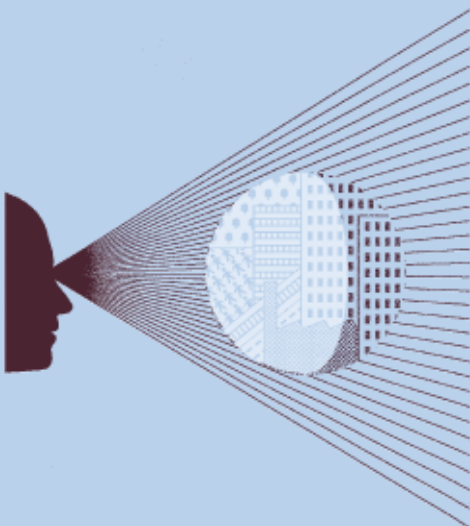


Economic analysis for the Water Framework Directive

Discounting and the calculation
of the present value

Prepared for Defra

October 2006



Strictly confidential

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Executive summary

Defra has asked Oxera to study the use of discount rates in appraisals to be carried out under the Water Framework Directive, with the primary objective being to provide a practical approach to assessing the net present value of social costs and benefits when the private sector is involved.

In the course of this study, Oxera undertook a comprehensive review of the economic concepts developed for social discounting and analysed leading economic research on discounting and the appraisal of public projects. Current project appraisal practice was examined across government departments and agencies. There was broad consistency between the economic framework espoused in the literature and the key issues considered in the course of public appraisal. Nevertheless, in practice, these considerations have not always been applied consistently. In response to this challenge, this study suggests an approach, which draws on both the literature as well as practical considerations, and is consistent with the recommendations of the Green Book (HMT 2003).

The principle underlying the proposed approach is that risk is costly. There is broad consensus that, for private agents (firms or individuals), the delivery of public policies or compliance with regulation is costly and, in particular, involves costly exposure to risks, which requires compensation.

This compensation reflects an exchange where risk is transferred to private companies and hence investors. In return, incentives are created, which lead firms to deliver projects in an efficient way, returning benefits to society through more efficient cost.

Financial compensation for risk is necessary because, without it, projects might fail to attract private capital or investors might reallocate capital among sectors, while the benefits of private sector efficiency would not be realised. In this context, the risk should be seen as a real cost, while expected efficiencies should be seen as a real benefit to society.

The amount of financial compensation is determined by the level of risk associated with the private agent's (firm or individual) characteristics and hence the nature of its activities, which should include those driven by the regulatory regime. In equilibrium, the level of compensation is necessarily equal to the agent's cost of capital or the return required by investors. Therefore, it is important which party is undertaking the investment and where the obligations of a policy or regulation fall because the nature of agent's activity, risk and, hence, the required compensation will differ from agent to agent.

According to the proposed methodology, compensation for risks should be included in the total costs of policy. It should be discounted to present terms from the time when the private sector recoups its costs from customers and other parties (eg, the government, if applicable). Following the Green Book's guidance, the social time preference rate (STPR) is the appropriate discount rate. This applies equally to cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA).

Taxes paid by firms from revenues obtained from customers are transfers rather than real costs. Therefore, for the purposes of calculating the required returns to investors, taxes should be excluded from the cost stream. Hence, the post-tax cost of capital is the correct measure of the actual compensation for risk, even though taxes will be reflected in the actual prices.

Several practical rules are implied by the proposed methodology:

- For projects where costs are offered through a contract tendered by a private agent, such as through the Private Finance Initiative (PFI), the costs of financing are already included and no cost mark-up for any risks is necessary.
- Costs and benefits are included in the analysis when they are incurred by society. Where capital expenditure (CAPEX) is concerned, it transforms into a social cost over the period when recuperated from customers (rather than when incurred by the agent). For example, in price-regulated industries, the regulator often defines the time profile over which capital costs are recovered; in market industries, it can be assumed that the profile is an annuity over the lifetime of the matching asset. In the case of PFI projects, payments already incorporate the cost of risk; therefore, the timing of costs is clear from the profile of payments.
- The public delivery of public projects is not associated with any incentives or risks to a private agent, and no cost of risk should be included beyond those encapsulated in the STPR.

In contrast to the above, which describes social or economic appraisal, financial appraisal takes the perspective of the firm or the private agent and reflects the elements of corporate budgeting and investment appraisal. In this case, costs are included at the time when they are incurred by the firm, rather than when they are realised as social costs, and all taxes must be included.

Relative to current practice, the proposed method reduces the likelihood of choosing a cost-inefficient option of policy execution, spending public resources on projects unattractive from the social perspective, and/or forgoing socially desirable investments.

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1 Introduction

1.1 Background

Public policies are often delivered via the private sector. When these policies are subject to social welfare analysis, private sector costs should be treated appropriately, but what is the correct way to treat these costs and the risks to the private sector? This question has been the subject of much discussion in recent years. Not only does it surface in discussions among policy experts, but it is also of concern to a wider audience of those who question why the private sector cost of capital is typically higher than the social time preference rate (STPR)¹ of 3.5%. In 2002, Oxera contributed to this debate and reviewed the CEA developed for investment appraisal under the Water Framework Directive (Oxera 2002). This Directive is likely to trigger large-scale investment, and currently there is substantial public interest in assessing social costs correctly.

In the absence of market failures, such as externalities, misalignment of incentives or coordination problems, private parties would be expected to undertake socially desirable projects since the private costs and benefits would equal the public costs and benefits. As a result, the optimal amount of investment would be expected to take place without government intervention. In the presence of market failures, however, some socially desirable investments might not be undertaken, while others that are undertaken might not be efficient. Therefore, government intervention—in the form of either regulation of market participants' activities or direct public investment in socially attractive projects—may be justified. In such cases, projects are assessed against social welfare criteria using a cost–benefit analysis (CBA) or cost-effectiveness analysis (CEA). This is the role of the appraisal tools being developed under the Water Framework Directive.

For all stages of project appraisal in all types of social welfare analysis, it is necessary to calculate the present values of costs and benefits (ie, the discounted costs and benefits). In each case, discounting aims to capture the time value of money and adjust for the risks and uncertainties characteristic of the specific capital investment. The result is a present-value sum of future net social benefits. The calculation of discounted present values also has a potentially significant impact on policy decisions. Indeed, deviations from the appropriate calculations of the discounted present value might lead to a significant bias in policy decisions and allocative inefficiencies. However, it appears that a variety of practices to calculate the discounted present value are currently in use, which raises the question: 'which is the most appropriate?'

1.2 Objectives

The primary objective of this study is to review the current practice of social welfare appraisal and to provide guidance for the calculation of discounted present value in social appraisals undertaken within the Water Framework Directive, especially where private agents are involved in delivering improvements to the water environment.

More specifically, the study addresses the appropriate treatment of public projects financed and executed by the private sector. It examines the treatment of risks to which private sector institutions are exposed, and the methods for their incorporation in policy and social welfare appraisals.

¹ STPR is also known as the consumption rate of interest (CRI).

The recommendations of this report are grounded in financial economics literature. For clarity of exposition, the key theoretical considerations are addressed in greater depth in Appendix 2.

The main objectives of this research, as set out in the contract letter from ABP Marine Environmental Research to Defra, were as follows:

- review the coverage of discounting in the current policy guidance and identify circumstances in which the current guidance might not be sufficient;
- set out in clear and concise terms the relationship between the components of the STPR, the risk-free rate, and the commercial cost of finance;
- define the circumstances in which it would not be appropriate to use the STPR as a discount rate² in assessing the costs of programme of measures (PoM); and
- propose the correct approach to the choice of discount rate when the STPR is not used.

In line with these objectives, the key outputs of this study are:

- a review of the literature;
- a proposed method to be followed;
- guidelines for appraisal in typical situations;
- illustrated examples.

1.3 Scope of analysis

The analysis focuses on providing a methodology for using discounting in governmental policy appraisals. It is supplemented by practice-oriented guidelines for application of the proposed methodology, numerical examples, and an academic literature review.

By focusing on the appropriate discounting method, the analysis does not address issues related to potential changes to processes involved in policy appraisal as a result of the adoption of the proposed methodology, or the assessment of implications for economy-wide allocations of resources.

1.4 Structure of the report

The report is structured as follows.

- Section 2 defines economic and financial costs.
- Section 3 describes current practice.
- Section 4 describes the proposed method.
- Section 5 provides guidelines on how to apply the method.
- Appendix 1 describes the theoretical framework.
- Appendix 2 provides a justification for the proposed methodology.
- Appendix 3 presents a summary table and illustrations.

² The terms 'discount rate' and 'interest rate' are used interchangeably in the report. They refer to the value used in the denominator of the present-value calculation of future payments.

2 Definition of economic and financial costs

2.1 Financial costs

Costs can be expressed in financial or economic social welfare terms. Financial costs are the private costs faced by a company in producing a good and carrying out its operations. They include capital, operational and administrative costs, taxes and other costs affecting cash flows.

Financial costs should be distinguished from the costs of financing—ie, the costs of raising funds from the capital market. In the context of an appraisal, the costs of financing represent the costs of raising funds necessary to implement the PoM. They can be incurred by the public sector in cases where additional government debt is issued, or by the private sector as the required rates of return on debt and equity.

2.2 Economic costs

The economic cost of a good (or service) is equal to the full value of the resources that have been used in its production (or consumed as a consequence of a particular action). This is the concept of opportunity cost—ie, the value of the forgone opportunities of using scarce resources on the next-best alternative use. Added to opportunity costs are any additional impacts on social welfare (such as externalities), with these together providing the measure of economic costs, or social costs.

2.3 Differences between financial and economic costs

Economic costs may differ significantly from financial costs. The latter often include elements that do not relate to the consumption of scarce resources, such as taxes, which are effectively a transfer payment from the private sector to the public sector. In addition, economic costs may not reflect the consumption of certain scarce resources. Unemployed labour resources are often cited as an example, but this depends on assumptions about labour market adjustments.

Financial costs might fail to account for welfare losses associated with changes in product quality or availability in some cases, and potentially for any external effects on other private agents. Moreover, they do not typically include any measure of the external environmental impact.

As a result, welfare analysis considers all costs (and benefits) to society, while financial appraisal typically focuses on financial costs (and benefits).

3 Current appraisal practice

- Since 2003 the practice for discounting has been to apply a STPR of 3.5% for the appraisal of public projects. For longer-term assessments, declining rates are proposed, where the rate of decline is defined in accordance with Oxera (2002).
- Recently observed yields on long-term government bonds have been significantly less than 3.5%. Several lines of arguments can be used to explain the difference between the rates of return on government debt and the STPR: the interaction between government policy and society's preferences, prevailing market characteristics based on actual participation in capital markets, and measurement issues with regard to the STPR can be considered as key differences.
- Current guidance does not seem to be explicit as to whether 3.5% should also be used for appraisal of projects financed by the private sector. For example, the Green Book (HMT 2003) does not explicitly state that the STPR should be used for private costs. Regulators have also been known to deviate from the 3.5% rate.
- Oxera research into current practice showed that, with a few exceptions, a common discount rate of 3.5% is applied. There also seems to be an agreement in the treatment of risks: they should be taken into account in appraisal. Doubts were raised as to whether the cost of risk should be included directly in the stream of costs to be discounted, or in the form of a higher discount rate.³

3.1 The discount rate

The current practice in public appraisal is to apply the STPR of 3.5% (and declining in the long term). This rate has been used since 2003, when HM Treasury guidance on discount rates changed from 6% to 3.5% real. The rationale was championed in a paper on discounting by Pearce and Ulph (1995), which was accompanied by an extensive debate in the lead-up to the revised estimate of the STPR.

The STPR is the rate at which society values the present compared with the future, and represents society's inter-temporal utility trade-off. As Pearce and Ulph (1995) point out, it is generally accepted that the STPR should be estimated by separating it into the following components:

- the rate of time preference, which can be presented in broad terms as the difference between the *pure* time preference rate and the increase in the risk to life (a);
- the marginal utility of consumption today relative to the future, expressed as the product of the elasticity of the marginal utility of the consumption schedule (b) and the expected rate of growth in average consumption per capita (c).

The STPR can therefore be expressed as:

³ As described in the next section, the methodology proposed by Oxera implies that cost of risk should be included in the stream of costs to be discounted. The STPR should then be used as the discount rate. This treatment of risks is consistent with the HM Treasury Green Book, which also advocates adjusting the numerator.

$$a + (b \times c)$$

Pearce and Ulph (1995) estimated each of the above-mentioned components, concluding that:

To go much above 4.0% one would either have to (i) be very pessimistic about future survival probabilities for mankind [this would increase the rate of time preference (a)], while at the same time being very optimistic about prospects for consumption growth in the meantime [this would increase (c)]; or (ii) be prepared to discount future generations at a very high rate; or (iii) be very much more egalitarian than people seem to be in terms of the tax policies they are prepared to vote for [this would increase (b)]. (p. 16)

Therefore, the authors found that it would be impossible to support the continued use of rates in the region of 6% for the UK.

Even with a discount rate of much less than 6%, questions emerged about the use of discounting rates over a long time period with respect to some policy and investment decisions. Notable issues were nuclear waste storage options, global warming control, and biodiversity conservation.

