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ADB Institute Discussion Paper No. 18

**Contract Design: Providing Incentives to Private Sector
Participation in Infrastructure**

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Introduction

This paper offers a framework to allow comparison and assessment of the costs and benefits of alternative modalities of private sector participation in infrastructure in Asia. It will cover

- (i) factors and conditions that influence contract design;
- (ii) principles for the allocation of cost and risk burdens between private sector and government;
- (iii) mechanisms to overcome information asymmetries to enable regulators safeguard consumer interest; and
- (iv) incentives and penalties to elicit efficient performance from the private sector.

Issues are illustrated as appropriate with sector examples.

Part of the motivation is the lack of private sector participation relative to the level that was once expected. The recent experience is reviewed by Harris (2003) who reported that flows of private investment into the infrastructure sectors of developing countries peaked in 1997 and have declined ever since (the turning point explained in part by the Asian financial crisis). There has also been a high rate of renegotiation of contracts, suggesting that the structure of the arrangements has been an important contributor to the reconsideration by private investors of these types of projects. Harris refers to a 'widespread pessimism' about private infrastructure projects (p. 6).

The next section reviews some decision-making criteria for the separation or integration of the key bottleneck element in the supply of infrastructure services. The following sections discuss how the private sector might contract with the government to provide that particular element. It includes discussion of the case for complementary regulatory institutions. Options for the operation of the regulatory process, with special attention to rules on price fixing are examined. The final section summarises some implications for designing policy on private sector participation in infrastructure in developing countries.

Value of separation

The starting point is usually to identify the monopoly element, or the 'bottleneck infrastructure', and separate it from the competitive components. The terms on which the bottleneck services might be provided is the topic of the following sections.

The World Bank (2002, chapter 8) reviewed some options for the structure of businesses around the bottleneck component:

- A: an integrated firm subject to competition in the non-bottleneck market
- B: an integrated monopolist
- C: vertical separation with competition

Four decision-making criteria were identified:¹

1. the extent of economies of scope in operations in the bottleneck component and the provision of services in the competitive market

¹ See also Estache and de Rus (2000) for a decision making tree for choices about structural separation.

2. the ease of detecting any discrimination by the bottleneck facility owner in favour of its own subsidiary operating in the competitive market
3. if such discrimination occurs, the consequences for competition if it remains undetected
4. the likely degree of competition in the non-bottleneck market.

The World Bank (2002) proposed that the following combination of characteristics favoured the various options summarised in Table 1.

Table 1: Options for separation or integration

Option	Bundle of characteristics	Example of an appropriate allocation
A (vertical integration plus competition in the non-bottleneck market)	Large economies of scope and easy of detection of discrimination which if it did occur would have little effect on a highly competitive downstream market	Telecommunications
B (integrated monopolist)	Large economies of scope but a high degree of difficulty of detection of discrimination which if it did occur would have a significant effect on competition in a less than highly competitive downstream market	Water (although the question arises of whether option A is also relevant to this sector) Rail (with competition between tracks in large economies – some economies have experimented with option C)
C (vertical separation with competition)	Small economies of scope but a high degree of difficulty of detection of discrimination which if it did occur would have a significant effect on competition in the highly competitive downstream market	Electricity supply

Source: World Bank (2002), pp 155-158.

This material suggests different options are preferred in various circumstances. The solution varies between sectors according to their characteristics, the nature of the economies attached to the stages of production and the character of competition in downstream markets.

Contracting for natural monopoly

Development of policy towards monopolies in the infrastructure sector is an example of a contracting problem, and a variant of a more common problem of managing investments which are specific to a particular relationship (Gomez-Ibanez, 2003). In some circumstances, suppliers and their customers can both reduce costs by make specific investments. But doing so opens each side to opportunistic behaviour by the other.

An example occurs in the production of automobiles. Once the component maker is committed to supplying specific parts to a particular assembler, parts which can only be used in the vehicles of that firm, then the assembler has the incentive to lower prices, knowing that the component maker has nowhere else to sell. But at the same time, the component maker could demand higher prices when there are no other suppliers of that particular component.

These situations arise when the component maker invests in durable assets to supply particular customers and then the customer makes specific investments to link to the products or services of the supplier.

