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The Valuation of Public Projects: Risks, Cost of Financing and Cost of Capital

Current evaluations of public projects by governments suffer from serious flaws, exposing taxpayers to unaccounted risks and bad investment decisions.

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The Study In Brief

It is often said that the private sector is in a good position to manage project costs and meet deadlines, but not, generally, to fund or finance projects. The underlying argument runs as follows: because the interest rate on government borrowings (the government's financing cost) is lower than what is available to the private sector, the cost of goods or services will necessarily be lower if it is funded by government. However, there is confusion between the cost of financing and the cost of capital (or discount rate) that stems from an analytical error in assessing the true cost of public funds. This is a subtle but important error that is widespread in both the public and private sectors as well as in academia.

This analytical illusion is due to the fact that a significant portion of the government's cost of capital is unaccounted for or not recognized. This portion is the implicit option granted by taxpayers to their government to require additional funds in order to meet the commitments made to the lenders when a project does not meet the expected level of profitability. Discounting at an essentially risk-free rate is often justified by "the virtually unlimited taxing power of the Crown" – the project appears risk-free to lenders, but is obviously not risk-free for taxpaying citizens.

The authors identify the implications for the evaluation of public investments and relevant public policies such as direct subsidies to businesses, government endorsements of corporate borrowings, the comparison of public sector versus private sector delivery of public projects and holding a portfolio of risky investments dedicated to the future repayment of the debt. It goes without saying that other evaluations of government policies and interventions could be similarly challenged.

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We often hear that it is more expensive for private companies than governments to finance a project, because government can borrow at lower interest rates. However, this statement is only half true, as it ignores the costs resulting from government authority to levy, when required, additional fees and taxes to repay lenders if one or several funded projects prove unprofitable.

This governmental power, which means a kind of insurance policy is held on the project, involves a cost to taxpayers that is essentially the difference between the financing rates for private and public parties for the same project. Our analysis of public and private investments and related public policies considers factors such as:

- direct subsidies to companies;
- governmental endorsement of corporate borrowing;
- a comparison of public-sector versus private-sector delivery of public projects (Infrastructure Ontario's "Value for Money Assessment" methodology); and
- holding a portfolio of risky investments dedicated to future repayment of public debt as an alternative to immediate repayment (Québec's Fonds des générations).

1. Framing the Issue

Four mistakes are commonly made when evaluating public and private investments. These mistakes are based on persistent analytical errors that are the cause of value destruction among public and private undertakings. They are:

1. Calculating the net present value (NPV) of a given project by using different discount rates, depending on whether the project is carried out by the public sector (lower rate) or by the private sector (higher rate).
2. Using a cost of capital for the business as a whole (e.g., the weighted average cost of capital, or WACC, corresponding to the cost of financing) in the assessment (usually the NPV) of all its investments rather than using a specific cost of capital for each project, properly assessed against the risk of that particular project.
3. Using a single cost of capital or discount rate for a project that is dependent upon several factors or sources of risk.
4. Using a discounting method such as NPV that fails to quantify the value of managerial flexibility in the development, implementation and/or continuation of a project in a changing and volatile environment.

This *Commentary* deals mainly with the first mistake, which is particularly relevant to the public sector. Nevertheless, in Section 4 we briefly discuss the other three mistakes because of their sometimes pernicious presence in public and

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private organizations and their potential for value destruction.

With the management of some public services increasingly delegated to private-sector organizations and the emergence of more complex risk-sharing arrangements with the private sector, among other developments, the determination of an appropriate public discount rate has taken on even greater importance, especially as it pertains to the risks involved in assessing public projects.[1]

We often hear that the private sector is in a good position to manage project costs and meet deadlines, but not, generally, to fund or finance projects. The underlying argument runs as follows: because the interest rate on government borrowings (the government's financing cost) is lower than what is available to the private sector, the cost of goods or services will necessarily be lower if it is funded by government. However, there is confusion between the cost of financing and the cost of capital (or discount rate) that stems from an analytical error in assessing the true cost of public funds. This is a subtle but important error that is widespread in both the public and private sectors as well as in academia.