At that time, Oxera (2002) prepared a comprehensive review of the literature regarding STPR for HM Treasury's revised Green Book, published in January 2003. The Oxera report set out the cases for and against a change from the 6% rate to a 3.5% social discount rate, and the arguments for a rate that declines over time, illustrating the results with simulations and examples from transport, climate change and nuclear policy. Oxera concluded that:

There are powerful reasons for choosing a declining social time preference rate. This conclusion is supported by robust recent theoretical work, which has taken several different approaches to the subject. (p. 34)

HM Treasury then adopted a declining social discount rate using the rate of decline proposed by Oxera (2002).

Therefore, the current guidance requires the use of a 3.5% social discount rate across projects and sectors. For longer-term assessments, declining rates are proposed where the rate of decline is defined in accordance with Oxera (2002).

3.2 Application of the social time preference rate

The rationale for discounting is described in the Green Book (HMT 2003) as reflecting individuals' pure time preference for money:

For individuals, time preference can be measured by the real interest rate on money lent or borrowed. Amongst other investments, people invest at fixed, low risk rates, hoping to receive more in the future (net of tax) to compensate for the deferral of consumption now. These real rates of return give some indication of their individual pure time preference rate. Society as a whole also prefers to receive goods and services sooner rather than later, and to defer costs to future generations. This is known as 'social time preference'; the 'social time preference rate' (STPR) is the rate at which society values the present compared to the future. (p. 26)

Since the introduction of the STPR, the recommendation that a rate of 3.5% be used has raised some questions regarding its practical application, including whether:

- the 3.5% rate should be universally applied to private and public sector projects;
- deviations from the use of the 3.5% rate might be necessary in some cases.

The base-case position that has been applied in most cases is the universal application of 3.5% as the rate for discounting all costs and benefits of any type, regardless of whether the analysis involves public or private agents. However, the Green Book does not explicitly state

that the STPR should be used for private costs. This might be explained by the fact that the Green Book is largely focused on appraising public rather than private expenditure. However, in the annexes to the Green Book, where the rationale for the STPR is presented more fully, there is no related discussion of regulated or private markets, and the recommendation to use the STPR appears universal:

This guidance recommends that the STPR be used as the standard real discount rate (p. 97)

with the exception of 'international development assistance projects', for which:

a discount rate derived from estimates of the social time preference rate appropriate to the recipient economy should be used. (p. 99)

Nonetheless, the Green Book specifies selected circumstances when deviation from the STPR might be justified. For example, it refers to cases where prices are set at commercial levels based on commercial costs of capital for services provided within the public sector, and points to the Treasury's 'Fees and Charges Guide' (HMT 1992):

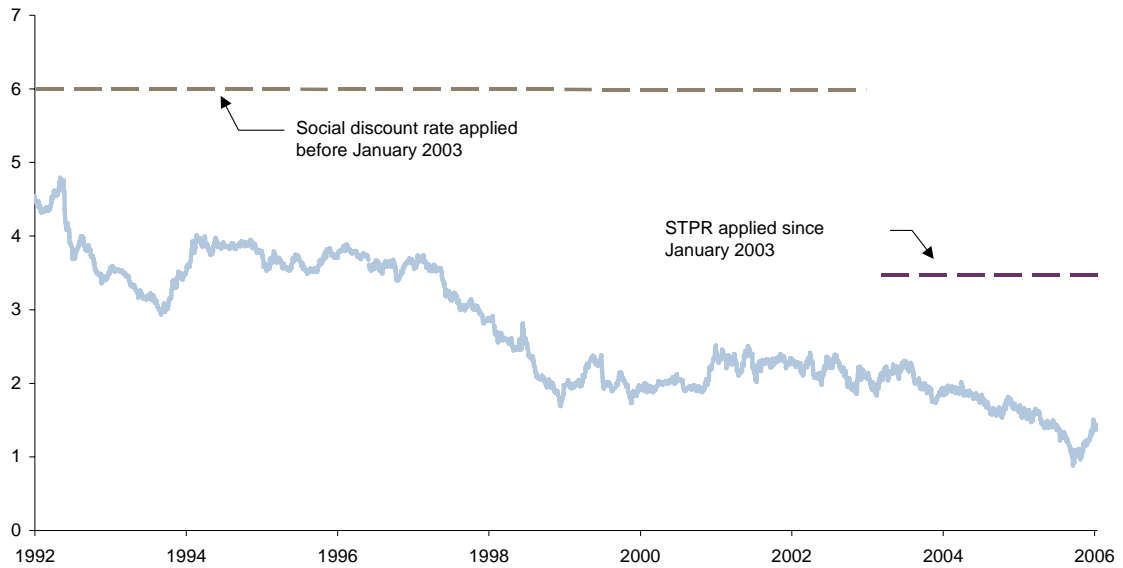
Some central government bodies sell goods or services commercially, including to the government itself. These activities may be controlled by requiring prices to be set to provide a required rate of return (RRR) on the capital employed by the activity as a whole. Government policy is generally to set charges for goods and services sold commercially at market prices, and normally to recover full costs for monopoly services (including the cost of capital as defined in the Treasury Fees and Charges Guide) (p. 27)

Regulators have been known to deviate from the 3.5% rate and Oxera research into current practice has confirmed such instances. For example, in its appraisal of certain capital projects, Ofwat has used a 5.5% discount rate to reflect the cost of capital of water companies.

3.3 Practical consideration regarding the existing approach

The use of a 3.5% rate raises further questions when it is juxtaposed with recently observed historically low yields on long-term government bonds, which have been significantly less than 3.5%, as shown in Figure 3.1 below.

Figure 3.1 The evolution of implied real spot yields on 18-year Treasury gilts, 1990–2006 (%)



Sources: Bank of England and Oxera calculations.

Not only does there appear to have been no convergence in recent years between the STPR and the government cost of long-term debt, but the demand for long-term bonds has also been so strong that the prices of such bonds have actually increased, further lowering yields. At the same time, on average, individuals and companies face rates above the STPR.

It is therefore of interest to ask how to reconcile the current low rates of interest on long-term government bonds with the 3.5% STPR. Specifically, society seems to require more compensation for postponing current consumption (STPR) than the rate offered by capital markets (the long-term risk-free rate).

Any potential response to this dilemma is likely to address the following issues:

- the interaction between government policy and society's preferences;
- prevailing market characteristics based on actual participation in capital markets;
- measurement issues with regard to the STPR.

In general, economic theory requires that, in equilibrium, the intertemporal rate of substitution between current and future consumption must be equal to the price of that trade-off offered to consumers. In practice, however, the estimate of the long-term preferences of society as a whole necessarily differs from the price of capital currently offered by the capital markets to the government acting on behalf of the society.

While it could be argued that the actual price of capital faced by the government is equal to the government cost of capital, the latter is unlikely to be reflected by the marginal cost of public borrowing, which can be observed in financial markets. As is often suggested, the argument that the government cost of capital equals the marginal return on gilts fails to recognise the potential presence of implicit equity risks that are borne by the taxpayer.⁴

At the same time, the channel of interaction between society's preferences (to the extent that these are actually revealed) and the government budgetary policy is imperfect. This raises

⁴ See, for example, Jenkinson (2003).

questions about the relevance of the market mechanism equalising the above-mentioned rates (government cost of capital and STPR).

Above all, while the government cost of capital and society's preferences (assumed to be reflected in the STPR) might be relevant to publicly funded projects, they are different to the private cost of capital, which is critical to privately funded projects or cases where the capital costs are imposed on the private sector via regulation.

Finally, the currently accepted level of STPR (3.5%) is necessarily an imperfect estimate and hence must be viewed as only one possible approximation of the actual STPR. Potential systematic or non-systematic estimation biases are likely to add further to the observed discrepancies mentioned above.

For this analysis, one of the key conclusions derived from the above discussion is that, while there are strong reasons for the estimated STPR to differ from the observed government cost of borrowing, neither is likely to be appropriate for public policy appraisal involving private agents.

3.4 Current practice across government and common considerations regarding private sector participation

Oxera asked economists working in central government about the discounting practice in their areas. The departments involved were Health, Trade and Industry, Environment, Food and Rural Affairs, Transport, the National Audit Office, HM Treasury and Ofwat.

This sample is neither exhaustive nor representative of all potential applications. It is based on short telephone interviews, and its aim is to convey an impression of the practice adopted across government, and to indicate whether the proposed approach to appraisal under the Water Framework Directive is consistent or out of step with current practice.

The survey uncovered a widely held view that policy appraisals and other CBA are typically computed using a common discount rate. With only a few exceptions, the rate used is 3.5%, as recommended in the Green Book. The consensus is that whoever delivers the project, be they in the private or public sector, the STPR is applied to calculate the present value of costs and benefits. There are also some who, while advocating this position, note that government could, if it wished, choose to apply a higher rate as a means of rationing scarce public sector investment.

Another area of agreement is the treatment of risks. Where there are risks, they should be taken into account. However, there is some confusion as to how these risks are, or should be, incorporated into the calculation of the present values under current guidelines. More specifically, a question arises as to whether the cost of risk should be included directly in the stream of costs to be discounted, or in the form of a higher discount rate.

Often, two options are compared: a project undertaken in the private sector, and one undertaken in the public sector. The refurbishment of the main MoD building is an example. The private sector contractor is asked to make a bid, and the payments set out in that bid are discounted at 3.5%. This present value is compared with the series of payments needed under public sector provision, also discounted at 3.5%. The payments set out by the private contractor are determined by the contractor, and are assumed to be sufficient to meet all the contractor's costs and liabilities, including its cost of finance. Contractors build their own financial models and policy economists expect them to test their business plans with appropriate hurdle rates of return that can be as high as 15% and 20% when devising their bids. The contractors are also advised to consult professional services firms to check that the cost of finance and the financial structure they have assumed is competitive for that type of project.

Although these hurdle rates of return are much higher than the 3.5% discount rate, higher efficiencies in executing the project are assumed and sometimes do result in lower overall costs, so that the present-value cost of a privately delivered scheme may be lower than the equivalent publicly delivered scheme. Similar assumptions about private sector performance, where private agents are assumed to be adequately incentivised and compensated for risks they have to manage, mitigate or bear, have been characteristic of privatisation decisions.

Private contractors supplying bids are typically asked to remove taxes and subsidies from their calculations for the purposes of evaluating the bid, but Oxera found no guidance on how to do this.

Another situation arises where a project is to be undertaken solely in the private sector, without a contract with government. Here, there is no private sector bidder and no market price available. Typically, as part of financial appraisal, policy economists build financial models of the private sector activity. For example, in the energy sector, a financial model of an electricity generation plant might be constructed. In a fairly simple model analysing returns to equity capital, the operating and maintenance costs are combined with the capital costs of construction and the costs of debt service. A capital financing cost of typically 10% (the post-tax required rate of return to equity) is applied to the total equity capital requirement, although a range of 8–15% is also known. In other cases, however, models are built without a specific financial profile, a defined financial structure, or required returns to debt and equity. In those cases, the range of 8–15% remuneration to equity is broadly believed to encompass the costs of capital of FTSE companies. However, in social appraisals of similar projects, the costs of financing are commonly totally excluded under the current practice.

Although the application of commercial rates of discount to private sector activities appears uncommon, there are some examples, such as the estimation of costs of a climate change policy by a consultant to Defra,⁵ where it appears that both the STPR and an alternative 'commercial' discount rate were used.

In summary, in cases where private companies bid for public projects, the current practice is to convert costs incurred or projects undertaken into a stream of costs, including a return on capital, and from these building blocks into a market price or stream of revenues to remunerate the service provided. It is this stream of revenues that is discounted at 3.5%. Correspondingly, return on capital is typically included in financial appraisals. For social appraisals involving private agents, this practice is not universal, however.

Those involved in the assessments raise concerns in two areas. First, whether the risks and financing costs associated with different projects are correctly accounted for. Second, whether the private sector rates of return being used in financial appraisals within government are reasonable and on a pre- or post-tax basis. There appears to be no central guidance available on either issue, while the theoretical debate has often reflected this dilemma in different recommendations.

⁵ Evidence from interviews.

4 Proposed method

- The analytical framework uses the principal–agent model to describe the relationships between parties involved in public policy. The government may be considered the principal in charge of introducing the policy. The private or public sector party executing the policy might be considered the agent.
- The principle underlying the proposed methodology is that private investments in projects driven by public policies are risky. They therefore require compensation for risk, which, within the principal–agent framework, should be seen as part of the social cost of the project.
- Once it is established that private risks constitute the social cost, they should be priced and considered as other policy costs in the numerator of the present-value calculation. The proposed basis for valuation of risk is the private sector cost of capital.⁶
- The appropriate rate for discounting streams of future social costs (and benefits) is the 3.5% STPR when private sector capital costs reflecting embedded risks are incorporated in the cost (and benefit) streams.
- A number of adjustments to project costs might be required. First, costs should be included in the appraisal when they materialise as social costs. Second, costs at market prices (ie, gross of taxes and financing costs) should be adjusted to obtain economic costs.
- In contrast to the above, which describes social or economic appraisal, financial appraisal takes the perspective of the firm or the private agent and reflects all the elements of corporate budgeting and investment appraisal. For example, costs are included when they are incurred by the firm, rather than when they are realised as social costs, and all taxes must be included.