The same risks of opportunistic behaviour arise in the infrastructure sector. The service provider makes specific investments to supply a particular community, for example, a network of water pipes. The supplier cannot relocate if the community (or the government representing them) decides to offer lower prices. But the customers also make specific investments to consume the services of the infrastructure service provider. They too find it difficult to move house once they make those investments if the company decided to charge much higher prices.

The problem is that these risks of opportunistic behaviour inhibit the investments required by both parties to generate the lower costs in the transactions. Both parties lose as a result of their concern about opportunistic behaviour by the other.

A solution to this problem is to sign a long term contract. These are used in a number of procurement arrangements. They have the advantage of creating the option to establish competition for the market, in circumstances where it is difficult to create competition within the market. The bidding process contributes to allocative and productive efficiency, through the movement to average cost pricing and the selection of the lowest cost firm (World Bank, 2004, p. 105). Opening up the bidding to foreign providers also leads to gains from trade in the service, and access to services which are competitive in terms of the world market. The bidding process can economise on the costs of the collection of information that is required in other approaches to the management of the bottleneck facility (as discussed further below). For example, the presence of foreign bidders is a mechanism for benchmarking the performance of local firms. However, two main issues complicate the use of contracts.

One is the number of parties involved. Contracts are easier to write when there one buyer and one seller. In the case of infrastructure services, then is one seller but many buyers. The government may then take the place of the buyers, and if it did so ideally would implement the same contract that the consumers would have done if the transactions costs were zero. The government however has its own interests and may not do achieve that result.

The option of private contracts in a market solution is worth consideration. They are observed, for example, in negotiated arrangements for access to essential facilities. They have the advantage of establishing direct contract between consumers and suppliers of infrastructure services. The preferences of consumers are taken into account in service design. However as also noted, there are high transactions costs when a large number of consumers are involved. This solution also requires a credible legal system that will support the enforcement of the contract.

Another problem in contracting is the risk of incompleteness. To protect against opportunistic behaviour, the contracts must last as long as the life of the assets, but the longer the contract, the more likely the circumstances in which it operates will change. This may impose costs on either party, who make then seek a renegotiation. When that happens, the outcome will depend on the bargaining power of the parties. These may have changed

since the contract was originally written, and there is no guarantee that the outcome of the renegotiation will be efficient or fair.

Various contingencies can be included in any contract, and appropriate distribution of the risks in each circumstance could be spelt out in advance. But over a long period of time, which is relevant for infrastructure assets, it is difficult include all of them and to agree on ways in which the parties will respond. It is highly likely therefore that any contract will prove to be incomplete. One solution to this problem is to introduce an arbitration process into a contract or to use 'relational contracting' which accepts that arbitration may not succeed, and therefore provides a framework for renegotiation.

As the World Bank (2004, p. 105) explains, the contracting approach is better suited to circumstances of a well developed technology, well defined demand, homogeneous service and low asset specificity. These conditions are less likely in infrastructure services sectors in developing economies, where there is substantial technological and demand uncertainty as well as high degrees of asset specificity.

The contracting approach is therefore likely to require some additional institutional support outside the contract, especially as Stern (2003) argues when the contracts involve large numbers of small customers and when it pays to meet general standards or requirements on the provision of the services.

Stern (2003) illustrates the nature of the incompleteness of infrastructure sector contracts by reference to the history of their application in the UK rail and electricity sectors. Incompleteness creates the scope for renegotiation that leaves both parties better off (or at least one no worse off) and regulatory agencies can facilitate this renegotiation. Stern points out that this is especially valuable in infrastructure sectors with large investments in sunken assets and in which new information on costs and technology emerges over time.

Stern refers to the work on Guasch, Laffont and Straub (2003) who review a data set of nearly 1000 concessions in Latin America from 1989 to 2000. They report that over 40 percent had been renegotiated by 2000: in transport, 53 percent and in water 76 percent had been renegotiated and these renegotiations took place on average 3.1 and 1.6 years respectively after signing. They find that the presence of a regulatory agency, set up in advance of the contract, reduces the probably of renegotiation. They also suggest that complex contracts, which attempt to deal with the problem of incompleteness, could be counter productive, if they 'lack transparency, contain contradictory requirements and lend themselves to opportunistic revision claims' (p. 27). They suggest instead the use of a short contract document with 'general rules...found in laws and the relevant jurisprudence' (p. 27), implementation of which would the role of the regulator. The regulator is a source of advice on previous experience. Stern interprets these results to say that the regulatory agency allows 'more incompleteness in ..contracts while maintaining a low risk of contract failure' (p. 211).

