Public Provision Versus P3 In Public Infrastructure:
Determining And Discounting The Procurement Decision

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ABSTRACT

The procurement decision is not the decision to invest in public infrastructure. The procurement decision is what is more cost effective: public provision or a public-private partnership (P3). Determining and discounting the public infrastructure are accomplished by detailing the total risks, illustrating the importance of the IRR in evaluating the cash flows, and providing a framework in which to evaluate the procurement decision based on generated savings. A recent P3 example is used to support the arguments made by taking a critical look at current valuation practices and using the proposed framework and discount rate.
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CHAPTER 1

Introduction

The purpose of this paper is to outline the procurement decision, provide a framework with which to evaluate this decision, and illustrate the importance of discounting the procurement decision with the appropriate cost of capital. The debate surrounding discount rates often centers on finding the correct rate with which to assess the most cost effective method of delivering public infrastructure. This paper will show that much of what has been already discussed regarding discount rates and public-private partnerships (P3) applies only to investment decisions. This model uses a different framework that is applied following such decisions; it uses the correct cost of capital as a discount rate for the “procurement” decision. The procurement decision, in the context of this paper, is whether to use public provisions or public private partnerships (P3) when delivering public infrastructure.

After defining a P3, the paper proceeds as follows. It first considers the rationale for a P3 as perceived by government. Second, this paper conducts a literature review to illustrate the importance of the discount rate in pricing these projects and their proposed P3 arrangements. An argument that much of the reviewed literature focuses on the investment decision is made. Third, we identify the risks that value the project and illustrate how the risks inherent in these projects are largely the same regardless of funding. A detailed look at discount rate theory shows how the capital asset pricing model (CAPM) provides theoretical explanation or underpinnings of the weighted
average cost of capital (WACC). Also that the latter, because debt to equity return change over the life of a project, is best estimated by the internal rate of return (IRR), which can be calculated as the cash flows of capital to and from the project. This discussion is followed by a look at limitations of the discount theory. Fourth, a recent P3 example demonstrates how the proposed framework better compares the procurement options. The benefits of using the proposed framework and this discount rate to evaluate the procurement decision are illustrated. A critical look at the Sea-to-Sky Highway Improvement project provides a conclusion. This example of a P3 is evaluated for both Partnerships BC’s valuation technique used for the project, as well as the model suggested by this paper. The findings of this paper are that the methodology based on discounting using the cost of capital, estimated as the IRR, more accurately describe the valuation needed. The IRR provides a justifiable discount rate to value the foregone payments to a P3 and thereby value the procurement decision based on net benefits to the government.

**Defining a P3**

There are many definitions for a P3. The Canadian Council of Public and Private Partnerships calls a P3 a cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks, and rewards. The National Council for Public Private Partnerships (US) defines it as the following:
a contractual agreement between a public agency (federal, state, or local) and
a private sector entity. Through this agreement, the skills and assets of each
sector (public and private) are shared in delivering a service or facility for the
use of the general public. In addition to the sharing of resources, each party
shares in the risks and rewards potential in the delivery of the service and/or
facility.

The Central Public Private Partnerships Unit (Ireland) refers to P3s as

a contractual arrangement between the public and private sectors (consistent
with a broad range of possible partnership structures) with clear agreement on
shared objectives for the delivery of public infrastructure and/or public
services by the private sector that would otherwise have been provided through
traditional public sector procurement.

The Partnerships BC definition of a P3 is a legally binding contract between government
and business for the provision of assets and the delivery of services. The contract
allocates responsibilities and business risks among the various partners. All definitions
use the same terminology with respect to contractual arrangements and allocation of risk;
however, for the purpose of this paper, the Partnerships BC definition is used.

In a typical P3, the government and the private consortium design, build, own, and run
the physical assets required for delivery of the service. This contrasts with traditional
public sector provision where the government builds or purchases physical assets, retains
ownership, and uses public sector employees or a private contractor to deliver the
required service (Grout, 2002). In this paper, a P3 occurs when the government contracts
a private consortium to build and maintain public infrastructure for a service fee for the horizon of that project.¹

**Rationale for a P3**

The P3 model is gaining popularity as an alternative to a long history of private franchising with national and international governments. Historically, both Canada and the US have used public subsidies for large-scale infrastructure (Vining et al., 2005). North American, European, and Australian governments have been most attracted to a P3 in capital-intensive areas such as transportation, water, and wastewater management to minimize the use of public capital (Norment, 2002). The definition of infrastructure in this paper includes both “hard” (bricks and mortar) projects and “soft” services (such as community services and financial management) that have traditionally been provided by the public sector (Norment, 2005). Close linkages between the public and private sectors re-emerged in the US and Canada in the mid-1990s in the form of a formal agreement versus private franchising known as a P3 (Vining et al., 2005). The province of British Columbia (BC) and Partnerships BC² is using the P3 model for nine different infrastructure projects in British Columbia totaling more than $3.4 billion. Of these projects, three are now in operation, including the transportation related project, the

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¹ There are many complex forms of P3s. This paper focuses on the most basic of models.

² Partnerships BC serve as the BC government’s center for establishing policies and best practices for partnership projects in the province of British Columbia. Their advisory role provides planning services to public sector agencies wishing to explore P3 options for building and managing public infrastructure. Their mandate is to facilitate, and, in some cases, manage partnerships on behalf of public sector agencies.
Sierra Yoyo Desan, and two health care projects, the Academic Ambulatory Care Centre and Abbotsford Regional Hospital and Cancer Centre. With five more P3 projects already in procurement and six more going into operation, this trend of infrastructure delivery shows no signs of slowing.

Many governments are in favor of moving to the P3 model of procurement for any number of the following five reasons (Pollitt et al., 2001). The first reason revolves around containing public sector debt. If private finances are used, taxpayer funds can be used for other projects. Second, many believe that a P3 can provide both infrastructure and on-going services at a lower cost. This remains a heated and unresolved argument, however. Valuing the costs associated with these differences means, the discount rate used is absolute when determining the better procurement strategy. Third, transferring risk from the public to the private sector is critical because risk is better absorbed by the private sector than managed by the public sector. Fourth, governments want to avoid up-front cost. By transferring financing to the private consortium, the public sector can pay a smaller nominal fee rather than a large initial capital outlay. Lastly, user fees are better implemented through the private sector, as the government risks political costs for implementing such tolls. The first two reasons involve financing costs; the next three relate to the relative non-financing costs of the public versus private sector delivery of infrastructure.

Some of the reasons presented above overstate the benefits of a P3. Vining et al. (2005) find the first rationale valid only in the short term. They argue that the benefits from
foregoing the whole value of the investment are mitigated by the servicing costs agreed to
by the partnership. Therefore, while short-term budgets are not affected by this decision,
future budgets would require accounting. The second rationale posited by Pollitt et al.
(2001) has been contested because it fails to consider pricing based on the cost of capital.
Basing savings on efficiencies in scale and technical capabilities rather than the cost of
capital suggests a flaw in the logic of project pricing. These arguments are the subject of
much of the reviewed literature.

This argument can be resolved by considering the procurement decision after making the
investment decision. Should the government acquire an asset through traditional
procurement methods or pay someone else a service fee to have it delivered to the end
user? Literature in this area often focuses on the investment decision. We argue that the
procurement decision is, in fact, an investment decision: the government either uses
public provisions or invests in a public-private partnership. In this decision, government
defines a project by the attributes delivered to the end-user over the life of the project.
Government then attempts to quantify these attributes by having the private sector bid on
the project. The cost differences between public provision and a public-private
partnership are calculated over the life of the project to yield a net cost for either option.
Finally, the government needs to determine the discount rate appropriate for valuing the
costs of these two decisions. This requires both a methodology to calculate the discount
rate and a relevant framework for valuing the procurement decision.
CHAPTER 2

Literature Review - The Importance of the Discount Rate

The sensitivity of the financial analysis of public provision versus P3 means the discount rate is an important test criterion in this analysis. P3s are economically sound because they decrease costs by transferring risks, avoid large upfront costs, and have other financial and non-financial benefits. Given this, the standard test criterion for a P3 monetary: does it cost less than conventional public provision (Grout, 2002)? The problem of comparison arises when cost cash flows under traditional procurement occur immediately or within a relatively short period. In P3 procurements, the private contractor is paid a servicing fee over an extended period; therefore, cash flows cannot be easily compared to traditional cash flows for the same project. This is a major reason the quality of cost-benefit analysis (CBA) varies widely in government (Moore et al., 2004).

