 RO: The capital cost is 137, 298, 246 RO and the discounted toll revenue is 148,015,792 RO. In fact, we discounted the cash flow at a rate of 7%, a discount rate specified in the bid documents.

input parameters	
traffic volume at year 1	47,000,000
toll rate in RO per vehicle	0.2
traffic growth rate before 10 years	6%
traffic growth rate after 10 years	3%
project discount rate	7%
risk free discount rate	5%
cost of dual carriageway	137,298,246

year	traffic volume	toll revenues	net earnings
0			
1	47,000,000	9,400,000	9,400,000
2	49,820,000	9,964,000	9,964,000
3	52,809,200	10,561,840	10,561,840
4	55,977,752	11,195,550	11,195,550
5	59,336,417	11,867,283	11,867,283
6	62,896,602	12,579,320	12,579,320
7	66,670,398	13,334,080	13,334,080
8	70,670,622	14,134,124	14,134,124
9	74,910,860	14,982,172	14,982,172
10	77,158,185	15,431,637	15,431,637
11	79,472,931	15,894,586	15,894,586
12	81,857,119	16,371,424	16,371,424
13	84,312,832	16,862,566	16,862,566
14	86,842,217	17,368,443	17,368,443
15	89,447,484	17,889,497	17,889,497
16	92,130,908	18,426,182	18,426,182
17	94,894,836	18,978,967	18,978,967
18	97,741,681	19,548,336	19,548,336
19	100,673,931	20,134,786	20,134,786
20	103,694,149	20,738,830	20,738,830

Table 5-2 NBH expected cash flow

However, this Net Present Value is sensitive to the initial traffic demand and to the traffic growth rate. From the analytic point of view, it seems that it is much more sensitive to the traffic growth rate than to the initial traffic volume because if we consider the same error in both estimates, the error on the traffic growth rate will be compounded, while the error on the initial traffic demand

will remain the same. A 1% variation in the initial traffic demand leads to a change in earnings by 1,480,158 RO, while a 1% change in the traffic growth rate leads to a change in earnings by 4,865,151 RO. However, from the traffic analysis point of view, we believe that it is easier to estimate traffic growth rate than to predict the initial traffic volume on the tolls because traffic growth is function of different predictable economic indicators. Therefore, we maintain a conservative value of 6% for the traffic growth rate and study the sensitivity of the project Net Present Value to the initial traffic demand.

As a result of this analysis, we conclude that for an initial traffic demand of 43,000,000 vehicles per year, the project becomes unattractive for the private investor (Figure 5-1)
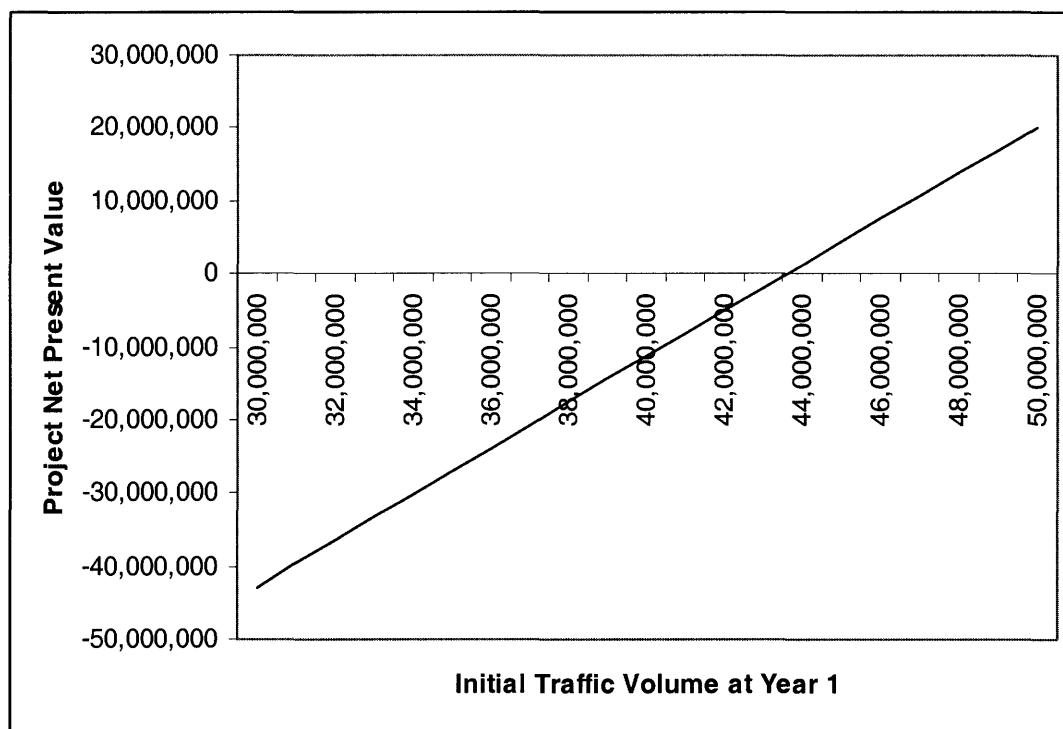

Figure 5-1 Sensitivity of NBH project value to traffic uncertainty

Phased Construction Approach and Value of Flexibility

From the previous sensitivity analysis, we can see that if the dual carriageway is constructed and the initial traffic volume falls below 29,000,000 vehicles per year, then this would result in a loss of 46,000,000 RO for the private investor (This loss could be greater when the government prohibits toll collection if the traffic demand on the road is low).