Government may undertake both social welfare and financial appraisals in assessing projects (or policies/programmes) where the private sector is involved. The former is designed to assess the net social benefit of implementing the project, and the latter allows for the assessment of the financial viability of the private sector's role in implementing it. Different approaches might be required in different types of appraisal, as discussed below.

4.1 Social welfare appraisal

4.1.1 Analytical framework

There are several ways of describing different parties involved in public policy—the government (acting on behalf of society) may be considered the principal in charge of

⁶ Risk exposure of the investment typically differs over time (eg, in large construction projects, the construction process itself involves considerable risks, which go away once the project is constructed). It is often observed that different discount rates are used for different stages of the project. However, where the project risk is in line with the normal business activities of the firm, the cost of capital will incorporate the changing risk exposure of the invested capital. Thus, when the cost of capital is used for discounting (or where there is no major reason to consider that project risks are substantially different from the risks of the firm's normal business activities), no specific adjustment for the profile of risk over time is required.

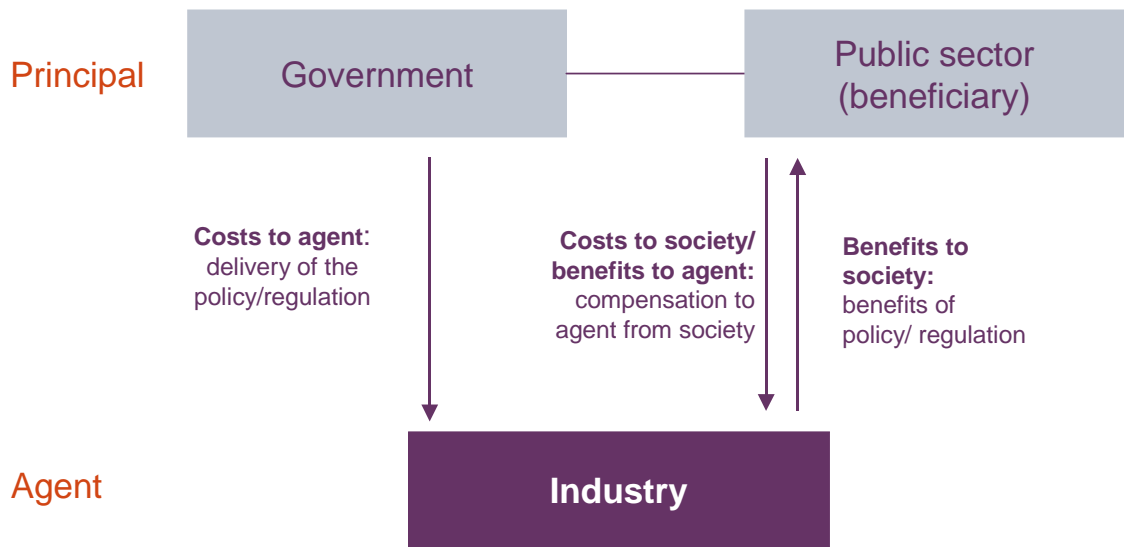
introducing the policy. The private or public sector party executing the policy might be considered to act as an agent.

Public policy may be delivered in a number of ways:

- the government may require an agent to deliver it;
- an agent may voluntarily bid for the public project tendered by the government;
- a regulator may make delivery a requirement of a licence to operate; or
- the government may execute the action itself.

The critical aspect is the difference in the principal–agent contract between these cases. When the principal (government) executes a project itself, there is no underlying separation between the agent and the principal. It is the same entity that commissions the project and undertakes it. However, when the private sector is involved, the principal and agent might be considered as separate parties (as illustrated in Figure 4.1).

Figure 4.1 Principal–agent framework for public policy appraisals



Source: Oxera.

The division of the principal (the government) and the agent (eg, a private sector institution) into separate entities might also be considered in the context of the separation of a beneficiary from the cost bearer, where this allocation differs by project. For example, by means of regulation, costs might be imposed on a private sector institution, whereas benefits might accrue to society.

4.1.2 Components of the discounting methodology

Within this framework, there are several issues that a robust methodology for calculating the present value of costs and benefits should consider:

- an option for implementing the policy according to which the same cost incurred earlier rather than later has a higher total project cost for the principal;
- an option associated with greater risks regarding costs is less attractive to the principal than one with a more certain stream of costs, other things being equal, where the former results in a higher total cost for the principal;
- the methodology should be able to discriminate between options to implement the policy via different parties;

- a policy imposed on the party which is less likely to be able to deliver it is less efficient;
- if costs are imposed on the private sector, the approach should consider the implications of particular characteristics of the operating and commercial environment, including:
 - the impact of operating in a regulated or non-regulated environment;
 - the impact of subsidies and government transfers to agents;
 - the nature and magnitude of the risk inherent in the agent’s activities;
 - the counterparty risk (agent-related risk).
- the relationship between the proposed methodology and HM Treasury recommendations regarding STPR.

4.1.3 Method for calculating the present value of costs

When private sector capital costs reflecting embedded risks are incorporated in the cost (and benefit) streams, the appropriate rate for discounting streams of future social costs (and benefits) is the 3.5% STPR. This ensures that social preferences about timing are taken into account in full, with short- and long-term projects compared in an unbiased manner.

The compensation for real risks (the cost of bearing real risks) to the private sector should be seen as part of the social cost of the policy.⁷ Once it is established that private risks constitute the social cost of the policy, they should be priced and considered as other policy costs in the numerator of the present-value calculation. The proposed basis for valuation of risk is the private sector cost of capital. Finally, the resultant stream of total costs, expenditure plus a cost of bearing risks, is discounted at the social discount rate.

Three important aspects of the proposed methodology need to be addressed specifically: the risks of the policy project for the agent and principal; the definition of project costs; and the time period when costs should be considered in the appraisal. These are explored below.

Overview of project risks

The private sector agent faces several types of real risk, for which it needs to be compensated, and the costs of which necessarily represent the cost of the policy.⁸

- *Compensation risk*—once the project is allocated to a particular agent, there is a risk that the agent will not be remunerated for the expected costs or will not be able to generate sufficient revenue. The higher the underlying risk of the agent’s activities, the greater is the compensation risk, and correspondingly the higher is the cost of bearing that risk.
- From the agent’s perspective there is uncertainty around the expected project costs and the corresponding *risk of cost overruns*. It might be expected that the riskier the public project is in terms of expected costs, the higher the risk is for the agent, and correspondingly the higher the cost will be to the agent for bearing that risk.
- *Political and regulatory risks*—the role of government in policy projects is critical. The higher the uncertainty surrounding the future regulatory treatment of a given public project imposed on an agent, or the higher the risk that the general political environment will change, the greater the political/regulatory risk and the higher the corresponding cost of this risk.

In addition to risks for the agent, certain risks accrue to the principal. These include the risk arising from the fact that project delivery is delegated (agent risk) and the risk that the costs

⁷ See Appendix 2 for a more detailed discussion of this point.

⁸ See Appendix 2 for a more detailed discussion of this point.

of delivering the project might be higher than expected (cost overruns, if not borne by the agent and passed through to the principal).

In accordance with current guidelines and theoretical developments, risks that accrue to the public sector (principal) need not be accounted for in the appraisal (over and above the risk element controlled for in the social discount rate). Therefore, the additional cost of bearing the risks is required to control for risks that accrue to the principal.

Definition of project costs

Several aspects need to be taken into account when considering the costs of the policy. For social welfare appraisal (CBA and CEA), costs are considered from the perspective of society as a whole or the principal (in the context of the presented analytical framework). This has an impact on the definition of the relevant costs and the time period when these costs should be included in the appraisal.

The key aspect regarding the appropriate definition of nominal costs is that before including the additional cost of risk, other costs at market prices (ie, gross of taxes and financing costs) should be adjusted to obtain economic costs. In particular, it is necessary to explicitly account for taxes. The tax flow to government is a transfer and should be subtracted from the cost base.

If the costs of the policy include financing costs (as in the case of the PFI, for example), they typically include the agent's required rate of return for a given project risk—or, in other words, the compensation that investors require for risk. In such cases, where financing costs are included in the cost estimates, no risk mark-up is required.

Timing of project costs

The final aspect of the proposed methodology is the timing of costs. The costs are included in the appraisal when they materialise as social costs.

In the analytical framework outlined above, costs are social costs when the principal delivers the payment to the agent (or when society pays the institution undertaking the project) as opposed to when the agent incurs these costs (given that the agent is treated as separate from the principal).

Take, for example, a capital investment. The agent usually invests the whole amount at once and then charges the end customer over a longer period of time. In this example, the capital cost should be included in the appraisal when society pays for it—ie, over the longer period.

4.1.4 Conceptual framework and the proposed methodology⁹

The transfer of ownership and management of assets to the private sector, or the private execution of public projects, takes advantage of private sector incentives to deliver higher efficiencies than would be expected within the public sector. These additional efficiencies are implicitly included in the policy appraisal.

At the same time, private sector participation creates an additional cost that is included in the appraisal. In the simplest terms, the cost is the agency cost. This is the cost of bearing risk, or the premium charged in compensation for risk (the risk premium). In this context, the incentives for higher efficiencies are part of the private sector cost of capital and represent the real cost of policy delivery through the private sector.

This risk compensation payment should be high enough to attract sufficient participation of capital (investors) and hence ensure the most efficient delivery of policy. The next step is to estimate the value of the necessary compensation or the price of risk transferred to the private sector. Once a given project is assigned to a private institution, the delivery of the

⁹ A more thorough theoretical discussion of these issues is provided in Appendix 2.

project is inseparable from its other activities. Therefore, the agent's expected private cost of capital should be used for pricing the risk involved in executing the project.¹⁰ In effect, rational investors cannot be continuously surprised by additional costs.

While the above considerations imply that public financing incurs a lower risk premium, they do not necessarily lead to 'a radical expansion in the role of public investment'.¹¹ This is because the public sector is assumed to be unable to create the same level of incentives and subsequent efficiencies characteristic of the private sector, which is revealed in the decision to ask the private sector to deliver the policy in the first place.

4.1.5 Proposed method and public delivery

The proposed methodology is equally applicable to cases where private costs are not involved—ie, for the public delivery of public projects. In this case, there is no separation between the agent and the principal, and the private sector is not involved, so it cannot be appropriate to price risks using a private cost of capital. This approach is consistent with the current practice provided that costs are included when they are passed on to consumers or on to the government via subsidy, and that transfers are omitted.

4.1.6 Implications of the proposed methodology

The proposed methodology extends the appraisal of public projects to private participation. The implications of this methodology relative to current practice include the following.

- The results of the CBA are likely to change since the private sector cost of risk is now explicitly incorporated into the analysis, while its inclusion under the current practice has not been consistent.
- Policy execution would carry a higher level of risk given that the agent involved (ie, the one with a higher cost of capital) would need to generate greater net benefits (eg, achieve greater cost efficiencies) to be tasked with delivering public benefits. In other words, riskier industries are likely to imply higher policy costs, other things being equal.
- There are several industry-specific characteristics that affect industry or company attractiveness as a potential policy target:
 - certain industries or companies are more likely to be tasked with delivering a policy since they require lower compensation for risk, other things being equal (ie, assuming that they are expected or contracted to deliver the same level of efficiencies, despite the lower incentives it faces). These include industries or companies that can pass costs through to customers more easily, or face more inelastic demand (ie, fewer risks);
 - more volatile industries (relative to the market) are less attractive delivery agents, other things being equal;
 - industries that represent a higher counterparty risk to the government are less likely to be charged with delivering policy benefits.
- The contractual allocation of risk between the private agent and the government will affect the necessary compensation and hence the discounted present value of the costs of the policy. Similarly, the allocation of cost overruns between the private agent and the government will affect policy appraisal, other things being equal.

¹⁰ In equilibrium, investors are assumed to account correctly for the cost of regulation in their investment appraisal.

¹¹ Klein (1997).

In cases where the risk of cost overruns is partly allocated to the government, the required compensation for risk to the agent must be lower. At the same time, shifting risks to the private agent would be typically assumed to be accompanied by additional incentives to achieve cost efficiencies. The proposed methodology therefore implies that not all risks should be carried by the public sector, but rather by the party best able to manage them.

- Finally, there are certain additional policy mechanisms present or anticipated that change the overall costs borne by the agent. For example, subsidies must be netted out since they represent transfers.

In practice, it might not be practical to take account of all the above adjustments when carrying out a particular appraisal, where these considerations are actually applicable due to estimation problems, for example. In these cases, approximation could be used or potential biases identified and noted.

4.2 Method for undertaking financial appraisal

Beyond CBA and CEA, financial appraisal assesses the financial impacts of policy on private institutions. In contrast to social appraisal, it takes the perspective of the private sector. The principle of compensation to investors for bearing risks is common to both, with the difference being the perspective of the analysis—ie, society or the private firm.

Financial appraisal mirrors the investment appraisals undertaken in the private sector and captures all costs relevant to the private sector, including taxes and cost of capital, at the time when they are incurred by the industry, as opposed to when they are realised as a social cost.

Financial appraisal should employ industry-specific financial models and take into account industry-specific factors, insofar as they might alter the impact of the policy on the industry.