Whether public sector projects should be discounted at a rate lower than equivalent private sector projects has been the subject of much discussion. This is partly because the discount rate is a factor in determining the procurement model. As Shaffer (2002) argues, the difference in the rate he supports at 5% versus the rate used for the Sea-to-Sky project (P3) by Partnerships BC of 7.5% adds almost $10 million per year for the 25-year debt repayment period. Much of the literature details arguments that either refute or agree with Arrow and Lind's preposition that government financing is more cost effective than private financing (Klein, 1996). Arrow and Lind (1970) made the formal argument that
there is no risk premium for public investment in projects with returns uncorrelated with aggregate income. They also argued that the public sector can pool and spread risk over several projects; taxpayers are mutually independent and therefore have a risk premium close to zero, otherwise known as the borrowing rate of government. The private sector, in Arrow and Lind’s (2005) opinion, does not have this ability; therefore, it would have to charge a discount rate higher than that of the government to account for added risk, a risk premium. This view has been criticized by others, who argue that the private sector can pool risks, and the nature of risks in the public sector make them unlikely to be independent of each other and of private investments (Grout, 2002). One shortcoming seen by Grant and Quiggin (2002) is that the Arrow-Lind argument relies implicitly on the existence of market failure but does not mention how market failure arises. Klein (1996) comments that Arrow and Lind (1970), while they mention risk pooling, make no mention of risk spreading. His argument is that any advantage the government may have in pooling diverse risks can be transferred to the private sector by privatizing the projects in question (Klein, 1996). Klein (1996) feels that the private sector can also tap into lower funds and will resolve any tradeoffs. He also argues that the private sector is more efficient than the government at maintaining project discipline. In Klein’s (1996) opinion, government costs are based more on coercive powers versus a superior system of exploiting low cost risk bearing investors. Grout (2002) refutes the Arrow and Lind (1970) argument, stating that, in theory and accounting for tax adjustments, individuals should be able to divest themselves of their risks at market prices whether these arise in the public or private sector. Grout (2002), however, supports Arrow and Lind, claiming that if the former is true, arguments for higher discount rates for private projects must rest
with imperfections in the market. Vining et al. (2005) provide the most neutral analysis, stating that it is unclear if governments are generally able to borrow at a lower cost than the private sector.

Other literature reviewed provided different methodologies for calculating or interpreting the discount rate. Grant and Quiggin (2002) use the Arrow and Lind (1970) argument to focus on problems arising from adverse selection rather than the moral hazards of risk spreading. According to Grant and Quiggin, because taxation is not voluntary, adverse selection problems can be overcome, but moral hazards cannot. Looking at errors and their impact on welfare analysis, Grant and Quiggin (2002) also show that privatization may reduce public sector net worth because a reduction in social welfare associated with privatization must be balanced against any improvements in operating efficiency. Burgess (1988) takes a different approach on public investment with his focus on complementarity and the discount rate. He argues two equivalent procedures for evaluating public investment in the private sector. First, the benefit of public investment includes its direct marginal productivity, which is then discounted at a rate that reflects the social opportunity cost of resources withdrawn from the private sector because of the project (Burgess, 1988). This discount rate is sensitive to the complementary, independent, or interchangeable relationship of public and private investment. Second, the benefit of public investment includes its direct marginal productivity plus any net external effects on distorted markets. These benefits are discounted at a rate that reflects the social opportunity cost of government borrowing.
Belli (1997) looks at the discount rate issue as one that involves time preference for consumption and social return. He argues that the cost of capital for the public sector is usually higher than the private sector cost of capital because the cost is the weighted average of the social marginal productivity of capital in the private sector and the social rate of time preference for consumption. He validates this argument by comparing the private after-tax return to the social return (which is lower), and the marginal return to "savers," which is lower than the social return. Belli (1997) uses this argument to help governments determine if society benefits from government involvement in the provision of goods. Moore et al. (2004) consider the intergenerational impact of the discount rate and the effect public investment has on crowding out private investment. Although there are several discount rates listed via a decision flow chart, the focus here is primarily on exogenous variables related to social opportunity cost and market behavior to capital investments. Moore et al. (2004) suggest using a method of social discounting where one would shadow price investment flows and then discount the resulting consumption equivalents based on the consumption-based social discount rate.

With the exception of Grout (2002), Jenkinson (2003), and Shaffer (2005), the literature reviewed focuses on the initial decision of whether to invest in public infrastructure. Arrow and Lind (1970) use their argument of risk spreading and pooling to highlight the welfare of the government related to the investment decision to invest. Grant and Quiggin (2002) use the same argument to highlight the implicit effect of market failures and argue the negative net effect of privatization on social welfare. Vining et al. (2005), Belli (1997), and Moore et al. (2004) emphasize the importance of calculating discount
rates with consideration of social consumption, intergenerational impacts, and social opportunity costs. Klein (1996) first poses the question that has received little to no focus. Klein (1996) asks who is in a better place to bear financial risk – taxpayers or investors. This point of separation between the decision to invest versus which investment vehicle to use (public provision or P3) is somewhat indistinct. Klein (1996) himself speaks more to the role of government in reducing risk for all projects through efficient monetary policies; he spends little time exploring the more pertinent financial analysis needed to make the procurement decision. Grout (2002) differs from other scholars because of his use of the Gorman polar model to argue that it is inappropriate to use the same discount rate for the public and private sectors. Grout (2002) looks at the relationship between the effects of discount rates on government costs versus private sector payments made via quantities and a fixed payment schedule. Using the Gorman polar model, however, restricts many externalities by assuming that all individuals face the same prices in the market. Jenkinson (2003) provides more insight with his focused look at private sector involvement in a P3 as two distinct elements: operational and financial. Looking at the pure provision of private sector finance, Jenkinson argues that while there are conditions where public and private finance will be similar; these conditions are unlikely to hold for many public services (Jenkinson, 2003). Jenkinson (2003) also argues that the use of private sector finance is preferable because the private sector may better evaluate risks than does the public sector. This paper resembles Jenkinson’s because of its use of the principles of finance to strengthen the argument. In his paper, Jenkinson’s (2003) argument involves the following steps. First, he argues that changing the way the infrastructure is financed will not add any value unless something
‘real’ is affected (based on the works by Modigliani and Miller [1958] and the weighted average cost of capital). Second, the argument is made that equity (not just debt) exists in all financing structures; government should account for the risk associated with this equity provided by the taxpayers, reserves, or government guarantees, even when it is difficult to measure (based on the capital asset pricing model introduced by Sharpe (1964) and Lintner (1965)). The third argument is that the public sector cost of capital is greater than private finance because of equity risks. Finally, Jenkinson (2003) argues that incomplete contracts increase the cost of private finance; some risks are not easily contractible or defined. Jenkinson (2003) provides strong but incomplete examples of analysis based on financial theory. Using a Special Purpose Vehicle (SPV) to extract cash flows and thereby separate risk analysis from the operational elements of risk is a plausible action. However, this action does not offer insight into pricing risk when it is not possible to separate operational and financial elements. Even Jenkinson (2003) mentions that it is often difficult to achieve a clear division between operational and financial risks based on the commonality of performance-based contracts and continued solvency of the operating company. The operational and financing elements, therefore, need to be considered together when pricing risk, as they determine the underlying risk associated with the infrastructure under consideration.