In the following sections further attention is given to

- The options for forms of contracts which might apply between the government and the service provider
- The design of the price setting system that might be used under regulation.

Coverage of contracts

Options for the forms of relationship between the service provider and the government include an extreme in which the private sector owns the assets and collects the revenue as

well as manages investment, but is subject to government regulation of prices. At the other extreme, the government performs all these roles. There are intermediate cases, for example, a lease in which the government owns the assets but capital investment is managed by a private operator who also collects the revenue and bears commercial risk (a concession) or the government manages the investment and the private sector manages the operations and shares the commercial risk with the government (lease).

Moving from government ownership to private participation to some degree has a number of advantages. As noted, it leads to competition for the market, which can be used to reduce costs. The difficulties remain however of the problem of incompleteness and the difficulties of identifying and incorporating consumer preferences on the services to be provided.

Contracting can also be applied to specific projects, for example, building a particular facility. However a further difficulty for some contract options is the separation of the capital expenditure decisions from the operational decisions. This is an issue in a lease and other forms of management or service contracts as well.

Hart (2003) examines a case in which the government can either contract out to the private sector both the building and operation of an infrastructure facility, or can contract the building and operations separately. The latter he refers to as 'conventional provision' and the former as having the core features of a public private partnership (PPP). He shows that the choice depends on the relative importance of different types of error. Unbundling provides an incentive to build at lowest possible cost, which includes too little investment in aspects of the facility which might later lower its operating cost. Bundling leads to investments which take these spillovers between structures and subsequent costs of operation into account. But bundling leads to other actions which shade the quality of, but also lower the cost of operation of, the services. The choice therefore depends on the relative importance of the first spillover effect compared to the quality shading effect.

Hart (2003) concludes that unbundling is preferred if the quality of the facility can be well specified, but the quality of the service cannot be: this approach therefore avoids the problem of quality shading that can occur in bundling. A bundled approach is preferred if the service can be well specified whereas the quality of the facility cannot be (that is, where the spillover effect between facility characteristics and operations is important and which, in the unbundled approach, the builder would not taken into account).

The choice of contract structure also depends on political support. Where the private sector recovers costs through collecting the revenue earned by sale of services (as in a concession or lease) then the price setting process must generate sufficient income. The question is then whether price increases are politically sustainable: Harris (2003) concludes that some governments overestimated their capacity to manage the price reform required, though in other cases governments may also have behaved opportunistically and not implemented a commitment to raise prices once the investment was in place. He notes that problems of sustaining and implementing reform vary between sectors: where prices are already close to cost recovery and where buyers were final product or service producers, reform was easier (eg telecommunications) but where the level of cost recovery was lower and where households were more important sources of demand, private participation has been more difficult to arrange.

Where there is insufficient political support for price reform, the forms of contracting with the private sector may necessarily be more limited, for example, to management contracts, or perhaps to building facilities (Brook Cowen, 1997).

Regulatory institutions

An important question in the design of regulatory agencies is the manner in which they control the prices of the monopoly provider of the bottleneck facility.²

The options include at one extreme rate of return regulation and at the other price cap regulation. There is a substantial literature comparing these options (see for example, Kirkpatrick and Parker (2004), Ergas and Small (2001) and Ergas (2004)). The options can be summarised in the following model.

If price (p) is set equal to actual costs (C), so that $p = C$, the problem is that there is no incentive to minimise costs. The alternative is to base price on expected costs and allow the regulated firm to keep (or bear) any margin between price and those costs. The firm is then fully rewarded for reducing costs below the level expected.

Regulation has headed for a middle ground in which price depends on both actual (C) and expected costs (C^*) of the firm.³

$$p = C + \beta (C^* - C) = \beta C^* + (1 - \beta) C$$

The parameter β defines the various cases, and in its extreme values:⁴

$\beta = 1$ implies price cap regulation where only C^* matters

$\beta = 0$ for cost plus where only C matters.