It is important to mention that we are not dealing with all aspects of evaluating public investment projects.[2] This *Commentary* relates mainly to the distinction between the discount rate to be applied in the evaluation of public projects and the interest rate at which a government finances its activities.

2. Origin of the Public Sector's Lower Financing Costs

It is undeniable that the public sector can generally borrow at lower interest rates than the private sector. But why is the cost of financing lower for a public-sector enterprise if it is involved in the same activities and in the same way as a private-sector company – same technology, same inputs, same

1 Recent books, articles and studies including, among many others, Gollier (2011), Burgess and Jenkins (2010), Harrison (2010), Sick (2009), Boardman, Moore and Vining (2010), Lopez (2008), Azar (2007), Montmarquette and Scott (2007), Caplin and Leahy (2004), Young (2002), Dasgupta, Mäler and Barrett (2000) and Pearce and Ulph (1995) reflect this unabated and steadily renewed interest in the relations between risks and social discount rates for public project evaluation. In most if not all of the above sources, the analysis suffers from neglecting the above four "mistakes," in particular the first one – Harrison (2010) is a notable exception here – which is the specific subject of this *Commentary*. The worldwide significant and increasing indebtedness of the public sector may in part be due to faulty public investment analysis.

2 For example, we do not deal directly with the specific role of discounting future cash flows to bring them to a common basis in today's dollars. Further, we are not dealing with the estimate per se of cash flow, cash benefits and costs, or the assessment of non-cash flow benefits or costs and their expression in monetary equivalents, risky or not. Neither do we refer to externalities, induced effects or eviction effects of public projects, although they may be relevant to their evaluation. We also do not deal with the role or the inclusion of taxes, as benefits of a project or as payments for goods and public services such as roads, business law and social security, used in a project. We do not deal with the inclusion of normative elements (equity, distribution of income or wealth) versus descriptive elements (efficiency and effectiveness, opportunity or alternative costs) in the value assessment of projects. Neither do we refer to various market imperfections that may be relevant such as distorting taxes, fixed prices and wages. Finally, it is important to note that we will not deal directly with the determinination of the risk-free discount rate reflecting the time-preference rate; in this context, we do not address the problems of endogenous preferences and time consistency – see Boyer (1975) and Caplin and Leahy (2004). On the other hand, our analysis does not exclude the possibility that the public sector considers the various effects of a project on public consumption and private investment, but in this case it is better to express the non-market benefits and costs (externalities, induced effects) in terms of their monetary equivalents that are clearly risky – see Bradford (1975), Boyer (1975, 1979), Dasgupta, Mäler and Barrett (2000), and the synthesis effort of Gollier (2011).

markets, same price – and, therefore, faces the same risk factors?

The answer is that a government has the power to levy additional fees and taxes to compensate and repay lenders if its projects incur cost overruns and/or lower than expected benefits. The interest rate paid by the public sector reflects the fact that, through its taxing power, it implicitly subscribes loan insurance wherein all taxpayers act as the insurer. This means that lenders to the public sector require only a small risk premium regardless of the project.[3]

As shown in Appendix A, the risk premium required by the lender will depend on several factors: the probability of default, the estimated loss in case of default and an assessment of the systemic (non-diversifiable) risk associated with these two quantities. A lender is not directly interested in the borrower's identity (public versus private) when determining the risk premium, the only important factors being the probability of default and the loss in case of default. The lender will, however, show an indirect interest in the public sponsor if the latter provides a complete risk insurance borne by taxpayers, since this has the effect of reducing to zero the loss in case of default, thereby implying a zero risk premium. As such, if a project fails, the public sector can repay the loan by increasing taxes or by reducing the number and/or quality of public services – in effect requiring compensation from the insurer (i.e., the taxpayers).

For the tax-paying public, the right and power of the state to demand additional contributions as required comes with a cost. This cost is real, but generally not acknowledged. It corresponds to the value of the financial option (or insurance policy) granted by taxpayers to the government to obtain from them additional funds to cover a project's possible non-profitability. The lower cost of funding is mainly due to the unaccounted implicit cost of this option or insurance policy held by a government. If citizens gave a private company a similar option, i.e., the right to levy a tax if it was in financial distress, the private company could finance its activities at a rate similar to that of a governmental agency.