The last result we got to is not trivial at all: The private investor would loose 46,000,000 RO if the initial traffic demand is 29,000,000 vehicles per year. If we look into Dulles Greenway

project, the initial demand was estimated to be 34,000 vehicles per day, but actually, after the opening of the road, the traffic on the facility was only 10,500 vehicles per day and the traffic growth, or 1/3rd of the initial estimate. So this decrease in the initial traffic demand (from 47,000,000 to 29,000,000 vehicles per year) is not improbable at all. Moreover, the value of the loss, 46,000,000 RO, is worth considering: In fact, a technical study was performed in order to study the feasibility of the construction of a single carriageway and the expansion of the carriageway to a dual carriageway in the future. The project is <u>technically feasible</u> and a cost estimation results in the following: The construction of a single carriageway costs 46,084,500 RO and the expansion costs 120,300,000 RO. We can notice that expansion might be costly because of the cutting and patching work involved. Moreover, road construction exhibits economies of scale because a major percentage of the cost is constituted of mobilization and overhead costs which, in a phased construction, might be duplicated. This observation makes us formulate the situation in another way:

If the investor builds a single carriageway at year 0 and acquires the right, but not the obligation, to expand it in the future, then the maximum loss he could incur is 46,084,500 RO and this when he is not able to collect any toll. However, if the private investor builds a dual carriageway at year 0, then his losses will be more substantial.

The question that we would raise now is thus the following: What is the value of the option to wait and acquire more information in order to see whether to expand or not? Is it greater or equal to the optimum paid to acquire it? What implications would we suggest, on the light of these results?

Simple Option Valuation Framework

We develop in this section a simple valuation model based on a binomial tree. Our main purpose is to recognize the importance of introducing flexibilities in the presence of traffic uncertainties, and we don't pretend that we will accurately calculate the value of these flexibilities.

But before being able to suggest our simple valuation model, we need to bind our study to the following considerations:

- The option to expand is limited to five years for two major reasons: First, we believe that a period less than 5 years is not sufficient for the sponsor to make sure that the initial traffic demand is sustainable and to determine the traffic evolution trend that will be more

or less deterministic after 5 years. These two parameters, the initial demand and the traffic growth, will shape his investment decision. Second, governments, especially in countries like Sultanate of Oman with unstable growth, are reluctant to be committed to such concession contracts over a long period because new plans might resurge.

- In the presence of the option, two scenarios may take place: Either a high initial demand materializes and the sponsor expands the road, or the initial demand comes up to be low and the sponsor does not expand the road.

- The 20-year concession period starts from year 0, the year at which the construction of the single carriageway took place.

- Based on the sensitivity analysis that was performed previously, we suggest two scenarios for the initial traffic demand at year 0: A low demand of 20,000,000 vehicles per year and a high demand of 60,000,000 vehicles per year. The expected demand that is used by the sponsors is 47,000,000 per year.

- We assume that the risk free interest rate is 5%; it should be normally the interest rate of the treasury bills.

Advanced real options evaluation tools are at our disposition today; however, we will adopt a simple dynamic approach, which consists of laying out possible future outcomes and folding back the value of the optimal future strategy". In particular, we adopt a binomial model for option valuation in discrete time, proposed initially by Cox, Ross and Rubinstein's. We believe that with the level of accuracy of the input data, more sophisticated valuation tools would not add value to our analysis.

The binomial option valuation model[39] we propose represents the evolution of the value of our underlying asset. At the exercise date (we consider only one period), the underlying asset takes one of two possible values, depending whether the initial traffic demand comes out to be high or low. If the "bad" scenario happens (low demand), then the expansion costs will offset the toll revenues, consequently, the option is not exercised and the asset value is zero (we assume that under this scenario, the government will prevent toll collection). In the other hand, in the case of the "good" scenario (high demand), the toll revenues are higher than expansion costs and the difference will be the value of the asset. Therefore, the value of the project with embedded

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[39] Valuing Flexibility in Private Toll Road Development: Analysis of the Dulles Greenway

