

# Public Money for Private Infrastructure

*Deciding When to Offer Guarantees, Output-  
Based Subsidies, and Other Fiscal Support*

*Timothy Irwin*



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# **FOREWORD**

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Private investment in infrastructure in developing countries boomed in the mid-1990s, and governments around the world were able to scale back their expenditure on infrastructure services. Yet even during the boom governments frequently remained involved in financing or paying for infrastructure services. The extent of fiscal support was difficult to estimate, because it often came in the form of tax breaks, in-kind grants, and guarantees, but it was often large. Now that private investors' enthusiasm for investing in emerging-market infrastructure has waned, governments find themselves needing to contribute more resources if they want to attract private investment.

In this environment, governments' success in extending access to good infrastructure services will depend crucially on the quality of their decisions to deploy public resources in otherwise private infrastructure projects—or, to use an expression currently in vogue, on the quality of their decisions about “public–private partnerships.”

This report presents a framework and analytical tools for comparing the costs and benefits of different types of fiscal support and proposes ways of improving the decisionmaking process.

**Nemat Shafik**

*Vice-President for Infrastructure  
World Bank*



# **ABSTRACT**

This report sets out a framework intended to help governments make better decisions about giving fiscal support for private infrastructure services and provides some tools to facilitate analysis.

It considers five possible government goals: (a) internalizing externalities in infrastructure markets, (b) overcoming failures in markets for financing infrastructure, (c) mitigating political-and-regulatory risks, (d) circumventing political constraints on prices or profits, and (e) redistributing resources to the poor via infrastructure. And it considers six possible fiscal instruments designed to achieve those goals: (a) output-based cash subsidies, (b) in-kind grants, (c) tax breaks, (d) capital contributions, (e) guarantees of risks under the government's control, and (f) guarantees of risks not under the government's control.

Because each infrastructure project is different, the report does not try to draw universally applicable conclusions about the usefulness of the various instruments of fiscal support available to the government. It argues, however, that output-based cash subsidies have two valuable features: they can be carefully targeted towards the achievement of the desired objective, and their costs are usually clear. This does not imply that cash subsidies are always cost-effective; in practice, they often appear poorly targeted. Whenever other instruments are used, however, the question naturally arises: is this instrument being used because it most efficiently achieves the objective or only because its cost is opaque and its use not subject to standard expenditure controls? In some cases, instruments other than output-based cash subsidies should be considered. In particular, political-and-regulatory risks are likely to be best addressed through government guarantees of the particular political-and-regulatory risks of concern.

Government decisions are rarely driven solely by the dictates of cost–benefit analyses. Generating good decisionmaking about fiscal support also requires processes for decisionmaking that facilitate good analysis and temper the influence of self-interest. Fundamentally, such processes ensure decisions are made by people or organizations that have enough information, and strong incentives, to make good decisions—either by assigning decisions to those who already have good information and incentives or by improving the incentives of, and information available to, existing decisionmakers. Several policies can enhance the collocation of information, incentives, and decisions: giving responsibility to people working on the objective (rather than the instrument or the infrastructure service); separating decisionmaking from delivery; involving those responsible for costs; utilizing decisionmaking forums that emphasize tradeoffs; routinely generating information on costs and benefits; requiring routine disclosure of information; charging for certain types of support; and ensuring accountability for decisions.



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# SUMMARY

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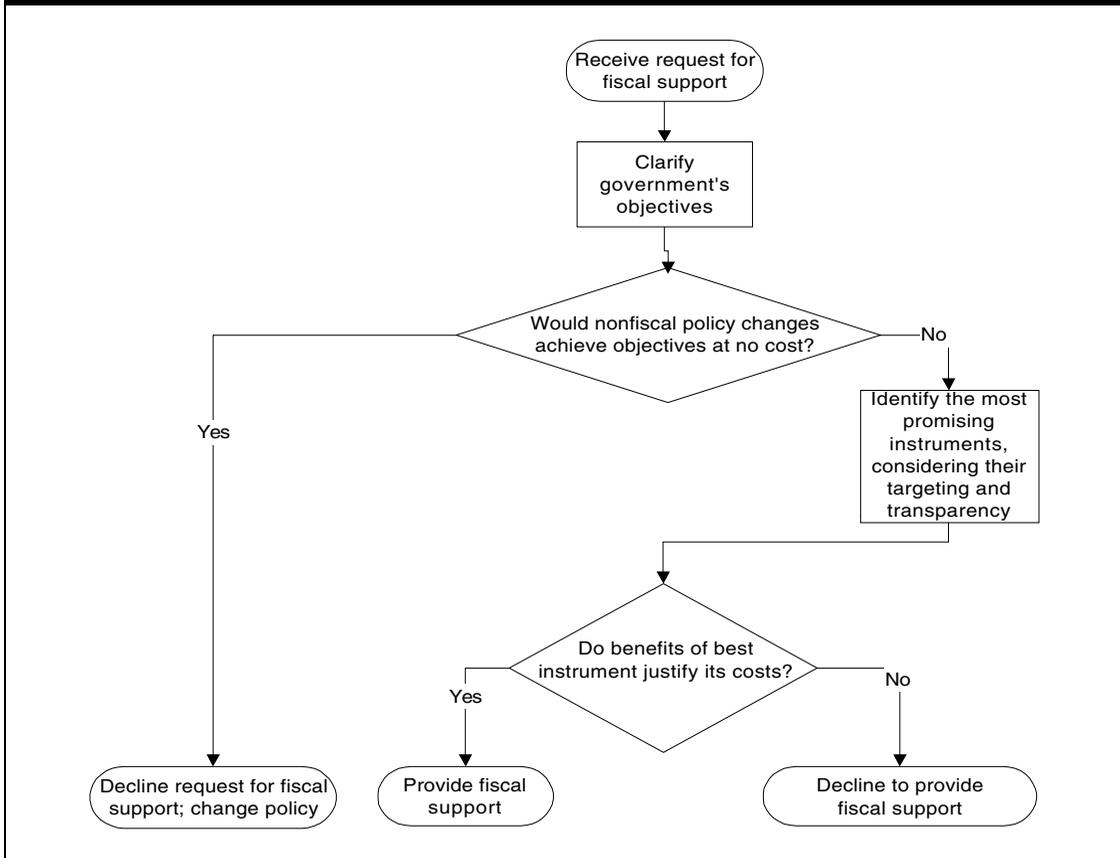
When governments seek private investment in infrastructure projects, they usually find themselves asked to provide grants, guarantees, or other forms of fiscal support. Often they prefer to provide support in ways that limit immediate cash expenditure but sometimes generate large costs later. Seeking to provide support without any immediate spending of cash, for example, governments often agree to shoulder project risks and sometimes encounter fiscal problems later. For example, in the 1970s and 1980s in Spain, the government was obliged to pay \$2.7 billion when the exchange-rate guarantees it had given private toll roads were called (Gómez-Ibáñez 1993).<sup>1</sup> More recently, the Indonesian government agreed to pay \$260 million as a result of its agreements, through the electricity company it owns, to bear demand and foreign-exchange risks in private power projects.<sup>2</sup> Yet even when governments have chosen to provide cash subsidies they have not always achieved their apparent goals: for example, over 80 percent of the Honduran government's "lifeline" electricity subsidies go to customers who aren't poor (Wodon et al. 2003). In still other cases, governments' decisions not to provide support may have caused problems. Some governments might arguably have averted opposition undermining private projects if they had temporarily continued to provide the subsidies they had implicitly been giving to loss-making state-owned enterprises—so that tariffs could have been raised gradually under private ownership rather than suddenly. And governments that do not provide support to reduce political-and-regulatory risks may fail to obtain investment at all.

This report sets out a framework intended to help governments make good decisions about the provision of fiscal support for private infrastructure services and provides some tools to facilitate the analysis. At one level, making good decisions about whether to provide support requires

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1. All dollar amounts in this report are U.S. unless otherwise noted.

2. See "Indonesia seeks resumption of geothermal projects," *Global Private Power* 76 (September 2001), page 22; "New OPIC talks to solve MidAm IPP dispute," *Power in Asia* 336 (September 4, 2001), page 13.

**FIGURE 1-1: STYLIZED PROCESS FOR DECIDING WHETHER TO PROVIDE FISCAL SUPPORT**

sound analysis of the cost and benefits of each type of support. Therefore, when considering providing public support to a particular private infrastructure project, governments need to ask themselves the following questions:

- (a) What objectives is the government seeking to secure by providing fiscal support to the project?
- (b) Are current government policies inhibiting the implementation of a satisfactory purely private project and, if so, could the government achieve its objectives by changing those policies at no fiscal cost?
- (c) If not, what instruments of fiscal support does the government have at its disposal?
- (d) How well does each instrument address the problem, taking account problems of implementation as well as desired effects? What is its expected benefit?
- (e) How much is each option likely to cost?

Figure 1-1 illustrates this decisionmaking process.

This report considers five possible government objectives:

1. internalizing externalities in infrastructure markets;
2. overcoming failures in markets for financing infrastructure;

**TABLE I-1: OPTIONS MOST LIKELY TO ADDRESS GOVERNMENT OBJECTIVES**

<b>Instrument</b> <b>Objective</b>	<b>Output-based cash subsidies</b>	<b>In-kind grants and tax breaks</b>	<b>Capital contributions</b>	<b>Guarantees of risks under the government's control</b>	<b>Guarantees of risks not under government's control</b>
Internalizing externalities in infrastructure markets	■				
Overcoming failures in markets for financing infrastructure	■		■		■
Mitigating political-and-regulatory risks				■	
Circumventing political constraints on prices or profits	■				
Redistributing resources to the poor via infrastructure	■				

**Key**

■ possibly well targeted; ■ possibly well targeted *and* relatively transparent.

3. mitigating political-and-regulatory risks;
4. circumventing political constraints on prices or profits; and
5. redistributing resources to the poor via infrastructure.

And it considers six possible instruments of fiscal support:

1. output-based cash subsidies;
2. in-kind grants;
3. tax breaks;
4. capital contributions;
5. guarantees of risks under the government's control; and
6. guarantees of risks not under the government's control.

Because each case is different, the report aims mainly to offer guidance on the issues governments should consider when choosing which instruments to use to achieve which objectives, rather than to specify which instrument should be used to achieve which objectives. By considering first the likely accuracy of each of these instruments in targeting the objectives above and second the transparency of their costs, however, the report argues that certain instruments are, *prima facie*, better candidates than others (see Table I-1).

Government decisions are rarely driven solely by the dictates of cost–benefit analyses. Generating good decisionmaking about fiscal support also requires processes for decisionmaking that facilitate good analysis and temper the influence of self-interest.

Fundamentally, such processes ensure decisions are made by people or organizations that have enough information, and strong incentives, to make good decisions—either by assigning decisions to those who already have good information and incentives or by improving the incentives facing and the information available to existing decisionmakers. Several policies can enhance the collocation of information, incentives, and decisions:

- giving responsibility to people working on the objective (rather than the instrument or the infrastructure service);
- separating decisionmaking from delivery;
- involving those responsible for costs;
- utilizing decisionmaking forums that emphasize tradeoffs;
- routinely generating information on costs and benefits;
- requiring routine disclosure of information;
- charging for certain types of support; and
- ensuring accountability for decisions.

# INTRODUCTION

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Private infrastructure projects often appeal to governments because they appear to allow infrastructure services to be provided without the government's having to finance the project or bear its risks. Yet, when governments seek private investment in infrastructure, they find themselves pressured to give subsidies, guarantees, and other forms of support. These pressures are likely to be particularly strong in developing countries and at times when investors' enthusiasm for developing-country infrastructure businesses is low. This report aims to help governments make decisions about whether to provide fiscal support to private infrastructure services, and in what form, by

- Clarifying some possible objectives of fiscal support (Chapter 3)
- Noting that policy options other than fiscal support may sometimes achieve the government's objective at no fiscal cost (Chapter 4)
- Identifying some of the instruments of fiscal support (Chapter 5)
- Illustrating how to generate comparable estimates of the costs of different fiscal instruments (Chapter 6)
- Describing some of the factors that may influence which instruments are most likely to achieve each of the possible objectives (Chapter 7)
- Suggesting which instruments are likely to be the best candidates for achieving each objective—and thus merit detailed, rigorous analysis—by considering their likely transparency and accuracy of targeting (Chapter 8)
- Offering some ideas on how to improve the institutions in which decisions about fiscal support are made (Chapter 9).

Box 2-1 provides definitions of some terms used in the paper that may be ambiguous.

**Box 2-1: SOME DEFINITIONS**

The meanings of some of the terms used in this report are set out below.

*Fiscal support:* assistance provided by a government to a company or its customers in the form of cash or other resources, whether an out-of-pocket contribution or an exemption from a fiscal requirement. Examples include output-based cash subsidies, in-kind grants, tax breaks, capital contributions, and risk bearing.

*Infrastructure:* electricity, natural-gas, water-and-sanitation, and telecommunications utilities and airports, ports, railroads, and roads.

*A private infrastructure firm:* a private firm that has a significant economic ownership interest in an infrastructure business, whether through a lease, concessions, or legal ownership of assets.

*Risk:* variability in the value of a firm.

*A risk:* a source of risk (for example, demand risk).

*Government guarantee:* the government's bearing a risk, either through an instrument known legally as a guarantee or through a law or contract.

The report does not consider the merits of private participation in infrastructure; nor does it attempt to argue for or against fiscal support to private infrastructure projects *in general*. Rather, it aims to set out some of the factors that should influence decisions—and, at a higher level, the design of institutional processes for making decisions—about whether to provide support. While the paper is thus normative in style, it doesn't assume governments serve only, or even mainly, to promote public-policy goals. Government actions result from a confluence of diverse influences, and policy advisers and policymakers may act in their own interests as well as the public interest. The report does assume, however, that analysis of the effects of policies on public-policy goals can influence outcomes.

In one sense, this report is about the application of the principles of cost-benefit analysis and good public management to decisions about providing fiscal support to private infrastructure services, a topic whose scope is potentially vast. The report does not attempt, however, to provide an overview of cost-benefit analysis or public management, but instead attempts to highlight some aspects of these fields that are particularly relevant to fiscal support for private infrastructure. It illustrates a set of techniques for estimating the cost of various instruments, but provides no more than an introduction to them and doesn't consider many of the controversies surrounding their application. It attempts to help governments think about how well different instruments may target their objectives, but doesn't offer general advice on the quantification of benefits. Where possible, however, the report refers to other sources of more detailed information on particular subjects.