All lenders require a premium related to the risk of default and associated potential loss. If the risk is borne by an insurer, represented here by the taxpayers, then the taxpayers should demand an equivalent risk premium: for a public project proponent, the requirement of a risk premium by the lender or its insurer (the taxpayers) is equivalent and must be taken into account. The proponent must then evaluate the project, taking into account the risk premium in order to avoid unduly depriving taxpayers.

In the investment community, there is much confusion between the risk ultimately borne by taxpayers and the cost of government funding which, reflecting the lender's point of view, does not take into account the cost of the implicit insurance provided by taxpayers to their government. This translates into a subtle, but undeniable error.

In the analysis of PPP partnerships, for example, one must be careful in comparing the commitments of the different partners, namely the first partner – client or principal – and the second

3 The liquidity of securities is undoubtedly a factor in explaining the difference in rates, but this liquidity is directly related to the option or implicit insurance that the government enjoys. In addition, rates of various securities guaranteed by government may differ from the government rate because of the expected transaction costs to validate such guarantees. Regardless of those differences, probably transactional in nature, it remains essential to distinguish the evaluation issue from the financing issue. The risk of a project must be taken into account in the assessment, regardless of the identity of the promoter and the financing method.

partner – supplier or contractor. The analysis of the commitments of the first partner should be based on the risks incurred by that partner whether public – in a public-private partnership- or private – in a private-private partnership. Similarly, the analysis of the commitments of the second partner should be based on the risks incurred by that partner. In a PPP, the risks incurred by the partners are very different and should be assessed accordingly. But the evaluation of the project by the first partner whether it is public or private should be the same. The value of a PPP formula actually lies in the sharing and more effective management of risk, along with the more rigorous management of costs and schedules made possible by a better alignment of incentives, but not because of the public or private nature of the partners.

To conclude, the argument that government funding is less expensive than private funding is not only wrong but also, unfortunately, ubiquitous in debates on public investment, especially for large infrastructure projects. This error is directly related to the determination of the appropriate discount rate for the evaluation of public investment, specifically how the risk of a public project is taken into account in cash flow stream discounting.

3. The Public Sector Cannot and Should Not Ignore Systemic Risk

The confusion in assessing the public sector's cost of financing and cost of capital has led many economists to suggest using the cost of government financing, essentially a risk-free rate, to discount the cash flows of public projects. Two main reasons are provided to justify this practice.

For one, these economists say that the government is able to finance its projects by borrowing at a risk-free rate and that this justifies not incorporating a risk premium in the discount rate because the risk does not appear in the government's cost of financing. As discussed in the previous section, this view stems from the confusion between the cost of financing and the cost of capital. Since the risk in government-financed projects is borne by taxpayers rather than by lenders, such lenders will require no risk premium on their loans. On the other hand, taxpayers will or should require, implicitly if not explicitly, that the project compensates them for the risk incurred, and the government must take this into account when determining the project's cost of capital (for an example, see Box 3).

Secondly, it is argued that the government has a significant portfolio of projects and, therefore, the risk is completely discharged through the diversification effect. As shown in Appendix A, if the systemic risk associated with a portfolio of projects is not nil, this statement is false.

These two "reasons" result from analytical errors in the evaluation of public investment projects and, as such, promote value destruction rather than value creation. For a given project, an investor must be compensated for non-diversifiable risk characterized by the correlation between the return on the project and the return on the overall market portfolio. Therefore, the discount rate for any particular project – public or private – should reflect the project's level of systemic risk.

Assuming that government has no interest at heart other than that of the citizens it represents, the allocation of public funds should follow the same principles used in the allocation of private funds since in both cases the funds come from the same source, the taxpaying citizens. Thus, a dollar to be received at moment t should have more value for typically risk-averse taxpayers if the correlation with general economic conditions is low. As a result, using the risk-free rate as the discount rate will lead to an error proportional to the project's non-diversifiable systemic risk as shown in Appendix A.