option would be the probability "p" of occurrence of "good" scenario times the asset value discounted at year 0. (Figure 5-2)
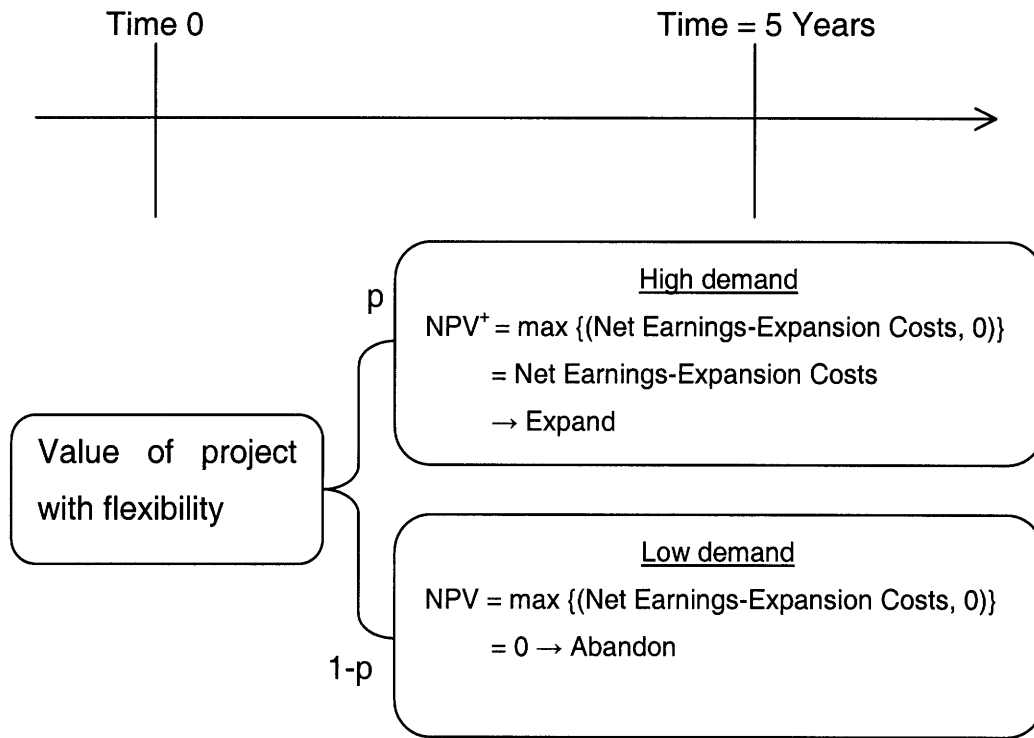

Figure 5-2 NBH project value with flexibility

However, one important issue should be considered here: With the introduction of the flexibility, the investor acquired a risk-free hedge position and the value of the asset now is independent of the investor's risk preferences. Thus, we discount the asset value at year 0 at the risk free interest rate. Moreover, the probability "p" weighs the outcomes to obtain the risk-free rate of return. It is called the risk-neutral probability and is derived by equating the expected toll revenues at year 0 with the probable weighted (and discounted at the risk free interest rate) toll revenue at year 5 .It is derived from the following equation:

$$E^0 = \frac{p \times E^+ + (1-p) \times E^-}{(1+r_f)^{\wedge}5}$$

Where: E^0 is the present value of the net earnings at expected traffic demand, E^+ is the present value of the net earnings at high traffic demand, E^- is the present value of the net earnings at low traffic demand and r_f is the risk free interest rate.

In this way, we are assuming that the volatility of the asset (present value of earnings less expansion costs) and the volatility of the revenues (or traffic volume) are the same.
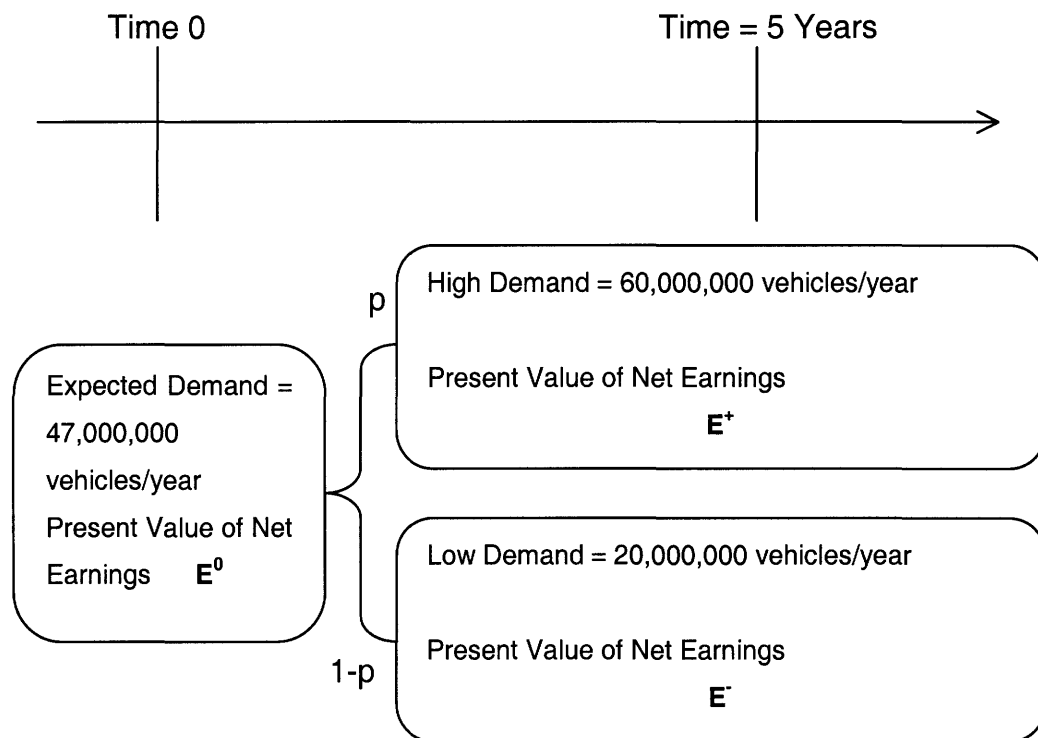
Time 0   Time = 5 Years

p — High Demand = 60,000,000 vehicles/year

Present Value of Net Earnings
E^+

Expected Demand = 47,000,000 vehicles/year
Present Value of Net Earnings E^0

Low Demand = 20,000,000 vehicles/year

Present Value of Net Earnings
E^-

1-p

Figure 5-3 Binomial Model for valuation of risk neutral probabilites

We define the flexibility value as the difference between the value of the project with the flexibility and the value of the project when built as double carriageway, with an expected initial traffic demand. The option premium or the cost of acquiring the option is simply the cost of building a single carriageway.

