DISCOUNT RATE METHODOLOGIES FOR P3 PROJECTS

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August 2010

When deciding between a Public-Private Partnership (P3) and public sector provision of an asset or service, governments generally seek to compare the expected benefits from these two methods of project implementation. This is typically done through discounted cash flow (DCF) analysis, which yields the net present value (NPV) of different implementation methods for the same project. In P3 methodology, the public sector option is referred to as the Public Sector Comparator (PSC). The PSC and P3 models are first developed at the assessment or feasibility study stage. The results determine whether the project will proceed through traditional procurement or through P3 procurement. If the project proceeds as a P3, the models are updated after bids are received from the private sector to measure the actual Value for Money (VfM), or savings that the government will realize if it implements the project as a P3.

Which discount rate or rates to use in measuring NPV has been the subject of discussion among P3 experts for years. This article presents and compares two methods currently in use, one by the UK's Private Finance Initiative (PFI) and the other by Australia's Partnerships Victoria.

In general we can express NPV using the following formula:

$$\mathbf{NPV = CF_0 + CF_1/(1+r) + CF_2/(1+r)^2 + CF_3/(1+r)^3 + \ldots + CF_n/(1+r)^n}$$

For the assessment of Value for Money between P3 projects and the Public Sector Comparator (PSC) that represents government provision of a project, risks need to be included in this equation. One of the central features of P3 is the transfer of risk to the private sector. How this risk transfer is calculated and incorporated into the NPV equation determines which discount rate methodology is followed. Basically, there are two options:

1. Incorporate risk calculations in the nominator of the NPV equation, or in the project's cash flows
2. Incorporate risk calculations in the denominator of the NPV equation, or in the project's discount rate

The first method is employed by the UK's PFI, under which risk-adjusted cash flows are used to account for identified project risks. These risk-adjusted cash flows are then discounted using a risk-free discount rate. Partnerships Victoria uses the second approach, incorporating risk values into the discount rate used for NPV analysis. These two approaches are described in detail below.

THE UK PFI APPROACH

As mentioned above, the UK approach is to adjust project cash flows for risks then to use a risk-free rate to discount those risk-adjusted cash flows. The risk-free discount rate used in the UK is 3.5 percent. This is the Social Time Preference Rate (STPR), referring to the value of money today versus the value of money in the future. It is the compensation provided to investors for postponing consumption. The STPR can be written as:

$$\mathbf{r = \rho + \mu g}$$

where:

ρ = the rate at which future consumption is discounted over current consumption

μ = annual growth in per capita consumption

g = elasticity of the marginal utility of consumption with respect to utility.

The UK Treasury has determined the actual values for these variables as:

ρ = 1.5 percent

μ = 1.0 percent

g = 2.0 percent

Thus,

$$\mathbf{r = 1.5 + (1.0)(2.0)}$$

$$\mathbf{r = 3.5}$$

As a result, 3.5 percent is the discount rate used to assess all projects in the UK's PFI. The justification for this rate is discussed in the Treasury's 2003 report, *PFI: Meeting the Investment Challenge*:

> Instead of reflecting risk in a risk premium on capital, Government investment decisions reflect risk by calculating the present value capital sum it regards as the necessary contingency for the risks inherent in a project. For example, when deciding between procurement options, project managers calculate an expected value of all risks for each option, and consider how exposed each option is to future uncertainty. They then discount the cost of these options in future years

> at 3.5 per cent per year to a present value, which purely reflects society's preference for consumption now over consumption in the future, rather than discounting the value of project cash flows at a higher rate to make a compensation for risk…Risks are therefore priced individually for each project option. The discounted costs of these risk-adjusted options can then be compared with each other, or with the cost of a PFI project, in a PSC, to determine which procurement option represents the best value for money taking account of risk and uncertainty. This approach is consistent with the fact that in conventional procurement the public sector pays for risk not in its borrowing – which for the public sector is at non-risk rates – but when risks crystallize and must be covered in publicly funded projects.