Although the government does not usually relate its borrowing to the funding of specific projects, it remains true that regardless of the project, loan or subsidy, the implicit guarantee taxpayers grant the government allows it to offer the lender an

essentially risk-free investment. Taxpayers do not get the same deal.

4. Three Other Analytical Mistakes When Assessing Projects

In this section, we briefly discuss the three other important mistakes identified in the introduction. These three mistakes are just as damaging as the one above, but we provide only an overview here given the limited space available.

When using the company's cost of capital as a whole (WACC) in the assessment of its investments, one will undervalue the risk of some projects whose level of risk is higher than the average risk of the company's project portfolio, thus over-investing in those projects. Similarly, one will overestimate the risk of other projects whose risk level is lower than the average risk of the company's project portfolio and, as a result, under-invest in such projects. Ultimately, this causes a potentially large destruction of value in the company. When assessing a particular project, we must use a discount rate or cost of capital specific to this project, pegging it to the project's specific systemic risk level.[4]

Concerning the mistake made by using a single cost of capital in assessing a project when it is dependent on several sources of risk, Boyer and Gravel (2006) show that the NPV methodology is at variance with or violates the principles of additivity[5] and of no arbitrage opportunities.[6] The use of a single discount rate for a project's net cash flows is the main problem, even when the rate is risk-adjusted. We cannot avoid considering separately the cash-flow components that are dependent on different sources of risk and assigning them a risk premium of their own. The optimized net present value or O-NPV developed by Boyer and Gravel (2006) overcomes the shortcomings of the standard NPV and, in the presence of multiple sources of risk, restores the correctness of investment choices with an objective of creating wealth.

Finally, when managers may intervene in the development, implementation, tracking and/or future of a project by reacting to a changing and volatile environment, the traditional NPV must be replaced with real option valuation (ROV). The latter integrates the value of managerial flexibility in the project's value. This is because traditional NPV implicitly assumes that a company investing in a project passively holds the underlying assets for the life of the project. NPV therefore neglects the value of active management.

In the presence of managerial flexibility, investments, in particular strategic investments, can be seen as portfolios of real options that managers exercise at the appropriate time. Managers are expected to respond to future events and market

4 Kruger, Landier and Thesmar (2011) verify investment biases empirically and measure the value destruction caused by this mistake in businesses.

5 The additivity principle states that the value of a portfolio of independent projects must be equal to the sum of its constituent projects. We must, therefore, be able to evaluate a sequence of cash flows broken into several components by the sum of the evaluations of these various components.

6 An arbitrage opportunity can be defined as an investment strategy at no cost (no net-cash outflow) that promises a positive return in some states of nature while having a zero probability of loss. The principle of no arbitrage states that in developed markets populated by rational agents, arbitrage opportunities for all practical purposes should be rare and of short duration or non-existent. If an arbitrage opportunity arises, the agents would exploit it immediately, and it would quickly disappear. In other words, "there is no free lunch," especially in the world of public or private finance.

developments as well as to changes in the intensity of competitive forces. There NPV methodology does not have the flexibility to account for managers' expected flexibility options. These options are similar to financial options but are generally more complex. However, they can be evaluated using similar methodology. Neglecting them produces a bias, usually downwards, in project evaluation.[7]

5. Economic Policy Implications

Funding costs and discounted cash flows in the presence of risk must be considered separately when evaluating public projects. The public sector's advantage with respect to financing costs is primarily related to the implicit risk insurance provided and supported by taxpayers. Since the government has a responsibility to protect the collective, or taxpayers', wealth, these elements must not be ignored when doing a cost-benefit assessment.

In evaluating an investment project, risk assessment should not differ according to the entity (public versus private) undertaking the project.[8] Our analysis shows that there is essentially no significant difference in cost of capital (including all components) for a given project between the public and private sector.