While the report does not attempt to argue for or against fiscal support in general, it is written on the assumption that governments generally face more pressure to provide support that isn't justified, than they face to withdraw support that is justified. Thus it errs of the side of emphasizing points or techniques that may help the government avoid unjustified fiscal support.

# **CLARIFYING THE OBJECTIVES OF FISCAL SUPPORT**

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If governments want to make good decisions about whether to provide fiscal support for private infrastructure services, they need to be clear about the objectives they would be pursuing in providing support. In discussing a private infrastructure project, governments may sometimes talk as though their goal were simply to get the project done. But providing fiscal support for one service usually means providing less support to another particular service, or raising taxes, which means raising the cost of services generally. Therefore governments need to have clear, selective grounds for providing fiscal support. We consider five possible rationales below.

## **Internalizing Externalities in Infrastructure Markets**

A classic rationale for fiscal support for a service is the existence of positive externalities: that is, benefits from consuming the service received by people who are not parties to the transaction in which the service is provided. For example, poor customers may not pay the price of connecting to the sewerage network even if—because of public-health benefits—the social value of their being connected exceeds the cost. Another possible source of externality in infrastructure services is an environmental benefit arising from the use of network electricity, rather than traditional fuelwood. In principle, fiscal support for the infrastructure service giving rise to an externality may compensate for the externality and thereby facilitate the development of a socially valuable infrastructure network.

## **Overcoming Failures in Markets for Financing Infrastructure**

The markets for capital and risk-bearing are also imperfect and, in particular, incomplete (see, for example, Stiglitz 2000). Loans for long maturities may be unavailable at any price, and even for shorter maturities borrowers may be quantity rationed. Similarly, certain risks may not be insurable at any price. Part of the cause is the asymmetry of information between lenders and insurers, on the one hand, and borrowers and those insured, on the other. Borrowers and those insured know more about the risks they face, and the amount of care they will take to mitigate those risks, than

the lenders and insurers (creating the problems known as “adverse selection” and “moral hazard”). While these problems are not specific to infrastructure or developing countries, they may be prominent there because of the long-term nature of the investments and the less-developed nature of financial markets. Fiscal support may aim to overcome these failures in the markets for financing infrastructure services.

### **Mitigating Political-and-Regulatory Risks**

Political-and-regulatory risk, as used here, is the variability in the value of a firm that results from actions by the government or its regulatory agencies. Examples include the risks that result from a regulatory agency’s decision about the price the firm is allowed to charge for its services and the possibility of government’s expropriating the assets of the firm without full compensation. Political-and-regulatory risk in this sense is inevitable. But if political-and-regulatory risks are large, they may dissuade firms from investing in private infrastructure. When investors are unwilling to undertake a project because of political-and-regulatory risk, fiscal support may ease those concerns and allow the project to proceed.

### **Circumventing Political Constraints on Prices or Profits**

In many developing countries, the prices of some infrastructure services are kept below cost by the government, deterring private investment in the provision of those services. Evidently, the government could solve this problem directly by permitting price increases. But experience suggests that this solution is sometimes politically impossible. When it is impossible, fiscal support may allow the private project to go ahead with low prices, and the outcome, while imperfect, may be better than no project.

### **Redistributing Resources to the Poor Via Infrastructure**

The government may also seek to improve the living standards of its poorest citizens, even when that is not efficient in an economic sense.<sup>3</sup> Fiscal support for a private project bringing basic infrastructure to the poor may, for example, help achieve this objective.

Sometimes, of course, policies may serve two or more objectives. Subsidized connections to a sewerage network may both internalize externalities and redistribute resources to the poor. Temporary subsidies for poor customers to ease the transition from noncommercial to commercial provision may aim to redistribute resources to the poor and to circumvent political constraints.

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3. That is, the Kaldor–Hicks sense of efficiency.

# **CONSIDERING POLICY OPTIONS OTHER THAN FISCAL SUPPORT**

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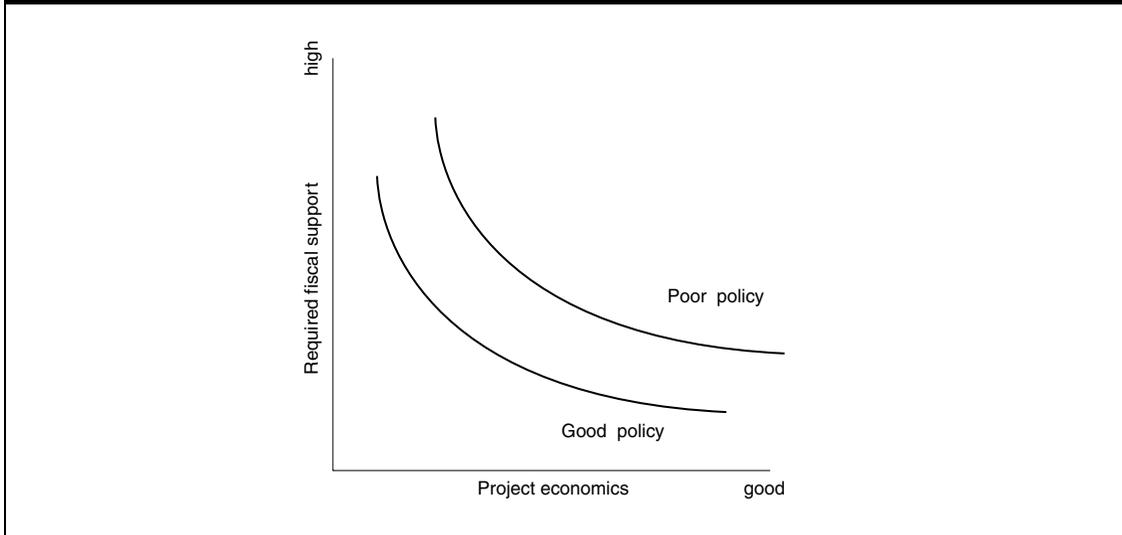
**T**ypically, fiscal support is not the only way of addressing the objectives just outlined or, more generally, of encouraging private investment in infrastructure.

Most obviously, governments may be able to reduce the severity of government-related problems that make private investments unprofitable or too risky. For example, if private investors seek fiscal support because of macroeconomic instability or inadequate enforcement of contracts, the most effective response is to stabilize the economy and enforce the law. Similarly, better policy and regulation of the industry concerned may also help address problems that give rise to calls for government support:

- More complete specification of property rights may sometimes reduce externalities by allowing people to internalize them through contracts.
- The introduction of competitive markets may mitigate political-and-regulatory risks, by turning administrative decisions into market decisions.
- Competition and the removal of regulatory barriers to entry may reduce prices and address concerns that services are too expensive (see Baker and Trémolet, 2003).
- Better institutions for setting prices (such as better contracts or better regulators) may reduce risks of prices being set below costs.

Figure 4-1 depicts the likely relationship between the extent of fiscal support required to make a project viable, the quality of the policy environment, and the project's "economics"—that is, its profitability holding the amount of fiscal support and the policy environment constant.

In a given policy environment, private investors also take steps to increase the profitability and reduce the riskiness of projects, by optimizing contracts with the providers of capital and insurance (for examples, see Doherty 2000, Finnerty 1996, Hoffman 1998, Nevitt and Fabozzi 2000, Standard & Poor's 2000). A combination of good government policies not involving fiscal

**FIGURE 4-1: FISCAL SUPPORT, PROJECT ECONOMICS, AND THE POLICY ENVIRONMENT**

support and optimal private structuring of a project is likely to be sufficient to ensure that most socially valuable infrastructure projects are implemented. This report therefore focuses on situations in which either

- the government's policy environment is poor, and even the most sophisticated financial structuring by the private investors cannot ensure that socially valuable projects are profitable; or
- despite good policy and clever structuring, problems remain that may be addressed by government support.

# IDENTIFYING THE INSTRUMENTS OF FISCAL SUPPORT

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Before we consider ways of estimating the costs and understanding the benefits of government support, it is useful to examine the types of support governments can provide.<sup>4</sup>

## Output-Based Cash Subsidies

Perhaps the simplest type of support is to give the private infrastructure firm a cash subsidy. Latin America offers many examples, including railway concessions in Argentina awarded to the bidder seeking the lowest subsidy (Carbajo and Estache 1996); rural electrification in Chile (Jadresic 2000); and rural telecommunications in Chile (Wellenius 1997) and Peru (Cannock 2001).<sup>5</sup> The government can also provide voucher-like support to selected customers of private infrastructure services. Latin America again offers examples: in Chile and Panama, targeted customers receive direct subsidies for water consumption (see Gómez-Lobo (2001), Foster et al. 2000).

While cash subsidies are not necessarily tied to the provision of certain services, they often are. That is, governments can provide infrastructure subsidies in return for the infrastructure firm's providing, or a customer's purchasing, a certain service. We call these *output-based* subsidies (see Brook and Smith 2001).

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4. For lists of possible forms of support in the toll-road and water sectors, respectively, see World Bank and Ministry of Construction, Japan (1998) and the World Bank "Water Toolkit" Number 2 (<http://rru.worldbank.org/Toolkits/water/index.htm>); Finnerty (1996: 201–203) also discusses forms of government assistance.

5. For subsidies in Eastern and Central Europe and the former Soviet Union, see World Bank (2000b), summarized in Lovei et al. (2000).

## In-Kind Grants

A government may also make certain resources, such as land and rights-of-way, available at subsidized prices or for no charge at all. Toll roads are frequent beneficiaries of such grants.<sup>6</sup>

Telecommunications companies often receive radio spectrum for less-than-market prices when it is allocated, not in an auction, but in a so-called beauty parade in which the government considers which companies will make the best use of it. Where the demand for spectrum is strong, the implicit subsidy may be very large. When spectrum suitable for so-called third-generation, or “3G,” mobile phone services was auctioned in the United Kingdom and Germany, for instance, investors were willing to pay tens of billions of dollars (Prat and Valletti 2001).

In the case of privatizations, in-kind grants may extend to selling an entire business at less than its cost. In this case, the difference between the cost of the business and its sale price can be considered a subsidy.<sup>7</sup> The case of water privatization in the United Kingdom is one of the most dramatic. Before privatization, the replacement cost of the utilities’ net assets had been estimated at more than £100 billion, but the utilities were sold for only £4 billion or so in total (Grout and Jenkins 2001: 55). The primary result was much lower initial prices for customers.

## Tax Breaks

Private infrastructure investors also lobby governments in the hope of receiving tax breaks, either in the form of reduced tax rates or a temporary “tax holiday.” As far back as the mid-nineteenth century, for example, the Egyptian government gave tax breaks to the private company constructing the Suez Canal (Levy 1996: 19).<sup>8</sup> The Indian government, to take a contemporary example, offers a five-year tax holiday for investments in all infrastructure sectors except telecommunications (World Bank and Public–Private Infrastructure Advisory Facility 2000: 58).

## Capital Contributions

At times, governments *require* private companies to give them partial ownership of the project at no cost (Finnerty 1996: 190), which amounts to a tax. At other times, however, governments may be petitioned to contribute some of the equity<sup>9</sup> or debt.<sup>10</sup> As noted earlier, capital contributions do not imply a subsidy as such. A subsidy arises, however, when the government makes a contribution without reasonably expecting to receive a return commensurate with the size of the contribution and the risks taken.<sup>11</sup>

## Guarantees of Risks Under the Government’s Control

When the government provides capital to a project, it takes on some of the risks of the project. The government may also take on particular project risks without initially injecting capital.

Governments are usually asked to assume risks over which they have significant control. Political-and-regulatory risks, such as the risk that the government will expropriate assets or keep prices below costs, are the clearest example (Smith 1997). There are also less clear-cut cases. One example is what have been called quasi-commercial risks, for instance the risk that a state-owned electricity

6. See World Bank and Ministry of Construction, Japan (1998: Paragraphs 60 and 79 and ff) and Finnerty (1996: 189).

7. Estimating the cost of the business may of course be tricky, especially when its assets are partly sunk.

8. For other discussions of tax breaks, see also Finnerty (1996: 202) and Shah (1995).

9. For examples in toll roads in Hungary, Colombia, China, Indonesia, and the Philippines, see World Bank and Ministry of Construction and Japan (1998).

10. See Finnerty (1996: 202).

11. Whether a particular capital contribution constitutes a subsidy is a question that has been considered by the European Commission and Court of Justice, because of the European Union’s rules against “state aid” that distorts competition. Subsidies are presumed to exist when the government makes “capital injections on terms which would not be acceptable to a private investor” (European Commission 1997: 8).

utility will default on obligations to pay for electricity it has contracted, for reasons that probably include an admixture of the political and the commercial (Smith 1997). Another is exchange-rate risk, in particular under regimes in which the rate is ostensibly fixed but may be devalued despite government promises to the contrary (Mas 1997).

### **Guarantees of Risks not Under the Government's Control**

Governments are also often asked to bear important risks over which no one has much control. One example is the risk relating to the strength of future demand for the services provided by a project. The risks created by natural disasters are another.<sup>12</sup>

The transfer of risk to the government can be set out in a contract or merely be implicit. That is, governments can sometimes turn out to be bearing certain risks even though they have never explicitly agreed to do so. In the early 1980s, for example, when the French government nationalized three private-sector concessionaires that were in financial difficulty, it indemnified their shareholders, despite the absence of legal obligations to do so.<sup>13</sup>

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12. As an example of demand risk, in the airport sector, the Colombian government offered a revenue guarantee when it sought private financing of a second runway at El Dorado International Airport in Bogotá (Juan 1996). Toll-road traffic guarantees are also common in developing countries (World Bank and Ministry of Construction, Japan 1998). For a construction-cost guarantee, see Lewis and Mody's (1997) description of the El Cortijo–El Vino toll road. Guarantees may also relate simply to the level of returns (see the telecom example in the same reference).

13. World Bank and Ministry of Construction, Japan (1998; II 8–9), which also notes that “More recently, strong government support has been provided to rescue private toll road projects in Indonesia, Malaysia, the Philippines, and Thailand,” Paragraph 27).