PARTNERSHIPS VICTORIA APPROACH[1]

Partnerships Victoria divides project risks into systemic risks and non-systemic risks. Its approach holds that non-systemic risks can be mitigated through diversification. Investing in a variety of assets can reduce or eliminate non-systemic risks. Non-systemic risks are included in the forecast cash flows for a given project. Systemic risks, on the other hand, cannot be "diversified away" because they affect all projects. The examples of systemic risks given by Partnerships Victoria include:

- Demand risk which depends on wider economic activity and growth;
- Unexpected inflation;
- Unexpected changes in interest rates or foreign exchange rates; and
- Unexpected obsolescence;

The Capital Asset Pricing Model

Partnerships Victoria uses the Capital Asset Pricing Model (CAPM) to determine cost of capital, which is the basis for its discount rates. The formula for the CAPM is given as:

$$R_a = R_f + \beta_a(R_m - R_f)$$

where:

R_a is the cost of capital of (or required return on) assets whose risk class is designated by the asset beta

R_f is the risk-free rate, though for the purposes of the CAPM this is the rate on an asset that is free from systematic risks only

[1] This section is based on the publication by Partnerships Victoria, "Use of Discount Rates in the Partnerships Victoria Process". Technical Note. July 2003.

$\mathbf{R_m - R_f}$ is the market risk premium that an investor would expect to receive before investing in an asset exactly correlated with the market

β_a is the asset beta, which reflects the degree to which asset returns (i.e. returns of a particular project) are expected to vary with returns of the market (i.e. a well-diversified portfolio of assets or projects), otherwise known as the systematic risk.

β_a is further defined by the equation:

$$\beta_a = \sigma_{am}/\sigma^2$$

where:

β_a is the beta for asset *a*

σ_{am} is the covariance of returns of asset a compared to market returns

σ^2 is the variance of market returns.

The Risk-free Rate (R_f)

The notion of the time value of money indicates that money has more value in the present than in the future. For this reason, it is believed that investors have a preference for early revenues and late costs on projects. This preference is referred to as the time preference of money. The value of the time preference is indicated by the risk-free rate of return on assets. Partnerships Victoria uses the government bond rate as the risk-free rate. It is written as $\mathbf{R_f}$.

The risk-free rate can be expressed in nominal terms and in real terms. The nominal risk-free rate includes expected inflation. Real rates do not include inflation effects. To convert from nominal to real discount rates, we use the Fischer equation:

$$\mathbf{N = (1 + r)(1+ i) - 1}$$

where:

N = nominal rate

r = real rate

i = inflation rate

For example, if the real risk-free rate is 3.0 percent and the inflation rate is 2.25 percent, the nominal discount rate is:

$$N = (1 + .03)(1 + .0225) - 1$$
$$N = 5.3$$

Market Risk Premium ($R_m - R_f$)

Government bonds are considered risk-free because their returns are guaranteed and, at least in a country such as Australia, that guarantee is credible and default is considered unlikely. Investments in other types of assets or securities are not guaranteed so are not considered risk-free. It is quite possible to lose money by investing in corporate securities on the stock market. This added risk of loss leads investors to require a higher rate of return. The difference between this higher rate of return and the risk-free rate is called the market risk premium and can be written as:

$$R_m - R_f$$

Partnerships Victoria has set the market risk premium at 6 percent.

Project Risk Premium

Partnerships Victoria recommends that each project be assigned to one of three risk bands and that its asset beta be taken from among those bands[2]. The bands and types of projects associated with each band are shown in the table below. These betas will generally be lower than those observed in the market, a result of the types of projects in which government is involved. This table is only a guide and some projects may combine characteristics of projects in more than one band so should use a beta that is between the betas shown for the relevant bands.

[2] These betas are not necessarily vaild for US projects. For example, aged care housing in Australia is implemented under an availability payment scheme so not subject to market risk in the same way as nursing homes in the US.

Risk bands for most Partnerships Victoria Project Categories				
Risk band	**Project sectors and example projects**	**Asset beta**	**Real risk premium***	**Real discount rate****
Very low	***Accommodation and related services***	**0.3**	**1.8**	**4.8**
	Aged care housing			
	Public housing			
	Hospital facilities			
	Correction facilities			
Low	***Water, transport and energy***	**0.5**	**3.0**	**6.0**
	Wastewater treatment plants			
	Water infrastructure			
	Hospital car parking			
	Hospital energy plants			
	Road projects (non-toll)			
Medium	***Telecommunications, media and technology***	**0.9**	**5.4**	**8.4**
	Entertainment			
	Telecommunications and IT			
	Knowledge economy			
*Risk premium assumes a market risk premium of 6.0%. The real risk premium is calculated as market risk premium x asset beta.				
**The real rate will be updated by DTF (at www.partnerships.vic.gov.au) from time to time as required.				

Tax and Inflation Considerations

Discount rates can be developed on a pre-tax or post-tax basis. They can also be developed on a real or nominal basis. Cash flows to which the discount rates are applied must be developed on the same basis. For example, a pre-tax, nominal discount rate should be applied only to pre-tax, nominal cash flows.