We may, therefore, wonder about the merits of subsidies and loan guarantees granted by a government to private companies based on the argument that the cost of government funding is lower than that of the private sector. Many public projects are routinely assessed on the basis of this faulty logic (see Box 1).[9]

We may also question whether it is appropriate for a government to hold a portfolio of risky investments rather than repay its debt, under the pretext that there may be a long-term capital gain or profit equal to the difference between the cost of government funding and the performance of said portfolio (see Box 2).

These examples raise the critical question: what is the best way for a government to assess and make transparent the cost of subsidies and other forms of assistance to businesses? Those grants and subsidies may be unavoidable but they represent for the taxpayers risky commitments, the cost of which must be determined.

A procedure applicable to the vast majority of government-supported initiatives would be to submit the project to an auction: the government would offer a number of local and international financial consortia to take responsibility for the project, bearing the costs and collecting repayments at levels and conditions determined by the

7 Dixit and Pindyck (1994) authored a classic reference book on real options, and Chevalier-Roignant and Trigeorgis (2011) is the source on strategic real option valuation; see also Boyer, Christoffersen, Lasserre and Pavlov (2003), and Boyer and Gravel (2012a, 2012b).

8 Klein (1997) deals with the consideration of risk when assessing public projects from an approach similar to ours, at least in spirit. Klein considers a project with a single source of risk and concludes that the discount rate adjusted for the risk of a project should be the same, regardless of the public or private nature of the entity undertaking the project. Klein concludes his analysis by stating that a given investment should be made by the public or private sectors depending on the effectiveness and efficiency provided by either sector in completing the investment. However, the discount rate should be the same for all practical purposes.

9 Having said this, the justification for such subsidies and guarantees may refer to various market failures (including financial markets), so that these projects could not be completed without the government's financial involvement, regardless of their economic or social viability. In such cases, the social cost of public funds must still be properly determined so that the decision is actually wealth-generating.

Box 1: Assessing Value for Money (Infrastructure Ontario)

The approach used by Infrastructure Ontario (IO) to evaluate and compare the public-sector delivery cost of a project with the private-sector delivery cost of the same project is in part fundamentally and fatally incorrect. The IO approach is likely to generate important losses of potential value for the taxpayer.[a] We identify four problems in this IO approach.

According to the IO 2007 *Guide* (page 10): "Total financing costs under AFP [private-sector Alternative Financing and Procurement] are typically higher than public-sector financing costs because the private sector borrows at a higher rate than the Province. This is a common criticism of the AFP." As we have demonstrated, the public-sector-observed cost of borrowing hides a significant cost of raising public funds, namely the cost of the implicit insurance policy or financial option granted to the government by taxpayers allowing the government to request additional money if necessary, through taxes and other fees, to compensate and repay lenders. Therefore, the evaluation methodology followed by IO will often lead to wrong decisions.

The *Guide* also states regarding risky costs: "[T]he discount rate chosen should match the uncertainty inherent in these cash flows. Since higher risks require higher returns, one could argue for a higher discount rate (i.e., risk-free rate plus risk premium) to capture the uncertainty in the project costs. However, this leads to the counterintuitive result of future uncertain costs being heavily discounted leading to a project appearing less costly in present-day dollars as a result of this increased risk. An appropriate method to avoid this result is to quantify the embedded uncertainty in costs through a comprehensive risk assessment" (page 15). This quote reflects a second shortcoming of the IO approach. It stems from the view that a lower discounted value of costs when costs are more risky is counterintuitive. It may be counterintuitive, but it is nevertheless correct! The reason why this so-called counterintuitive result is correct is that risky costs, assuming that the systemic riskiness of costs is properly measured, act as a form of insurance against the fluctuations of the market: if costs are systematically more risky, it means that they are high when market returns are high and low when such returns are low. This makes the project more valuable and should not lead to manipulations (or "comprehensive risk assessment" in IO's vocabulary) to "avoid this result."

Third, IO calls for applying the same discount rate to any publicly delivered project, namely the same risk-free rate for all projects. As we have shown above, using a unique discount rate would be value destroying insofar as some projects may be subject to multiple sources of risk: some valuable (positive NPV) project delivery will end up being rejected and some non-valuable (negative NPV) project delivery will end up being accepted.