5 Practical guidance

- This section describes the application of the proposed methodology, specifically discussing how to determine the timing of social costs and how to price the risk in relation to CAPEX and OPEX.
- In regulated industries, the regulatory regime defines how consumers pay for CAPEX incurred by the private investor. Thus, the timing of social costs is defined by the exact profile according to which CAPEX is recovered from customers. In unregulated industries, the proposed solution is to consider time characteristics of a ‘typical’ project in the industry.
- To calculate the cost adjustment for risk, CAPEX is inflated at the cost of capital according to the period between the initial investment and subsequent return. The latter is defined by the initial capital investment and the profile according to which it is recovered.
- Where OPEX forms part of a project associated with a certain CAPEX, compensation for OPEX risks is included in the compensation for initial investment. However, where a public project is associated with OPEX only, appropriate compensation for risk should be estimated separately. Where no CAPEX is involved, OPEX is assumed to be recovered within one year from the sales of products and services.
- Due to the nature of OPEX (ie, the fact that OPEX is assumed to be continuously recovered from operating activities), the risk premium is the cost of capital adjusted for the cost of capital less the STPR.
- In certain types of public project, private firms volunteer to undertake a public project at a proposed bid price (for example, as in the PFI framework). No further cost adjustment for risk is necessary for this type of projects. When the private sector is not involved (as in the case of public investments), it is not necessary to price and account for private sector risks, and no cost of risk is included.

This section discusses the application of the proposed methodology and the practical aspects of the calculation of the present value of costs and benefits. This guidance is concentrated around three themes:

- how to price risk for different institutions;
- how to adjust for taxes;
- how to determine the timing of social costs.

Consistent application of the proposed methodology might require any actual adjustments to costs to differ according to the way public policy is implemented. For example, as indicated earlier, calculation of the present value of project costs will be different for projects where the private sector voluntarily expresses interest in undertaking a public project, offering a price assumed to include a risk premium, versus cases where regulation is imposed on the industry.

Practical exposition of the proposed methodology might be best served through a series of stylised examples. In order to facilitate application, the following four distinct types of stylised project are discussed in this section:

- requirement or agreement with the regulator to undertake an investment in a regulated industry—for example, an obligation imposed on a water utility in the UK;
- new regulatory requirements leading to the imposition of costs on an unregulated private industry;
- a private bid for a contract to execute a public project—for example, under the PFI;
- a public project executed wholly within the public sector.

Table A3.1 in Appendix 3 summarises the characteristics of each case.

The adopted approach is to consider the stylised regulated industry example as the base case first, and then to discuss the other three cases with reference to the base case in order to highlight potential differences in the practical application of the proposed methodology.

5.1 Regulated industry

This case occurs when a private institution operates under a regulatory regime (eg, it is subject to regulation), and is undertaking a public project that results in public benefits, or private and public benefits. The discussion of the application of the proposed methodology in this case focuses on three issues:

- determination of the appropriate risk premium given the industry cost of capital;
- definition of the costs and treatment of taxes;
- the appropriate time period for considering costs.

5.1.1 Basis for valuation of risk adjustments

As discussed in the previous section, the activity of delivering a given regulatory project is assumed to be inseparable from the overall activity of the firm, since the same project cannot in principle be considered outside of the given industry. Therefore, the expected required rate of return (equal to the company's cost of capital in equilibrium) must reflect the risks inherent in the activities undertaken by the company, including policy risks.

Hence, the cost of risk—or of the risk premium characteristic of the project in the case where all risks discussed earlier are transferred to the private agent rather than assumed by the public sector—can be approximated by the firm- or sector-specific cost of capital.

In a regulated industry, a company's cost of capital is likely to be estimated by the regulator. Alternatively, the firm might be asked to provide its estimate of the required cost of capital for a given public project.

The cost of risk borne by the firm is sensitive to the degree of risk transfer from the public to the private sector. Under the base case, it is assumed that all risks are transferred to the agent in line with normal business activities. In a regulated industry, a company might face fewer compensation risks than in an unregulated one—this factor would already be reflected in the cost of capital and does not differ for the specific project. However, if the regulatory policy with respect to the particular undertaking differs from the course of the company's normal business activities, an adjustment might be needed to reflect this change. For example, if the project is subsidised or the risks of cost overruns are retained by the public sector, the appropriate cost adjustment for risks might need to be estimated explicitly.

5.1.2 Treatment of taxes

As discussed above, taxes are transfers within society and are not social costs. Therefore, the tax paid by the firm should be netted off. Correspondingly, the agent's post-tax cost of capital is the correct measure of the cost of risk.¹²

5.1.3 Timing of costs and calculation of risk premia

Costs should be included in the analysis at the time when they materialise as social costs—ie, when society pays the private agent. The treatment of OPEX and CAPEX is discussed in turn below.

Treatment of CAPEX

The principles for the estimation of CAPEX and OPEX compensation are similar: to remunerate capital employed in financing the project at the appropriate rate (price of risk) over the relevant investment period.

As discussed before, a private firm's cost of capital is the appropriate rate. To calculate the amount of capital employed in the project in each year, given the initial investment (CAPEX), it is necessary to consider the profile of cash flows that constitute the returns on the initial investment.

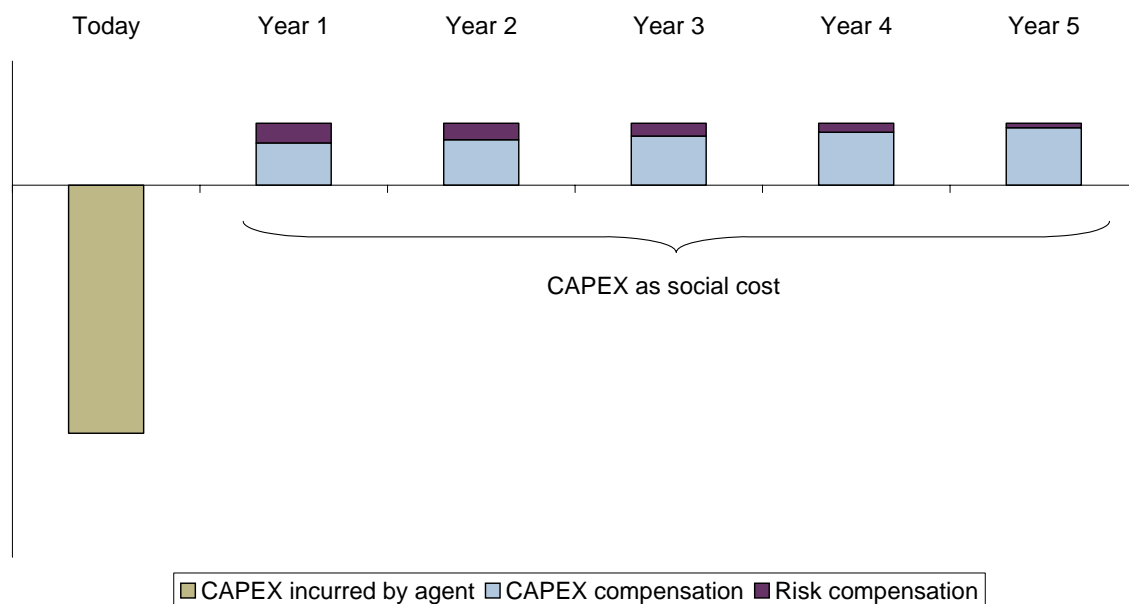
The regulatory regime defines how consumers pay for CAPEX incurred by the company (the private agent). A regulator typically defines the exact profile according to which CAPEX is recouped from customers and consequently realised as a social cost.

To calculate the cost adjustment for risk (the risk premium) in this setting, CAPEX is inflated at the cost of capital according to the period between the initial investment and subsequent return. The latter is defined by the initial capital investment and the regulator's profile according to which it is recovered.¹³ The schematic illustration of CAPEX as the social cost is shown in Figure 5.1.

¹² The appraisal should also consider the taxes on intermediate goods (eg, VAT). To adjust for such taxes, an average economy-wide rate of tax flow-back of 30–40% can be assumed and should be subtracted from estimates of expenditure.

¹³ The depreciation profile will affect the compensation path and, therefore, the timing of payment from society to the agent.

Figure 5.1 CAPEX as a social cost, schematic illustration



Note: 'CAPEX compensation' for years 1–5 sums to 'CAPEX incurred by agent'. 'Risk compensation (mark-up)' is based on the CAPEX employed in the project ('CAPEX incurred by agent' less the sum of 'CAPEX compensation' up to a given year), the agent's cost of capital and the time period when CAPEX was employed in the project. This example assumes constant payments from consumers to agent ('CAPEX compensation' plus 'Risk compensation'). The effect of taxes is not modelled in the example.
Source: Oxera.

It is worth reiterating that the risk adjustment to costs is applied to cash flows from the society (customers) or from the government to the private agent. This is consistent with the public as opposed to the private consideration of the investment in question.

When the compensation for risks (represented by the adjustments to costs) has been calculated and added to expected cash flows in accordance with the proposed methodology, the adjusted costs are then discounted at the STPR to obtain the net present value. A stylised numerical example of this calculation is shown in Appendix 3.

Treatment of OPEX

With regard to OPEX associated with delivering a public project or regulation, a private agent is exposed to risks of outturn costs as well as compensation risks. As discussed before, the appropriate basis for valuation of these risks is the agent's cost of capital.¹⁴

Where OPEX is a part of a project associated with a certain CAPEX, compensation for OPEX risks is included in the compensation for the initial investment. However, where a public project is associated with OPEX only, the appropriate compensation for risk should be estimated separately.

OPEX is assumed to be recovered within one year from the sales of products and services.¹⁵ This suggests that compensation for OPEX-related risks might be calculated as the value of OPEX adjusted for the additional costs of bearing such risks—the risk premium. Due to the nature of OPEX (the fact that OPEX is assumed to be continuously recovered from operating activities), the risk premium is the cost of capital adjusted for the cost of capital less the STPR.

¹⁴ Compensation for OPEX-related risks can be based on a number of alternative measures, such as the OPEX margin.

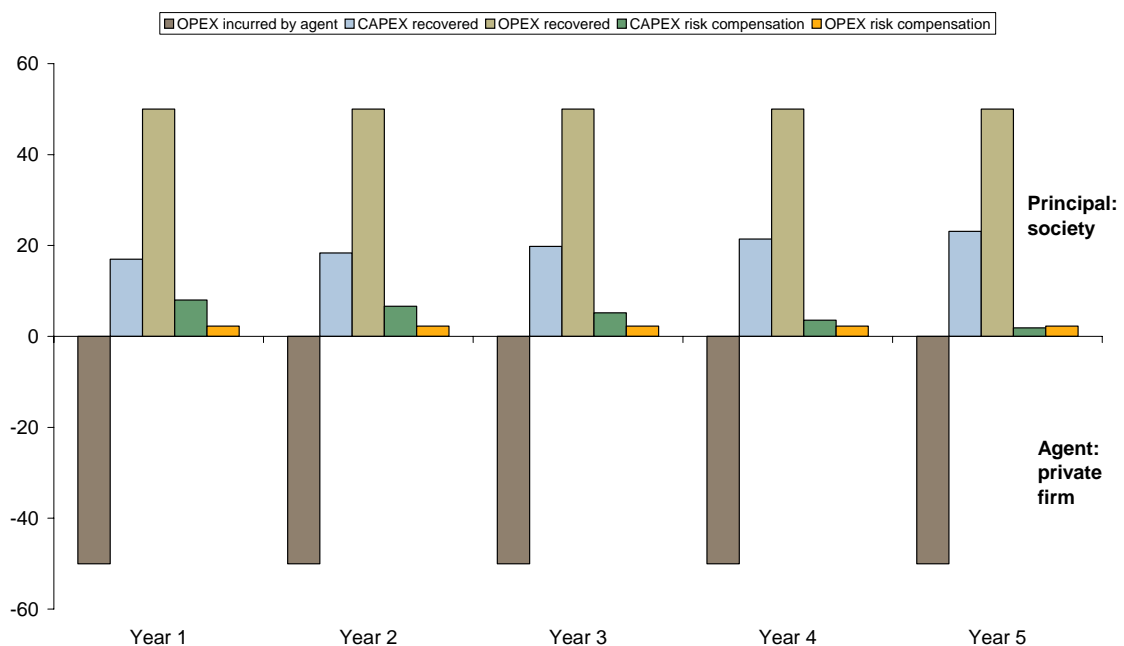
¹⁵ Notably, it is assumed that OPEX will be recovered not over the full year, but over a shorter period. This depends on the speed of turnaround of working capital, as measured, for example, by the current ratio.

This approach is analogous to the certainty equivalence approach. For each year, uncertain expected operating costs can be converted into a certainty equivalence cost (including provisions for cost overruns, for example) by inflating the expected cost by the risk premium—private agent’s cost of capital less the STPR.

Figure 5.2 compares the proposed treatment of CAPEX, and of OPEX (where CAPEX is not present). In the case of CAPEX, the initial capital investment is recovered from customers over five years; in the case of OPEX, costs are incurred over the same five-year period for comparison.

The figure indicates differences in the treatment of OPEX and CAPEX in this example: OPEX represents a social cost in the year in which it is incurred by the agent; CAPEX is recovered by the agent over the period of investment. To account correctly for the time difference, compensation for risks in OPEX is based on the cost of capital less the STPR, while the compensation for CAPEX is based on the cost of capital including the rate of intertemporal time preference.