# COMPARING THE COST OF DIFFERENT INSTRUMENTS

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Decisions about providing support require analysis of the costs of different instruments. Often, however, the costs of different instruments are not easily compared. While the cost of cash subsidies may be relatively clear, the cost of using other instruments is usually opaque. Guarantees, for example, create liabilities that are contingent rather than inevitable and thus difficult to value. Capital contributions have a known cost in the short term, but also generate uncertain future returns that offset the initial costs and cloud the estimate of the net cost.

## **Framework: Present Value of Expected Cash Flows**

Part of the challenge in assessing whether to provide assistance through an instrument other than an immediate cash subsidy is to determine the cost of using the instrument, in such a way that its cost can be compared with the cost of other instruments, as well as judged against the value of achieving the goal.

The fiscal cost of an instrument depends, ultimately, on the cash payments the government may have to make, or forgo, as a result of using the instrument. To compare the costs of different instruments, we need to be able to estimate the present value of the costs, taking into account their timing and the risks.

## **Output-Based Cash Subsidies**

The fiscal cost of a cash subsidy is the amount of the subsidy plus the associated administrative cost of delivering it.

When the government has not committed itself to providing subsidies for more than a year, the problems of estimating and taking account of the cost are usually relatively small. Although the amount of expenditure under such a subsidy scheme may not be known with certainty, governments typically have experience estimating the amount of expenditures of this sort. Moreover, when the entire cost is incurred in cash relatively soon after the government has made the decision to provide the support, the costs of support are salient and easily taken into account by decisionmakers.

The government's budget, for example, will usually reveal the expected cost at about the time the decision to provide support in this form is made.

When the government commits itself to providing subsidies over a longer time period, in order, for example, to persuade a firm to make investments in providing the subsidized service, the costs become somewhat harder to estimate and somewhat less likely to be adequately considered. Now, the government must forecast expected expenditures over the period of the commitment and then discount those expenditures to find the present value of the cost of the scheme (or its "present cost" for short). If the amount of the future subsidies is certain, the present cost can be found by discounting the expected costs at the risk-free rate of interest. Typically, however, the amount of expenditure on the subsidies will vary according to demand and eligibility for the subsidized service. In such a case, accurately estimating the cost of the subsidy typically requires adjustment for the risks involved, which can be difficult. The Annex sets out one way of estimating the present cost of such a subsidy.

While estimating the present cost of long-term subsidies can present some problems and the total cost of a decision to provide support may not be fully transparent, the problems associated with cash subsidies are still likely to be small compared with other types of support. While the amount of expenditure on the subsidy scheme may be contingent on factors beyond the government's control, there is little risk that the government will ignore the costs, as may happen, for example, in the case of guarantees.

### **In-Kind Grants**

The cost of an in-kind grant is its opportunity cost. Unless the government uses accrual accounting—and changes in the value of assets on its balance sheet show up in the budget deficit or surplus—it is unlikely to be prompted by regular budgeting and accounting procedures to estimate the opportunity cost of in-kind grants. In many cases, however, estimating the cost will not involve any significant conceptual complications. The value of land granted to a private infrastructure project, for instance, may have an easily estimated market value. Other in-kind grants may be harder to value: how much, for instance, is a right-of-way worth? In principle, the cost to the government can still be estimated as the opportunity cost of the grant—how much could the government have received by selling or leasing the resource to someone else or by using the resource itself, whichever is more profitable? Sometimes, the amount can be roughly estimated by reference to the amounts actually paid by investors in other jurisdictions. The cost of giving away radio spectrum is easier to estimate, for example, now that many governments have auctioned it.

### **Tax Breaks**

The fiscal cost of providing tax exemptions is again the opportunity cost; it is the net loss in tax revenue to the government. As in the case of in-kind grants, the nature of government budgeting and accounting means that standard government procedures cannot be relied upon to generate estimates of the cost of tax exemptions. Moreover, the cost of tax breaks may be quite difficult to estimate as well. Shah (1995) is a useful reference.

### **Capital Contributions**

Estimating the cost of capital contributions requires comparison of the expected returns on the capital invested and the opportunity cost of that capital. The problem facing the government in this respect is thus similar to the problem dealt with by private investors thinking of investing in a project. The standard approach to such problems is to compare the present value of the cash flows the government expects to receive from the investment with the amount of the investment.<sup>14</sup>

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14. Traditional approaches to calculating the present value of a project are vulnerable to the criticism that they ignore the benefit of future flexibility (Copeland and Antikarov 2001; Dixit and Pindyck 1996). Nevertheless, ignoring the benefit of future flexibility may be a reasonable, conservative assumption for government investments in some private infrastructure projects.

### Box 6-1: ESTIMATING THE COST OF A CONCESSIONAL LOAN BY REFERENCE TO COMMERCIAL INTEREST RATES

Suppose the government is considering giving a concessional loan of \$100 million to a private company, to be repaid over a period of ten years with annual end-of-year interest payments of \$5 million and repayment of the principal at the end of the tenth year. Suppose the best estimate of the interest rate privately owned banks would charge for such a loan, given its seniority, security, and other conditions, is 12 percent.

The cost of the loan to the government can be expressed as follows:

Cost of the loan = amount lent – value of the loan,

and the value of the loan can be estimated as the present value of the interest payments and principal repayment, discounted at the commercial interest rate. Thus the cost of the loan to the government in millions of dollars is

$$100 - \sum_{t=1}^{10} \frac{5}{(1+0.12)^t} + \frac{100}{(1+0.12)^{10}} = 39.55$$

Choosing the discount rate to use to calculate present values is difficult and controversial (see, for example, Klein 1996 and Stiglitz 2000). One reasonable approach is to estimate the opportunity cost of the capital; that is, the rate of return that could be earned on the amount contributed if it were not invested in the project. This is, essentially, the approach taken by private investors.

Consider first the cost of providing debt capital to a project. One way of finding the appropriate discount rate is to take the risk-free rate of interest and add a margin to reflect risk. The risk-free rate is usually taken to be the rate at which the government could borrow (despite the fact that loans to governments are not necessarily free of risk). The appropriate margin is more difficult to specify, but can often be estimated by observing the interest rates that commercial lenders demand on loans to projects or companies that are similarly risky. Box 6-1 illustrates.

Other approaches to measuring the cost of debt contributions are possible. One option is to adjust the cash flows in a discounted-cash flow analysis for the probability of default and then to add a margin to the risk-free rate to reflect only the systematic element of default risk. On this, see Benninga (2000: 40) and Box 6-2, which describes how this approach can be used to estimate the cost of equity. Another approach uses option-pricing techniques, which implicitly estimate certainty-equivalent cash flows and then discount those at the risk-free rate. Box 6-3 illustrates the use of these techniques to value either a loan or a loan guarantee.

The providers of equity capital typically bear more risk than the providers of debt, and estimates of the cost of equity are commonly derived from models that explicitly estimate the appropriate compensation for bearing risk. The most common is the capital-asset pricing model (CAPM). It says that the rate for discounting cash flows to equityholders is calculated as the sum of the risk-free rate and a margin for risk, the margin being the product of a premium for bearing equity market risk generally and a factor (“beta”) that measures the extent to which returns on the project are correlated with returns on the market as a whole. Box 6-2 illustrates.

For practical introductions to the estimation of the cost of debt and equity, see, for example, Brealey and Myers (2000) and Benninga (2000). For a discussion focusing on regulated companies in developing countries, see Alexander (2000). For a detailed guide, available on-line, to estimating the cost of capital invested in state-owned companies, see New Zealand Treasury (1997).

**Box 6-2: ESTIMATING THE COST OF AN EQUITY CONTRIBUTION USING THE CAPM**

Suppose the government is considering contributing equity to a mainly privately-owned electricity-distribution company and has commissioned a financial analysis that estimates the dividends the government can expect to receive over the life of the project. Suppose it wishes to use the CAPM to estimate the discount rate it should use for valuing those cash flows. According to the CAPM, that discount rate, or “cost of equity,” is to be estimated as

$$r + \beta \cdot MRP$$

where  $r$  is the risk-free rate of interest,  $\beta$  is a parameter that measures the extent to which returns on the equity in the company and returns on the equity market as a whole move together, and  $MRP$  is the difference between the return investors expect on the investments in the equity market as a whole and the risk-free rate of interest.

The risk-free rate is usually interpreted as the rate the government could borrow at and is usually the easiest of these parameters to estimate. Let’s suppose the rate is five percent. The market risk premium cannot be observed in the same way, but estimates of it usually exist in countries with stock markets, and the government can make use of such estimates. Let’s suppose a common estimate in the country is seven percent, meaning that investors currently expect a return on the stock market as a whole of 12 (= 5 + 7) percent.

Unless the electricity-distribution company in which the government has invested is already listed, obtaining an estimate of its beta is not straightforward. A common approach, however, is to assume its beta is similar to those of listed electricity-distribution companies facing similar risks, noting that the nature of regulation is an important source of variation in risks for most infrastructure firms. Such comparisons have to take into account differences in firms’ leverage, and the standard approach is to get estimates of the unlevered (or “asset”) betas of the comparable listed firms and then to adjust them for the company’s leverage to get an estimate of its levered (or “equity”) beta—which is the beta required by the equation above.

Ignoring tax (to keep things simpler), the relationship between the levered beta and unlevered beta  $\beta^u$  is as follows:

$$\beta = \beta^u \left( 1 + \frac{D}{E} \right)$$

where  $D$  and  $E$  are the market values of the company’s debt and equity, respectively. The Web site [www.damodaran.com](http://www.damodaran.com) is one source of estimates of the unlevered betas, and it provides an estimate of the average unlevered beta of six European electricity-distribution companies of 0.51. (Commercial data providers such as Bloomberg also offer estimates of betas.) If the electricity-distribution company in which the government was considered investing had a debt–equity ratio of one, the estimate of its levered beta would be close to 1 [ $\cong 0.51 \times (1 + 1)$ ]. As a result, the estimate of the company’s cost of equity—the rate for discounting the cash dividends—would be found as follows:

$$r + \beta \cdot MRP = 0.05 + 1 \times 0.07 = .12$$

or 12 percent.

As should be clear from the discussion, estimates of the cost of debt and, especially, equity contributions may be difficult to make and subject to considerable error. Given the difficulties and uncertainties surrounding estimates of the cost of debt or equity capital, it may sometimes be reasonable to use a rough-and-ready number in place of elaborately calculated estimates that attempt to incorporate the specific nature of the investment project. In a slightly different context, the U.K. Treasury recommends, for example, that government departments generally use a 6 percent real discount rate when appraising investment projects, even though analysis might suggest that the appropriate rate differed from day to day (with changes in interest rates) and between projects

according to their risk (H.M. Treasury 1997). On the choice of discount rate, see also Belli et al. (2000) and Victorian Department of Treasury and Finance (2001a).

### Guarantees of Risks Not Under the Government's Control

When governments offer guarantees, they typically incur no immediate cash cost, only the possibility of future liabilities. To compare the cost of guarantees with the cost of other instruments, the government needs to be able to estimate the expected present value of those possible future cash costs.

By making judgments about the risk that the government is insuring, it is usually possible to estimate the cash payments the government can *expect* to pay—that is, to pay “on average.” Just as in the case of equity and debt investments, finding a present value for the payments requires the adjustment of the expected payments for their riskiness. Guarantees are often similar to put options; that is, the payments the government must make, if any, are often similar to the payments it would have to make if it had sold a put option to the investor. As a result, option-pricing techniques can often be used to make the adjustments for risk and arrive at a present value of the possible future payments. Box 6-3 shows how reasonably well known option-pricing techniques can be used to value a loan guarantee and, in addition, provide an alternative means of valuing risky loans. Box 6-4 describes how similar techniques were used to value several types of risk bearing by the government of Colombia.

#### Box 6-3: ESTIMATING THE COST OF A CONCESSIONAL LOAN AND A LOAN GUARANTEE BY OPTION PRICING

In this Box, we set out an alternative way of valuing loans and also show how to value a loan guarantee. Suppose the government is considering giving a loan of \$100 million to a \$150 million project that is also being financed with \$50 million of equity from private investors. In return, the government expects to get repaid \$140 million in seven years' time. It is a zero-coupon loan—there are no interest payments before then. The equity investors will receive no dividends in that period; all profits will be reinvested. Suppose the (annually compounded) risk-free rate of interest is known to be five percent, but there are no commercial loans comparable to this, so there is little information about the commercial rate of interest for such a loan. If we have an idea of the volatility of the value of the firm—that is, the standard deviation of the firm's annual returns—we can use option-pricing techniques to estimate the value of the loan. The basic idea is as follows: the value of the government's (risky) loan can be related to the value of a hypothetical risk-free loan (that is, one that will certainly be repaid) and the value of a hypothetical loan guarantee (according to which the guarantor would make the government whole if the company did not pay the loan in full). The relationship between these three financial instruments is as follows:

Value of the risk-free loan = value of the risky loan + value of the guarantee

or,

Value of the risky loan = value of the risk-free loan – value of the guarantee.

Thus

Cost of the loan = amount lent – value of risk-free loan + value of the guarantee.

The value of the risk-free loan is easily calculated by discounting the promised loan repayment (denoted  $K$  and equal to \$140 million in this example) at the risk-free rate ( $r$ , or five percent):

$$\frac{K}{(1+r)^T} = \frac{140}{(1+.05)^7} = 99.5$$

To value the loan guarantee, we need first to specify the payoffs received by the holder of the guarantee. We suppose that the loan will be repaid in full if and only if the value of the firm at the maturity of the loan exceeds the amount of the promised loan repayment. Otherwise, the lender gets the firm. In the first case, the guarantor will pay nothing; in the second case, he will pay the difference between the value of the firm and the value of the promised loan repayment. Thus the payoff to the holder of the guarantee can be written

$$\max \{0, K - V_T\}$$

where  $V_T$  is the value of the firm at the maturity of the loan. This is also the payoff that would be received by the owner of a European put option written on the value of the firm, with a strike price of  $K$  and a maturity of  $T$  years.