Discount Rates for the PSC and Bids

The Public Sector Comparator is the model that assumes the government will implement the project directly and not as a P3. In the Partnerships Victoria approach to discount rates, this means that all systemic risks are retained by the government. With the introduction of P3, it is expected that some of the systemic risks will be transferred to the private sector. As a reminder, the systemic risks are:

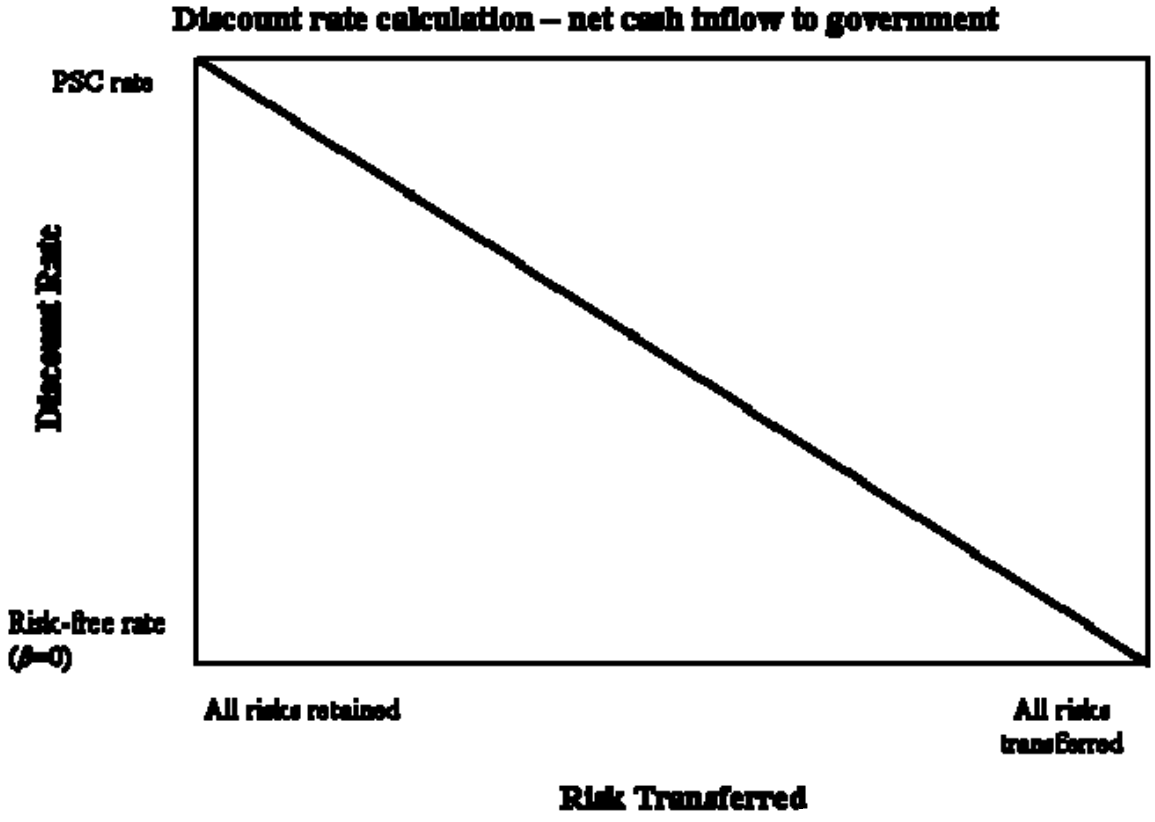
- Demand risk which depends on wider economic activity and growth;
- Unexpected inflation;
- Unexpected changes in interest rates or foreign exchange rates; and

- Unexpected obsolescence;

In this case, the government's cash flows will retain less systemic risks than under the PSC. For projects in the very low and low risk categories in the table above, Partnerships Victoria considers the transfer of systemic risk negligible so recommends the use of the same discount rate for the PSC and P3 models. For projects of medium or higher risk, it is recommended that a different discount rate be used for PSC and P3 cash flows. The methodology for determining the adjusted discount rate depends on whether the net cash flows to the government are positive or negative. The methodology for these two approaches is described below.