Finally, the IO approach invokes (page 15) that "As the public sector financing rate reflects the virtually unlimited taxing power of the crown to repay its debt, crown borrowings are viewed as risk free" to justify a risk-free discount rate. Indeed, those Crown borrowings are seen as risk free by the lenders, but certainly not by taxpayers who will be called to foot the bill if the public projects turn out to be less profitable than expected, if not disastrously so.

a The procedure at Infrastructure Québec raises similar problems, but since the process is explicit and transparent in Ontario, while it is rather opaque in Quebec, we will stick to IO.

Box 2: Investing v Repaying the Debt (Québec Fonds des générations)

The Québec Government created the *Fonds des générations* in 2006. The Fonds is dedicated to the future repayment of public debt and to inter-generational equity, sustainable social programs and prosperity.

The Fonds reached $4.4 billion by the end of March 2012 and is expected to more than double to $10.1 billion by 2016. Since its inception, the Fonds has posted a relatively low 2.2 percent average annual return, in part due to the financial crisis, compared to the government's average annual cost of financing of 4.4 percent over the same period (Joanis 2012).

At the time of the inception of the Fonds, the Department of Finance calculated that the cost of debt financing was 6.9 percent over the 1995 to 2005 period, compared to a rate of return of 9.4 percent at the Caisse de dépôt et placement du Québec: hence the expected profitability of the Fonds.

As shown here, this comparison is flawed, since the first rate does not consider the cost of the implicit insurance policy or financial option granted to the government by taxpayers allowing the government to raise taxes and other fees if necessary to compensate and repay lenders, while the Caisse's rate of return includes a significant risk premium.

On the other hand, the existence of the Fonds may be seen as a constant reminder that the government must contribute each year to the Fonds and therefore implicitly repay the provincial debt, this being something it could otherwise easily neglect.[a] At the time of the September 2012 provincial election, the Parti Québécois platform called for the immediate use of the Fonds to repay the provincial debt, but this element of the party program was scrapped after the election of the PQ minority government.

a Initially, the Fund was to be provisioned mainly through hydro royalties to be paid by Hydro-Québec and private producers of hydroelectric power and, depending on the evolution of the situation, by other sources of income identified by the government. The 2013/14 provincial budget includes the following contributions to the Fonds des générations: revenues that result from the indexation of the price of the "heritage electricity pool" from 2014 (i.e., $95 million in 2014/15; $190 million in 2015/16; $290 million in 2016/17 and $395 million in 2017/18); all mining royalties from 2015/2016 ($325 million yearly); future Hydro-Québec cost savings fixed at $215 million per year as of 2017/18, in part resulting from the decision to abandon the Gentilly 2 nuclear plant; and $100 million per year from 2014/15 from the increase in the alcohol tax.

government, in exchange for a premium paid by the government. Obviously, if a government sets up an aid and/or subsidy project for a company or companies, it means that the conditions attached to the project are more business-friendly than those available on the financial markets. This explains the premium that would be required by the consortia called upon to take charge of the project. For the government, the anticipated cost of the project is equal to this premium, the most favourable one generated by the auction. It could and should consider this premium as a budget expenditure (see Box 3 for a practical example of what would be entailed by this suggestion).

Box 3: Determining the Costs of Subsidies and Guarantees through Auctions

The federal and provincial governments often grant loans, subsidies or other financial support to private firms as a contribution to the development of new products or to ensure the very survival of firms in difficult financial positions.

Consider the hypothetical case of different levels of government coming together to provide comprehensive financial assistance to a private firm for the development of a risky project or product tied to some repayment terms.

A proper assessment of such business support measures offered by governments requires not only disclosure of the characteristics of the measures including repayment terms but also that the benefits and costs can be quantified, especially in highly volatile markets involving significant risks. Various support measures are often justified and criticized with opportunistic political arguments, which is an obstacle to the pursuit of efficiency and transparency.