Thus the guarantee can be approximated using the Black–Scholes formula for valuing European put options (see, for example, Hull 2003)—so long as we have an estimate of the volatility of the value of the option. One way to get such an estimate is to calculate the historical volatility of the equity of similar listed firms and to adjust these equity volatilities for leverage to get an estimate of the levered (or asset) volatility. Aswath Damodaran offers some guidance on such adjustments along with data for firms listed in the United States on the Web site [www.damodaran.com](http://www.damodaran.com). The volatilities for listed infrastructure firms in the United States, in July 2002, range from around 15 percent for water utilities up to 40 percent for power-generation companies and more for telecom companies. Suppose we estimate that the volatility of the value of the company at issue is around 20 percent. Using the Black–Scholes equation for valuing a European put and our assumptions, we find the value of the guarantee is about \$8 million. The cost to the government of giving the loan is then found as the amount of the loan less the value of the hypothetical risk-free loan plus the value of the put option, or  $100 - 99.5 + 8 = 8.5$  million dollars.

#### Box 6-4: ASSESSING THE FISCAL IMPACT OF COLOMBIAN GOVERNMENT GUARANTEES

Measuring the fiscal cost of guarantees is typically difficult, and governments usually grant them without a clear idea of their fiscal costs. In the mid 1990s, however, the government of Colombia undertook an innovative project to measure the expected fiscal costs of the risks it bore in three private infrastructure projects: the El Cortijo–El Vino toll road, a telecommunications joint venture, and a power-sector project.

Using techniques developed to price financial options, the study simulated possible outcomes in each project, by making assumptions about the way the key variables evolved over time (for example, do they roughly follow a random walk or do they have a tendency to revert to a mean), the expected growth rates of those variables, and their variability.

In the case of the toll-road, for example, the government had given a guarantee that would top-up the private operator's revenue if traffic fell below a certain level. By making assumptions about the evolution of traffic volumes, their expected growth, and volatility, the study estimated that the government could expect to pay about \$3 million as a result of the guarantee. The study also identified that the government bore some construction-cost risk in the toll-road project and estimated that the government could expect to pay about \$1 million as a result.

In the power-sector project, on the other hand, the government's biggest exposure to risk came from guaranteeing the obligations of a financially precarious state-owned utility that had agreed to purchase the output of the private generator. If retail electricity prices were too low to pay for the wholesale power, the government would have to step in. The study estimated the expected cost of these obligations at about \$52 million.

Since then, the government has introduced a general policy requiring the identification and quantification of guarantee obligations, and government agencies entering into guarantees must now make up-front payments to a "contingent fund" to cover the estimated cost of the liabilities. The Colombian debt-management office must approve the method used to quantify the liabilities.

### Box 6-5: ILLUSTRATIVE ESTIMATION OF THE COST OF BEARING CONSTRUCTION RISK FROM VICTORIA, AUSTRALIA

In describing how to estimate the cost of risk-bearing in public-sector comparator projects (which are used to test whether private projects offer better value for money), the Victorian Department of Treasury and Finance (2001a: 36) provides the following simplified and hypothetical example. Consider a water-treatment plant, with an estimated construction cost, in net present terms, of \$80 million. The estimate of \$80 million is not assumed to be the expected cost; in the example, it is assumed that there is only a small probability of costs being below the estimate but a rather large probability of cost overruns. The expected cost is found by multiplying various possible costs by subjective, but desirably informed, estimates of their probabilities.

Expected future cash flows are then converted to a present value by discounting at a constant nominal discount rate based on a real rate of six percent. In the example, the expected net present cost is \$96 million, and the cost of the risk is thus estimated to be \$16 (= 96 – 80) million. Under this approach, if the risks around the forecast cost were symmetric, so that the expected cost was the same as the forecast cost, bearing the risk would be considered to have no cost. That is, the approach aims to provide an accurate estimate of the expected cash costs that are incurred in bearing a risk; but it does not aim to estimate the cost of bearing *risk* as such (using “risk” in the sense of variance around an expected outcome).

Source: Victorian Department of Treasury and Finance (2001a).

The Annex shows one approach to valuing a revenue guarantee. For more on option-valuation techniques and their application, see, for example, Copeland and Antikarov 2001, Dixit and Pindyck 1994, Hull 2003, and Lewis and Mody 1977.

Option-pricing approaches can be difficult to apply, and an alternative is to just to estimate the payments the government will expect to make and to discount them at the risk-free rate. The advantage of such an approach is that is simpler to implement and to explain; its disadvantage is it imputes no cost to bearing risk as such and thus typically underestimates the fiscal cost of guarantees. Box 6-5 briefly describes the current approach of the government of Victoria, Australia in this respect.

### Guarantees of Risks Under the Government’s Control

The valuation of government guarantees of risks under the government’s own control raises difficult questions. For example, suppose the government has entered into a contractual commitment with a private concessionaire to allow it to charge a certain tariff. If the government then chooses not to allow the company to charge the contractual price (perhaps because electoral pressures against higher tariffs become very strong), the government will have to compensate the concessionaire. In principle, if we can construct a model that provides a probabilistic prediction of whether the government will renege on its commitment, we can estimate the payments the government could expect to make as a result of its guarantee and, in principle, estimate the cost to the government of the guarantee.<sup>15</sup> But such models are unlikely to be available “off the shelf” in the way that models of risks not under the government’s control (such as demand and foreign-exchange risk) may be. And whether any governments have undertaken such an analysis is unclear. Indeed, governments may fear that the existence of the modeling would reduce the credibility, in the minds of the investors and customers, of the commitments. In any case, valuing these risks may reasonably be considered a lower priority than the other forms of support discussed in this study, and we don’t address it.

15. Because a government guarantee of risks controlled by the government changes its behavior, the expected cost to the government is less than the expected benefit to the investor.

## Summary

Table 6-1 summarizes the preceding discussion of ways to measure the cost of fiscal support and the likely transparency of costs, interpreted as whether they show up in the government's budget when the decision to give support is made.

**TABLE 6-1: ESTIMATING THE COST OF DIFFERENT FORMS OF SUPPORT**

Instrument  Issue					Guarantees of risks not under the government's control	Guarantees of risks under the government's control
	Output-based cash subsidies	In-kind grants	Tax breaks	Capital contributions		
How to measure costs	Use standard expenditure forecasting techniques for short-term subsidies. For long-term subsidies, estimate present value of expected expenditures, using techniques such as those discussed in the Annex.	Estimate opportunity cost of resource	Estimate net revenue foregone	Estimate the difference between the amount of investment and the expected present value of repayments (interest, dividends, principal) discounted at a rate reflecting the risks.	Employ option-pricing techniques. Or, to simplify, estimate expected cash flows and discount them at the risk-free rate, noting this will typically underestimate costs. In either case, Monte Carlo simulation may be useful (see Annex).	In principle, the same techniques can be used. But it may be reasonable not to estimate these costs.
Do they show up in the budget when government decides to provide support?	Yes in the case of short-term subsidies. Only partly in the case of a commitment to a long-term subsidy	No—unless government has introduced accrual budgeting and includes changes in asset values in its reported deficit.	No. Lower revenue is reflected in the budget, but its cause is not identified.	No. In cash budgets, disbursements and repayments show up, but the cost does not. Accrual budgeting can show the costs, if equity and debt investments are accurately valued.	No. Even in accrual accounting, the costs of guarantees are usually not recognized (though the resulting contingent liabilities may be footnoted).	No. Same as for guarantees of risks not under the government's control.

# COMPARING THE ACCURACY OF DIFFERENT INSTRUMENTS

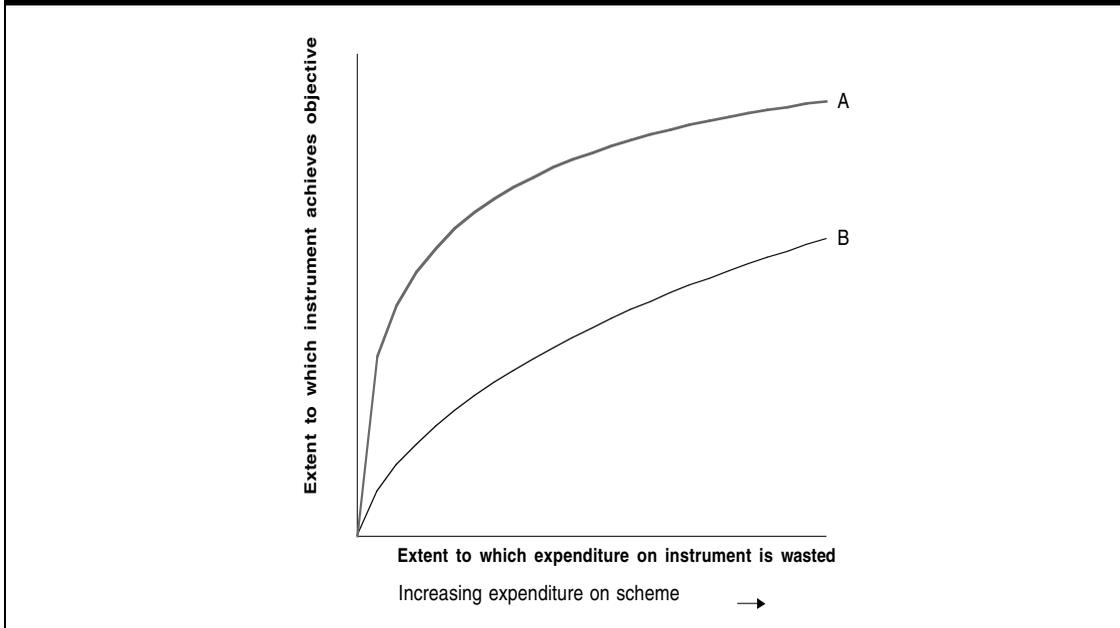
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Narrowing the choice of instrument requires careful consideration of the way in which the instrument might help achieve the government's objective. That involves thinking about problems of implementation as well as the hoped-for effects of the policy. For example, will proposed subsidies end up targeting the problem or will they be diverted, because of unintended changes in the scheme's design and implementation, to more influential groups? Recognizing such problems should of course make policy advisers and policymakers cautious about proposing solutions even if they work "in theory." But considering the realities of politics and implementation doesn't necessarily lead to the rejection of fiscal support. On the one hand, imperfect support may be better than no support. On the other, the politics of the situation may mean some form of fiscal support is inevitable; so the relevant alternative to the best form of imperfect support may be a worse form of support (Dixit 1996).

In this chapter, we consider for each of the five objectives outlined earlier which instruments might most accurately target the problem. Accuracy can be thought of, roughly, as the extent to which the expenditure on the instrument achieves the objectives, rather than being wasted. An accurate fiscal instrument for redistributing resources to the poor, for example, will be one that delivers subsidies to the poor rather than to the rich. An accurate fiscal instrument for overcoming a failure in financial markets will be one that overcomes the failure with the least "distortion" of other markets. Figure 7-1 illustrates, using the hypothetical instruments A and B, of which one (Instrument A) targets more accurately.

## Internalizing Externalities in Infrastructure Markets

To start, consider the objective of internalizing externalities and the example of water and sanitation services. Suppose that the provision of safe drinking water and sewage disposal to a household will not only improve the living standards of the household but also reduce health risks to people in the neighborhood. If such externalities are important, the government needs to consider how well different options, including fiscal support, internalize them and encourage more people to use the water-and-sanitation networks.

**FIGURE 7-1: ACCURACY OF TARGETING**

This is likely to require careful consideration of the nature of the particular problem. To begin with, the greatest public health benefits may be achieved not by increasing the extent to which existing customers of the main utility use the utility's services but by connecting new customers or giving them some other high-quality, low-cost service. Many types of fiscal support could address the problem. Subsidizing the price of water actually consumed would encourage more households to connect to the network. Similarly, in-kind grants to the firm, exemptions from company tax, guarantees, and the provision of cheap loans or equity might also increase the profitability of investment by the private company in serving marginal customers and thereby capture some of the external benefits. Yet these measures may not target support to the externality very well: much of the assistance might subsidize activities without positive externalities. For example, reducing the tax rate on the water utility's profits might lead to a reduction in the cost of water for all customers. And while this would do something to encourage connections by the poor, creating external benefits, its main effect might well be to encourage extra consumption by wealthier customers, creating little external benefit.

More effective may be to provide output-based subsidies to new customers in poor areas or to the firm on condition that it connects new customers. One possibility would be to subsidize consumption by these new customers; but subsidizing the cost of new connections might work better still, if the high cost of connections is what prevents their connecting. If the problem is the cost of *access* and not a problem in capital markets preventing lending, annual subsidies for access may be better targeted than one-off subsidies for connections.

### **Overcoming Failures in Markets for Financing Infrastructure**

Other possible market failures call for the consideration of different instruments. Capital-market failures that limit the availability of long-term loans even at high interest rates give rise to the question whether the government could improve outcomes by offering or guaranteeing or subsidizing loans. Similarly, the absence of insurance at any price against certain risks gives rise to the question of whether the government could improve outcomes by providing, or subsidizing, insurance for those risks.

In the fields of health and education, government involvement may serve in part to address such problems in the markets for capital and insurance. In the infrastructure sector, governments sometimes provide loans and loan guarantees and sometimes offer insurance against risks, such as revenue risk, that private insurers typically do not insure.

Several instruments seem capable of addressing missing financial markets. If the problem were the absence of products that allow people to transfer (that is, insure against) a particular risk, one possibility would be for the government to provide that insurance itself. Another would be for the government to subsidize the provision of the insurance.

Because there are failures in financial markets, it is possible that the use of such instruments will improve outcomes. Yet unless the particular market failure is clearly understood it will be difficult to know whether the government response remedies the problem.

### **Mitigating Political- and-Regulatory Risks**

When investors are exposed to major political-and-regulatory risks, they will be reluctant to invest and if they do invest will tend to require high returns. Anything that increases investors' expected returns will therefore tend to offset the effects of political-and-regulatory risks. Higher consumer tariffs, if they seem sustainable, will help. Any type of fiscal support will also increase expected returns. Government guarantees against political-and-regulatory risks will, however, target the problem most directly. Such government guarantees mean the government bears (certain) political and regulatory risks rather than the firm. And, to the extent that the government's behavior changes because it bears the risk, the fiscal cost to the government of bearing the risk will be less than the value of the guarantee to the investor of the risk.