Flexibility Valuation: Results and Flaws

Based on the framework described above, the analysis results show that phased construction may not be attractive for the private concessionaire when the expansion costs are high. We can see that the value of the flexibility declines as the expansion cost increases (Figure 5-4). Moreover,

Figure 5-5suggests that a single carriageway should be built at year 0 when the chances of having a high demand are low, while a dual carriageway should be built at year 0 when the chances of having high demand are high and the expansion costs are high. On the other hand, the more the traffic is volatile, the more valuable is the flexibility (Figure 5-6).
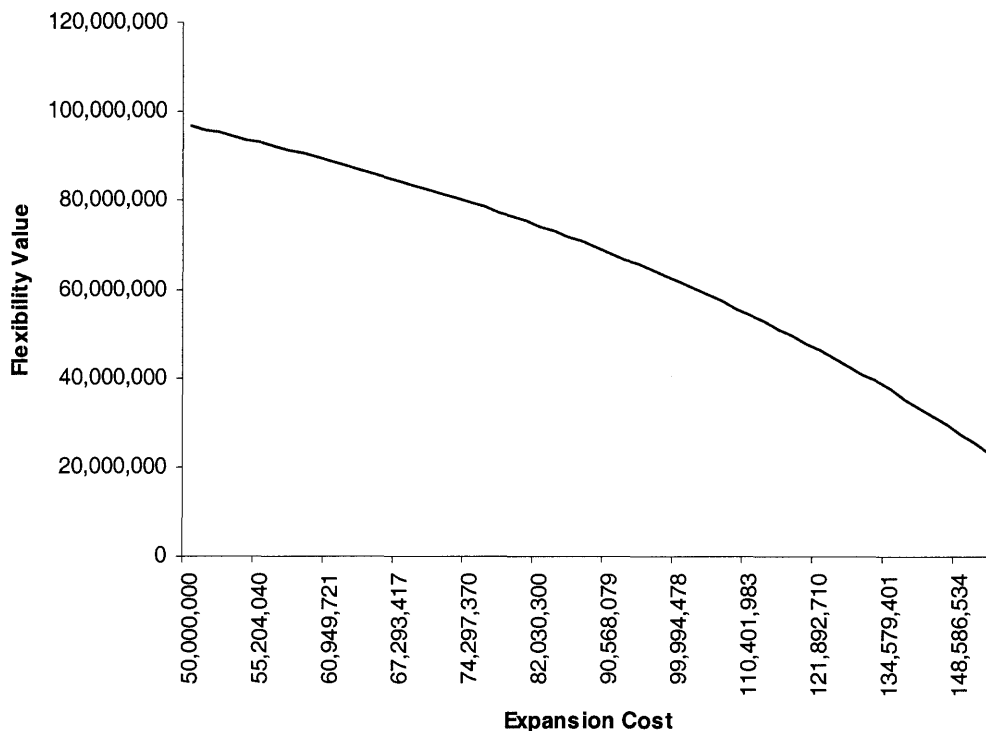

Figure 5-4 Variation of Flexibility with Expansion Cost

Sensitivity Analysis on
probability of high traffic demand and ratio of upgrade cost over cost of single carriageway
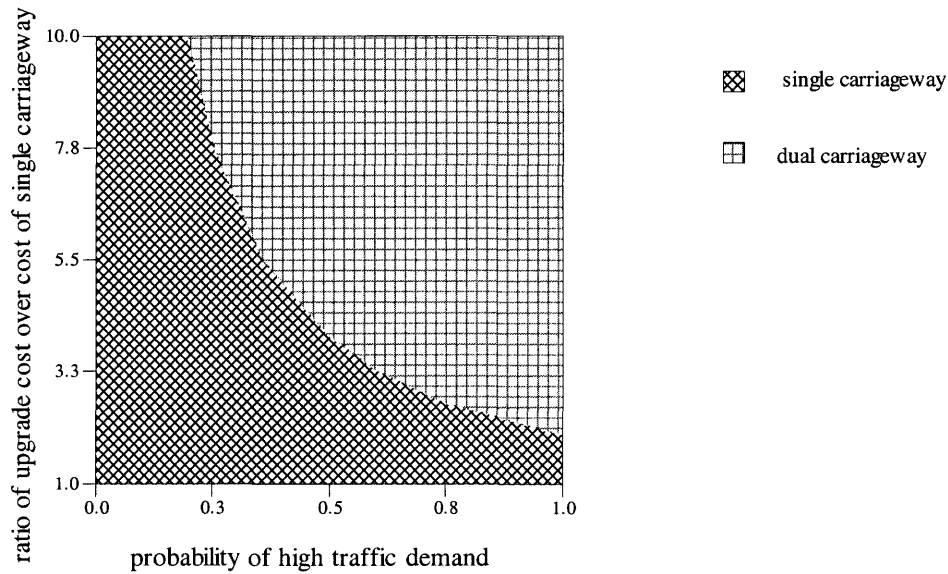
Figure 5-5 Sensitivity Expansion Cost