To make possible an explicit and objective assessment of the costs of these publicly financed support measures or contracts, they should be transferred to the competitive sector at market value. How could this market value be determined? By auctioning off such measures or contracts (both the commitments in terms of loans and investments and the repayment provisions). If the best bid requires the government to compensate the winning consortium for accepting the responsibility of the support measure or contract, this amount would be entered as an expense in the government budget. This amount is indeed for taxpayers the best estimate of the expected cost or net benefit of the measure or contract.

This sanction by the market would also allow citizens to verify that their government is defending and protecting their interests.

Various models for the contract with the selected consortium could be considered, such as annual payments for a few years or variable payment options, as well as the possibility of the government taking over the project. Alternatively, the government could take out an insurance policy to ensure that the project will be carried out, with taxpayers fully compensated for the risks involved.

6. Conclusion

In this *Commentary*, we have shown how and why the standard methodology used for the evaluation of public projects suffers from serious flaws, particularly with respect to the use of a discount rate corresponding to the government's cost of financing. Our analysis suggests that the underlying rationale for this approach stems from an analytical illusion that the cost of capital incurred by the private sector to undertake a project is higher than the cost of capital incurred by the public sector to undertake the same project.

This analytical illusion is due to the fact that a significant portion of the government's cost of capital is unaccounted for or not recognized. That is the implicit option granted by taxpayers to their government to require additional funds in order to meet the commitments made to the lenders when a project does not meet the expected level of profitability. Discounting at an essentially risk-free

rate is often justified by "the virtually unlimited taxing power of the Crown" (Infrastructure Ontario) – the project appears risk-free to lenders, but is obviously not risk-free for taxpaying citizens.

We have identified the implications suggested by our analysis with respect to the evaluation of public investments and relevant public policies such as direct subsidies to businesses, government endorsements of corporate borrowings, the comparison of public-sector versus private-sector delivery of public projects and holding a portfolio of risky investments dedicated to the future repayment of the debt. It goes without saying that other evaluations of government policies and interventions could be similarly challenged.

Unlike the current methodology that evaluates public investment projects essentially by discounting flows at the rate at which the government can finance its debt, we must instead define and measure the systemic risk of each specific project and discount the cash flows or cash equivalents of the project in question at a cost of capital properly pegged to this systemic risk. The result: different discount rates for different projects with different levels of systemic risk. Generally, for a project characterized by a given level of systemic risk, the discount rate to be used should not depend on the public or private nature of the company or organization that undertakes it.[10]

Given the significant value destruction potential entailed by the standard approach to the evaluation of public policies and projects, a thorough and urgent examination of this approach and its components should be undertaken.

10 However, the flows to be discounted may differ to the extent that different companies or organizations responsible for the project have different reporting environments. For example, the presence of externalities and induced effects may be relevant to the public sector but not to the private sector. If this is the case, the discount rate to be used may differ to the extent that the project's level of systemic risk depends on the relevant reporting environment to be considered. Such differences in reporting environments require that they be clearly and properly identified, justified, and measured.

APPENDIX

A.1 Determination of The Risk Premium for A Borrowing

To illustrate our argument, consider the simple case of an organization that must borrow $100 for one year to buy a quantity of natural gas valued at $100 today that will be sold in a year at prevailing market prices. Let us assume that the probability of default P_D equals the probability that the project will not be able to repay the entire loan ($100 plus interest at the end of a year), given the price of gas at $t = 1$.

To assess the value of the debt V_0, assuming that the lender bears the risk, we proceed as follows. Rather than weighing the various possible cash flows of a project or a loan by the probability $(1-P_D)$ of receiving such cash flows and discounting this expected cash flow at a risk-adjusted discount rate, we can, as is often done for the valuation of bond products, weigh the possible cash flow using the risk-neutral probability of default $\tilde{P}_D$ which takes into account the risk premium in order to obtain the certainty equivalent cash flows and discount these back using the risk-free rate.