The rubric of political-and-regulatory risk includes a variety of specific risks, including the risks associated with expropriation, regulated tariffs, and quality standards. Guarantees against political-and-regulatory risks can be targeted against the risks that cause the greatest concern to the investor. For example, if an electricity-distribution investor's concern is that the government will not allow electricity tariffs to increase as the costs of efficient service provision increase, the government does not have to provide guarantees against all political-and-regulatory risks. It can enter into a contract with the investor to allow electricity tariffs to increase according to a formula. That contract functions as a guarantee, to the extent that it requires the government either to allow electricity tariffs to increase according to the formula or to pay compensation for breach of contract. Similarly, if a toll-road investor's concern is that the government will build a competing free road after the private toll-road is built, the government can agree to compensate the investor for losses of revenue that result from the construction of competing free roads—without insuring the investors against other causes of revenue loss over which it has at best limited control.

### **Circumventing Political Constraints on Prices or Profits**

In considering whether to provide support to circumvent political constraints, the central issue is again to identify precisely the nature of the problematic political constraint.

For example, if the binding political constraint is low prices, the first question is whether the government can increase prices. If it can't, it needs to provide some form of support to the private company, to induce it to provide services. Here, many options are potentially effective, including the provision of direct subsidies to the firm (see Box 7-1 for an example from Guinea). If private investors are sought in the context of divestiture or concession, the government can also provide an implicit subsidy by selling the business, or providing its assets, below cost.

To take another possible case, there may be political constraints that make it difficult for a government to allow a private infrastructure provider to earn a high rate of return in any year. Yet if the private infrastructure project is risky, the investors will demand high expected returns to

**Box 7-1: TRANSITIONAL WATER SUBSIDIES IN GUINEA**

Transitional subsidies were used in Guinea in the early 1990s to facilitate the introduction of a private operator in the water sector.

As part of an attempt to improve the provision of water services, the government entered into an agreement under which a predominantly privately owned company would operate the water utility under a 10-year lease contract.

Before reform, the price of water to customers was far below cost. Households paid \$0.12 a cubic meter (in 1989 U.S. dollars), while it was estimated that the average charge to consumers would need to increase to \$0.76 a cubic meter to cover costs—an increase of more than 500 percent.

Brook and Locussol (2001: 32) described the government as “committed to seeing tariffs rise to cover costs, to ensure the financial viability of providing water services and enable their expansion over time” but wanting to “phase in tariff increases gradually, both to ease the burden on consumers and to exhibit improvements in performance before the full costs of those improvements showed up on consumer bills.” To this end, the government introduced a scheme that would subsidize consumer tariffs during a transitional period of six years.

Illustrating some of the complexity of typical motives for government support, the subsidy did not simply provide cash; it was designed also to transfer foreign-exchange risk from the operator to the government: part of the subsidy was linked directly to the operator’s foreign-currency costs. Further, the subsidy was not the only form of government fiscal contribution. As well as continuing to own the assets leased for 10 years to the private operator, the government provided 49 percent of the equity of the predominantly private operator.

The introduction of the private operator was not free from problems, but on most counts services seem to have improved. And the subsidy did turn out to be only transitional: tariffs increased to \$0.83 a cubic meter. Brook and Locussol conclude that “the declining, output-based subsidy used to smooth the introduction of Guinea’s lease contract holds promise for other developing countries where tariffs are well below cost recovery levels and long-term capacity to subsidize is limited.”

*Source:* Brook and Locussol (2001).

compensate them for the risks. The combination of high expected returns and high risk (that is, high variance) means there is a good chance that actual returns will be very high in some years. If the government cannot change the political constraint that prevents high actual returns, the only way to get the project done may be for the government to bear some of the risk of the project.

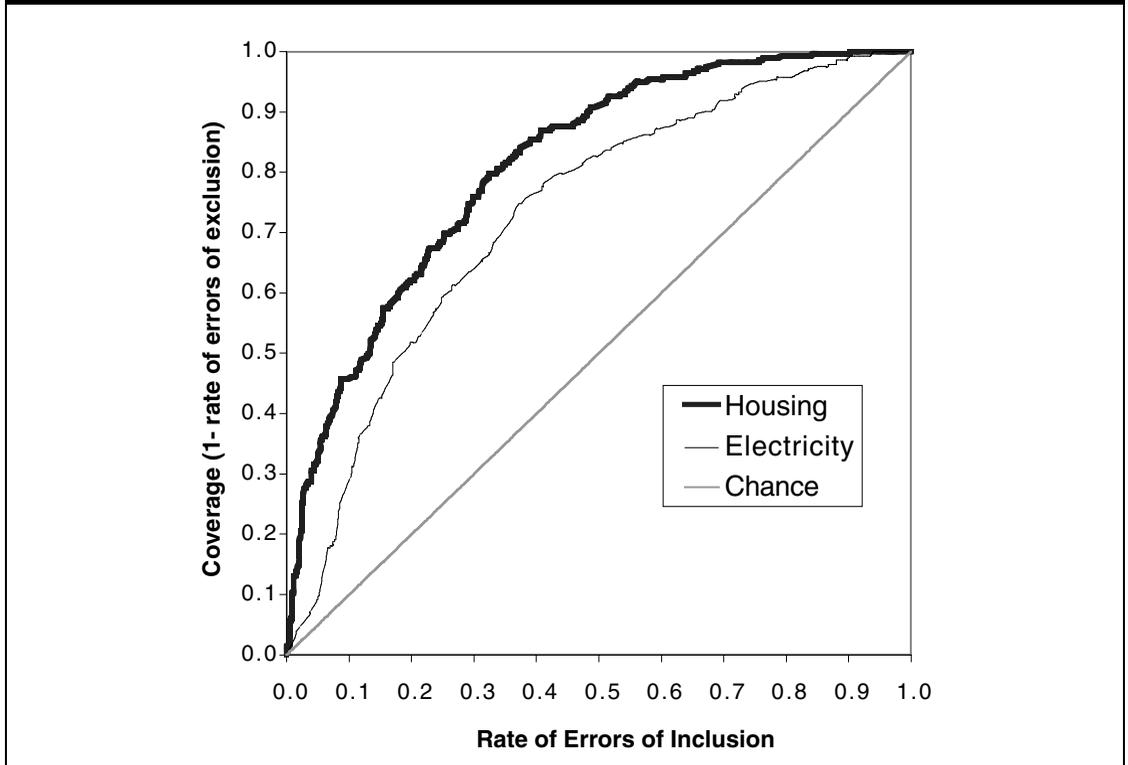
Finally, if political constraints require uniform national tariffs—or the maintenance of cross-subsidies despite differences in costs or other commercial circumstances—governments often consider the option of granting the provider a monopoly. The monopoly allows the infrastructure firm to charge some customers more than it could in a competitive market, and to use the proceeds to subsidize services to other customers. Monopoly, of course, can cause problems. Another option, which works in the presence of competition, is to provide direct subsidies for certain customers.

### **Redistributing Resources to the Poor via Infrastructure**

If the government is considering providing fiscal support in order to alleviate poverty, it needs first to compare the effectiveness of support in the infrastructure sector with support in other sectors. How important to reducing poverty is infrastructure compared with education, health, and social welfare?

Because the government’s concern is with alleviating poverty, a central issue is the extent to which the form of support succeeds in getting assistance to the poor. What proportion of the

FIGURE 7-2: ACCURACY OF TWO CRITERIA FOR TARGETING ASSISTANCE TO THE POOR IN HONDURAS: ROC ANALYSIS



Coverage is defined as the fraction of the poor who receive subsidies; it is the complement of the rate of errors of exclusion and in different contexts is also called the hit rate or sensitivity of the scheme. The rate of errors of inclusion is the fraction of the nonpoor who receive subsidies; it is also called the rate of false alarms, and is the complement of the specificity of the scheme. *Source:* Wodon et al. (2003).

poor ends up receiving support; that is, what is the scheme's *coverage*? And what proportion of the nonpoor ends up receiving the support—that is, what is the rate of *errors of inclusion*? Many infrastructure subsidies turn out not to target the poor at all accurately. Figure 7-2 presents an example from Honduras, where a study by Wodon et al. (2003) found that more than 80 percent of the subsidy in a “lifeline” electricity-consumption program (in which the government reduced the cost of electricity to those consuming relatively small quantities of it) went to those who were nonpoor. And even limiting the range of potential beneficiaries to those who were clients of the electricity utility, and thus ignoring the predominantly poor households unconnected to the electricity network, other targeting criteria, such as characteristics of the households' housing, were more accurate than electricity consumption (Wodon et al. 2003). Figure 7-2 illustrates this point, showing the extent to which the electricity-consumption-based and housing-based subsidies could succeed in delivering subsidies to the poor, as eligibility criteria were progressively loosened.

As in the case of positive externalities, many of the available instruments are likely to have some beneficial effects. Tax breaks, for instance, will encourage the provision of services to the poor as well to others. Yet they, like most of the other mechanisms, may not target assistance well, thus reducing the chance that the benefits will exceed the costs. Subsidies either given directly to poor customers or to the firm on behalf of targeted customers appear most likely to be

**Box 7-2: CHILEAN WATER SUBSIDIES**

The government of Chile subsidizes the cost of water sold by mainly private water companies to consumers that pass a means test. The subsidy was first introduced when the government began to allow the price of water to increase to a level reflecting its cost, and the purpose of the scheme has been described as “to guarantee adequate and affordable services for low-income households” (Gómez-Lobo 2001: 23).

Eligibility for the survey is determined on a household-by-household basis, according to the results of a survey in which households interested in receiving subsidies agree to take part. The subsidy can cover between 25 and 85 percent of an eligible household’s consumption of water, up to a maximum of 15 cubic meters a month. The proportion of water that is subsidized for each household is based on the unsubsidized price of water and the household’s estimated income; the subsidies are intended to ensure that no household spend more than 5 percent of its income on water. The water companies effectively send two invoices for water supplied to subsidized customers: one to the household customers and one to the local municipal government. Municipal governments are, in turn, given grants by the central government to cover the cost of subsidies.

In 1998, roughly 450,00 households, or 13 percent of all households in Chile, received a subsidy, with an average value of \$10 a month. Compared with typical infrastructure-related subsidies, the scheme appears reasonably well targeted. In particular, it has a relatively low “error of inclusion”: Gómez-Lobo (2001) notes only 23 percent of the subsidies go to households that are richer than average. Nevertheless, Wodon et al. 2003 report that the scheme’s “overall performance in reducing poverty and inequality is substantially weaker than that of other social programs targeted using the national means-testing system”, such as “noncontributory pensions for the elderly poor, family allowances for poor families with children or pregnant women, subsidized child care centers, and housing subsidies.” Even a relatively good infrastructure subsidy may not be an inefficient way of alleviating poverty.

Source: Gómez-Lobo 2001; Superintendencia de Servicios Sanitarios Servicio, Chile, at <http://www.siss.cl/usuarios.html>; and Wodon et al. 2003.

well targeted. The Chilean government’s scheme for subsidizing water consumption by low-income households requires a lot of administrative work, and so might not work well in countries with poor administrative capacity. It appears to work better than many infrastructure subsidy schemes, but may still not work as well as good noninfrastructure subsidies (see Box 7-2).

# **NARROWING DOWN THE CHOICE BY CONSIDERING TRANSPARENCY AND TARGETING**

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**M**aking decisions in any particular case about which, if any, instruments to use to achieve an objective requires careful consideration of the circumstances, the costs of actual instruments, and their likely benefits. To narrow down a list the options deserving careful consideration, it may help to consider the transparency of the options' costs and the likely accuracy of their targeting. Table 8-1 (repeated from the summary) sets out the implications of the analysis above.

**TABLE 8-1: OPTIONS MOST LIKELY TO ADDRESS GOVERNMENT OBJECTIVES**

<b>Instrument</b> <b>Objective</b>	<b>Output-based cash subsidies</b>	<b>In-kind grants and tax breaks</b>	<b>Capital contributions</b>	<b>Guarantees of risks under the government's control</b>	<b>Guarantees of risks not under government's control</b>
Internalizing externalities in infrastructure markets	■				
Overcoming failures in markets for financing infrastructure	■		■		■
Mitigating political-and-regulatory risks				■	
Circumventing political constraints on prices or profits	■				
Redistributing resources to the poor via infrastructure	■				

Key

■ possibly well targeted; ■ possibly well targeted and relatively transparent.

# IMPROVING INSTITUTIONS FOR DECISIONMAKING

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In addition to considering on a case-by-case basis whether fiscal support in some form is justified, governments can work to develop better institutions—broadly construed—for making such decisions. The term “institutions” is ambiguous; we mean by it the set of rules governing decisionmaking: who is involved in making which decisions, who has the right to be consulted and to make recommendations to the decisionmakers, what justifications must the decisionmakers provide about the decision, what monitoring of the results of the decision must be undertaken, and so forth.

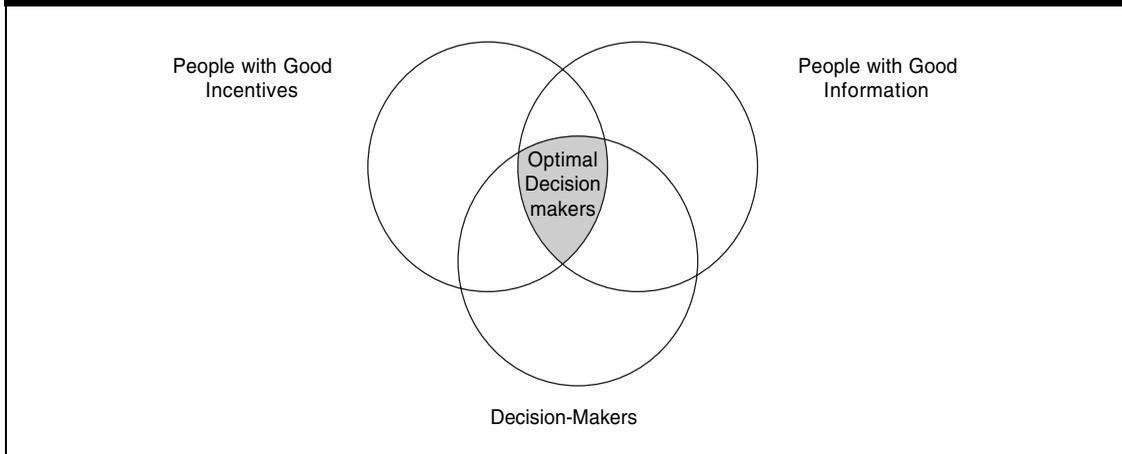
## Framework: Information, Incentives, and Decisions

Good institutions can be thought of as those that, first, make it easier for reasonably well-motivated advisers and decisionmakers with similar public-interest goals to make reasonably good decisions, despite the limits on human ability to collect and process information. But successful processes must also allow differing but equally “public spirited” objectives to be reconciled. And, more difficult still, these processes must reduce the extent to which self-interested objectives skew decisionmaking away from the public interest. Clearly, no set of procedural improvements and innovations is likely to lead to uniformly informed, rational, and public-spirited decisions. But on the whole decisions will be well made when those who make them have good information about the effects of the decisions and good incentives to make the right decision. For example, a decision whether to subsidize water consumption to redistribute resources will tend to be well made if the decisionmaker has good information about the costs and benefits of the subsidy and has incentives to care about those costs and benefits. Good institutions thus are those that ensure that incentives, information, and decisionmakers are collocated.