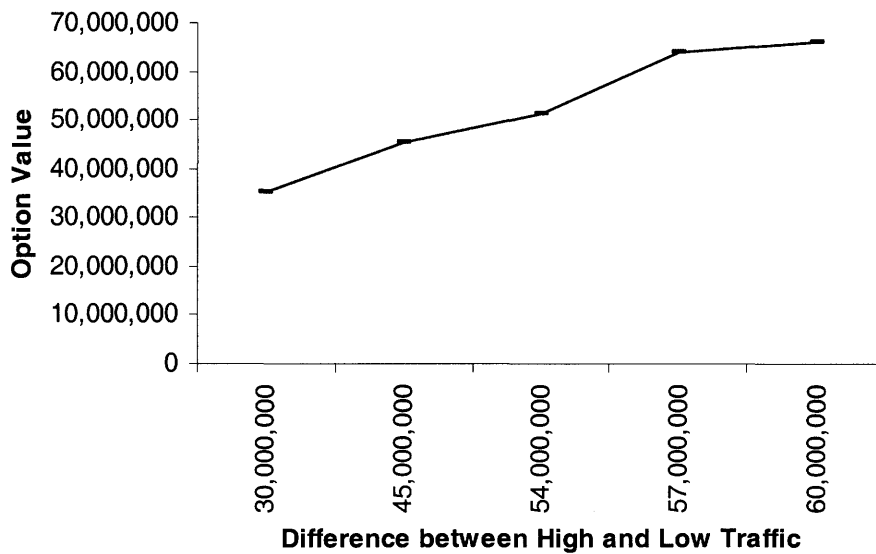| high Demand	Low Demand	Option Value
50,000,000	20,000,000	35,009,523
57,500,000	12,500,000	45,293,396
62,000,000	8,000,000	51,372,014
63,500,000	6,500,000	64,107,722
65,000,000	5,000,000	66,122,867

Figure 5-6 Variation of flexibility value with traffic volatility

Finally, we believe that real options analysis in road projects is still at its infancy for one major reason: an infrastructure project is a "non-traded asset" in the market and it is very difficult to find a tracking portfolio for the first phase of the project (between year 0 and year 5) that replicates the risk of the project. Therefore, the risk free probabilities cannot be considered as reflective of a risk free situation. Moreover, in the second phase of the project, we discounted the toll revenues at the project discount rate and not at the risk free interest rate since we assume that this discount rate is still reflective of the operation risk of the project after the 5th year. This limits our real option analysis since we are only tackling one type of risk (initial traffic demand) and we are still foregoing the drawbacks of using a risk adjusted discount rate, which is after all, more of an arbitrary value that does not reflect the effective project risk. However, we still believe that our intent is not to capture the real value of the flexibility, but rather to pinpoint that phased construction can value to the project and this value if sensitive to traffic volatility and expansion costs. At the end, the intent of our valuation is more to capture the presence of flexibility and the sensitivity of its value to traffic volatility and expansion costs, rather than to provide an accurate value.

Conclusion

A toll road like Batinah Highway in Oman is a risky project; the private concessionaire might incur high[40] investment costs without being able to recover them by toll collection. While many contractual arrangements can shift the risk from one party to another, we believe that phased construction limits risks in this case; it allows the private concessionaire to wait in order to acquire more information about the traffic demand, thus limiting his losses in case the traffic demand does not materialize. The value of this option depends on the highway upgrade cost relative to the full construction cost, as well as the uncertainty in traffic demand. The lower the expansion costs and the higher the traffic volatility, the more valuable is the phased construction.

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[40] We note that the project we considered is a small scale project and the absolute value of the monetary losses for the private concessionaire might be small. However, our intent is to show the implication of a flexibility and to suggest this risk management strategy for large scale projects.

Chapter 6 Case Study: Melbourne City Link Project

Project Background

Melbourne City Link project, initiated in 1994, is Australia's largest privately financed infrastructure project. It is a 22-kilometer toll highway, composed of two bypasses linking three of the four major expressways in Melbourne; the western link joins Tullamarine freeway to west gate freeway and the southern link joins the west gate freeway to the south eastern freeway. The main objective of the project is to efficiently circulate the traffic towards and away from the Central Business District of Melbourne, the capital city of the State of Victoria and Australia's second largest city, situated in the southeast corner of the continent. The work is complex and comprises the upgrade of the existing freeways (addition of more lanes), the construction of a six-lane elevated road, a bridge over the Yarra River and two three-lane tunnels. The project was designed to be awarded as a Build-Operate-Transfer project; In fact, the State of Victoria was committed to foster the private participation in infrastructure projects, especially after it had suffered an important downgrading of its credit rating by Standard & Poor's and Moody's in the 1990's and a chronic deficit in its balance[41].