The decision to invest is theoretically distinct from the decision to use public provision or a P3 arrangement. To illustrate this point, we consider a public infrastructure that can be procured through either public provision or a P3. It is helpful to think of the specific example of a bridge being considered to bypass a longer, riskier alignment of road. The
public sector can either build the bridge itself or engage a consortium of private sector agencies to build the bridge and maintain it for some duration. The risks associated with making the decision to invest would include, but not be limited to, the following: social opportunity cost of using public funds, political risk associated with not building the bridge, and environmental risks associated with the affected area. The benefits of such an undertaking would include the following: more efficient flow of traffic, timesaving to commuters, reduced accidents or fatalities, and political goodwill. Most of the risks and transferable noted are not immediately tangible; nonetheless, they represent real risks that need to be considered when evaluating the investment decision. This paper argues, however, that the risks mentioned do not transfer to the procurement decision. Once the decision to invest has been made, the decision of whether to use public provision or a P3 inherently involves a new set of risks and therefore a different discount rate and do not take into consideration social costs and benefits. Shaffer (2005) argues that factors like the private sector investment discipline and social investment criteria relate to the decision to invest. In his paper, the decision of whether to invest in the Sea-to-Sky Project has already been made, and taxpayers will assume that responsibility regardless of the investment vehicle chosen (Shaffer, 2005). Using the example of the bridge, once the decision to invest in the bridge has been made, the risks to be priced include those inherent to the underlying risk of choosing public provisions versus a P3 arrangement. Risks involved in the procurement decision are numerous and can include: construction risk (delays), procurement of resources, price sensitivity of materials, design risks (improper fits), miscalculation of load bearing capacities, failure to consider traffic.

3 The Sea-to-Sky Project is a 95km section of Highway 99 from West Vancouver to Whistler in BC, Canada. The P3 is a Design-Build-Finance-Operate being undertaken through a 25-year performance partnership with the Province. It can be viewed on the Partnerships BC website.
patterns, financial risks (solvency of the partner), claims, funds availability (if the project should be delayed to future fiscals), and political risk (administrative policy, and legislative decision that can effect the cost of the project). It is clear from the example above that these risks are inherently different from those that would be used in the investment decision. We do not wish to discuss whether the investment should be made; rather, we focus on the calculation of risks associated with the public sector investment in infrastructure. Unlike Moore et al. (2004), we do not assign a specific discount rate, but instead provide a model with which to evaluate the discount rate for the procurement decision.

CHAPTER 3

Methodology

The methodology for calculating the discount rate in the procurement decision is as follows. Section I defines risk within the context of the procurement decision. It uses the example of a Design-Build-Operate-Finance (DBFO) P3 to capture the risks associated with the procurement decision. The risks are categorized as transferable and non-transferable. In Section II, we identify the most applicable method with which to calculate these risks. The importance of equivalency of the total risk to both the public and private sector is illustrated, and a detailed discussion of the theory of discount rates is provided. The shortcomings of WACC are illustrated by an IRR that evaluates net cash flows, providing a revenue stream with which to solidify the procurement decision. In
Section III, the limitations of the discount rate theory are identified. Section IV provides a recent example of a P3 arrangement used to provide a practical framework for using the discount rate to evaluate the procurement decision.

I. Defining Risk in the Procurement Decision

Investment risk is concerned with the range of possible outcomes from an investment. The greater the range, the greater the risk (Higgins, 2004). In some investments, the risk involved can be calculated objectively from scientific or historical evidence. History can be used to predict future outcomes. However, given the complexity and uniqueness often involved with a P3, estimating risk becomes more of a challenge. In this situation, risk appraisal often depends on the perceptions of the decision makers, their knowledge of economics of the industry, and their understanding of the investment’s ramifications (Higgins, 2004). This subjectivity lends itself to differing opinions regarding risk and the procurement decision. Risks differ as the proposed project differs, but can be categorized in the following categories: transferable risk, including construction risks, operational risks, and financial risks; and nontransferable risks, including economical, informational, and political. The risks that are transferable will vary from project to project and will depend on project circumstances, the P3 deal and the willingness of the P3 market to accept the risk at reasonable cost. To facilitate this discussion, a popular model of P3,
DBFO⁴, applied to the preceding bridge example, is used to capture these categorical risks.

A DBFO involves the delivery of infrastructure and therefore highlights construction risks. Although there is relatively little written on this subject, identification of construction risks involves simple concepts. In the United Kingdom, the HM treasury uses a document entitled The Greenbook: Appraisal and Evaluation in Central Government (2003), and refers to construction risk as the risk that the construction of physical assets will not be completed on time to budget and to specifications. These risks could include extraneous unaccounted costs that could range from lost profits, performance claims, and ramifications to goodwill. Using our example, construction risks can be further subdivided into the following: design, geotechnical investigations, construction costs, construction safety, environmental issues, unexpected site conditions, traffic management, etc. These risks are not mutually exclusive; adverse conditions in one area can affect others. All risks identified under construction are real risks that are transferable to both a public sector service delivery or business unit or the P3 consortium. This highlights the fact that regardless of who delivers the final infrastructure, both the public sector and the P3 consortium face the same construction risks. The difference lies more with how these risks are managed within each group.

A DBFO involves the ongoing maintenance and operation of the infrastructure delivered and therefore highlights the operational risks of the project. Operational risk does not

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⁴ In the DBFO P3 model, the private sector designs, finances, and constructs a new facility under a long-term lease, and operates the facility during the term of the lease. The P3 consortium transfers the new facility to the public sector at the end of the lease term.
include market risk or credit risk. Theories on operational risks relate largely to financial institutions, although we can borrow these concepts, as they apply to any organization in business. The Bank for International Settlements illustrates these risks in a document entitled **Basel II, International Convergence of Capital Measurement and Capital Standards** (2004), also known as The New Accord. This document is a collection of recommendations advising the banking regime of changes to international standards for measuring the adequacy of capital. Operational risk in this document is defined as the risk of monetary loss resulting from inadequate or failed internal processes, people, and systems, or from external events (Basel, 2004). Much like construction risk, it is difficult to identify or assess levels of operational risk and its main sources. In this paper, operational risk can include, but is not limited to, the following: changes in traffic composition, changes in required standards, equipment availability, and latent effects. As much of the operational risk is tied to the construction process, a timeline must be used to separate the two categories. The example used to test our model shows incentives in operations between the public sector and the P3 consortium in the performance-based contract. This risk does not differ significantly from construction because it is easy to argue its applicability to either the public sector or the P3 consortium. The P3 consortium considers operational risk a real cost to the project. Adverse effects resulting from poor construction or design lead to decreased profitability. Project profitability is derived from cash flows that, in many cases, have already been accounted for as performance-based incentives in contracts. The public sector view of operational management is similar to that of ongoing maintenance of public infrastructure; deficiencies represent large costs to taxpayers and need to be managed accordingly. Poor
construction or design produce budgetary pressures that are often difficult to manage in a system where funding (government) is based on voted appropriations.  

Financial risks are critical risks to a DBFO, given its direct application to the value of the project. By their nature, investments require the expenditure of money in anticipation of uncertain future benefits (Higgins, 2004). At an applied level, risks increase the uncertainty of cash flows and make it difficult to estimate cash flows. It is important to understand the return needed on an investment and the investment value needed to support the risk taken. Financial risks often serve as precursors to any other risks mentioned in the timeline; an understanding of financial implications is needed before any decisions about a contract can be made. Uncertainty is a cost; lenders and shareholders (private or public) want a higher return when the outcome of future cash flows is uncertain. The assumption here is one that is largely applied in financial theory. Given two investments that promise the same expected return but have differing risks, most people prefer the low-risk alternative (Higgins, 2004). This theory is backed by the psychology of risk. Financial risk can involve a more scientific financial approach to decision-making than is possible with construction and operational risks. Financial risks usually involve calculating inflation, interest rates, and financing costs and risk associated with a given project. Information is often generally available via stock indices and market prices for various financial instruments. Revisiting our discussion on Jenkinson’s (2003) paper, we also see that financial risk is not mutually exclusive from either construction or operational risk, as the role it plays in determining the value of the project.

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5 The author speaks to the current provincial practice of funding projects annually, versus multi-year contracts based on project management experience.
is interdependent. Financial risks are real risks to the public sector as well. Jenkinson’s (2003) look at the National Air Traffic services P3 shows that governments often face challenges with internal debt consumption and are averse to multi-year programs. Increases in the cost of materials and labor also pose challenges when projects are not completed within the fiscal year; forecasting such changes after project implementation is often a daunting task. Government should take a more critical look at the value these infrastructures bring to the taxpayers and ensure it is using the most cost-effective approach possible.