Figure 9-1 illustrates the idea, showing three sets of people:

- those with good incentives: those who, if they had the right information and decisionmaking power, would tend to make good decisions;

FIGURE 9-1: INCENTIVES, INFORMATION, AND DECISIONMAKERS



- those with good information: those who, if they had the right incentives and decisionmaking power, would tend to make good decisions; and
- those who make decisions—and would tend to make good decisions if they had good information and good incentives.

Sometimes, improvements in the collocation of decisions, incentives, and information can be achieved by improving the information and incentives of those who currently make the decisions (that is, expanding the good-information and good-incentives sets so they overlap more with the decisionmaker set. At other times, collocation can be improved by changing the locus of decision-making, so that people or organizations that already have relevant information and good incentives are given decisionmaking authority (changing the decisionmaker set so that it overlaps more with the good-information and good-incentives sets). This section describes, without attempting to be exhaustive or systematic,<sup>16</sup> some policies that can have the effect of improving the collocation of information, incentives, and decisions. Table 9-1 summarizes the policies and their intended effects.

### Giving Responsibility to People Working on the Objective

Infrastructure policy advisers typically know more about infrastructure services than other government advisers. Thus it is natural to expect them to be involved in making recommendations about fiscal support for those services. It is also natural to expect ministers with responsibility for infrastructure to be involved in decisions about support. Yet it may be best to give the *lead* responsibility for making recommendations and decisions on support to other advisers and decisionmakers, namely to those whose areas of responsibility correspond most closely with the objective of fiscal support.

These advisers will tend to have better information on the extent to which the support will achieve the objectives and whether the same expenditure (in present values) in a different area would be more or less effective. Likewise, people whose jobs relate to the objective may have better incentives to achieve the objective. Infrastructure advisers, however much they know about infrastructure, will tend to know little about alternative means of achieving the objective; and their

<sup>16</sup> For more information, see, Stiglitz (1998) and the literature on public management, including Allen and Tommasi (2001), Scott (2001), and World Bank (1998).

**TABLE 9-1: EFFECTS OF POLICIES ON THE COLLOCATION OF INFORMATION, INCENTIVES, AND DECISIONS**

<b>Function</b> <b>Policy</b>	<b>Assigning decisions to parties that already have good information and incentives</b>	<b>Improving existing decisionmakers' information</b>	<b>Improving existing decisionmakers' incentives</b>
Giving responsibility to people working on the objective			
Separating decisionmaking from delivery			
Involving those with an interest in minimizing costs			
Utilizing decisionmaking forums that emphasize tradeoffs			
Routinely generating information on costs and benefits			
Requiring routine disclosure of information			
Charging for certain types of support			
Ensuring accountability for decisions			

motivation may be as much to promote infrastructure services or projects, as to achieve the objective. In terms of the decisionmaking framework illustrated in Figure 9-1, involving those responsible for the objective is a way of assigning decisions to people who already have good incentives and information.

Assume, for example, that the objective of fiscal support is to internalize external health benefits of increased coverage of the sewerage network. In this case, advisers on public-health policy may be better placed than infrastructure policy advisers to determine whether sewerage-connection subsidies are the most effective use of public funds made available for achieving public-health benefits. They, more than infrastructure advisers, for example, may know whether (inevitably limited) funds for public health would be better spent on, say, a vaccination program instead. Similarly, if the objective is to redistribute resources to the poor, advice and decisions on whether to channel the subsidies through infrastructure services should probably be the responsibility of a poverty-reduction rather than an infrastructure agency.

### **Separating Decisionmaking from Delivery**

Another possible way of assigning decisions to people who have good incentives is to ensure that the chief advisers on what type of fiscal support to provide do not have an interest in the provision of some type of support, irrespective of its benefits. Part of the advantage of giving responsibility to people working on the objective is avoiding conflicts of interest: when infrastructure advisers have an interest in getting a project implemented, their advice on whether to provide

fiscal support for the service at hand may become less objective. Another way to minimize conflicts of interest is to ensure that providers of a certain type of fiscal support are not the preeminent advisers or decisionmakers regarding whether to provide that support. When advisers responsible for an objective are also involved in providing services designed to meet the objective, they too may have a type of conflict of interest: for example, a health-policy ministry will not necessarily have good incentives to recommend whether to subsidize sewerage connections or carry out a program of vaccinations if that ministry provides, and gets funding for providing, vaccinations. While decisions about providing support require the expertise of those who deliver fiscal support, advice also needs also come from those who have no business interest in providing the support. That is easier to achieve if primary policy advisers and decisionmakers on fiscal support do not also deliver, or administer, fiscal support.

### **Involving Those with an Interest in Minimizing Costs**

Because good decisions require comparisons of costs of benefits, decisionmaking processes should involve not only people who have an interest in the benefits (in achieving the objective) but also those who have an interest in minimizing costs. Involving both groups is a way of assigning decisions to a group of people who, collectively, have good incentives. Involving people working on the objective is one way of ensuring that those who care about the benefits are part of those who make the decision to provide support. Often it is officials in ministries of finance who care more than others in government about restraining expenditure; thus they should typically be involved in at least high-level decisions about subsidies; that is, in decisions about the total cost of the subsidy. Cash subsidies require budget appropriations and ministries of finance are usually appropriately involved in decisions about how much to spend on at least near-term subsidies. They should also be involved in decisions to commit to long-term cash subsidies and in decisions to provide noncash forms of support, such as guarantees. Likewise, when the obligations of local governments are explicitly or implicitly guaranteed by central governments, central governments need to be involved in local governments' decisions to provide long-term or contingent fiscal support.

### **Utilizing Decisionmaking Forums that Emphasize Tradeoffs**

Reliably making good decisions about government support requires the government to take a sufficiently broad perspective of its choices. Some decisions need to be taken at a high level. The most important decision about reducing poverty, for example, may be the relative weights to give to actions in the fields of education, health, infrastructure, and social welfare or insurance. Decisions about whether to redistribute resources to the poor by providing subsidies for infrastructure services are unlikely to be optimal, except by chance, unless made with consideration of the value of subsidies in other sectors. Likewise, a good decision about the government's ability to bear the risks created by a program of guarantees may require consideration of the whole of the government's portfolio of assets and liabilities, not just the government's exposure to a particular private infrastructure project.

Broad framing of choices is likely to be fostered by requirements that the total costs the government is willing to incur in providing all forms of fiscal support be approved in a coordinated process, such as budget decisionmaking. The advantage of such a process is that it forces consideration of the tradeoffs involved in the provision of public support, making salient the fact that a dollar spent on an infrastructure service means a dollar less to spend on another service, and vice versa.

Ideally, then, both guarantees and in-kind grants and cash expenditure should be considered as part of the same budgeting process. Otherwise, decisionmakers are not required to confront the relative merits of the two types of support, and there is a particular risk that less-transparent forms of assistance will be preferred to more-transparent forms. A comprehensive central budgeting process allows the benefits of, for instance, guarantees to be considered and compared with the benefits of other interventions of similar cost. See Table 9-2 for a view from the Organization of Economic Cooperation and Development (OECD) on the management of fiscal risks.

**TABLE 9-2: AN OECD VIEW OF MEASURES TO MANAGE FISCAL RISKS OF GOVERNMENT PROGRAMS**

Before the government accepts a new obligation	<p>Assess how the obligation [to provide support] fits the announced role and strategic priorities of the state.</p> <p>Assess the program risks individually and together with the existing risks, estimate the potential fiscal cost of the obligation, and set additional reserve requirements.</p> <p>Consider the choices of policies and forms of support with respect to the associated financial risks, as well as government risk-management capacity.</p> <p>Design the program to protect the government against risks.</p> <p>Define and communicate the standards for and limits of government involvement so as to minimize moral hazard.</p>
When a new obligation is accepted	<p>Budget and account for the potential fiscal cost.</p> <p>Monitor the program risk factors.</p>
When an obligation is executed	<p>If implicit, assess whether fulfilling the obligation coincides with the state's announced role and promotes the desired behavioral response in the markets.</p> <p>Execute the obligations within their preset limits and take lessons for future policy choices.</p> <p>Compare and report the actual fiscal cost against estimated costs, evaluate performance, and penalize failures.</p>

Source: Allen and Tommasi (2001: 57).

### **Routinely Generating Information on Costs and Benefits**

Frequently no one has very good information about the costs and benefits of government support. Because acquiring information is costly, it is not always better to be better informed. Yet governments cannot reliably make good decisions about fiscal support without information on its likely costs and benefits.

For example, good decisions on whether to use infrastructure subsidies to redistribute resources to the poor requires information on the extent to which the poor are, or are likely to be, users of the infrastructures services. Gómez-Lobo et al. (2000 a and b) show how familiar surveys can be used to provide better subsidy-relevant information.

Likewise, governments cannot reliably make good decisions about providing guarantees or long-term subsidies unless they understand the cost of providing the guarantee or the subsidy. The rules that govern these decisions should therefore require estimates of the cost.

Lastly, generating good information on the costs and benefits of fiscal support also requires processes for routinely evaluating the success of public support in achieving its objectives.

### **Requiring Routine Disclosure of Information**

Decisionmaking processes are also likely to be improved by making information about the government's choices and the reasons underlying them widely available. If infrastructure subsidies are identified as such, for example, both government decisionmakers and interested parties outside the government are better able to consider whether the subsidies are an effective means of pursuing the intended objectives.

Achieving such transparency requires that it should be clear to government decisionmakers and to interested parties outside government when the government is providing fiscal support and the extent of any support that is given. It is also helpful if the government supplies reasons for providing the subsidy, including any information on its costs and benefits. Box 9-1 sets out the International Monetary Fund (IMF) fiscal-transparency code which provide some basic guidelines concerning the disclosure of information. Many governments, especially in developed countries, go well beyond the requirements of the code. In the area of private infrastructure specifically, the Victoria, Australia government's "partnerships" program requires disclosure of bidding documents and the contents of contracts worth more than the equivalent of approximately US\$5 million (Victorian Department of Treasury and Finance 2001b: 105).

### **Box 9-1: THE INTERNATIONAL MONETARY FUND CODE OF GOOD PRACTICES ON FISCAL TRANSPARENCY**

The IMF's Code of Good Practices on Fiscal Transparency sets out principles for budgeting that can be applied to the provision of public financial support to private infrastructure. The headings of the Code are reproduced below.

- 1 Clarity of Roles and Responsibilities
  - 1.1 The government sector should be distinguished from the rest of the public sector and from the rest of the economy, and policy and management roles within government should be clear and publicly disclosed.
  - 1.2 There should be a clear legal and administrative framework for fiscal management.
- 2 Public Availability of Information
  - 2.1 The public should be provided with full information on the past, current, and projected fiscal activity of government.
  - 2.2 A commitment should be made to the timely publication of fiscal information.
- 3 Open Budget Preparation, Execution, and Reporting
  - 3.1 Budget documentation should specify fiscal policy objectives, the macroeconomic framework, the policy basis for the budget, and identifiable major fiscal risks.
  - 3.2 Budget estimates should be classified and presented in a way that facilitates policy analysis and promotes accountability.
  - 3.3 Procedures for the execution and monitoring of approved expenditures should be clearly specified.
  - 3.4 There should be regular fiscal reporting to the legislature and the public.
- 4 Assurances of Integrity
  - 4.1 Fiscal data should meet accepted data quality standards.
  - 4.2 Fiscal information should be subjected to independent scrutiny.

The Code also contains certain provisions particularly relevant to government support for private infrastructure, including

- 1.1.3 Clear mechanisms for the coordination and management of budgetary and extrabudgetary activities should be established.
- 1.1.5 Government involvement in the private sector (e.g. through regulation and equity ownership) should be conducted in an open and public manner, and on the basis of clear rules and procedures that are applied in a nondiscriminatory way.
- 2.1.3 Statements describing the nature and fiscal significance of central government contingent liabilities and tax expenditures, and of quasi-fiscal activities, should be part of the budget documentation.
- 2.1.4 The central government should publish full information on the level and composition of its debt and financial assets.

Source: IMF (see [www.imf.org/external/np/fad/trans/code.htm](http://www.imf.org/external/np/fad/trans/code.htm)).

Although governments and others may support transparency in the abstract, in any specific circumstance individual decisionmakers and advisers may favor confidentiality. Thus increasing transparency generally requires system-wide rules for the routine revelation of specified information.

Requirements to disclose information can take many forms. Freedom-of-information laws can require governments to disclose documents relating to their decisions to provide support when requested. Other laws might require the government to publicize decisions to provide support and their cost at the time the decisions are made, even before any request for the information was made. The laws governing the government's budgeting and accounting are some of the most important in the domain of transparency. Laws requiring the publication of accrual budgeting and accounting information can help, for example, by requiring estimates of the cost of certain noncash forms of fiscal support (such as in-kind grants of resources already owned by the government) to be disclosed. Typical accrual budgeting and accounting will not reveal the cost of tax breaks or many guarantees, however. So budgeting and accounting rules that require further disclosure of costs may be useful.