The concession contract was awarded in 1993 to a consortium of two companies: Transfield and Obayashi Corporation. Transfield is an Australian Construction Company which has participated in different large scale local projects such as the Harbor Tunnel. Obayashi Corporation is one of the largest Japanese construction companies with an expertise in tunneling. The estimated project cost is around A $2 billion, and the concession term is 34 years. When concession terminates, the ownership is transferred to the State of Victoria.[42]The highway was fully opened in late 2000; tolling commenced on the western section of the link in January 2000 and on the southern section in December 2000.

Project Organization and Contractual Agreements

The State of Victoria designated a separate entity, Melbourne City Link Authority, to negotiate and sign the contract with the private concessionaire, Transurban.

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[41]"Privatization in Australia", The Reserve Bank of Australia Bulletin, December 1997.
[42] http://www.citylink.vic.gov.au/pages/home.html

Transurban is a single-purpose entity constituted by Transfield and Obayashi Corporation to finance the project off-balance sheet, limiting the liabilities of the two companies to the risks involved in the project. Transurban signed the concession deed with the government, thus is responsible, in front of the government, for delivering the road, operating it and then transferring it at the end of the concession period. Transurban contracted with Transfield-Obayashi Joint Venture (TOJV) to design and construct the highway on a fixed-price, lump sum basis. Thus major engineering and construction risks are transferred to the Joint Venture, freeing investors in Transurban from risks they are not able to control.

TOJV subcontracted with Translink Systems Pty, Ltd, a company jointly owned by Transfield and Transroute, a French toll road operator. A separate operation and maintenance contract was also signed between Transurban and Translink Operations Pty Ltd, a second company jointly owned by Transfield and Transroute.

This organization allows risk allocation to the parties most able to assume it, through contractual arrangements. Moreover, if the participants were to be investors too, then this organization allows to separate the parties concerned mainly with the downside risks (and which should be encouraged to provide debt) from the parties concerned mainly about the upside risks (which should be encouraged to provide equity). The project organization is summarized in Figure 6-1.
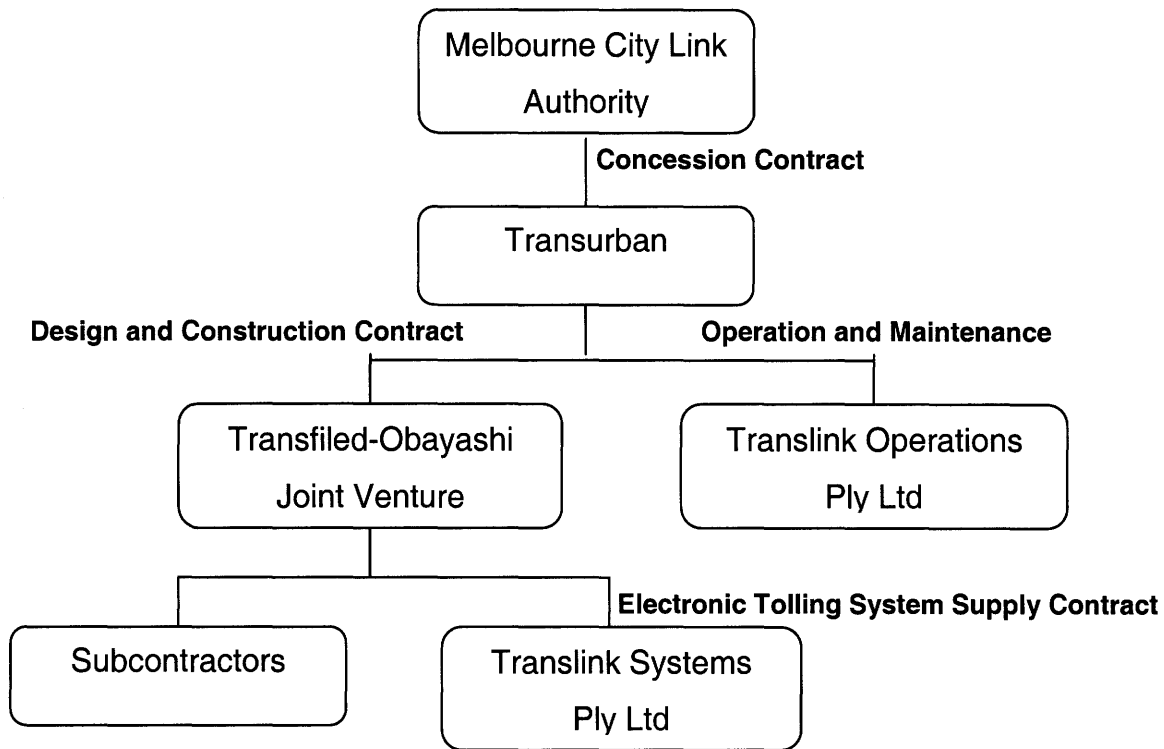
```
                    ┌─────────────────────┐
                    │  Melbourne City Link│
                    │      Authority      │
                    └─────────────────────┘
                              │ Concession Contract
                    ┌─────────────────────┐
                    │     Transurban      │
                    └─────────────────────┘
   Design and Construction Contract    │    Operation and Maintenance
          ┌─────────────────────┐          ┌─────────────────────┐
          │  Transfiled-Obayashi│          │  Translink Operations│
          │    Joint Venture    │          │       Ply Ltd        │
          └─────────────────────┘          └─────────────────────┘
                                    Electronic Tolling System Supply Contract
     ┌─────────────────────┐      ┌─────────────────────┐
     │   Subcontractors    │      │  Translink Systems  │
     │                     │      │       Ply Ltd        │
     └─────────────────────┘      └─────────────────────┘
```