Economic, informational, and political risk are nontransferable risks in the procurement decision. In the broadest sense, economical risks are brought about either by future practices of the government or economic changes in industry and, therefore, the economy. Engaging in or insuring one from these risks could be costly. Political risk is also evident, as both parties cannot predict the future for the often long contractual tenures of a P3. Current government policies may not be followed by future government practices and exercising or implementing changes in certain types of laws could have positive or negative affects on both the public and private sector. The respective government often supports these projects, while ministries or federal organizations (as would be the case in Canada) often administrate the respective projects over the life of the contract. The Sea-to-Sky Highway improvement project is a P3 contract between the Ministry of Transportation (MoT), the S2S Transportation Group (S2S), and not the Provincial governing party of the time (Project Report, 2005). The risks borne from the P3 in the Sea-to-Sky example are therefore borne to MoT and the S2S group. While both
parties share in these economic and political risks, the risks are not transferable by MoT to the S2S group, but are shared. Informational risk is risk associated with the project that may be absent or unknown at the time of the P3 arrangement. An example of this could be a sub-surface slide that shows no signs of distress and therefore goes undetected during normal geotechnical investigations. This is obviously not the fault of any party, but significant cost pressures could ensue. Using the absence of vital geotechnical information in the Sea-to-Sky example, the risk borne from matters such as conditions below the highway surface are shared; it is outlined that it is the MoT’s responsibility to provide accurate data, and the responsibility of S2S to interpret it (Project Report, 2005). Much like the construction and operational risks, these nontransferable risks are difficult to measure and rely more on subjectivity and managerial input than on any one scientific theory.

The associative risks involved in the procurement decision using a DBFO have been clearly identified. The value of these risks is anecdotally important; however, it is the measurement and valuation of these risks by way of the appropriate discount rate model that are of importance to this paper.

II. Calculating the Discount Rate in the Procurement Decision

The discount rate in the procurement decision can be estimated as the IRR of the P3 partner’s cash flows to and from the project. This paper first illustrates how in making the procurement decision the public and private sectors face comparable circumstances.
Second, it shows how the discount rate can be calculated as the IRR of the cash flows for the P3 project to and from the providers of capital.

II.I Calculating Total Risk in the Procurement Decision

Transferable risks cannot be valued independently of each other during the procurement decision. In defining these risks, this paper has illustrated how adverse conditions in one area can ultimately affect multiple variables. Jenkinson (2003) exemplifies this point in his look at the project to refurbish the HM Treasury. Jenkinson (2003) states that even though the risks associated with this project were essentially construction costs and maintenance costs, the costs of these risks were passed to the SPV (Exchequer) through construction contracts and service agreements. The reverse is also true: financial costs can affect construction and operational risks in the procurement decision. Increased financial risks can jeopardize the profitability of the company and therefore lead to increased construction and operational risks. Vining et al. (2005) use the example of the Dulles Greenway P3 to illustrate how raising tolls to cover the financing and operating costs discouraged usage and led the company into default only six months after it opened. Efforts were made to lower tolls, whereby demand increased; however, total revenues did not increase enough to cover the financing and operating costs, ultimately leading to the bankruptcy of the company and government intervention. It is clear from the above examples that risks should be considered collectively, rather than independently.
Nontransferable risks are constants in the total risk calculation. The risks mentioned in this paper are largely transferable and are often shared by both the public and private sector in a P3 model, and can be assumed to equivalents in the calculation of risks when comparing P3 with traditional procurement through a public sector business unit. Usually, the risks that are not transferred are those that neither party can control, such as the economic, political, and latent defect risks associated with the project. This is why the P3 arrangement for the Sea-to-Sky project presents such risks as retained or shared, rather than transferred or retained by any one party (Project Report, 2005).

The private sector evaluation of risk is reflected in the valuation of the proposed project. There is little disagreement as to whether the private sector values risk in its project proposals. Private investments take many forms and usually carrying a mixture of debt and equity. Backed by a consortium of large lenders and private shareholders, the private sector takes an arguably more critical look at the expected rate of return. In the Sea-to-Sky Project (2005), the cost of capital relative to the government-borrowing rate has a premium of 2.5%. The premium could reflect not only the risks associated with the project, but also some form of compensation in excess of these costs that would provide a return on equity to shareholders for the additional risk borne (Shaffer, 2005). This seems logical, as part of the rationale for a P3 earlier is the optimal transfer of risk to the private sector, a risk that would have to be compensated.

For the purposes of determining the appropriate discount rate, we assume risk allocated to a public sector business unit are the same as those allocated to the private sector. This
assumption is based on the discussion above and a focused look at the total risk equation presented next. As this paper considers projects that are often unique in nature, we need to view these infrastructures (assets) in isolation and address the risks accordingly. The public sector business unit, like the private sector, has two types of risk to consider, as is illustrated in the following equation:

Equation 1, Total Risk of Asset, Higgins (2004):

\[
\text{Total Risk of Asset} = \text{Nondiversifiable Risk} + \text{Diversifiable Risk}
\]

An asset’s risk in isolation is its total risk; its risk as part of a portfolio is its nondiversifiable risk. The risk remaining after the asset has been diversified is known as diversifiable risk. The portion of an asset’s total risk that is nondiversifiable depends on the correlation of its returns with market returns (Higgins, 2004). When the correlation is high, nondiversifiable risk is a large fraction of total risk, and vice versa (Higgins, 2004). Adapting this equation to the procurement decision, the risk premiums investors will require before they will invest in a project arises from the nondiversifiable component of transferable risk. The relevant risks can be expressed in the following equation:

Equation 2, Total Risk of Project:

\[
\text{Total Risk Of Project} = \text{Transferable Risk} + \text{Nontransferable Risk}
\]
In addition, Equation 3, Transferable Risk:

\[
\text{Transferable Risk} = \text{A Nondiversifiable Component} + \text{A Diversifiable Component}
\]

Intuitively, this equation makes sense and according to standard finance theory, the risk premium is paid to investors for assuming the nondiversifiable component. Both the public and private sector have a portfolio of projects with which they gauge the overall risk-reward characteristics; this is in comparison to merely compiling portfolios from securities that individually have attractive risk-reward characteristics (Markowitz, 1952). The public sector would also expect to earn this risk premium because it has a multitude of other projects and assets that would offer it similar risk-reward tradeoffs and from which it could earn a market rate of return on behalf of the taxpayers. The private sector consortium, although often brought together specifically for this venture, can also have other securities with which to measure this tradeoff within its portfolio. That is, the private sector can also hold other equity investments in its portfolio; one venture may be but a smaller subset of a larger collection of projects. A diversifiable risk, therefore, represents the risk that one is able to reduce from the portfolio by way of diversification, and nondiversifiable risks are the risks that remain after this has taken place. These two variables represent the total risk to the asset in consideration.

The P3 is a business opportunity that is assumed to take on all the transferable risks. The public sector has the option of transferring these risks to a P3 in exchange for delivery of a service. Some of those transferable risks could be retained by the public sector, but by definition, the real benefit lies with transferring these risks to the P3. If these transferable
risks are not transferred to a P3, they would remain with the government (and the value to government of the deal will be reduced). This highlights the importance of equivalency.

The public sector, through traditional procurement and through an internal business unit, would retain the total risk to the project. It is the risks that the public sector can transfer to the P3 that provides value to the government.

Adapting this equation for the procurement decision, we can use equations 2 and 3 to obtain the following:

Starting with equation 2

2. Total Risk of Project = Transferable Risk + Nontransferable Risk

Use equation 3 to obtain equations 4a and 4b, Total Risk to Procurement Decision (Detailed) as follows:

4a. Traditional Procurement Risk (Risks for public sector business or service delivery unit) = Transferable Risk (But not transferred) = Diversifiable Component + Nondiversifiable Component

4b. Total Risk of Project to P3 Private Partner = Transferred Risk = Diversifiable Component + Nondiversifiable Component

Equations 4a and 4b show that the risks assumed in traditional procurement by a public sector service delivery unit can for the purposes of this discussion be assumed to be comparable to the risks assumed by a P3 partner. Recall that the procurement decision
involves the comparison of what is more cost effective to deliver public provision or a P3. Using Equation 5, below we see that the public sector should base this decision on fact that the total risks for both the public sector business unit and private sector partner are similar. As mentioned, these transferable risks would continue to exist even if the public sector chose to use public provisions. The nontransferable risk is shared, not transferred. If the total risk involved for traditional procurement is equal to the value of the total risk of the P3 option, then we can rewrite Equation 3 as follows:

Equation 5, Total Risk to Procurement Decision (Equivalency):

Traditional = P3 = Transferred = Diversifiable + Nondiversifiable
Procurement Option Risk Component Component

Where risks to the public sector are substantially the same as those associated with a P3 option. These risks determine the discount rate used to define the cost of capital.