Figure 5.2 OPEX and CAPEX (£) as a social cost, differences in treatment



Note: In Year 0 (not shown in the graph) initial CAPEX of £100 was incurred. In any given year, ‘OPEX recovered’ is equal to the ‘OPEX incurred by the agent’ before adjustment for risk. In addition to OPEX recovered, the agent receives compensation for OPEX risk (‘OPEX risk compensation’). Therefore, OPEX as a social cost is equal to the nominal OPEX incurred by the agent plus the compensation for risk.

Source: Oxera.

5.2 Unregulated industries

The principles of applying the proposed methodology in the case of a public project imposed on a private agent in an unregulated industry are the same as in the base case discussed above. The firm- or sector-specific post-tax cost of capital is deemed to be the appropriate basis for risk adjustment to costs or the risk premium, and the same methodology should be used as presented above. Correspondingly, the analysis should be undertaken for costs net of taxes.

A potential complication may then arise with respect to the timing of cash flows from society to the agent because the time profile of cost recuperation of the initial investment is not specified in an unregulated industry. In other words, given that there is no predefined profile

according to which CAPEX is recovered from consumers, it is not immediately clear when CAPEX materialises as a social cost—ie, when it is imposed on consumers.

In this case, the proposed solution is to consider the time characteristics of a 'typical' project in a given industry. For all practical purposes, an assumption could be made that the time profile of investment resembles the time profile for recuperating the costs of regulation or public policy. Therefore, the parameters of interest in this context include the payback period and the distribution of expected returns over the period. In most cases, this approach can be further simplified by assuming equal annual returns on investment (ie, equal payments from consumers over the average lifetime of the typical industry-specific project).

The treatment of OPEX remains unchanged in the case of unregulated industry compared with the base case.

5.3 Private contracts for public projects

In certain types of public project, private firms volunteer to undertake a public project at a proposed bid price (for example, as in the PFI framework). The companies bidding for such projects are assumed to undertake the necessary due diligence and nominate to the public sector the compensation they require in the form of future payments.

These payments typically include the compensation of expected OPEX and CAPEX required to execute the project, as well as the required return on capital employed. These must necessarily reflect the risks of the project to the private company and hence are conceptually identical to the required risk compensation adjustment to costs in the proposed methodology.

Therefore, for cases where the nominated costs represent the total payments to the agent and hence include the required compensation for bearing risks, no further cost adjustment is necessary. The costs are expressed net of taxes and are included in the appraisal when the payment from the public sector to the private firm is made. The resulting stream of payments net of taxes is discounted at the social discount rate.

5.4 Public delivery of public projects

The final example of the application of the proposed methodology considers the case when projects are undertaken wholly within the public sector. When the private sector is not involved, it is not necessary to price and account for private sector risks, and no cost of risk is included. The costs are discounted at the social discount rate, which is assumed to account for the compensation for risks faced by society as a whole, if any.

In terms of timing, costs should be included in the appraisal when budgeted by the appropriate government agency. The treatment of taxes is consistent with the base-case scenario, and taxes should be excluded when social costs are considered.

Appendix 1 Introduction to concepts for social discounting

Discounting in the course of public policy appraisals is typically considered to be social discounting or discounting using the social discount rate.¹⁶ The process itself—applying the discount factor to future costs and benefits being the consequences of policies under consideration—is, in terms of its basic mechanism, the same as the discounting process in private sector investment appraisal. Nevertheless, the conceptual tools typically employed with respect to social discounting differ, and include a STPR, shadow price, or the opportunity cost of capital. This appendix briefly reviews some of the key approaches suggested in the literature for practical application of the social discount rate in policy assessment.

A1.1 STPR approach to social discounting

Under specific assumptions of no taxes, no risks present, and perfect capital markets, the appropriate discount rate should reflect individuals' decisions regarding their preferred allocation of consumption through time. The rate at which individuals are willing to trade off consumption over time is normally referred to as the 'consumption rate of interest' (CRI). The CRI is also known as the STPR.¹⁷

The specific assumptions mentioned above typically imply that the STPR equals the market interest rate, which also equals the rate of return on private sector investments. In this case, individuals discount future consumption at the market rate of interest, which is also the rate at which consumption can be translated through time via private sector investment. Hence, if the government seeks to value costs and benefits in present-day terms in the same way as affected individuals, it should also discount using the market rate of interest.

However, since some of the underlying assumptions do not hold in practice, there appears to be a divergence between the STPR (or the consumption rate of interest) and the market rate of return on investments. This raises the question as to which one should be applied in the process of policy appraisal. Different potential approaches the social discount rate (ie, the discount rate used in the policy appraisal) have been considered using various conceptual tools, which are briefly introduced below.

A1.2 STPR-shadow price of capital: the traditional view

One approach recommended for social discounting is to use the STPR to discount future costs and benefits, where the latter have been valued in terms of future consumption. Intuitively, this procedure makes sense because the government is assumed to be valuing future consequences of its policies in the same way as the affected citizens. If individuals discount future consumption (and the costs and benefits of a public policy) using the STPR then so should the government. The implication of this is that the social rate of discount should equal the STPR.

However, if the costs of financing a public project or of regulatory compliance displace private investments, society loses total returns from those forgone investments. Private capital investments might be displaced if, for example, public projects are financed using government debt and the supply of investment capital is relatively fixed. In this conceptual framework, the discounting of costs and benefits using the STPR does not seem to capture

¹⁶ This section draws on US EPA (2000).

¹⁷ Pearce and Ulph (1999).

the fact that society loses the higher, social rate of return on forgone investments, but requires the assumption of a closed economy.

Under the STPR-shadow price of capital approach to social discounting, the social value of displacing private capital investments is taken into account prior to discounting. Under this approach, when a public project displaces private sector investments, the correct method for measuring the social costs and benefits requires an adjustment to be made to the estimated project costs (and potentially benefits as well) prior to discounting using the STPR. This adjustment factor is referred to as the 'shadow price of capital'. The shadow (social) price of private capital aims to capture the fact that a unit of private capital produces a social return that is greater than the corresponding discount rate characteristic of individuals' intertemporal preferences.

Therefore, if financing a public project displaces private investments, the STPR-shadow price of capital approach suggests that the project's costs should be adjusted upwards by the shadow price of capital and then all the costs and benefits should be discounted using a social rate of discount equal to the STPR.

A1.3 Weighted average of pre- and post-tax of return

Alternatives to the STPR-shadow price of capital focus on other methods for evaluating policies that displace private sector investments. For example, another approach to addressing the divergence between the higher social rate of return on private investments and the lower STPR is to set the discount rate for public projects equal to a weighted average of the two. In this case, the weights equal the proportions of project financing that displace private investment and consumption, respectively.

One potential problem with the weighted average return approach is related to the 'over-discounting' of the benefits when accounting for the higher social cost of displaced private investments. The amount of such over-discounting necessary to adjust for the actual social costs of the project depends on the time profile of the stream of benefits—the further in the future the benefits occur, the less over-discounting is required.

A1.4 Opportunity cost of capital

Another approach to social discounting is based on the idea that the government should not invest (or compel investment through its policies) in any project that offers a rate of return that is lower than the social rate of return on private investments. Stated another way, because citizens collectively enjoy the benefits of all public and private investments, combined social welfare will be higher if the government invests in projects with the highest rates of return.

However, a potential criticism of this approach is that the project with the highest net present value (where all projects are discounted at the STPR) should not be used as the criterion for assessing all other projects. In other words, the project with the highest value might provide too high a threshold for other projects to attain. The potential implication of the opportunity cost of capital approach is therefore that it would rule out projects that are justifiable in terms of meeting their required rate of return (and hence are socially desirable), yet fail to match the identified opportunity cost of capital of the most valuable project.

A1.5 STPR-shadow price of capital: the open economy perspectives

It has been highlighted that the key assumption behind the STPR-shadow price of capital approach—the assumption that the economy is 'closed' to foreign capital flows—is problematic in light of international capital markets. More specifically, the 'closed economy' assumption that international capital flows are either non-existent or highly insensitive to interest rates is unlikely to hold in practice.

There is mixed empirical evidence regarding international capital flows and their responsiveness to changes in the interest rate. However, if international capital flows are elastic with respect to interest rates (the open economy condition), the private capital displacement might be considerably less important than previously assumed.

Under this alternative view, it is inappropriate to assume that financing a public project through borrowing will result in a pound-for-pound crowding out of private investment. If financing of public projects results in no crowding out of private investment, no adjustments using the shadow price of capital are necessary and the costs and benefits should be discounted at the STPR.

However, other adjustments might be necessary in the absence of crowding out of private investment by the public sector. More specifically, if a given project is undertaken by the private sector, the investors might need to be compensated for the assumed risks. Furthermore, this compensation might be necessary to introduce the appropriate incentives that would ensure efficient execution. In this case, the adjustment would not reflect the opportunity cost of capital of the private sector, but the opportunity cost of alternative project execution.

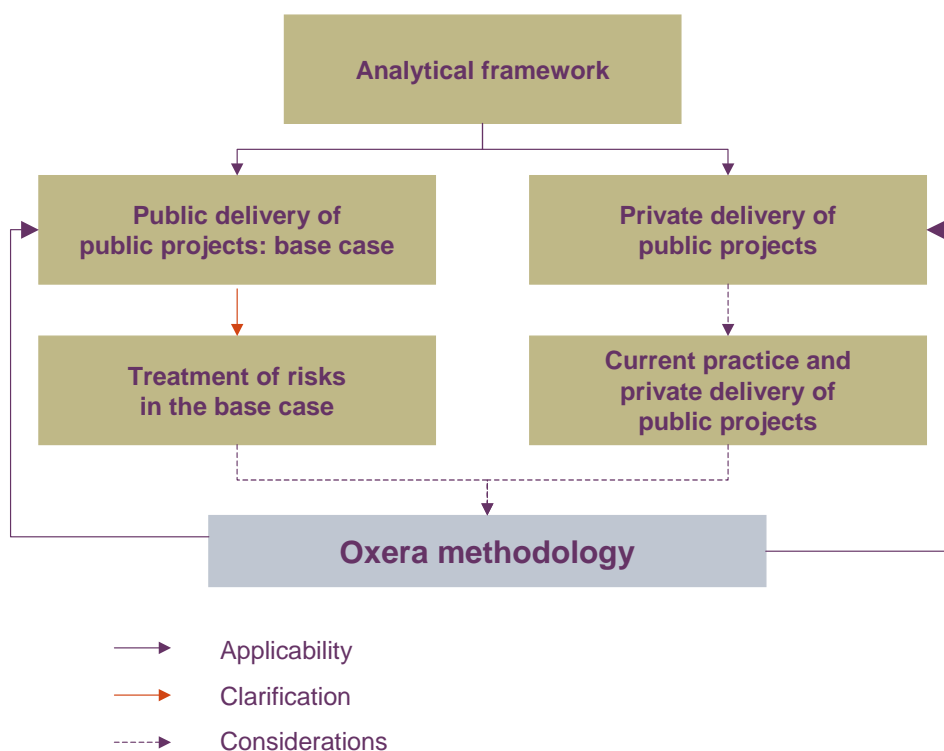
Appendix 2 Proposed methodology for policy appraisal: explanations

This appendix presents the proposed methodology for calculating the present value of costs for the CEA where the private sector is involved in public projects. It is structured as follows.

- The **analytical framework** for considering discounted present values is described (section A2.1).
- The **base-case scenario** is outlined in which a project is funded and undertaken by a public sector institution (section A2.2).
- This scenario is then discussed in the context of academic research on the **treatment of risk** (section A2.3).
- **Departures from the base-case scenario** are then addressed (section A2.4), where the private sector is involved and charged (by means of regulation or by the government relative to a contractor) to implement a given policy or project. The treatment of risk faced by the public and private sectors in such cases in the context of CEA and the potential implications for the CBA is also examined.
- The critical implications of the **universal rate of 3.5%** when applied in cases where **private costs are involved** are then explored (section A2.5).
- Details on the **proposed methodology** for dealing with private delivery of projects in the context of public policy appraisals are provided (section A2.6).

Figure A2.1 below presents a stylised illustration of the links between the key building blocks leading to the development of the proposed methodology.

Figure A2.1 Key building blocks in the proposed methodology



Source: Oxera.

A2.1 Analytical framework

The concept behind public project appraisal is similar to that followed in investment appraisals undertaken in the private sector—ie, whether benefits derived from the project outweigh the costs necessary to deliver it in present-value terms. However, there are often important differences. For example, the beneficiary and the cost bearer might not be the same entity—as a result of regulation, costs might be imposed on a private sector institution, while the benefits might accrue to society.

There are several ways of describing the parties involved in public policy. For example, the government (acting on behalf of society) may be considered the principal in charge of introducing the optimal policy. It undertakes this task by commissioning an agent to deliver the required policy, or by regulating the agent to implement it. Alternatively, the government may undertake the required investment itself.

For the purpose of public policy appraisal—in particular, to identify the correct discounted values of future costs and benefits—it is typically necessary to analyse the specific project characteristics. These include the nature of the required investment by a specified agent being considered for the policy, given its business plan and associated risks, as well as its preferences. These factors are important as they may have implications for the net present value of costs, in particular for the discount rate and mean value of costs.