Figure 6-1 Project Organization

Risk Identification

At the project level, Melbourne city link presents many technical challenges:

The Western Link elevated six lane highway was built according to a complex segmental bridge construction approach. It is a 4.5 km bridge, built in 45 m span lengths and each span was composed of 13 concrete units, precasted and then transported to the site because of the absence of storage facility at proximity of the bridge. This sequential approach implies that the scheduling of the activities and the coordination of the tasks interfaces are very critical. As to Bolte Bridge, it is a four span cantilever bridge; the construction technique used is the "balanced cantilever" method which consists of starting to build the central pier of the bridge and then expanding the spans symmetrically. This technique is complex and requires also proper technical expertise, scheduling and coordination. For the Domain Tunnel, it is a shallow tunnel with a rectangular concrete box section beneath Yarra River. The construction of this tunnel should not obstruct the boat traffic, thus it took place in two stages, starting from each side of the river. Finally, the Burney tunnel, it was considered the most difficult element of the entire project. It is

a 3.4 km tunnel excavated in complex and critical geologic formations, with permeability and settlement problems. [43]

The land for the project would be acquired by the government and leased to the concessionaire; it was a not critical issue in this project, nor was the environmental clearance, even though many environmental challenges were faced in the project.

As to the tolling system, it involved state of art technologies and a 100% electronic tolling was not an option because the Melbourne City Link Project is predominately an urban freeway where the price of land needed for toll plazas is at a very high premium. Thus, there is no fallback should the electronic tolling system, for any reason, fail to function. Indeed, this project came out to be the first fully electronic tollway in the world. This tolling system involves the installation of transponders in vehicles and each vehicle is assigned an account in order to charge to toll. It is expected that more than 700,000 vehicles will each carry an electronic tolling tag or e-tag to use the city link. Transurban assumed the main risks of toll collection but the government was committed to prosecute road users who avoid toll payment.

The project viability was very sensitive to the traffic level: It was stated that 10% less traffic reduces the pre-tax IRR of Transurban by 1.8%, which can be problematic if the traffic is highly volatile.

The observation of traffic levels in 2001 has shown a discrepancy between the actual and the predicted traffic volumes in the 1996 prospectus. According to recent surveys, there is a difference in the usage of City Link by motorists on the Western and Southern links (26% below expectation). Toll avoiders are using alternative routes in preference to paying tolls. Different hypotheses were suggested to explain this discrepancy: one hypothesis states that there are a lot of alternative, major private transport routes in the north and west than in the east and south of Melbourne. Another hypothesis states that major managerial/executive people live in the east and south, thus are more willing to pay for the tolls because most probably they are reimbursed in a way or another. [44]

At the country level, the project does not involve high risks because of the stable legal and political system of the country. At the market level, financial prices are rather constant and the

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43 J B Laurie (2000) "Melbourne City Link Project" The Australian Academy of Technological Sciences and Engineering ATSE Focus, No. 112, May/Jun 2000
44 Odgers, J. (2001) "An initial performance review of Melbourne's City Link toll road". www.btre.gov.au/docs/atrf_02/papers/01Odgers.pdf

Australian market is a mature market where financial hedging tools are at the disposition of the participants. However, we don't possess information about these risks because the sponsor does not share these financial data publicly.

Risk Mitigation Strategies

We have already seen how the contractual organization of the project played an important role in allocating risks between participants. In fact, the two main features in this organization are the joint venture, as well as the unbundling of the different services (construction, operation and maintenance, electronic tolling system supply).

The joint venture allows risk sharing between a foreign company with valuable technical expertise in tunneling and a local company which is familiar with the milieu and which undertook previous infrastructure projects in Australia. The unbundling shifts the risk to the party in the best position to assume since every work package is attributed to a company with very specific know-how and expertise.

As to the financial structure of the project, with the limited publicly available information, we can still infer that the types of securities used to finance the project played an important role in risk managing; The City Link project involves a complex financial structure consisting of publicly listed stapled securities (consisting of both a unit in a unit trust and a share in a company), CPI indexed bonds, equity infrastructure bonds (or Develop Australia Bonds) and loans. We note that out of a total cost of A$2 billion, the government imposed an equity stake to be assumed by the sponsor and which should not be less than A$ 510 million, leading to a leverage of 75%, a typical leverage for large infrastructure projects.