II.2 Discount Rate Theory

This section illustrates how the risks evaluated in the previous section affect the premium portion of the discount equation. The expected return (discount rate) on the project is priced using a modified capital asset pricing model with the following determinants: the government-borrowing rate and a risk premium to account for the additional return required by taxpayers for a risky asset.
The discount rate for the procurement decision is often calculated using a modified version of the capital asset pricing model. Introduced by Sharpe (1964), Lintner (1965), and Mossin (1996) independently, the capital asset model (CAPM) is a common method to price an asset’s discount rate or expected return on the market. CAPM is used to determine a theoretically appropriate price of an asset given that assets non-diversifiable risk. The CAPM formula has as its components a risk-free rate (interest rate on government bonds), the asset’s sensitivity to non-diversifiable risk in the form of a beta (also known as transferable and nontransferable risk), and an expected return to the additional risk born (known as a premium) (Sharpe, 1964). This formula is shown below:

Equation 6, CAPM, Higgins (2004):

\[
\text{Expected Return on a Risky Asset} = \text{Interest Rate on Government Bonds} + \beta_{\text{Risk Asset}} \times \text{Risk Premium}
\]

Where \( \beta \)-risk asset is defined as the asset’s volatility and the risk premium is “the increased return on a security required for compensating investors for the risk born” (Higgins, 2004). The interest rate on government bonds (or respective risk-free instrument) can be sourced through various publications of financial government debt instruments.

The total risk to the investment is not the risk premium. In the context of comparing the use of public provisions versus a P3, this paper uses the total risk (transferable, nontransferable) to help value the underlying risk to the project. This value forms the total risk to the project, but not the premium. The premium is a measure of the cost of the
risk of the asset from the investor's point of view. That is, if the total risk is seen as a cost, the investor will want to be rewarded for assuming this cost; the risk premium for a P3 is an additional return to investors for assuming the transferred, nondiversifiable risk.

To calculate the β-risk, we must understand the correlation of the asset return with the returns of a market portfolio. We would estimate the correlation using a list of prices for the asset and the respective index (or returns to the market portfolio of assets). In recent decades, β-risk has become an important fact in security analysis, so much so that stockbrokers advise regularly with published β-risk for all publicly traded companies (Higgins, 2004).

Other financial theory considerations are important to mention within the context of this discussion. In calculating the cost of capital, Jenkinson (2003) uses Modigliani and Miller's theory to prove that the overall cost of capital, the minimum required in a project, is independent of the method of financing. This principle rests on a number of assumptions, however, including tax implications, transaction costs, and financing used to overcome principal-agent costs and other forms of asymmetric information (Jenkinson 2003). Many of these costs are real costs that complicate the theory provided. Agency costs exist because of the partnership evaluation and tax implications; while these costs do not have implications for government, they do have implications to the P3 consortium. Jenkinson (2003) supports the concept of valuing the cost structure of the firm. As Jenkinson (2003) argues, the cost of capital is determined by the underlying risks associated with the activity. However, the cost structure, with its equivalency of the
discount rate for both public and private sector, is also an important consideration. Jenkinson (2003) claims that equity exists in all public sector investments. He uses the example of a project buffer or existing funds with which to cover overruns as a form of equity. These monies do not differ from their practice in private sector projects; therefore, the risk-reward relationships of the taxpayers need to be accounted for in the discount rate. Jenkinson’s (2003) argument would therefore illustrate the need to value both debt and equity within the discount rate equation. As the amount of debt and equity used in public sector project would differ, we would weight the respective costs according to their expected rates of return.

Incorporating these theories, we rewrite the capital asset pricing model as follows:

Equation 7, CAPM with Equity (Simplified),

\[
\text{Expected Return on a Risky Asset} = \frac{K_d \cdot D}{D + E} + \frac{K_e \cdot E}{D + E}
\]

Where \( K_d \) is the interest rate on bonds issued to finance the project, as the expected return on debt, and \( K_e \) consists of the \( \beta \)-risk of the equity asset and its associated risk premium. This equation is quite similar to that of the weighted average cost of capital represented in Higgins (2004):
Equation 8, WACC, (Higgins 2004):

\[
WACC = \frac{(1-t) \times K_d \times D}{D + E} + \frac{K_e \times E}{D + E}
\]

where \( t \) is the tax rate, \( K_d \) is the expected return on debt or the cost of debt, \( D \) is the amount of interest-bearing debt in the companies' capital structure, \( K_e \) is the expected (after tax) return on equity or the cost of equity, and \( E \) is the amount of equity in the companies' capital structure (Higgins, 2004). The annual return that the companies should earn on existing capital is therefore the weighted average costs of capital (WACC). Equation 7 and Equation 8 therefore represent an equivalency minus the consideration of taxes on debt. This is predicated upon government financing of a project, as there would be no additional tax considerations with a governing body financing a public project. Therefore, companies WACC would be equivalent to the expected return on a risky asset, considering the financial implications of equity within an investment and the proportionality representative to the overall weighted costs of capital. This is expressed formally in the following equation:

Equation 9, Expected Return on a Risky Asset and WACC (Equivalency),

\[
\text{Expected Return on a Risky Asset} = WACC = \frac{(1-t) \times K_d \times D}{D + E} + \frac{K_e \times E}{D + E}
\]

A P3 consortium would use the project's internal rate of return (IRR) instead of the WACC to value this business opportunity. Equation 9 shows the equivalency that exists between the CAPM and WACC equation. However, a traditional P3 consortium would
not use the WACC to value this business opportunity because of the debt to equity ratio of the project would not remain constant. Over the life of the project, the debt would be paid down more quickly than the decline of the enterprise value of the project. The WACC calculated at the onset of the project would be different from the WACC calculated throughout the project and would not adequately measure return on investment. To estimate the required cost of capital that the P3 should use, the P3 consortium should calculate the IRR to the project. The IRR is the discount rate that gives a net present value of zero (Higgins, 2004). This equation is illustrated below:

Equation 10, IRR, Higgins (2004):

\[
NPV = 0 = (\text{Capital Outlays}) + \frac{\text{Payment Streams}}{(1 + IRR/100)^n}
\]

Where \(NPV\) is net present value, \(IRR\) is the internal rate of return, and \(n\) is the number of payments over the life of the project (in years). As this is an investment decision, a P3 consortium would need to know whether they should invest in this or another project. To do this, the IRR calculated for each opportunity is used to rate the alternative investments; the investment alternative with the highest IRR is preferable (Higgins, 2004). The IRR is preferred to WACC for two reasons. First, the payment stream to the P3 consortium is relatively constant; second, there is minimal reinvestment into the cash flows of the project once completed. The IRR equation builds the time sensitivity needed to evaluate the cost of capital (discount rate) by averaging all the payment streams from the project. It is equal to an average of WACCs calculated using a WACC from each
payment period over the life of the project. The P3 consortium would therefore use the IRR instead of the WACC to evaluate this investment decision.

The public sector should use as a discount rate the cost of capital calculated as the P3 consortium's IRR. Equation 9 illustrates the equivalency between CAPM and WACC. Ordinarily a weighted average cost of debt and equity capital would work well as an estimated of the cost of capital. However, because in the case of an infrastructure P3, debt to equity ratios varies over the life of the project, the IRR provides a better estimate. The IRR is in effect a measure of WACC, weighted for time periods and amount of capital. The IRR, therefore, provides a better measure of the required return on capital. The public sector therefore still needs a measure to evaluate its alternatives. To illustrate this point, we use the following model to present the respective costs to a project of using traditional procurement or a P3 consortium:

Table 1: Valuation Model for the Procurement Decision

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Costs ($ Millions)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Traditional Procurement</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Capital Costs</td>
<td>-X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations &amp; Maintenance Costs</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation Costs</td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td>-5</td>
<td></td>
</tr>
<tr>
<td><strong>P3 Consortium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payments to P3 Consortium</td>
<td>-45</td>
<td>-45</td>
<td>-45</td>
<td>-45</td>
<td>-45</td>
<td>-45</td>
</tr>
<tr>
<td>($60M-$15M=$45M)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3 Consortium: Capital Cash Flows</td>
<td>-100</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>IRR of Cashflows to the Consortium</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Public Sector IRR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>if X is equal to $90 million</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>if X is equal to $100 million</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>if X is equal to $110 million</td>
<td>12%</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
The above table is a simplified presentation, in actual application the low cost capital project would be much more difficult to identify.