Assuming r_f is the risk-free rate, $\tilde{r}$ is the rate required by the lender and L_D is the loss in case of default (expressed as a percentage of the amount owed),[a] we have today's value of the loan (asset) for the lender V_0: $V_0 = e^{-r_f}\left[e^{\tilde{r}}\left(1-\tilde{P}_D\right)100 + e^{\tilde{r}}\tilde{P}_D\left(1-L_D\right)100\right]$. At the time of the transaction, the rate $\tilde{r}$ required by the lender will be determined by the condition $V_0 = 100$, which gives us the following expression for the risk premium: $\tilde{r} - r_f = -\ln\left[\left(1-\tilde{P}_D\right) + \left(1-L_D\right)\tilde{P}_D\right]$. In cases where government carries out the project, we assume a situation of full insurance for the lender $L_D = 0$, since the taxpayers and not the lender will absorb the losses, if any. In this situation, the risk premium associated with the loan is equal to zero: $\tilde{r} = r_f$.

a For example, if at the time of default the loan balance (including accrued interest) is $105 and the sale of the assets securing the loan generates $80, the loss in case of default L_D expressed as a percentage of the loan will be equal to ($105 – $80)/$100 = 25%.

A.2 The Consideration of Risk in A Portfolio of Projects

The variance of returns associated with a portfolio N of projects can be expressed as $\sigma_{R_p}^2 = \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma_{ij}$, where w_i is the weight (value between 0 and 1, representing the relative importance of the project) of project i within the portfolio, σ_{ii} is the variance of project's i's returns, and σ_{ij} is the covariance between the returns of projects i and j, where $i \neq j$. Let us assume, without loss of generality, that each project has the same weight $w_i = 1/N$ in the portfolio. In this case, the variance of portfolio returns becomes

$$\sigma_{R_p}^2 = (1/N^2)\sum_{i=1}^{N}\sigma_{ii} + (1/N^2)\sum_{i=1}^{N}\sum_{\substack{j=1 \\ i\neq j}}^{N}\sigma_{ij}.$$

Let us assume L is the largest variance of project returns. The first term in the above expression is thus always smaller than or equal to $(1/N^2)NL$. In a portfolio with a large number of projects, this term tends to zero. Now suppose that $\overline{\sigma_{ij}}$ is the average covariance of all pairs of projects. The second term of the above expression can then be written as $(1/N^{2)}N\left(N-1\right)\overline{\sigma_{ij}} = \overline{\sigma_{ij}}\left(1-(1/N)\right)$. With a very large number of projects, this term tends to $\overline{\sigma_{ij}}$.

For total elimination of risk through diversification, *all* projects in the portfolio must be independent (zero covariance). If the cash flows of a number of projects are correlated with general economic conditions, logically, these projects will be correlated, therefore, it will not be possible to reduce the variance of project-portfolio returns to zero. For all practical purposes, even with a very large number of "government projects," systemic risk persists.

A.3 Evaluation Error Caused by The Use of The Risk-free Rate

Using the risk-free rate for public sector project assessments leads to errors proportional to the level of the project's systematic (non-diversifiable) risk. For instance, the present value at the risk free rate r_f of an uncertain amount V_t receivable at period t is equal to $V(r_f) = E[V_t]e^{-r_f t}$.

Applying the capital asset pricing model with a single risk factor represented by the overall market portfolio, we get $V(r_v) = E[V_t]e^{-r_v t}$ by discounting at the rate $r_V = r_f + \beta_V \left(E[r_m] - r_f\right)$, with $\beta_V = (\rho_{Vm}\sigma_V)/\sigma_m$, where ρ_{Vm} is the correlation between the cash flows of the project and the market portfolio, and σ_V and σ_m are respectively the volatility of project cash flows and of the market portfolio. If the particular project has no systemic risk, it is correct to use the risk-free rate, because $\beta_i = 0$.

Using the ratio of the two discounted values $V(r_f)$ and $V(r_v)$, we have:

$$\ln\left[\frac{V(r_f)}{V(r_v)}\right] = \beta_V \left(E[r_m] - r_f\right)t. \tag{1}$$

The mistake made in using $V(r_f)$ instead of $V(r_v)$ increases in significance with the level of the project's systematic risk (β_V), the price of the risk $\left(E[r_m] - r_f\right)$ which is established on financial markets and the timing of the flow V_t. The situation is the same in the private sector. In expression (1), the level of risk β_V is calculated for the particular project.

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