According to this approach:

- The higher is β the greater the incentive to cut costs
- The lower is β the greater is the pass-through of any change in costs
Kirkpatrick and Parker (2004) suggest a number of features of price cap regulation and also examine their relationship with the movement from rate of return to price cap regulation (ie with increasing levels of β).
- Incentives for efficiency increase with the level of β , since efficiency benefits are retained by the firm until the next price review
- The difficulty of administration, relative to full government ownership as being equivalent to rate of return regulation, may increase with β , since the setting of the price cap requires data and analysis that may exceed the experience and capacity of the regulatory office. However incentives to withhold information are also higher under the rate of return regime, so that challenges of collecting and auditing data may be greater in that regime.
- Risk of political rejection increases with β , since slight errors in setting the cap lead either to large profits for the regulated firm, or to bankruptcy. As Ergas (2004) puts it, the price cap decouples price and cost outcomes which is 'only plausible when errors

² Valletti and Estache (1998) review the special issues associated with regulation of access to a bottleneck facility by downstream competitors.

³ Even in price cap regulation, information specific to the firm must be taken into account to set the appropriate target cost level, and meet the constraint that the firm continues to operate Ergas and Small (2001).

⁴ The relationship can be thought of as applying over a number of regulatory periods, or if within one period, then pricing based on actual costs requires adjustments so that full cost recovery is guaranteed. The relationship can also be used to characterise 'sliding scale' regulation where adjustments to prices are made automatically as the actual cost information is revealed.

are not likely to be significant'.⁵ Responses to a cap through the political system will add to the risks faced by investors under this regime.

- There is a question of the link between the choice of β and the risk of regulatory gaming: this refers to the problem of withholding the correct information or inflating cost figures, which is a particular problem under rate of return regulation. Price reviews can be used to correct this problem (although higher frequency of reviews increases the risk of capture of the regulatory process). Under price cap regulation, the firm has less incentive to withhold information, but once the regulator has made a decision, the regulated firm has an incentive instead to cut quality and add to profits.
- Kirkpatrick and Parker (2004) suggest that the threat of regulatory capture might be high for either extreme value of β . They argue that this is particularly relevant for developing countries. For example, a high value of β can lead to either very high profits or negative profits where circumstances can change quickly (as they might in a low income but rapidly growing economy). Consumer interests (in the former case) or producer interests (in the latter) would lobby regulators to change prices. Where the political institutions are not so robust to resist this pressure, the regime would shift and its legitimacy would be undermined. The parties would also be encouraged to play this regulatory game. As noted again below, the cost of capital could also increase. Ergas (2004) observes that as the price cap removes a link between prices and actual costs, then it also removes a constraint on the regulatory process and increases the risk of 'regulatory opportunism'.

Overall, there is a trade-off between the efficiency effects and other risks in the regulatory process, as well as administrative costs (although there maybe a qualification to this point, depending on the degree of 'micro-management' undertaken by the regulator under rate of return regulation).

Further direction on this choice is available from the empirical work linking regulatory structures with performance.

Kirkpatrick and Parker (2004) in their review of the impacts of methods of regulation conclude that while price caps have been successful in developed economies in improving performance, they are more difficult to apply in developing economies. They refer to higher levels of uncertainty under the price cap which affects investment decisions, problems of incentives to cut quality, and greater risk of political pressure to change a decision.

Guasch, Laffont and Straub (2003) draw on their review of actual contracts to argue for the rate of return 'as the salient choice' (p. 34). Price caps in their sample increased the likelihood of renegotiation: firms appear to actually bear little risk, since they 'kept the efficiency gains when business was good and renegotiated when it was poor' (p. 34). Gains were generally not shared with users. Price caps also increased the cost of capital. Price caps tended to reduce investment, since the rewards were not available until a later date. The renegotiation process tended to turn the price caps into a hybrid scheme.

Rate of return regulation reduces the incentive to cut costs. 'Provided full cost recovery is guaranteed, neither shareholders nor managers gain any advantage from streamlining production processes or investing in more efficient technologies' (Ergas and Small, p. 8). One mechanism to avoid this problem is to extend the length of the regulatory period. When the period is lengthened, the regulated firm has an incentive to cut costs early in the period, since it retains the benefits of doing so.