As seen in Table 1, a traditional project would incur a large initial outlay, followed by smaller subsequent costs to service the project over its life. If the government decided to use a P3 to deliver and service a project, it would incur payments to the P3 consortium over the same life of the project, but would forego the large initial outlays and servicing costs required to build and maintain the same project. The return therefore to an infrastructure investment, between using traditional procurement is the savings to the government during the operations period of not having to pay a P3 partner. If we were to take the public sector’s initial capital outlays and use the payment to the P3 consortium (less the public sector operating costs) as a revenue stream, then it is possible to calculate an IRR for the public sector investment. Framed this way the public sector’s alternative to a P3 is to invest in public provision of infrastructure. This approach yields an IRR and government should choose public sector provision versus P3 based on the approach that yields a larger IRR. It, therefore follows that, when determining the public sector costs, one should use the IRR of the P3 consortium as a basis for doing comparisons with the present value of P3 procurement.

In the example above, the private sector IRR for the project given is 15% based on this framework. It therefore follows that, if the public sector would have an IRR for the given project of less than 15%, the government obtains a positive net benefit by using a P3. If on the other hand, the public sector has an IRR equivalent to that calculated for the private sector for the same investment, the public sector is indifferent to the procurement
decision (all other things being equal). Finally, if the public sector would have an IRR larger than the private sector partner's IRR, the government should choose traditional procurement for obtaining the infrastructure, as there is a negative net benefit for using the P3 option.

III. Limitations of the Discount Rate Model for the Procurement Decision

First, the above model assumes that the all investors have rational expectations and are averse to risk. While there is a level of profitability that a P3 consortium would need to achieve to meet the requirements of its shareholders, this profitability would not be in amounts in excess of what a normal risk-averse taxpayer would require for a similar risk-reward tradeoff. This model assumes that investors demand higher returns in exchange for higher risk and does not allow for investors who will accept lower returns for higher risks. Much of financial theory focuses on this risk-aversion relationship. In efforts to simplify this model, it does not account for taxes or transaction costs. Government decisions often do not consider taxes, although transaction costs could be real, given the agency relationship of P3 partnerships. Agency costs are not argued in detail; however, they could be included as an additional risk in the procurement decision if deemed significant. This model also assumes that investors choose assets solely as a function of the risk-reward tradeoff and not because of personal preference. This premise speaks to the rationality of the investor and the relationship the investor has to the risk-reward relationship. Personal preference, government idealism, and managerial preference are all
risks that could be incorporated into the above model. However, they are not weighted heavily in Equation 10 or in the total risks to the project discussed earlier.

IV. Evaluating the Procurement Decision

This is an exercise in financial evaluation of the investment opportunity involving three discrete steps: estimating relevant cash flows, calculating a figure of merit for the investment, and comparing the figure of merit to an acceptance criterion (Higgins, 2004).

Estimating relevant cash flows, at best, is often the most difficult challenge in financial evaluation (Higgins, 2004). Difficulties can involve financing costs, working capital investments, excess capacity, contingent opportunities, and many important costs and benefits that cannot be measured in monetary terms (Higgins, 2004). This situation is also complicated by the fact that the cash flows under traditional and P3 procurement generally take place over different time-periods and under different terms. To the public sector, these cash flows represent costs; to the private sector, these cash flows are revenue from the payments made to build, maintain, and/or service the infrastructure. To make the payment streams comparable, Partnerships BC uses a public sector comparator (PSC) to represent traditional procurement of similar infrastructures. Partnerships BC defines the public sector comparator as a means to estimate the public sector cost to procure a similar asset or service in the absence of a P3 (Project Report, 2005). The PSC is generally unique to the project and tries to match the payment streams to a P3 and a traditional procurement over the same period. This enables Partnerships BC to compare
the net present cost (NPC) or net present value (NPV), discounted for both options, to determine the most cost efficient procurement model. As an example, this figure of merit is illustrated in Table 2 in our discussion of the Sea-to-Sky highway improvement project.

Higgins (2004) describes a figure of merit, as a number summarizing an investment is economic worth, comparable to the commonly used rate of return or, in this case, the discount rate. Partnerships BC use the net present value (NPV) cost adjusted for risk as a measure of the respective projects worth.

The discount rate used by Partnerships BC to value the project is illustrated below:

Equation 11, Partnerships BC Discount Rate Equation, (Project Report, 2005)

Discount Rate = Private Sector WACC = Public Cost of Debt + Project Risk Premium

Partnerships BC use the same discount rate as the private sector to value public investment. Partnerships BC argue that the public sector borrowing rate is not the appropriate measure to compare the PSC and the P3. The public sector borrowing rate reflects the taxpayer-supported credit of the Province, whereas the weighted average cost of capital (WACC), used by the private sector, reflects risk associated with the individual project (Project Report, 2005). S2S calculates its WACC by weighting the marginal cost of each type of capital (i.e., interest on debt and return on equity) against the proportion of that type of capital in the project’s capital structure. According to Partnerships BC, the
WACC better reflects the level of risk associated with the individual project, and the public sector when evaluating the cost of making payments to a P3 partner, versus traditional procurement, should use a discount rate that incorporates a risk premium to be comparable to the private sector (market) WACC for the same project (Project Report, 2005).

Partnerships BC uses the private sector WACC because that measure best reflects the cost of taking the risk that has been transferred under a particular P3 project (Project Report, 2005). Even though the discount rate used by government is conceptually equal to the WACC, calculating an IRR is a more practical way of estimating the WACC over the life of the project.

Using the Partnerships BC Model we see that P3 projects have been evaluated using the following acceptance criterion:


\[
\text{NPC of PSC} > \text{NPC of P3} = \text{Procure through P3}
\]

\[
\text{NPC of PSC} < \text{NPC of P3} = \text{Procure through Public Provisions}
\]

(All other things being equal).

Equation 12 describes an acceptance criterion where the inequality function compares the cost to the public sector in present value (PV) terms for both delivery models, public provisions and a P3. The net lowest cost determines the delivery model, all other things
being equal. The net present cost (NPC) is the total cost to the project discounted at the market cost of capital for a project with this project’s risk profile.

Partnerships BC’s model does support common valuation theory, as does Grout (2002), which looks at each project delivering a flow of benefits and costs. His cost benefit test would opt for public provision if the following were true:

Equation 13, P3 Acceptance Criterion-Theory, (Grout 2002):

\[
\text{Benefit of Public Provision} - \text{Cost of Public Provision} > \text{Benefit of P3} - \text{Cost of P3}
\]

Where the benefit minus the costs of public provision discounted to some rate respectively was greater than the benefits minus the costs of a P3 discounted to some rate.

As the procurement decision values the costs of the risks involved, Grout (2002) proposes a pure finance based test to compare the cost to the government of public provision with the cost to the public sector of conducting the project as a P3:


\[
\text{PV of Cost of Public Provision} < \text{PV of Cost of PPP (Price*Quantity)}
\]

When Equation 14 holds true, public provision is preferable; P3 is preferred if the inequality is reversed. Equation 14 is identical to Equation 12 if we think of the payment to the P3 consortium as a function of price and the amount of usage occurring through the infrastructure.
In this paper, we treat the procurement decision as a traditional project with a payment and revenue stream. The acceptance criterion we use is as follows:

Equation 15, Acceptance Criterion-Paper:

\[
\begin{align*}
\text{Net Benefit to Public Sector of Forgoing P3} & > 0 \quad \Rightarrow \quad \text{Procure through Public Provision} \\
\text{Net Benefit to Public Sector of Forgoing P3} & < 0 \quad \Rightarrow \quad \text{Procure through P3}
\end{align*}
\]

Equation 15 represents the inequality that compares the total net benefit (in PV terms) to the public sector of foregoing the P3 partnerships. If the net benefit of foregoing the P3 is positive, then foregoing a P3 procurement strategy is beneficial. If the net benefit is negative, the public sector is incurring a cost larger than the payments to a P3 and should proceed with a P3 procurement of public infrastructure. It is worth mentioning, that this acceptance criterion could be adapted to represent the inequalities between both the public sector and the P3 consortium IRR for a project. This paper chooses to use a net benefit analysis as it feels an investor would be able to better recognize the net benefit if stated in nominal terms versus as a reflection of internal rate of return on capital cash flows.