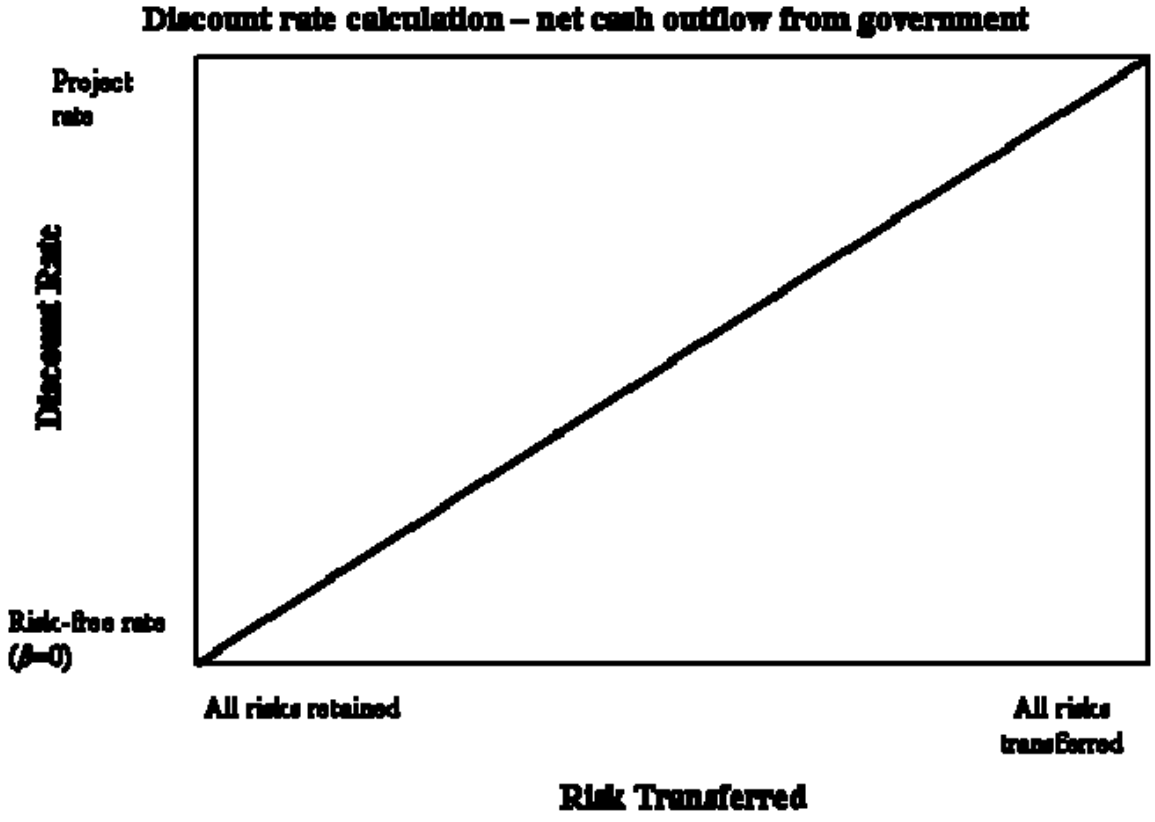
Projects with net cash inflows

If government cash flows are subject to less systemic risk under the P3, then the beta used to calculate the P3 discount rate will be lower and so the discount rate used for the P3 bids will be lower than that used for the PSC. To calculate this lower discount rate, it must be determined how much systemic risk is transferred to the private sector. The following graph shows the relationship between the discount rate and the amount of risk transferred. This graph can be used to help determine the discount rate to be used for the P3 bids.



Projects with net cash outflows

Projects with net cash outflows require a separate methodology for calculating discount rates. If the methodology outlined above is used, then the riskiest projects are discounted the most and appear to have the lowest cost to the government. So, an alternative must be used. In projects with net cash outflows, Partnerships Victoria recommends using the risk-free rate as the discount rate for the PSC. For the P3 bids, Partnership Victoria recommends using a higher discount rate for projects that feature greater transfer of risks to the private sector. In this way, the more risk is transferred, the higher the discount rate will be and therefore the higher the net present value (or lower the net present cost) of the project for the government. The opposite is true for projects that feature limited risk transfer to the private sector. This relationship is displayed in the graph below.



Conclusion

As we have seen, there are basically two approaches to discount rates in P3 analysis. The first is to incorporate risk measures in the pro-forma cash flows of

the project and the second is to incprorate risk measures in the discount rate employed. Each method has its pros and cons and whichever method is used should be fully documented. Most importantly, analysts should be sure not to use both methods in the same analysis or to double discount project cash flows.