To assess systematically the potential impact of these aspects on policy appraisal, the base-case scenario is first analysed, examining the situation where the policy is funded and delivered by the public sector.

A2.2 Public delivery of public projects—the base-case scenario

In the base case, the government decides to undertake the project, funds it, delivers it, and bears all associated risks. There is no role for a private agent and the government or a public

agency—as the principal—is the sole party involved. All benefits, costs and risks accrue to the principal or society.

In order to determine the present value of costs and benefits, two approaches are usually considered to identify the appropriate social discount rate:

- the STPR approach;
- the ‘social opportunity cost’ (SOC) approach.

The STPR is the rate at which society values the present compared with the future, referring to people’s (or society’s) intertemporal preferences for other people’s well-being. The STPR reflects the fact that the same value of benefits (costs) in the present is more valuable (costly) than in the future. Furthermore, according to academic evidence (although there is little), the STPR should exclude project-specific risks but potentially include a small factor for a general risk of man-made or natural catastrophes (eg, war, bio-disasters, asteroid impacts, volcanic eruptions, etc) that may eliminate some future costs and benefits (Spackman, 2004).

The SOC is a factor by which the amount of public investment is multiplied relative to the amount of current expenditure to reflect the higher opportunity cost of current expenditure. In other words, the SOC is based on the concept that current consumption can be forgone in order to generate returns (private sector returns) and increase consumption in the future.

In the base case, the Green Book (HMT 2003) recommends the use of a 3.5% discount rate, which represents the STPR. This is supported by substantial academic research and is well established within the relevant academic literature. For example, Spackman (2004) indicates that the STPR should be used for public projects where no private agents are involved. Accordingly, for practical purposes (CBA and CEA), the relevant discount rate seems to be the STPR.

Further support for this approach can be found in, for example, Lind (1982), who recommends STP discounting with shadow pricing to take into account the opportunity costs. At the same time, he recognises the importance of arguments that, for CEA, the shadow price is irrelevant, where the shadow price of capital is the return on available alternative investments or the social return on public projects. Lind (1982) also advocates STP rates that vary according to the systematic risk component of a given project (taken as the correlation with the national income in line with consumption capital asset pricing model, or CAPM).

Similarly, Spackman (1991) advocates the use of STP as the discount rate for practical appraisal, concluding that the rates of STP and SOC of public expenditure are, for all practical purposes, equal.

Further arguments supporting the STPR can be found in Pearce and Ulph (1995), who have had a significant impact on the analysis of the SPTR value currently used in the appraisal of public projects. The authors note that in an economy without any distortions (eg, without taxes), the STP and SOC rates are the same. If there are distortions, a choice between the two rates must be made.

Following Lind (1982) and Bradford (1975), Pearce and Ulph (1995) advocate that £1 of necessary CAPEX (investment cost) considered should be classified as originating from consumption or investment. The investment component should then be converted into consumption-equivalent units through the SOC, and the resulting consumption-equivalent flows discounted at the STPR. A similar procedure can be applied to the benefits.

Pearce and Ulph (1995) provide the following rationale for not pursuing the SOC approach, referencing Spackman (1991):

- ‘the problems of quantifying in practice how much a particular public expenditure is financed by diversion from investment and how much directly from consumption are formidable’;
- that shadow pricing ‘would be quite foreign, and not attractive, to most practical managers’;
- ‘it appears in practice that, even where time preference and the opportunity cost of displaced investment might in principle conflict, this conflict, at least in present UK circumstances is not generally material.’

This seems to indicate that the social return on private projects (the social opportunity cost of capital) is similar to the STPR. The academic evidence, however, appears to be mixed.

In line with Spackman (1991), Pearce and Ulph (1995) also conclude that not adopting this approach can be justified using a combination of practicability and the belief that alternative approaches would yield very similar results. The authors then focus on the estimation of the STPR to be applied in the appraisal of public policy projects.

Young (2002) argues that the STPR is considered to be the appropriate approach to discount public policy projects. When STPR estimates are unavailable or unreliable, and the government is considering financing a project, the SOC should be used.

The base case has established that the STPR is the justified approach to discounting when projects are initiated, financed and delivered by the public sector. The current practice seems to indicate that the 3.5% rate is the best estimate of the STPR to be applied in ‘not very long-term’ discounting. It is then important to understand how the choice of the STPR and the 3.5% estimate addresses the risks inherent in investment projects.

A2.3 Treatment of risk in the base-case scenario

One of the key dimensions of any investment appraisal—in either a public or a private context—is the treatment of uncertainty and risks. Uncertainties concern total costs as well as project execution and adherence to the original timetable and/or budget. They also include technology risks, managerial risks, financeability, potential policy ramifications, and implications for other parties, including regulatory and political risks. Almost any aspect of the policy under consideration is likely to face some uncertainty. It is therefore critical to investigate the implications of the treatment of risks for the discounted value of costs and benefits insofar as they incorporate the identified risks.

There is, however, no unified approach to the treatment of risks in public policy appraisal. According to Spackman (2002), there is no consensus among practitioners on whether a general public sector discount rate should include any factors for risk.

Historically, according to the ‘welfare economics academic convention’, risks have been *excluded*. However, financial economists have argued for the inclusion of a risk premium that reflects the systematic risk component in line with the consumption CAPM, which reveals the social cost of the activity and therefore should be controlled for in the discounted value of costs.

The debate concerning the impact of risk on public projects appraisal by financial economists largely focuses on whether costs of capital, and subsequently discount rates, are different in the private and public sectors.

When the private sector undertakes the investment appraisal, risks are identified, assessed and valued. They are therefore explicitly accounted for and usually included in the discount rate. (Alternatively, risks are measured and the costs and benefits adjusted accordingly without affecting the discount rate.)

Given that risks are explicitly recognised by the private sector, the conclusion that discount rates should be identical irrespective of who finances the project would suggest either that the risks are the same for both the public and private sector (which would imply that, for the public sector, risks should be priced at the same cost) or that higher risks in the private sector should be reflected in the stream of costs (and benefits) to be discounted.

Flemming and Mayer (1997) suggest that for publicly and privately funded projects, the cost of capital is constructed from a combination of a risk-free rate and a risk premium, which should depend on the covariance of project returns with those of investments in the market.

According to Brealey, Cooper and Habib (1997), there are some clear parallels between the problems faced by the public and private sectors. In particular, both sectors must choose between making investments and returning the cash to be invested to their beneficiaries—shareholders in the case of private sector firms, and society in the case of governments. These beneficiaries can then invest the cash directly into the capital markets or spend it on current consumption. As all parties involved have access to the same capital markets, the opportunity cost of these investments should be the same. The authors go on to suggest that, for the reasons outlined above, among others, in the case of publicly or privately funded projects, risk should explicitly be controlled for in the appraisal.

To identify whether, when undertaking a project, the public sector should price the same risks in the same way as the private sector, undertaking the same project, Grout (1997) suggests that public sector provision does not involve less risk and that the public sector cannot fund projects more cheaply than the private sector.

Grout (1997) also provides reasons why a public project might bear a lower risk premium than a private one:

- ‘heterogeneity of population’—aggregating the same risk borne by each consumer (in the case of a publicly funded project) would *not* result in the total risk borne by a private provider;
- ‘contractual problems’ between the private and public sectors;
- ‘if financial market do not work efficiently’.

At the same time, Spackman (2004) argues that the systematic risk faced by taxpayers and public service users is usually low. In addition, from the perspective of those who view the cost of fluctuations as being mainly specific to equity markets, the premium has little relevance to activities that are publicly financed. This seems to indicate that, in the case of publicly funded projects, no risk premium is required.

As such, academic discussion seems to focus on whether the discount rate should be derived from the elasticity of the marginal utility of income of society (sometimes referred to as the ‘welfare economic’ approach), or from the total of the market risk-free rate and the market equity risk premium in recognition that society is the equity holder (sometimes referred to as the ‘financial economic’ approach). Indeed, since the STPR is widely agreed to be the conceptually correct approach to discounting, financial economics generally views market interest rates as the appropriate way of measuring STPR.

This brief review of academic developments seems to suggest that there are strong arguments for considering risks. However, some welfare economists indicate that systematic risks to taxpayers are generally low and the impact on the discount rate would therefore be little or negligible.

The academic literature seems to indicate that discount rates to be applied when public projects are undertaken by the private sector should be higher than when they are undertaken by the public sector, which suggests that the risks for the private institution should be considered. For example, in the context of public–private partnerships, Grout

(2002) argues that lower discount rates should be used for the public sector than the private sector.

A2.4 Private ownership and delivery of public projects

Having considered the base-case scenario, it is necessary to refocus the discussion slightly more in the context of the Oxera analysis. In the alternative scenario—the focus of this report—the role of the public sector is limited to determining whether the project should be undertaken, while the delivery of the project is passed through to the private sector.

Where the agent is a private sector institution, certain aspects are particularly worth discussing.

- It is often the case with public policy—in particular, regulation—that benefits accrue to certain parts of society at the cost of others. It appears that the agent (as one element of society) bears costs while potentially some other elements of society receive benefits.
- The agent, as a private sector institution, is exposed to private sector risks. It is required to finance its activities on the basis of the private sector cost of capital and is expected to deliver private sector returns to its investors.
- The agent will assess the effect of the particular project on the basis of private sector rates.
- Once the agent is commissioned to undertake the project, the principal becomes exposed to the risk that the agent will not be able to deliver.

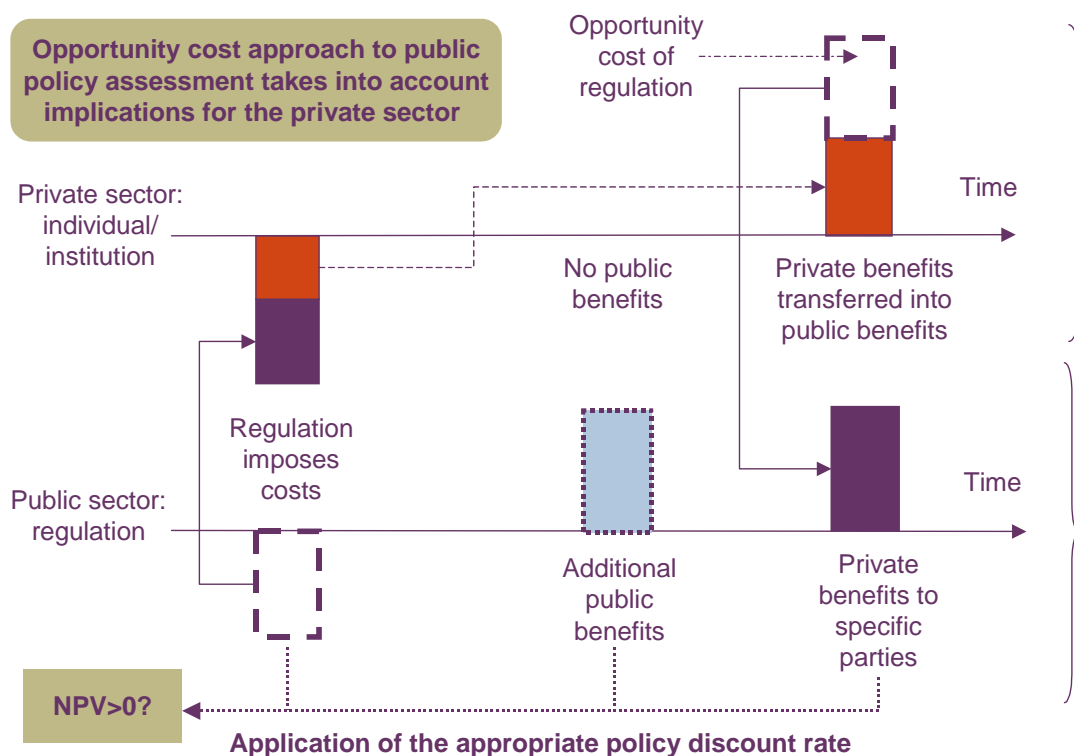
Given these observations, the key question is whether risks should be accounted for in the appraisal and included as the social cost of the policy, and if so, on what the adjustment should be based.

If, in the CBA and CEA, risks are not accounted for, or the adjustment is not based on private rates, the following issues may arise:

- if risks are not accounted for, it is unclear why there should be no level playing field;
- the implications for resource allocative efficiency are unclear;
- if the agent bears the costs, and the benefits accrue to the principal, there is a clear social cost (of the risk of employing the agent) that is not accounted for;
- in the case of regulated industries, it is unclear how to reconcile increases in allowed revenues, based on private rates, with the fact that the CEA applies the 3.5% rate.

Figure A2.2 below illustrates the implications of undertaking public policy for the private sector in terms of the opportunity cost of capital.

Figure A2.2 Public policy and/or regulation: implications for the private sector



Source: Oxera.

Taking into account the above areas of consideration, section A2.5 discusses practical aspects of the application of the 3.5% rate to cases where the private sector is involved in public projects—in particular, the potential allocative inefficiencies.

A2.5 Methodology for estimating the discounted present value of costs

The proposed methodology focuses on providing a systematic approach to assess policy projects with private sector involvement, in particular giving a detailed description of risks relevant for the analysis and how to integrate these into the appraisal.