### **Charging for Certain Types of Support**

Charging the beneficiaries of some types of fiscal support is self-defeating; the purpose of the support is to transfer resources and would be undone by requiring the recipient to transfer resources to the government in return. But charging for other types of support does not defeat the purpose of the support. Rather, it can improve the incentives of some of those involved in the decision to provide support.

This report has argued, for example, that guarantees against risks not under the government's control cannot normally be justified as ways of transferring resources but may be justified as ways of overcoming failures in the markets for financing infrastructure. Charging for these guarantees reduces the risk that the government will provide them when their cost to the government exceeds their benefit to the investors.

### **Ensuring Accountability for Decisions**

Finally, good decisionmaking requires that decisionmakers be accountable for their decisions, but not for other factors that may affect the success of the project. Accountability in turn requires clarity about responsibilities not only for the main decision about whether to provide support but also for other related decisions. For example, who is responsible for administering the support? Who is responsible for the information and advice underlying the decision? Who will be responsible for evaluating the decision subsequently?



# **CONCLUDING REMARKS**

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This report has not attempted to draw systematic and general conclusions about the usefulness of the various instruments of support available to the government, including cash subsidies, in-kind grants, tax breaks, risk-bearing, and capital contributions. But the analysis shows that output-based cash subsidies have two generally desirable properties: by their nature, they can be carefully targeted towards the achievement of the desired objective; and their costs are usually clear. This does not imply that cash subsidies are always or even usually cost-effective; in practice, they often appear poorly targeted. Whenever other instruments are used, however, the question naturally arises: is this instrument being used because it most efficiently achieves the objective or only because its cost is opaque and its use not subject to decisionmaking procedures that require tradeoffs? In some cases, instruments other than output-based cash subsidies should be considered. In particular, political-and-regulatory risks are likely to be best addressed through government guarantees of the particular political-and-regulatory risks of concern.

Deciding whether to offer fiscal support requires clear understanding of the objectives of the assistance, its benefits, and its costs, which implies careful case-by-case consideration. Such consideration is unlikely to occur, however, unless governments carefully design the institutions in which the decisions are made. Good decisions are most likely to be made in institutional environments that ensure that decisionmakers are well informed and have incentives to make choices in the public interest.



# VALUING REVENUE GUARANTEES AND VARIABLE SUBSIDIES

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## Introduction

Accurately estimating the cost of government guarantees and subsidies of unknown amounts is difficult. The most common approach to valuation of risky future cash flows, used for example in the valuation of businesses, is to estimate the expected cash flows and then discount them at a rate that is higher by some margin than the risk-free rate, the margin reflecting the amount of the risk. This method doesn't work well for valuing subsidies and guarantees, because many subsidies and all guarantees tend to have option-like characteristics, and options cannot be valued accurately by means of the standard methods for determining risk-adjusted discount rates. This Annex sketches an alternative method for valuing risky expenditure commitments that overcomes the problems with the traditional approach, using as examples a revenue guarantee and subsidy for customer connections to a utility.

### *The revenue guarantee*

We start by considering a simple revenue guarantee, under which the government agrees to make a payment to a private infrastructure company if the company's revenue from customers falls below a certain threshold. Specifically, the government's payment ( $G_T$ ) is given by

$$G_T = \max \{0, K - Y_T\},$$

where

$K$  is the guaranteed amount of revenue, and

$Y_T$  is the amount of revenue received by the company over the period (that is, between time 0 and time  $T$ ).

Thus, if the company generates more than  $K$  in revenue, the government pays nothing, but if the company receives less than  $K$  the government makes up the difference. Such guarantees are common for private toll roads, but can also be used in other infrastructure industries. To keep the example simple, we assume the guarantee covers only one period.

### The connection subsidy

We also consider a connection subsidy that works as follows. Suppose the government has decided to subsidize access to water among households that currently have no connection to the water reticulation network. In particular, suppose it will pay a private water concessionaire a fixed sum every year for each new connection in place, new connections being defined as those not in place before the subsidy scheme. We assume the government has committed itself to providing these subsidies for ten years, to strengthen the concessionaire's incentive to invest in connections.

We consider four stylized variants of the connection subsidy scheme, distinguished by

- whether the government's expenditure is capped or open-ended; and
- whether the number of subsidized connections depends on customers' demand for such connections and therefore tends to be procyclical (the *demand-driven* scheme); or whether the number of subsidized connections depends on the number of customers satisfying an income-based eligibility criterion and is therefore countercyclical (the *income-tested* scheme).

The four subsidies are thus (1) capped demand-driven, (2) open-ended demand-driven, (3) capped income-tested, and (4) open-ended income-tested.

If the subsidy is open-ended, the payment in period  $t$  ( $S_t$ ) is the subsidy per connection ( $s$ ) multiplied by the cumulative number of new connections in place that year ( $N_t$ ):

$$S_t = sN_t.$$

The cumulative number of new connections  $N_t$  at the end of period  $t$  is equal to the number at the end of the past period plus the number added during the present year ( $n_t$ ):

$$N_t = N_{t-1} + n_t.$$

If the subsidy is capped, the payment is

$$S_t = \min\{sN_t, C\}$$

where  $C$  is the expenditure cap.

### Modeling the Underlying Risky Variable

Central to estimating the cost of both the guarantee and the connection subsidy—and indeed any risky expenditure commitment—is finding a way of modeling the variables that create the risk: the company's revenue in the case of the revenue guarantee and the number of new connections in the case of the connection subsidy. Crucially, the modeling needs to incorporate forecasts of both the expected change in the variable over time, and its variability (or the extent to which it is not predictable).

In this Annex, we assume that the risky variables follow what is called a geometric Brownian motion with drift. This means that the variables (revenue and new connections) can never be negative and have constant rates of expected growth or decline and volatility. Making this assumption means that we need to estimate, or make guesses about, two parameters: the expected rate of growth and volatility (or the annualized standard deviation of the growth rate).

The assumption of geometric Brownian motion is not the only possible assumption, but it keeps the analysis relatively simple and is often reasonably plausible.

The evolution of a variable ( $x$ ) that follows a geometric Brownian motion can be described mathematically as follows:

$$dx_t = x_t \left( \mu dt + \sigma \sqrt{dt} \tilde{Z}_t \right)$$

where

$dx_t$  is the incremental change in the variable (the incremental increase in revenue or new connections) at time  $t$ ;

$\mu$  is the annual rate at which the variable is expected to grow;

$dt$  is an increment of time;

$\sigma$  is the annual volatility of the variable; and

$\tilde{Z}$  is a normally distributed random variable with a mean of 0 and a variance of 1.

Alternatively, we can express the value of the variable (as opposed to its change) at time  $t$  as follows:

$$x_t = x_0 \exp \left[ \left( \mu - \frac{\sigma^2}{2} \right) dt + \sigma \sqrt{dt} \tilde{Z} \right]$$

where  $x_0$  is the value of the variable at time 0.

On the mathematics of geometric Brownian motion and some of its applications, see, for example, Baxter and Rennie (1996), Benninga (2000), and Hull (2003).

Given this approach, we can make estimates of the expected payments, and indeed the whole probability distribution of payments, under the revenue guarantee and the connection subsidy. Then by extending this approach we can estimate the value of the guarantee and the connection subsidy. We start with the guarantee.

## The Revenue Guarantee

### *Modeling revenue*

To model revenue using this approach, we need to make assumptions about its expected rate of growth and volatility. If the business already exists, and data on past revenue are available, it might be appropriate to estimate future growth and volatility by extrapolating past values. If the guarantee applies to a new project, however, such information will not be available. In this case, forecasts of revenue are likely to exist and may be suitable. Estimates of volatility are less likely to be available, but an idea of the range in which the volatility is likely to lie can sometimes be found by looking at the volatility of revenue in similar businesses. For example, if the guarantee applies to a new toll road, estimates of volatility can be derived by looking at toll revenue on existing, similar toll roads. For the purposes of this illustration, we simply assume that the expected rates of growth and volatility are, respectively, 5 and 10 percent a year.

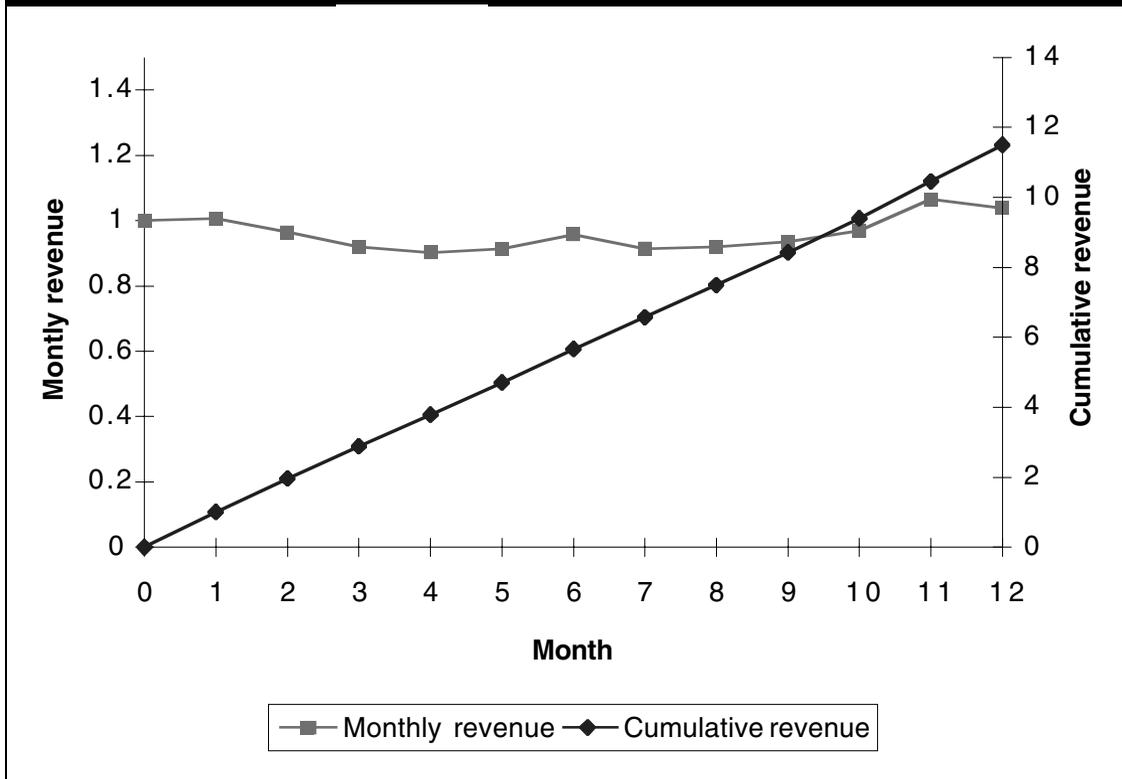
Figure A-1 shows one path that revenue might take over a year, if it starts at \$1 million a month.

In the case shown, actual revenue falls initially instead of growing, before recovering a little at the end of year. As a result, cumulative revenue for the year falls short of the expected level of about \$12.3 million (derived by assuming monthly revenue grows at a rate of 5 percent a year, continuously compounded, and summing over the twelve months). If the government had guaranteed that the company would receive this forecast level (that is, if  $K$  were \$12.3 million), it would have had to pay an amount of somewhat less than \$1 million.

### *Expected payment*

Figure A-1 shows one possible outcome for revenue and the amount the government will pay under the guarantee. To estimate the amount the government can expect to pay, we can do “Monte Carlo” simulation analysis, in which we take a large sample of possible outcomes (say 10,000) and calculate the average payment by the government in that sample. If our assumption that revenue follows a geometric Brownian motion is correct, and if our estimates of the growth and volatility parameters are also correct (two big “ifs”), simulation will give an approximately correct estimate. The larger the sample of possible outcomes, the better the approximation.

FIGURE A-1: MONTHLY AND CUMULATIVE REVENUE: ONE POSSIBLE PATH (\$ MILLION)



Using the parameters mentioned above, and taking a sample of 10,000, we get an estimate of the expected payment of about \$0.29 million. That is, over the 10,000 trials, the government paid a total amount of about \$2.9 billion; dividing by 10,000 gives the estimate of the expected payment.

**The probability distribution of payments**

Monte Carlo simulation can also provide an idea of the risks involved. Figure A-2 shows the estimated frequency distribution of the payments.

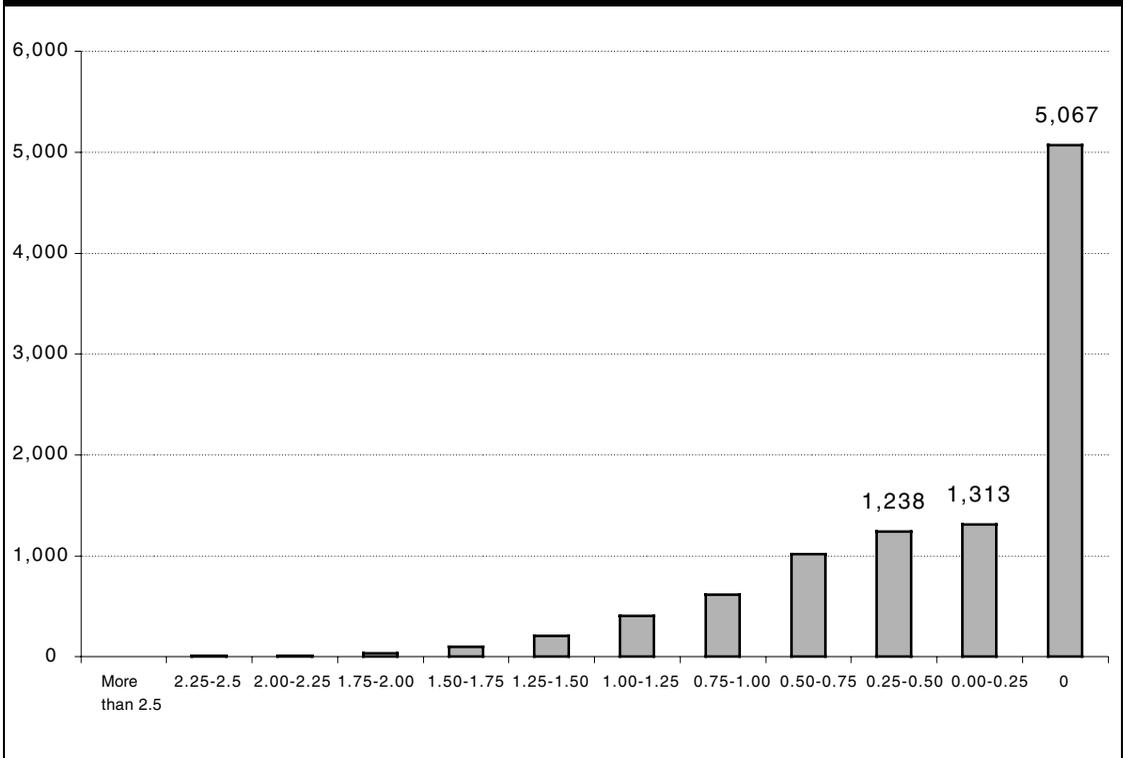
The chart implies the government has roughly a fifty-fifty (5,067/10,000) chance of paying nothing, roughly a 13 percent chance of making a positive payment of up to \$0.25 million, a 12 percent chance of paying between \$0.25 and \$0.50 million, and so on. The chances of paying more than \$2.0 million are remote.