⁵ This risk however may be greater when the regulated firm is closer to frontier-level performance.

The finite length of the regulatory period is also an issue in incentive regulation. As Ergas and Small (2001) explain, the regulator generally sets an initial level of prices and then requires that prices fall in real terms by a percentage X each year until the next review. Both the initial level of prices and the X factor would be set on the basis of the firm's own history and circumstances, but can be influenced by various systems for benchmarking that performance. A finite length to the review period is required, since if an error is made in the X value then the arrangement is not likely to be sustainable. The problem is that as the review date approaches, the firm has an incentive to work less hard to reduce costs, because if it can convince the regulator that the scope for further productivity gains is small, it may be rewarded with a smaller X (Ergas and Small 2001).

One solution is to adopt a carryover mechanism so the firm is allowed to charge higher prices than otherwise (ie a cost reduction is ignored in the price setting process) for a longer period, to recoup a cost-reducing investment. However as Ergas and Small point out, the incentives of this approach, and of the price cap itself, are sensitive to the length of the regulatory period.

Incentive regulation encourages firms to cut costs, but the reductions could be the result of improvements in productivity, or reductions in quality: when costs are reimbursed then this is less of a problem (Ergas and Small, 2001). A variety of methods are used to give attention to service quality. One option is to impose minimum standards on suppliers, with penalties or compensation to be paid if these are not met. Another is to endorse a (usually narrow) range of prices depending on the quality of service produced.

A further issue for the regulatory is that circumstances may change over the regulatory period, for example, because of the uncertainties related to both demand and technology in these sectors. As in the contracting environment, such changes lead to the scope for renegotiation that leaves all parties better off or at least one no worse off. However, the introduction of discretion opens up the regulatory process and creates incentives to try to capture it. The renegotiation process also tends to lead to higher degrees of intrusiveness by the regulator, since the basis of the claim for an adjustment has to be established and the case made for a distribution of the effects of the change in circumstances between consumers and producers.⁶

The reference to quality of service highlights another important issue in the design of regulatory institutions. On what grounds does the regulatory choose the minimum quality standards or confront the firm with a trade-off between price and quality? This problem becomes more important as the regulatory process becomes more intrusive.

Ideally these reflect the view of the consumers of the service, but that is difficult to establish. Many regulatory agencies are now seeking evidence from firms of formal consumer codes or customer consultation systems, and some are allowing firms to propose different business plans depending on the information that comes from these consultations. But even better is to establish regulatory processes that permit direct contact between the demand and supply sides of the market. This is possible when consumers are large and sophisticated (leading to a case for private contracting) but more difficult when a many small consumers are involved. One response is to look for ways to introduce retail competition, so the retailers act as the agents for consumers in negotiating price and quality packages with the upstream suppliers. The introduction of larger buyers on the demand side ameliorates one of the constraints on the use of contracts.

⁶ In some schemes, the regulator tries to establish in advance the manner which variations will be shared between consumers and producers, that is, tries to make the contract more complete: if actual costs are higher or lower, then prices are adjusted immediately (as in 'sliding scale' price regulation).

This approach places more weight on the role of a complementary agency with responsibility for competition policy in this sector (for example, giving attention to mergers among or forms of uncompetitive behaviour by the supplier group). Attention to these competition policy issues is important even in the presence of an economic regulator: its work helps economise on the task of the regulator and lets the regulator specialise in the matters of price control.

These considerations highlight the complexity of the task of regulation of prices. The work involves the auditing and analysis of data on costs and productivity, now and in the future. It also involves consideration of the incentive effects created by the various administrative processes which are adopted. Responding to these tends to lead to higher degrees of complexity of the work and also to greater intrusiveness by the regulators in the business of the firm (through the design of efficiency carryover mechanisms and incentives for quality increases, for example).

Administrative resources required to perform regulatory tasks and to manage the regulatory agency have a high opportunity cost in developing economies (Domah, Pollitt and Stern, 2002). Building a large regulatory institution may not be efficient, as a result. There is value in adopting procedures that economise on the resources consumed. Higher β values may require additional amounts of administrative resources, or at least, more inputs of the relatively scarce resources. However, over time, as the opportunity cost of those resources fall, there may be a case to raise the β value, although that choice also depends on the other impacts of that choice.