The proposed methodology incorporates the evidence from the academic literature and the practical considerations outlined above. It seems reasonable to consider that when private financing is involved, the appropriate method of appraisal should reflect the risks faced by the private agent and that these risks should be priced according to private sector rates. These risks seem to be social costs, which becomes even more apparent if the principal receives benefits and the agent effectively incurs the costs (but then recovers them from consumers), which in turn leads to the principal–agent non-identity.

It is essential to recognise that risks are relevant for policy appraisal in terms of choosing how to deliver privately financed projects, including the choice between potential private agents. At the same time, when the risks are transferred back to the public sector—eg, when the project is publicly financed and publicly delivered—these should not be priced, or might require a minimal risk premium (see section A2.4); in such cases, the STPR of 3.5% is again the most appropriate rate.

A2.5.1 Treatment of risks

When the project is awarded to the agent, it seems appropriate to compensate the agent for the additional risk to which it becomes exposed. Even if the project is delivered by the agent (the private sector institution), the principal might still be exposed to certain risks. These

include the risk arising from the fact that project delivery is delegated (*agent risk*) and the risk that the costs of delivering the project might be higher than expected (*cost overruns*, not borne by the agent and passed through to the principal).¹⁸

The base-case scenario, examined above, suggests that risks that accrue to the public sector need not be included in the appraisal. (These risks arise either when public financing is involved or when the private sector undertakes the project but, due to the nature of contractual relations, the public sector remains exposed to some risks.) This is because, even if such risks require the risk premium, they are generally seen as negligible for practical purposes (see section A2.4).

Given that risks are included as mark-ups to costs, the total project costs include two components:

- the expected stream of costs of the project, or costs not driven by the project risk;
- compensation to the agent for the risks to which it is exposed.

These components are discussed in greater detail below.

A2.5.2 Expected costs of policy project

The base element of costs is formed by the economic costs of the policy project. It is important to emphasise that the expected economic costs should be used and that no adjustment for associated uncertainty, and no account for the costs of financing, is required for expected costs.

In addition, the nominal costs of the policy (ie, the pre-financing costs) should be adjusted to reflect the tax stream (ie, taxes should be excluded). Thus, the expected costs of the policy are pre-financing and post-tax costs.

A2.5.3 Compensation to the agent

There are several types of risk to which the agent might be exposed, including compensation risk, the risk of cost overruns, and political and regulatory risk. The nature of these risks, the factors affecting them and the basis for estimating the required mark-up are discussed below.

Compensation risk

Once the project has been allocated to a particular agent, there is the risk that the agent will not be remunerated for the expected costs, or will not be able to generate sufficient revenue (*compensation risk*). This depends on the following factors.

- The degree of pass-through of project costs to customers (the higher the potential for cost pass-through, the lower the risk), where it depends on the following.
 - *Whether the agent operates in a regulated or unregulated environment*—in the former, regulators tend to allow for a certain level of cost pass-through to consumers via increased charges, while, in the latter, the potential for cost pass-through via price increases is determined by market conditions. Therefore, for regulated industries, where costs are likely to be passed through in full, compensation risk will be lower than for unregulated industries, where the scope for pass-through is uncertain.

¹⁸ Construction projects and maintenance of nuclear decommissioning facilities could serve as examples. In these cases, the agent is compensated by the government for all cost overruns. The nature of the risks to which the principal is exposed is discussed in greater detail in section A2.5.4.

- *The elasticity of customers' demand*—the potential for price increases will be partly determined by customers' sensitivity to these increases, which in turn is defined by the price elasticity. In particular, the higher the elasticity, the harder it is to pass through costs and therefore the higher the compensation risk.
- *The competitiveness of the product markets in which the agent operates*—the level of competitiveness influences the price elasticity and therefore the potential for cost pass-through. Therefore, the higher the competitiveness of product markets, the higher the compensation risk.
- The general business risk of the agent's activities, including revenue risk and cost risk—uncertainty surrounding costs and revenues affects the ability of the agent to generate sufficient revenues to cover the costs of other activities and of the public project. Therefore, the riskier the agent's business, the higher the compensation risk.

In addition to factors that might influence the risk itself, it should also be considered what is at risk (essentially, how much is affected by the uncertainty) and the period over which the value is at risk.

The value at risk (for the compensation risk) is the capital investment undertaken by the agent (CAPEX). The period over which the value is at risk lasts from when the investment is made until it is fully recouped. It might also be appropriate to include OPEX necessary to deliver the project to the total value at risk, since, in any given year, OPEX is at risk of not being recovered from the agent's revenues. In such a case, the period over which the risk is effective is one year, since OPEX is generally recouped in the same year as it is incurred.

Therefore, the mark-up required to reflect the compensation risk to society is defined on the basis of two main components:

- expected CAPEX associated with the project, the period over which the CAPEX is recouped, the profile of recoupment (or how much is recouped each year) and the compensation risk of the agent;
- expected annual OPEX and the compensation risk (which is completely recouped within one year).

Risk of cost overruns for the agent

Once the agent is awarded the project, there is uncertainty surrounding the expected project costs and the corresponding *risk of cost overruns*. This risk depends on:

- the uncertainty of costs, as outlined above —the higher the cost uncertainty, the higher the corresponding risk of cost overruns;
- the allocation of the risk of cost overruns between the agent and the principal—contractual relationships between the two parties with respect to who bears the risk are critical. For example, in the water industry, it is common practice for the agent to bear the risk. Therefore, if the actual costs are higher than expected, these are paid from the equity of the agent. In nuclear decommissioning projects, all cost overruns are passed through to the principal. Therefore, in the first case, an agent would require a compensation for potential cost overruns, while in the second the agent is exposed to this risk.

In terms of the value at risk, as with compensation risk, the risk of cost overruns applies to CAPEX over the period from investment until recuperation and to OPEX over the period of one year.

An additional factor that is likely to affect both compensation risk and the risk of cost overruns is potential government subsidy to the agent. If the project is subsidised with payment upfront, compensation risk and the risk of cost overruns are mitigated.

Political and regulatory risks

Given that the role of government in policy projects is critical, there are also *political* and *regulatory risks*. The higher the uncertainty surrounding the future regulatory treatment of a given public project imposed on an agent, or the higher the risk that the general political environment will change, the greater the political/regulatory risk and the higher the corresponding compensation.

Similar to the previous two types of risk, the compensation for political/regulatory risk is based on the value at risk—the future CAPEX over the period from which it is incurred to when it is recouped and OPEX for one year.

Other considerations

There are two important aspects regarding the nature of risks for the agent:

- whether these risks (and corresponding compensation) differ across agents;
- whether they depend on the nature of contractual relationships with the principal.

Compensation risk will differ from agent to agent (as will the corresponding compensation), while, for the given structure of the contract with the principal, the risk of cost overruns is the same for all agents. Political and regulatory risks might also differ across agents.

Neither compensation risk nor political/regulatory risk depends on the contractual relationships between the agent and the principal, being defined by the nature of the former's activities. The risk of cost overruns, on the contrary, depends on the allocation of overruns.

To summarise, it is necessary to compensate the agent for risk that is generated from being exposed to delivering the project. There are several types of risk (including compensation risk, the risk of cost overruns and political risk), some of which will differ across agents, as will the corresponding levels of compensation.

Having discussed the risk adjustment to expected costs, it is worth considering the risks faced by the principal. Given that the principal is the public sector and that the literature recognises that risk premiums for the public sector are negligible in the practical applications, no mark-up is required for these risks.

A2.5.4 Risks to the principal

In the framework of the investigation, the principal makes a decision to proceed with the policy and commissions an agent to deliver the policy project.

First, therefore, there is the *counterparty risk*, which represents the risk that the agent will not be able to deliver the project and will depend on the overall riskiness of the underlying activities of the agent. This risk will be agent-specific, and will not depend on the contractual relationships between the agent and the principal.

Second, there is the *risk of cost overruns for the principal*. As outlined above, project costs are often uncertain. Depending on the contractual agreement with the agent regarding the allocation of cost overruns, the principal might be exposed to the risk that the policy will be more expensive than expected.

The risks of cost overruns to the agent and the principal represent two components that add up to the overall cost risk that is driven by the uncertainty surrounding the project costs. Given that, for the public sector, risks require minimal mark-up, it might seem justifiable to suggest that, in order to decrease the overall mark-up, contracts should be defined such that the risk of cost overruns is borne by the principal. In this case, the risk is not priced for and

the total mark-up is lower than if this risk were, at least partly, shifted to the private sector, which would require compensation based on private rates.

This is related to the argument that the public cost of capital seems to be lower than the private one. Even if this appears to be the case, the public sector fails to create the same incentives for cost efficiency as the private sector. In the example with cost overruns, if this risk is shifted to the public sector, there are lower incentives to deliver the project at lowest possible cost. When, however, the risk is shifted to the private sector, the overall risk adjustment might be higher, but there would be significant incentives for the private sector to achieve high cost efficiency.

A2.5.5 Discount rate

Having adjusted measured costs for risks, the appropriate rate to discount future costs and benefits is the social discount rate. The currently used 3.5%, which is linked to the STPR and is generally seen as risk-free for practical purposes (or bearing a negligible risk premium), is assumed to be the appropriate discount rate.

Appendix 3 Application of the proposed methodology for different types of public projects

Table A3.1 Application of the proposed methodology for different types of public project

	Price-regulated industry	Market industry	Voluntary participation	Public execution
Description	Private institution operating in the regime for price regulation is required to deliver public project/regulation	Private institution operating in a price-unregulated environment is required to deliver public project/regulation	A private institution bids for the public project (eg, within the PFI framework)	A public project is initiated and delivered by a public agency without private involvement
Example				
Type of agent	Private sector firm obliged to participate—separate from principal		Private sector firm willing to participate—separate from principal	Public sector agency—not separate from principal
Financing and asset ownership	Private sector capital (raised from capital markets); private sector ownership		Private sector capital (raised from capital markets) and typically private sector ownership	Public capital (financed taxes) and public ownership
Contract	Regulated compensation defined by contract; defined cost-pass-through allowance	Regulated compensation absent; unclear potential for cost pass-through	Typically, special purpose vehicle with defined future payments from public sector	Government planning and budgeting
Risk allocation	Typically, risk of cost overruns allocated to agent; compensation risk minimal	Typically, risk cost of overruns allocated to agent. Compensation risk defined by market conditions and likely to be higher than in price-regulated industries	Typically, risk cost overruns allocated to agent. No compensation risk since entitled to predefined payments	All risks are allocated to public sector
Principles of proposed methodology	To price risks for agent on the basis of private cost of capital		Risks already priced by agent and included in the stream of required payments	There are no private risks, so no adjustment for these is necessary and they do not need to be priced
Definition of costs	Net of transfers (taxes) and adjusted to reflect private risks; risk mark-up required		Net of transfers (taxes); private risks do not need to be adjusted for since they are included in the stream of required payments	Net of transfers (taxes); no adjustment for risks required
Timing of costs	When incurred by principal; in accordance with regulatory allowances to pass through costs	When incurred by principal, this requires further analysis. For example, potentially assume lifetime of industry average project and annuity	When the required payment is expected to be made to the agent: risk mark-up not required	When allocated to budget

	Price-regulated industry	Market industry	Voluntary participation	Public execution
Potential departures from optimum under current practice				
CBA	Potentially not all social costs are considered (costs of risks); socially unattractive projects adopted		No departure	
CEA	Potentially inefficient allocation of resources, society might pay too much, no recognition of the trade-off between private incentives and higher private cost of risk			
Implication for policy under current practice				
CBA	Certain projects might be not delivered		No implication	
CEA	Riskier industries are less likely to be required to deliver the policy; price-regulated industries are more likely to be required to deliver the policy		No implication	Recognition of the trade-off between private incentives and higher cost of capital

Source: Oxera.

Three examples below illustrate the proposed concepts. It is assumed that a public project might be delivered by either of two, different private agents operating in a price-regulated environment (alternatively, regulation is considered to be imposed on one of the two agents).

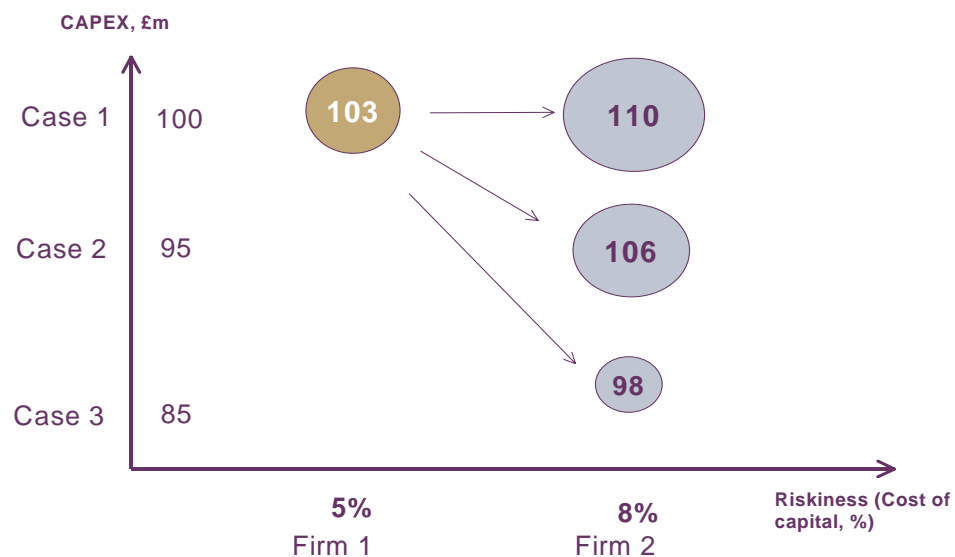
In the first example, firms have different costs of capital but their expected delivery of the project is characterised by the same expected level of efficiency—ie, the nominal costs of the policy are the same for both firms. In this case, the social cost associated with the same expected benefits is higher when it is to be delivered by the firm characterised by a higher cost of capital.