The Develop Australia Bond scheme was introduced in 1992 and frozen in 1997 due to its cost to the budget, but was replaced with a tax rebate scheme to encourage private participation in infrastructure projects. This scheme involves the transfer of tax benefits from project proponents to project financiers. In other words, interest payments of the borrower are non-deductible for tax purposes, while the interest income is exempted from taxes for the lender. It may also bring forward the timing of the benefit of the deduction, because typically infrastructure projects have a long lead time before tax is payable, whereas an investor is likely to receive the effective interest deduction immediately. In return, the financiers will charge lower interest rates on

borrowings.[45] These bonds are very attractive for investors since the marginal tax rate in Australia is high (48%). Moreover, these bonds are called equity infrastructure bonds because they are converted to equity at the end of the scheduled construction period, thus allowing the investor to gain from any upside in toll revenues.

The $505 million equity financing were raised by means of the sponsor equity of $50 million each from Transfield and Obayashi (as committed in their proposal), direct equity from the institutions, and the balance from the public offering. In the public offering, the shares or parcels were underwritten by financial institutions and each parcel was composed of Equity Infrastructure Bonds, a share in the company and a unit in the Unit Trust. This repartition leads to a maximum benefit from the tax advantages allowed by the government, as well as a voting right for the holder of the share. Moreover, the fact that part of the equity is publicly traded implies that less opposition from the public against the project would be incurred because they are stakeholders in the project.

The debt funding team within Transurban was lead by the ANZ, the CBA and Westpac. At the time of tendering, almost every bank in the world which dealt in Australian dollars was in one bid or the other of the project. Thus, the debt market was extensively used. Moreover, the fact that these loans were made in the local currency reduces financial risks since the sponsor will have to pay back debt financing with the currency of the revenues he is collecting.

As to the inflation risk, Transurban was allowed to increase tolls by CPI plus 2.5%, maximum, matching its current costs with the current revenues earned.

For the government support to the project, we believe that this project demonstrates a high level of government commitment. In fact, the concession agreement was attached to legislation, ratified by it, and enacted as if it were a law. [46]This will reduce political risks, even though can lead to the greatest inflexibility, in that to change the agreement you need to change the law. Moreover, the government agreed to defer the actual encashment of the annual concession fee that the city link act specified to be paid half yearly in arrears, until such time as notional initial investor a real after tax internal rate of return of 17.5% per annum on the initial investment. This

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[45]"Privatization in Australia", The Reserve Bank of Australia Bulletin, December 1997.
46 Bradley,V, and Clayton, U(1998) "Recent Experiences in BOT projects in Australia," http://www.prac.org/materials/1998_Taipei/AustraliaBOT.html

allows Transurban to manage its cash flow by claiming full tax deductibility on these concession notes payable to the government, thus delaying taxation on its revenues. However, if the after tax internal rate of return to equity exceeds 17.5%, and all project debt has been repaid, then the concession length will become 25.5 years. On the other hand, an extension can be triggered by the incidence of a material adverse effect. The maximum allowed concession length is 53.5 years.

Finally, diversification was a keystone in the success of this project. As we have already stated, the franchise extended along a long corridor, covering a very wide area. Thus, even if the traffic volume in the north and west was less than predicted, the traffic in the south and east was greater than the predictions, leading to an acceptable aggregate traffic level. Had the two parts of the highway (north-west and south-east) been awarded to two different concessionaires, then the one being granted the north-west segment would have suffered substantial losses, while the one responsible of the south-east segment would have realized very high gains.

Conclusion

Melbourne City link project is a major success in the history of toll road concessions; it proved that a private concessionaire is able to successfully develop a complex toll highway, relying primarily on toll revenues, if the appropriate risk mitigation strategies are deployed; Among the various strategies used, we emphasized in our study the importance of project organization, contractual agreements and financing structure in managing risks. Moreover, a great support was provided by the government through the stable and mature legal framework, as well its deep commitment, even though he did not provide any cash subsidies or equity or debt contributions. Finally, the franchise was structured in a way that allows risk diversification, which was a crucial factor in the viability of the project.

Conclusion

In sum, risk mitigation in private toll roads is achievable when the government has a proactive attitude during project lifecycle, preparing a favorable investment milieu to the private sponsor. Even though we have seen that the private concessionaires can develop innovative risk mitigation strategies and handle the challenges and threats of these endeavors, those strategies cannot be effective unless the government allows a favorable setting. Thus, we conclude this study with a redefinition of the role of the private sponsor and the role of the government in developing a risk management framework.

The role of the government is to provide a mature and stable legal and regulatory framework in order to show credibility to the investors, thus allowing the private sponsor to extensively use the capital market. The government should also be committed to the concession terms, preventing, as much as possible, concession contracts from being shaped by the political trends. Besides the equity, loans and subsidies provision, the government can provide guarantees when he is in the best position to control the guaranteed risk. Moreover, the government should package the franchises in a way to provide a portfolio of investment with a potential of diversification for the concessionaire. Finally, the incentives and regulations imposed on the franchise manager should be designed in a way not to conflict with the incentives provided by the shareholders to the franchise manager, which allows the objectives of all participants to align.

On the other hand, the role of the concession sponsor is to unbundle the concession and confer each package, with the risks associated to it, to the participant that is in the best position to control those risks. Moreover, the sponsor should build a solid financial structure that involves, in addition to the "external" investors, the participants in the project, in order to create more performance incentives. On the other hand, participants should be incited to perform not only through incentives, but also through well organized contracts. Finally, whenever the market instruments can be accessible at an acceptable cost, the sponsor should make use of them to hedge for financial risks.

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