**Valuation ignoring the cost of risk bearing**

So far, we have estimated the probability distribution of payments and the expected payment, but have not estimated the value of the guarantee. Valuation normally takes into account both the timing of the expected payment and its risk characteristics. A simple approach that might sometimes be justified is to ignore the cost of risk bearing (or, equivalently, assume it is zero) and to make an adjustment only for the timing of the expected payment. In general, then, the value of the guarantee at time  $t$ ,  $V_t^G$ , would be found as follows:

$$V_t^G = e^{r(T-t)} E_t^*[G_T]$$

FIGURE A-2: ESTIMATED FREQUENCY DISTRIBUTION OF GUARANTEE PAYMENTS (\$ MILLION)



where  $r$  is the risk-free rate of interest and  $E_t[G_T]$  is the expected amount at time  $t$  of  $G_T$ , the guarantee payment.

Suppose that the government must settle any obligation to pay under the revenue guarantee immediately at the end of the year. Continuing to ignore risk, the appropriate discount rate is the one-year risk-free rate. Assuming that rate is 10 percent (continuously compounded), the present value of the expected payment of roughly \$0.29 million would be roughly \$0.26 million.

#### *Valuation incorporating an estimate of the cost of risk bearing*

Ignoring risk in this way, however, will tend to underestimate the value of the guarantee. Because the guarantee exposes the party that writes the guarantee to extra risk (compared with the case in which there is no guarantee but everything else remains the same), its cost to the writer is higher than the estimate arrived at by discounting the expected payment at the risk-free rate. Likewise, the guarantee's value to the beneficiary of the guarantee is higher than the expected payment discounted at the risk-free rate. The question is, how much higher?<sup>17</sup>

As mentioned in the introduction to this Annex, the common technique of using a risk-adjusted discount rate to answer such questions is fraught with difficulties when it comes to valuing guarantees, which have option-like characteristics. First, it is not always appropriate to *add* a risk premium; in the case of the guarantee, it would be necessary to subtract a risk premium in order to get the correct risk-adjusted discounted rate. More fundamentally, the appropriate

17. We focus here on estimating a market value of the guarantee—or the value it could be expected to have if it traded in a market. In principle it would also be possible to estimate separately the value of the guarantee to the government, assuming it could not sell its position.

adjustment to the risk-free rate can change from period to period and there is no easy way to calculate the appropriate adjustments. An approach that avoids these problems is to use techniques developed to value financial options. Unfortunately, the simple option-pricing approach that we used to value a loan guarantee (see Box 4) cannot be used to value the revenue guarantee or the variable subsidy.

The problem is that the underlying risky variables are not traded assets and, indeed, are not even assets. If revenue were a traded asset, it would be possible to hedge the risks associated with the guarantee. This would simplify the problem of valuation, allowing us to use the “risk-neutral” approach to pricing underlying the Black–Scholes and other standard approaches to option pricing. Even if the underlying variable were not traded but was at least an asset, we might—in the absence of a better approach—act as if the underlying variable could be hedged (see Copeland and Antikarov, 2001: 94–95).

Because revenue is not an asset (let alone a traded asset) and revenue risk cannot be hedged by buying or selling the underlying asset, the value of the guarantee depends on the market price of bearing revenue risk. Specifically, to estimate this value, we assume that revenue evolves according to the following certainty-equivalent process (see Hull 2003, especially chapter 28):

$$dx_t = x_t \left[ (\mu - \lambda\sigma)x_t + \sigma\sqrt{dt}\tilde{Z}_t \right] \tag{A-1}$$

where  $\lambda$  is a parameter representing the market price of revenue risk. Or, expressing this in terms of levels rather than changes,

$$x_t = x_0 \exp \left[ \left( \mu - \frac{\sigma^2}{2} - \lambda\sigma \right) dt + \sigma\sqrt{dt}\tilde{Z} \right] \tag{A-2}$$

These equations describe the evolution of risk-adjusted, certainty-equivalent revenue. We can estimate the value of the guarantee by calculating what would be the expected guarantee payment if revenue actually followed this process, and then discounting the expected payment at the riskfree rate.

Estimating  $\lambda$  requires a model of the cost of risk, and unfortunately there is no agreement among experts about the appropriate model of the cost of risk. One possibility is to assume, as we did earlier in the report, that the capital asset pricing model (CAPM) holds, in which case

$$\lambda = \rho \left\{ \frac{E[R_m] - r}{\sigma_m} \right\},$$

where  $R_m$ ,  $\sigma_m$ , and  $\rho$  are, respectively, the expected return on the market portfolio, the standard deviation of that return, and the coefficient of correlation between the return on the market and revenue.

We then estimate the value of the guarantee as follows:

$$V_t^G = e^{r(T-t)} E_t^*[G_T]$$

where  $E_t^*[G_T]$  is the expected value of the guarantee payment,  $G_T$ , assuming that revenue follows the risk-adjusted process set out in equations 1 and 2 above. That is, we estimate the value of the guarantee by estimating the expected value of the payment, assuming that revenue follows this risk-adjusted process, rather than the actual process.

If we assume that the CAPM holds, that the correlation between revenue and returns on the market is 0.5, that the market-risk premium is 7 percent, and that the standard deviation of returns to the market is 25 percent, will be 0.14. Using that value, simulation gives an estimate of

the value of the guarantee of \$0.31 million. Note that even though we discount the risk-adjusted expected payment by the risk-free rate of 10 percent, the estimated cost of the guarantee, taking into account the assumed price of risk, is slightly higher than the (undiscounted) expected payment of \$0.29 million. It is also higher than the estimate arrived at by discounting the expected payment at the risk-free rate (\$0.26 million).

### The Connection Subsidy

We can value the connection subsidy scheme using the same techniques.

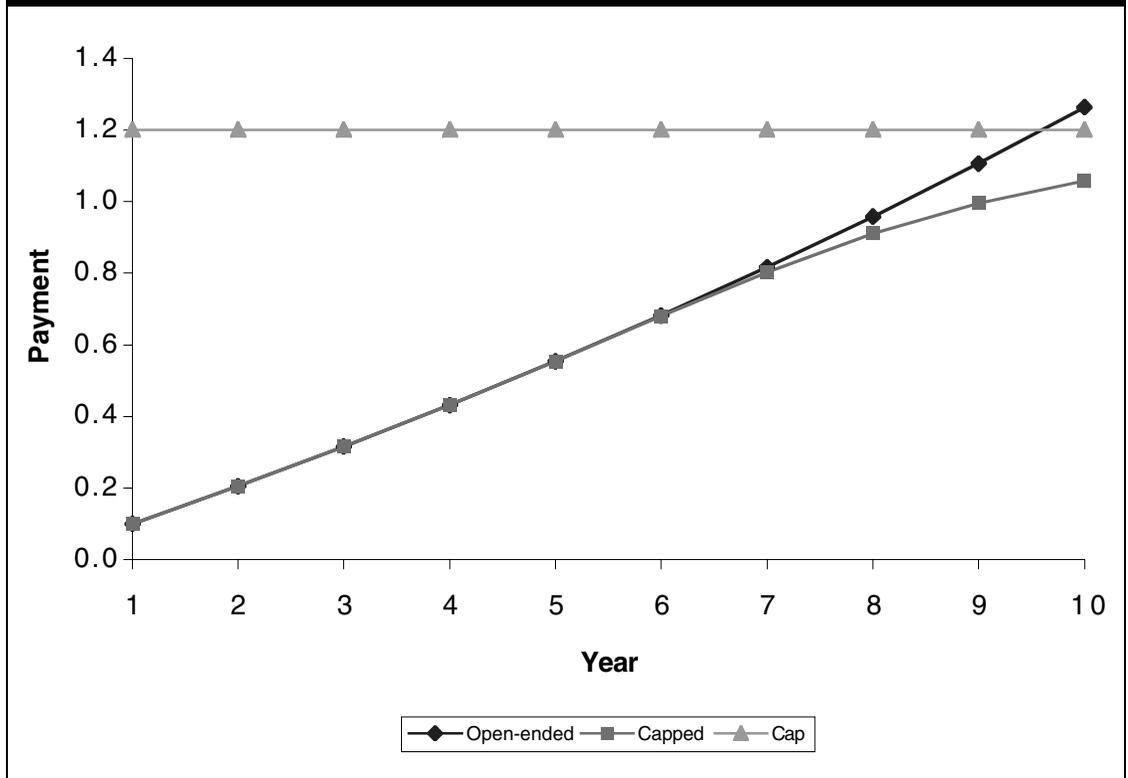
We assume the number of new connections added each year follows a geometric Brownian motion, implying that the number of new connections each year cannot be negative and has constant rates of expected growth and volatility. We suppose, further, that the number of new connections in the first year will be 1,000; that the expected annual growth rate of additional new connections is 5 percent ( $\mu = 0.05$ ); and that the annual rate of volatility is 20 percent. We assume that the subsidy is \$100 per new connection a year.

#### Expected payments

Given these assumptions, we can estimate the expected subsidy payments. For the uncapped subsidy, these estimates are straightforward. The government expects to spend \$100,000 (equals 1,000 times \$100) in the first year, \$205,000 (equal 2,050 times \$100) in the second year, and so forth. For the capped scheme, the estimates are not so simple and are most easily made using Monte Carlo simulation.

Suppose annual expenditure is capped at \$1.2 million, slightly less than the amount the subsidy payment is expected to reach in year 10 in the absence of the cap. Figure A-3 shows expected

FIGURE A-3: EXPECTED PAYMENTS UNDER THE CAPPED AND UNCAPPED SUBSIDY SCHEMES (\$ MILLION)



**TABLE A-1: ESTIMATED COST OF SUBSIDY SCHEMES, IGNORING AND INCORPORATING THE COST OF RISK BEARING (\$ MILLION)**

	Subsidy Scheme	
	Open-ended	Capped
Ignoring the cost of risk bearing		
Demand-driven or income-tested risks	3.2	3.1
Incorporating the cost of risk bearing		
Demand-driven risks	3.0	2.9
Income-tested risks	3.5	3.3

payments for the open-ended and capped schemes (calculated in both cases from the Monte Carlo simulation) for each year.

### Valuation

As with the revenue guarantee, to value the subsidy scheme, we need to know more than just the expected value of the subsidies in each year; we need to know the present value of these expected payments.

If we discount these expected payments at the risk-free rate of 10 percent a year, we get estimates of the cost of the schemes, incorporating the time value of money, but ignoring any cost of risk bearing—\$3.2 million for the open-ended and \$3.1 for the capped scheme (see Table A-2). The relatively small difference reflects in part the fact, shown in Figure A-3, that the cap makes a difference only in the last few years of the subsidy.

If we want to incorporate the cost of risk bearing, we can either adjust the expected payments for risk (that is, use certainty equivalents) or adjust the discount rate. For the reasons discussed earlier, we use the former approach (see Table A-2).

### Open-ended demand-driven subsidy

Consider first the open-ended (uncapped) demand-driven subsidy: that is, the one in which subsidized connections tend to be greater than expected when the economy expands more quickly than expected, which, we assume, also tends to be when the returns on the market are higher. In particular, suppose we have estimated that the correlation ( $\rho$ ) between connections and returns on the market is 0.5. Then  $\lambda$  will be 0.14. The effect of the risk-adjustment is then to *lower* the present cost of the subsidy. The intuition is as follows: because the risk in the subsidy is “countercyclical”—because the government pays more when times are good and less when they are tough—the risk is actually a benefit to the government.

Given our assumptions, the Monte Carlo simulation estimate of the present cost of the open-ended demand-driven subsidy commitment is \$3.0 million—lower than the \$3.2 million obtained by discounting the expected payments at the risk-free rate.

### Open-ended income-tested subsidy

Now consider a slightly different subsidy scheme, in which only customers with an income below a certain threshold are eligible for the subsidy and in which, as a result, payments will tend to be higher than expected when the economy grows less quickly than expected and returns on the market are lower than expected. In this case, the correlation between subsidized connections and

returns on the market can be expected to be negative. If we estimate or guess that the correlation is  $-0.5$ , the Monte Carlo simulation estimate of the present cost of the open-ended income-tested subsidy commitment is \$3.5 million, higher than the value obtained by discounting expected payments at the risk-free rate.

### *Capped subsidies*

Under the capped scheme, the government limits the maximum subsidy it will pay in any year to \$1.2 million (see Figure A-3). The cap limits the government's risks and lowers the present cost of the commitment. Conceptually, the capped subsidy scheme is like a combination of the open-ended scheme and a call option.<sup>18</sup> Although the valuation is conceptually more complicated, the complication is easily handled in Monte Carlo simulation. The estimated cost of the demand-driven capped subsidy is \$2.9 million, while the estimated cost of the income-tested capped subsidy is \$3.3 million. By comparison, the value obtained by ignoring the cost of risk is \$3.1 million.

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18. Recall that the payment by the government under the capped subsidy is given by  $S_t = \min \{sN_t, C\}$ , which can be re-expressed as  $S_t = sN_t + \min \{0, C - sN_t\}$  or  $S_t = sN_t - \max \{0, sN_t - C\}$ . The second term on the right-hand side of this equation is the payoff to the holder of a call option on the subsidy with an exercise price equal to the expenditure cap.



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