In the second example, the firm with a higher cost of capital is assumed to be more cost-efficient—ie, it is expected to deliver the same benefits at a lower CAPEX. However, the reduction in CAPEX generated by greater expected cost efficiency in this case is insufficient to outweigh the costs associated with the higher risk of the second agent (ie, the agent with a higher cost of capital).

In the third example, the riskier agent is expected to achieve sufficient CAPEX efficiency to outweigh the higher cost of capital. In this case, the policy is more expensive when associated with the less risky but also less efficient firm.

These cases are illustrated in Figure A3.1. The underlying calculations are shown below.

Figure A3.1 Present value of social costs of policy: the impact of risk and cost efficiency (£m)



Note: The same annual OPEX (£10m) is assumed for three cases for both firms. Higher cost efficiency means that the same policy can be delivered at lower cost, in this example CAPEX.
Source: Oxera.

The characteristics of the project are summarised in Table A3.2.

Table A3.2 Characteristics of the investment project: Case 1

	Firm 1	Firm 2
Initial capital investment (£m)	100	100
Annual operating cost (including depreciation) (£m)	10	10
Life of the project (years)	5	5

Source: Oxera.

The characteristics of the two alternative firms are as follows.

Table A3.3 Characteristics of private firms

	Firm 1	Firm 2
Post-tax cost of capital (%)	5	8
Period over which CAPEX can be recuperated (years)	5	5
Basis for CAPEX recuperation	Equal annual payments (cost and risk mark-up)	Equal annual payments (cost and risk mark-up)
Average tax rate on intermediate goods, OPEX (%)	35	35
Marginal corporation tax rate, CAPEX (%)	30	30
Social discount rate (%)	3.5	3.5

Source: Oxera.

Using this information, it is possible to calculate the discounted present value of social costs of this public project if undertaken for each of these two firms. This example illustrates that for riskier firms (those with higher costs of capital), the costs of delivering policy will be higher.

Table A3.4 Stylised example of the calculation of the present value of social costs of the policy: Case 1 (£)

Year	Today	Year 1	Year 2	Year 3	Year 4	Year 5
Nominal expected costs of the policy						
CAPEX						
Firm 1 (cost of capital=5%)	100					
Firm 2 (cost of capital=8%)	100					
OPEX						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Social costs of policy						
OPEX recovery						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Compensation for OPEX-related risk						
Firm 1 (cost of capital=5%, STPR=3.5%)		0.2	0.2	0.2	0.2	0.2
Firm 2 (cost of capital=8%, STPR=3.5%)		0.5	0.5	0.5	0.5	0.5
Total OPEX						
Firm 1 (cost of capital=5%)		10.2	10.2	10.2	10.2	10.2
Firm 2 (cost of capital=8%)		10.5	10.5	10.5	10.5	10.5
CAPEX recovery						
Firm 1 (cost of capital=5%)		18.1	19.0	20.0	21.0	22.0
Firm 2 (cost of capital=8%)		17.1	18.4	19.9	21.5	23.2
Compensation for CAPEX related risk						
Firm 1 (cost of capital=5%)		5.0	4.1	3.1	2.1	1.1
Firm 2 (cost of capital=8%)		8.0	6.6	5.2	3.6	1.9
Total CAPEX						
Firm 1 (cost of capital=5%)		23.1	23.1	23.1	23.1	23.1
Firm 2 (cost of capital=8%)		25.1	25.1	25.1	25.1	25.1
Corporation tax¹						
Firm 1 (cost of capital=5%)		7.0	7.0	7.0	7.0	7.0
Firm 2 (cost of capital=8%)		7.7	7.7	7.7	7.7	7.7
Taxes on intermediate good²						
Firm 1 (cost of capital=5%)		3.5	3.5	3.5	3.5	3.5
Firm 2 (cost of capital=8%)		3.5	3.5	3.5	3.5	3.5
Total taxes						
Firm 1 (cost of capital=5%)		10.5	10.5	10.5	10.5	10.5
Firm 2 (cost of capital=8%)		11.2	11.2	11.2	11.2	11.2
Total costs³						
Firm 1 (cost of capital=5%)		22.8	22.8	22.8	22.8	22.8
Firm 2 (cost of capital=8%)		24.4	24.4	24.4	24.4	24.4
Present value of policy costs (at 3.5%)						
Firm 1 (cost of capital=5%)	102.8					
Firm 2 (cost of capital=8%)	109.9					

Note: The calculation of the annual amount of recovered CAPEX and corresponding risk mark-up is based on the following assumption: total amount of CAPEX is recovered on the basis of the equal annual payment over five years, where the embedded risk mark-up is based on the amount of CAPEX employed in the business. This is similar to calculations of the annuity. ¹ Corporation tax = marginal corporation tax rate * EBIT = 30% * (OPEX compensation + total CAPEX). ² Taxes in intermediate goods = marginal tax on intermediate goods * OPEX = 35% * OPEX. ³ Total social costs = total OPEX + total CAPEX – total taxes.

Source: Oxera.

In the second example, firms have the same characteristics as in the first one; however, the nominal costs of the policy differ.¹⁹ Specifically, the riskier firm is more efficient and is able to deliver the same policy with lower CAPEX and the same OPEX. In this example, the costs of higher risk outweigh the benefits of higher efficiency and, for the riskier firm, the costs of the policy are still higher.

The characteristics of the policy project for each firm are summarised in the Table A3.5.

Table A3.5 Characteristics of the investment project: Case 2

	Firm 1	Firm 2
Initial capital investment (£m)	100	95
Annual operating cost (including depreciation) (£m)	10	10
Life of the project (years)	5	5
Post-tax cost of capital (%)	5	8

Source: Oxera.

The present values of policy costs for each firm are shown in Table A3.6 below.

¹⁹ Although the nominal costs of the policy differ, the benefits are assumed to remain unchanged.

Table A3.6 Stylised example of the calculation of the present value of social costs of the policy: Case 2 (£)

Year	Today	Year 1	Year 2	Year 3	Year 4	Year 5
Nominal expected costs of the policy						
CAPEX						
Firm 1 (cost of capital=5%)	100					
Firm 2 (cost of capital=8%)	95					
OPEX						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Social costs of policy						
OPEX recovery						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Compensation for OPEX-related risk						
Firm 1 (cost of capital=5%, STPR=3.5%)		0.2	0.2	0.2	0.2	0.2
Firm 2 (cost of capital=8%, STPR=3.5%)		0.5	0.5	0.5	0.5	0.5
Total OPEX						
Firm 1 (cost of capital=5%)		10.2	10.2	10.2	10.2	10.2
Firm 2 (cost of capital=8%)		10.5	10.5	10.5	10.5	10.5
CAPEX recovery						
Firm 1 (cost of capital=5%)		18.1	19.0	20.0	21.0	22.0
Firm 2 (cost of capital=8%)		16.2	17.5	18.9	20.4	22.0
Compensation for CAPEX related risk						
Firm 1 (cost of capital=5%)		5.0	4.1	3.1	2.1	1.1
Firm 2 (cost of capital=8%)		7.6	6.3	4.9	3.4	1.8
Total CAPEX						
Firm 1 (cost of capital=5%)		23.1	23.1	23.1	23.1	23.1
Firm 2 (cost of capital=8%)		23.8	23.8	23.8	23.8	23.8
Corporation tax¹						
Firm 1 (cost of capital=5%)		7.0	7.0	7.0	7.0	7.0
Firm 2 (cost of capital=8%)		7.3	7.3	7.3	7.3	7.3
Taxes on intermediate good²						
Firm 1 (cost of capital=5%)		3.5	3.5	3.5	3.5	3.5
Firm 2 (cost of capital=8%)		3.5	3.5	3.5	3.5	3.5
Total taxes						
Firm 1 (cost of capital=5%)		10.5	10.5	10.5	10.5	10.5
Firm 2 (cost of capital=8%)		10.8	10.8	10.8	10.8	10.8
Total costs³						
Firm 1 (cost of capital=5%)		22.8	22.8	22.8	22.8	22.8
Firm 2 (cost of capital=8%)		23.5	23.5	23.5	23.5	23.5
Present value of policy costs (at 3.5%)						
Firm 1 (cost of capital=5%)	102.8					
Firm 2 (cost of capital=8%)	106.0					

Note: The calculation of the annual amount of recovered CAPEX and corresponding risk mark-up is based on the following assumption: total amount of CAPEX is recovered on the basis of the equal annual payment over five years, where the embedded risk mark-up is based on the amount of CAPEX employed in the business. This is similar to calculations of the annuity. ¹ Corporation tax= marginal corporation tax rate * EBIT = 30% * (OPEX compensation + total CAPEX). ² Taxes in intermediate goods = marginal tax on intermediate goods * OPEX = 35% * OPEX. ³ Total social costs = total OPEX + total CAPEX – total taxes.

Source: Oxera.

In the third example, the riskier firm is sufficiently more efficient; in this case, the higher nominal cost efficiency (lower CAPEX and the same OPEX) allows the riskier firm to implement the policy at lower total costs.

The characteristics of the policy project for each firm are summarised in the Table A3.7.

Table A3.7 Characteristics of the investment project: Case 3

	Firm 1	Firm 2
Initial capital investment (£m)	100	85
Annual operating cost (including depreciation) (£m)	10	10
Life of the project (years)	5	5
Post-tax cost of capital (%)	5	8

Source: Oxera.

The present values of policy costs for each firm are shown in Table A3.8 below.

Table A3.6 Stylised example of the calculation of the present value of social costs of the policy: Case 3 (£)

Year	Today	Year 1	Year 2	Year 3	Year 4	Year 5
Nominal expected costs of the policy						
CAPEX						
Firm 1 (cost of capital=5%)	100					
Firm 2 (cost of capital=8%)	85					
OPEX						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Social costs of policy						
OPEX recovery						
Firm 1 (cost of capital=5%)		10	10	10	10	10
Firm 2 (cost of capital=8%)		10	10	10	10	10
Compensation for OPEX-related risk						
Firm 1 (cost of capital=5%, STPR=3.5%)		0.2	0.2	0.2	0.2	0.2
Firm 2 (cost of capital=8%, STPR=3.5%)		0.5	0.5	0.5	0.5	0.5
Total OPEX						
Firm 1 (cost of capital=5%)		10.2	10.2	10.2	10.2	10.2
Firm 2 (cost of capital=8%)		10.5	10.5	10.5	10.5	10.5
CAPEX recovery						
Firm 1 (cost of capital=5%)		18.1	19.0	20.0	21.0	22.0
Firm 2 (cost of capital=8%)		14.5	15.6	16.9	18.3	19.7
Compensation for CAPEX related risk						
Firm 1 (cost of capital=5%)		5.0	4.1	3.1	2.1	1.1
Firm 2 (cost of capital=8%)		6.8	5.6	4.4	3.0	1.6
Total CAPEX						
Firm 1 (cost of capital=5%)		23.1	23.1	23.1	23.1	23.1
Firm 2 (cost of capital=8%)		21.3	21.3	21.3	21.3	21.3
Corporation tax¹						
Firm 1 (cost of capital=5%)		7.0	7.0	7.0	7.0	7.0
Firm 2 (cost of capital=8%)		6.5	6.5	6.5	6.5	6.5
Taxes on intermediate good²						
Firm 1 (cost of capital=5%)		3.5	3.5	3.5	3.5	3.5
Firm 2 (cost of capital=8%)		3.5	3.5	3.5	3.5	3.5
Total taxes						
Firm 1 (cost of capital=5%)		10.5	10.5	10.5	10.5	10.5
Firm 2 (cost of capital=8%)		10.0	10.0	10.0	10.0	10.0
Total costs³						
Firm 1 (cost of capital=5%)		22.8	22.8	22.8	22.8	22.8
Firm 2 (cost of capital=8%)		21.7	21.7	21.7	21.7	21.7
Present value of policy costs (at 3.5%)						
Firm 1 (cost of capital=5%)	102.8					
Firm 2 (cost of capital=8%)	98.1					

Note: The calculation of the annual amount of recovered CAPEX and corresponding risk mark-up is based on the following assumption: the total amount of CAPEX is recovered on the basis of the equal annual payment over five years, where the embedded risk mark-up is based on the amount of CAPEX employed in the business. This is similar to calculations of the annuity. ¹ Corporation tax= marginal corporation tax rate * EBIT = 30% * (OPEX compensation + total CAPEX). ² Taxes in intermediate goods = marginal tax on intermediate goods * OPEX = 35% * OPEX. ³ Total social costs = total OPEX + total CAPEX – total taxes.

Source: Oxera.

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