Again, if we refer to Table 1, this acceptance criterion makes sense for a number of reasons. Government projects usually have a large initial capital outlay, followed by a
series of smaller operational, maintenance, and rehabilitation costs. To make the payment streams more comparable for the purposes of discounting, we looked at the net difference of foregoing the P3 (i.e., the payments to the P3 consortium). These additional savings are now treated as a revenue stream for this project.

The central premise of the model is to identify a revenue stream with which to compare public provision to a P3. The opportunity cost of the foregone payments represents this revenue. The net value is the difference between the total stream of costs to the public sector under traditional delivery and the total stream of payments that would be made to the P3. This value is then discounted with Equation 10 to achieve a NPV for the revenue stream. Using our acceptance criteria, if the net benefit is therefore positive, this represents governmental gain obtained by foregoing a P3 model.

The model for evaluating the procurement decision and the discount rate presented in Equation 10 is used in the following P3 example.

CHAPTER 4

Using the framework and discount theory discussed to evaluate the Sea-to-Sky P3

The paper in this section proceeds as follows. In Section I, the Sea-to-Sky Highway improvements project is described. In Section II, the P3 example is defined as a

---

6 These costs were reverted back to Future Value terms to demonstrate the payment stream spread over the 25-year term of the project.
procurement decision. In Section III, the risks associated with the underlying value of the project are identified. In Section IV, we use the investment evaluation technique (Higgins, 2004) to consider Partnerships BC’s evaluation of the procurement decision. In Section V, we further analyze this evaluation using both the framework presented within this paper and the discount rate equivalent to the P3 IRR. Section VI concludes with a discussion of the limitations of this assessment.

I. The Sea-to-Sky Highway Project

The Sea-to-Sky Highway is a 95-kilometer section of Highway 99 running from West Vancouver to Whistler. British Columbia’s (Canada) Ministry of Transportation (MoT) decided to make improvements to this section of highway to accommodate the following: population growth, economic development in corridor communities, increasing demand for resident and visitor travel, and increased goods movement (Project Report, 2005). The improvements, to be completed by 2009, include highway widening and straightening and other measures designed to reduce hazards, shorten travel times, and increase the capacity of the highway (Project Report, 2005). MoT decided to undertake two Design-Build (DB) contracts for a portion of the overall project to gain knowledge of geotechnical, constructability, and traffic management issues associated with the overall project. The remainder of the project procured under a DBFO because it added private sector financing, integrated a wider range of services, and transferred additional risks to the private sector (Project Report, 2005). A risk assessment estimated the potential cost of transferring certain risks to the private sector: capital cost risks, construction risks,
operating risks, maintenance risks, rehabilitation risks, financial risks, and traffic management risks. MoT established an annual affordability ceiling, detailed in the Request for Proposal (RFP) as the maximum price that MoT was prepared to pay for the private sector portion of the baseline highway improvements and for operations, maintenance, and rehabilitation of the entire corridor (Project Report, 2005). The final 25-year performance-based contract was awarded to the S2S Transportation Group (S2S). The contract designates a standard payment for fulfilling contractual obligations, as well as financial incentives for meeting certain performance standards for project schedule, traffic management, and final asset conditions.

II. The Procurement Decision in the Sea-to-Sky Highway Project

In January 2003, the Provincial Treasury Board approved a maximum $600 million capital commitment for improvements to the Sea-to-Sky Highway (Project Report, 2005). MoT subsequently advised the Treasury Board of its ability to provide the same project at a lower capital cost, but this does not effect the initial decision to invest. The Ministry decided to make improvements to the highway to meet the mandate and objectives of transportation in the Province. Partnerships BC were at that time helping MoT decides between two methods of delivery: public provision, or a DBFO P3 arrangement. This is the procurement decision discussed in this paper.

III. Identification of Risks
Now that this paper has identified the procurement decision, we must identify the underlying risks associated with the delivery of this asset. The Project Report (2005) identifies the following risks to the project: capital cost, constructional, operational, maintenance, rehabilitation, and traffic management risks. Financial and inflationary risk are also identified and discussed later.

There are additional risks not explicitly identified by the Project Report (2005). These risks include economic risk, informational risk, and political risk associated with the project.

IV. Evaluation of the Procurement Decision – Partnerships BC

Partnerships BC used the following to compare the cost efficiency of the two delivery systems: a series of design and build contracts tendered by MoT (the public service comparator, PSC) and a public private partnership using a DBFO structure. Cost cash flows were calculated for both the PSC and the P3 option, and a net present cost (NPC) valuation was rendered. Partnerships BC used the following acceptance criterion to determine the delivery model:

\[
\text{If } \text{NPC of PSC} > \text{NPC of S2S} + \text{Value of Additional Improvements by P3} = \text{Procure through S2S Partner}
\]

\[
\text{If } \text{NPC of PSC} < \text{NPC of S2S} + \text{Value of Additional Improvements by P3} = \text{Procure through Public Provisions}
\]

To make the payment streams comparable, Partnerships BC used the public sector comparator (PSC) to represent traditional procurement of similar infrastructures through a series of DBs over the same 25-year time period. In the following table Partnerships BC has presented the payment stream for the P3 partnership assuming full payments and the payment stream for traditional procurement without cost for risk events.
Table 2, Partial Comparison of Payments under DBFO, (Project Report, 2005):

<table>
<thead>
<tr>
<th>Contract Year</th>
<th>Year Ended 31 Month</th>
<th>MoT &amp; DBFO Total Payment</th>
<th>Non Adjusted PSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2006</td>
<td>63.6</td>
<td>87.7</td>
</tr>
<tr>
<td>2</td>
<td>2007</td>
<td>22.4</td>
<td>24.3</td>
</tr>
<tr>
<td>3</td>
<td>2008</td>
<td>30.1</td>
<td>42.8</td>
</tr>
<tr>
<td>4</td>
<td>2009</td>
<td>42.2</td>
<td>54.1</td>
</tr>
<tr>
<td>5</td>
<td>2010</td>
<td>68</td>
<td>55.2</td>
</tr>
<tr>
<td>6</td>
<td>2011</td>
<td>76.3</td>
<td>53.9</td>
</tr>
<tr>
<td>7</td>
<td>2012</td>
<td>75.8</td>
<td>52.9</td>
</tr>
<tr>
<td>8</td>
<td>2013</td>
<td>75.5</td>
<td>52.1</td>
</tr>
<tr>
<td>9</td>
<td>2014</td>
<td>75.2</td>
<td>51.4</td>
</tr>
<tr>
<td>10</td>
<td>2015</td>
<td>75</td>
<td>50.6</td>
</tr>
<tr>
<td>11</td>
<td>2016</td>
<td>74.7</td>
<td>49.9</td>
</tr>
<tr>
<td>12</td>
<td>2017</td>
<td>74.3</td>
<td>52.6</td>
</tr>
<tr>
<td>13</td>
<td>2018</td>
<td>74.1</td>
<td>48.6</td>
</tr>
<tr>
<td>14</td>
<td>2019</td>
<td>73.8</td>
<td>52.4</td>
</tr>
<tr>
<td>15</td>
<td>2020</td>
<td>73.6</td>
<td>52.1</td>
</tr>
<tr>
<td>16</td>
<td>2021</td>
<td>73.3</td>
<td>51.4</td>
</tr>
<tr>
<td>17</td>
<td>2022</td>
<td>73.1</td>
<td>50.8</td>
</tr>
<tr>
<td>18</td>
<td>2023</td>
<td>72.7</td>
<td>50.2</td>
</tr>
<tr>
<td>19</td>
<td>2024</td>
<td>72.5</td>
<td>49.7</td>
</tr>
<tr>
<td>20</td>
<td>2025</td>
<td>72.3</td>
<td>49.2</td>
</tr>
<tr>
<td>21</td>
<td>2026</td>
<td>72.1</td>
<td>50</td>
</tr>
<tr>
<td>22</td>
<td>2027</td>
<td>71.9</td>
<td>49.6</td>
</tr>
<tr>
<td>23</td>
<td>2028</td>
<td>71.6</td>
<td>49.3</td>
</tr>
<tr>
<td>24</td>
<td>2029</td>
<td>71.4</td>
<td>52.1</td>
</tr>
<tr>
<td>25</td>
<td>2030</td>
<td>102.3</td>
<td>60.6</td>
</tr>
</tbody>
</table>

Total          | 1727.8              | 1293.5                   |

Partnerships BC does not provide a breakdown of its estimate for the respective yearly costs to pursue the PSC except to say that the payments do not include any costs of risk.
events. Payments to the DBFO include the availability payments, volume usage payments, performance incentive payments, end of term payment, and the theoretical cost of a MoT DBFO. The DBFO payment is the maximum payment that S2S would receive if it met all the obligations and financial incentives of the P3 contract. Assuming that the calculations of the PSC are comparable to those of an actual future DB contract, the next step would be determining a figure of merit. The figure of merit used by partnerships BC is presented in Table 3. Both the private partner and Partnerships BC have estimated their discount rate at 7.5% (Project Report, 2006).