According to results of Guasch, Laffont and Straub, choosing a lower β value would also reduce the cost of capital and avoid the risk of reductions in investment associated with a choice closer to incentive regulation. Those outcomes would be highly undesirable in an environment where there were higher returns to adding capacity to the system.

Another factor that could influence the choice of the regulatory architecture, and stressed by Kirkpatrick and Parker (2004), is the presence of complementary institutions. The role of a competition policy agency has already been mentioned. The effectiveness of the regulatory institution depends on the ability of the regulators to provide consistency and predictability, and on a legal system which provides an appeals process. These are primarily the institutions which are outside the regulatory agency but which help bolster the regulatory process. If this support is absent, then there is greater risk of capture. If so, then the regulatory mechanism might be chosen to take into account their absence, for example, by shifting down from higher levels of the β coefficient.⁷

The available of complementary institutions is also emerging as an issue in developed economies, where the range of policies associated with the sector has been increased. For example, over time greater attention is given to environmental impacts of the provision of services. Political pressure grows for a response to the perception of the problem, and rather than create a new specialist agency, there is a tendency to load this problem into the set of objectives of existing agencies. An economic regulator might then be charged to take more attention to the environmental 'sustainability' of the business being regulated. Another example is a requirement that the economic regulator pays attention to the provision of services to low-income households. The addition of social and environmental targets means the regulator is being asked to make choices about conflicting objectives, which leads to more complex regulatory processes (within the economic regulatory agency), to risk of violating the participation constraint (Ergas and Small, 2001) and to higher degrees of intrusiveness into the business.

⁷ Kirkpatrick and Parker (2004) argue for sliding scale regulation partly on these grounds.

Conclusion

The presence of a bottleneck component in the infrastructure sector creates a policy problem associated with the risk of the abuse of market power by the business controlling the bottleneck. A first step to a solution is to consider the case for isolation of that component compared to its retention within a vertically integrated firm. The response is likely to vary between sectors, since a number of desirable but sometimes conflicting characteristics (capturing scale and scope economies, promoting competition, and so on) must be assessed.

The next step is to consider the relationship between the community and the controllers of the bottleneck. Contracting between government (on behalf of consumers) and private builder/operator of the facility is one option. But that alone may not be the solution, especially with rapidly changing circumstances as occur in developing countries. However contracting has the advantage of making a closer link with the demand side of the market. In some cases, with retail competition, relatively large retailers might represent consumers' interests. Also attention is required to the design of contracts, in terms of their scope and allocation of responsibilities.

A more significant problem with relying on contracts is the likelihood of gains from renegotiation. Generally some complementary institution is required to manage the renegotiation to an efficient outcome, given the character of the investments involved in these sectors. The role of the regulator can be defined in this context. It makes the contracting process easier. However the empirical evidence suggests this contribution is more valuable when an independent regulatory process is established prior to contracting.

The regulator's choice of procedures remains a question: there are costs and benefits of the various approaches to setting prices and the right choice may vary between sectors and over time. Price caps have some considerable advantages and circumstances can be identified in which they will work. There are returns to further empirical work on the links between regulatory processes and outcomes in terms of cost reductions and productivity growth, as well as service quality changes and innovation. Also of interest are the links between choice of regime and its stability (renegotiations of associated contracts, for example).

Cost based regulation might appear to be a safer choice when complementary institutions to reduce the risk of capture of the process are not available. The downsides of that choice are the lack of incentive for productivity growth and its information problems. A transition to a price cap might be made as development proceeds and more of the conditions required for its success are met. The regulatory institutions should therefore be open to evolution and reform over time. This adjustment might be anticipated by offering firms a choice of regulatory regime (eg under a price cap, a lower X value as long as productivity gains were also shared with consumers as they occur (Ergas, 2004)).

The management of the regulatory process is relatively expensive. An interesting suggestion is to look at options for cooperation (World Bank 2004, pp. 125-128) ranging from a common agency (which may be difficult due to differences in political support for reform and concerns about sovereignty) to other forms of joint work on procedures and methodologies. The cross-market effects of choices made by individual regulators or competition policy agencies (on mergers for example) strengthen the case for some form of cooperation in regulatory and competition policy.

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