Table 3, Comparison of the NPC of the PSC and the DBFO, (Project Report, 2005):

<table>
<thead>
<tr>
<th>Description</th>
<th>Analysis Completed December 2005</th>
<th>December 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payment to S2S</td>
<td>0</td>
<td>578.5</td>
</tr>
<tr>
<td>Capital Costs</td>
<td>516</td>
<td>208.1</td>
</tr>
<tr>
<td>Operations &amp; Maintenance Costs</td>
<td>107.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Rehabilitation Costs</td>
<td>36.3</td>
<td>0</td>
</tr>
<tr>
<td>Risk Adjustment</td>
<td>42.9</td>
<td>0</td>
</tr>
<tr>
<td>Self-Insurance Policy of the Province</td>
<td>37.1</td>
<td>0</td>
</tr>
<tr>
<td>Tax-Exempt Status of Public Sector Corporations</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost - Risk Adjusted</strong></td>
<td><strong>744</strong></td>
<td><strong>789.8</strong></td>
</tr>
</tbody>
</table>

Partnerships BC and MoT chose to use the P3 consortium based not on their acceptance criterion, but on additional benefits provided by the P3 proposal. Partnerships BC and MoT felt that highway improvements in excess of the baseline improvements required
were presented in the bid; therefore, the PSC estimate was significant underestimate of the cost of the improvements the Ministry will receive through a P3\(^7\).

V. Evaluation of the Procurement Decision – A Critical Look

We treat this decision as a traditional project payment and revenue stream. The acceptance criterion (discussed earlier in this paper) is as follows:

Equation 17, Acceptance Criterion for Sea-to-Sky-Paper:

\[
\begin{align*}
\text{Net Benefit to Public Sector of Forgoing } S2S & > 0 = \text{ Procure through Public Provision} \\
\text{Net Benefit to Public Sector of Forgoing } S2S & < 0 = \text{ Procure through S2S}
\end{align*}
\]

Table 4 (Appendix I) illustrates the model presented in Table 1 to make the payment streams represent that of a traditional project and to forecast the costs over the time horizon provided by Partnerships BC. This model excludes some constants, including risks, operational and maintenance costs, and capital outlays. Capital costs exist in both options (Project Report, 2005), and certain operational and maintenance costs exist outside of this agreement. Here, the net difference of these costs represents what would exist in a traditional procurement. Risks associated with the project in the procurement decision are also equitable (Equation 4) and have therefore been omitted from the

\(^7\) This represents the difference between the NPC of the P3 and the PSC. The sum of the expected user benefits from the incremental improvements (above baseline improvements) is estimated to be $131 million NPV over the life of the contract by Partnerships BC (Project Report, 2005).
equation. To make the payment streams more comparable, an opportunity costs (OC) calculation at the bottom of the table yields the benefit to the government of foregoing the P3 in terms of payments. This represents the capital cash flows to S2S of investing in the Sea-to-Sky project. Table 4 shows that while the capital outlay would still be significant at $355.82 million; S2S would receive an additional $35.6 million in payments made over the next 25 years. As the cost difference between the traditional procurement and P3 consortium (assuming the capital costs were also averaged over the life of the project) is simply the service payments made to the P3, we should be able to use S2S’s IRR of 7.5% to value the foregone payments. Given that we have simplified this evaluation, the IRR for the project yields 9%. Based on our acceptance criterion, MoT should choose public provision for the Sea-to-Sky Highway only if they are able to invest in the given project at a larger IRR. However, as we will discuss next, evaluating the Sea-to-Sky procurement decision would lead one to believe that a lower IRR for government provision was more plausible given the extra scope of the work entailed with the project.

The problem with the application of this simplistic approach to the Sea-to-Sky project is that the scope of the project used to develop the PSC was less than the scope of the P3 project. The costs of the additional improvements from a P3 were not estimated; however, the value, as a benefit was. This additional value was placed at $131 million. In applying Equation 17, as the decision rule, this $131 million value should be taken into consideration for this particular project. The above framework does not account for the additional perceived benefits of the P3. These benefits, valued at an NPV to users at $131 million, represented an additional consideration. Although it is not the intent of this
paper to dispute this claim, it illustrates the importance of considering these types of other factors when a non-conventional P3 procurement process is used.

VI. Limitations of the Assessment for the Sea-to-Sky P3

There are several limitations of our analysis of the Sea-to-Sky P3. First, our model is based on information provided in the Project Report (2005) prepared by Partnerships BC. The accuracy and validity of the assumptions, context, decisions, procurement process, and results to date of the Sea-to-Sky project come from a review by the auditor general of the Province (Project Report, 2005). Second, the forecasting used in Table 5 assumes a straight-line relationship of the costs involved with the project over the life of the contract. This makes forecasting more practical and reduces the complexity of the analysis. Finally, the information as presented in the Project Report (2005) is slightly dated; we assume, however, that it is still accurate and relevant to discussion.

CHAPTER 5

Conclusion

This paper has illustrated the importance of distinguishing, modeling, and discounting the procurement decision. Much of the current literature focuses on determination of the discount rate and whether to invest in public infrastructure. Once the decision to invest has been made, both transferable and nontransferable risks need to be considered in
valuing the underlying risk to the project. These transferable risks have been presented categorically as construction, operational, and financing risks; economic, informational, and political risks are nontransferable to the P3 consortium. The financial valuation of the procurement decision then follows with a look at the net benefit to the government of foregoing the P3 agreement. Net benefits are discounted by the IRR because calculating an IRR from a private partner’s procurement provides a better estimate of the cost of capital than does an observed WACC or application of the CAPM models to estimate the return investors (taxpayers or private) would need to receive the compensate for the investment made. As the difference between the procurements decisions is simply the payments made to the P3, the IRR of the P3 consortium can be used to discount the net difference of the foregone payments to the P3 to arrive at a net benefit to government of procuring public infrastructure through traditional procurement. A positive net benefit means public provision is preferred, and the alternative is true if the net benefit is negative.

To validate this methodology, this paper examined the recent Sea-to-Sky P3 project and Partnerships BC’s valuation of the procurement decision. The purpose of this exercise was to validate the model and the arguments made within this paper. The model and methodology used by this paper were both more valid as well as relevant to the procurement decision. The model also better analyzed the risks involved with this project and the net benefit of foregoing the P3 investment. The net benefit realized using our model would not be calculated for the Sea-to-Sky project, and the decision to deliver through public provision or P3 had to be based on other considerations. These
considerations were deemed valuable to the assessment and therefore the P3 model was chosen. However, the framework used does provide a better analysis for conventional P3 projects and has application when additional considerations are not present. It can also be said, that the above framework can incorporate such benefits if information at the outset of the project is readily available and such non-conventions are identified.


Appendix 1:

Table 4, Valuation of Procurement Decision for Sea-to-Sky Highway:

| Year | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Project Costs ($ Millions) |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Tax adjustment | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 | -0.38 |

P3 Consortium: S2S

| Capital Costs (MoT) |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

S2S: Capital Cash Flows

| IRR of Cash Flow to S2S |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| The Public Sector IRR if X is equal to $300 million | 11% |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| The Public Sector IRR if X is equal to $356 million | 9%  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| The Public Sector IRR if X is equal to $400 million | 7%  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |