

Infrastructure Regulation and Investments

Peter Forsyth
Department of Economics
Monash University
Melbourne, Australia
peter.forsyth@buseco.monash.edu.au

7th Conference on Applied Infrastructure Research (INFRADAY)
TU Berlin October 10-11, 2008

Introduction¹

These days, much of the investment in infrastructure is carried out by regulated, usually monopoly, private or corporatised firms which are subjected to regulation. The form of regulation will be critical in determining what investments are made. The question is – how can regulators get it right?

This paper seeks to explore how efficient investment decisions can be encouraged by regulators. In addition, it examines how actual practice compares with the ideal. Achieving efficient levels and patterns of investment poses a number of difficult issues, and there are no completely satisfactory solutions for several of them. It is important, however, to be aware of where the difficulties lie, and what the limitations of the instruments available are.

The core of the paper explores how a welfare maximising regulator can set up incentives for efficient investment in the firms it regulates. The move in recent years has been towards incentive regulation, and away from cost based forms of regulation such as rate of return regulation, which was often associated with incentives for excessive investment. By contrast, it is often considered that incentive forms of regulation, such as price caps, will lead to inadequate investment. This will be so in some cases, but there are other, perhaps equally likely cases in which price caps will lead to excessive investment.

While the focus is on the issue of incentive mechanisms, the paper also puts the question of achieving efficient investment into a broader context. This poses several questions:

- What objectives do regulators pursue, how do they measure welfare, and what pressures to pursue other aims are they?
- What problems might there be in designing price caps to encourage adequate investment in capacity to provide for demand, and to provide the quality of service that users are willing to pay for?
- What alternative mechanisms are open to regulators and what are their properties?
- Can regulatory mechanisms which rely on price caps lead to excessive investment?
And
- Granted that infrastructure investment often creates positive and negative externalities, and has impacts on substitute markets, how can these broader aspects be handled within a model consisting of a firm responding to incentives set by a regulator?

The paper begins with a brief outline of approaches to investing in infrastructure and the problems that they pose. Next it considers the objectives regulators pursue, and the pressures they are under. After this, the ways in which regulator mechanisms, such as price caps and conditional triggers can influence firm's investment choices are explored. The difficulties in taking broader impacts into account within a model of a firm facing incentives set by a regulator making investment choices is examined, as are some of the structural alternatives and institutional considerations. Finally some conclusions are drawn.

¹ I am grateful to David Gillen, Hans-Martin Niemeier David Starkie, and especially Achim Czerny for helpful discussions on the issues. All errors are my own. I am also grateful to Karsten Froelich for assistance with figures.

The Problem of Regulating Investment

Investment in infrastructure is of particular interest, not only because of its quantitative importance but because of the difficulties posed in getting it right. To a large extent, infrastructure investment is undertaken by monopolies, or small group oligopolies. This means that specific firms must be relied upon to make the investments- if they do not, there is little scope for other firms to make up for their mistakes, and make the investment themselves. There can be a high cost of mistakes in providing too little or too much capacity- this will especially be the case when bottlenecks are present, when small additions to capacity can have large benefits. The fact that there is market power means that monopoly rents can be realised, and this makes it feasible for excessive investment to be funded. Thus infrastructure suppliers can be induced to deliver the uneconomic but high profile projects desired by governments if they are promised higher regulated prices on condition that they make the investment. There is some evidence also that infrastructure investments can have high positive externalities. Thus macro level studies have suggested that infrastructure investment can have a very high impact on the productivity of other sectors of the economy, and at the micro level, it has been suggested that some types of infrastructure investments, especially those in transport and communications, and create economies through agglomeration. While both the macro and micro studies are suggestive rather than conclusive, they have significant implications for investment regulation if confirmed.

In spite of this, there has been relatively little attention given to the problem of infrastructure investment under regulation (though see Helm and Thompson, 1991; Guthrie, 2006). Much of the theory of incentive regulation is unspecific about investment, or focuses on the short run. This could have been the case because when the moves to the new models of privatised or corporatised enterprises, subjected to regulation, were made, in many countries there was more than adequate capacity available. Over time, as demand has caught up with capacity, there has been a need for investment, and this has posed a problem for regulators. In fact there are really two aspects to the problem:

- Designing mechanisms to ensure that an efficient program of investment comes about in regulated firms and
- Developing a broader institutional environment in which agencies such as regulators have an incentive to promote efficient investment.

The old model of infrastructure was one in which infrastructure was supplied by a public enterprise, which was presumed to have a welfare maximising objective. When major (and even many minor) investments were proposed, either the enterprise or the government would undertake a cost benefit analysis, and those investments which met the test would be made. In practice, reality usually fell well short of the ideal, and investment decisionmaking was much more ad hoc. One response was to develop specific incentives for public firms to maximise welfare, by relating managerial rewards to welfare indicators. However this was overtaken by the shift to privatisation and corporatisation. Thus economies moved to the US model of private, but regulated, infrastructure providers. At the same time, the deficiencies in older forms of regulation, such as rate of return regulation, were recognised, and incentive regulation was developed. In this paper, the problem of achieving efficient investment in a regulated firm is considered – the broader question of the institutional environment is recognised but not treated here. Another approach which has become popular as a means of

infrastructure provision is that of the public private partnership. This model poses particular issues of its own, such as the sharing of risk between government and private firms, but it will not be directly discussed here. Several of the issues here are relevant in the public private partnership case however.

Under the regulated firm model, the regulator sets key parameters, such as the allowable maximum price, and allows the firm to make choices about production, sales and investment. The regulator is imperfectly informed, about the cost of production, the cost of and willingness to pay for quality, and the cost of adding to capacity through investment.

There is likely to be three key functions of investment:

- To enable capacity to increase output,
- To improve quality of service, and
- To reduce congestion.

The third of these is identified separately because it is not exactly a case of either of the first two. Investment in a congestible facility will reduce congestion, and encourage more use of the facility, which can be achieved at a lower level of congestion. In addition, congestion, unlike quality choice, involves an externality between users (see Czerny and Forsyth, 2008). Thus getting investment right in congestible facilities poses additional aspects to be resolved.

Thus the objectives for the regulator which will be assumed here are:

- Insuring that capacity and output are optimised,
- Insuring that investment is sufficient to supply the optimal level of capacity, and
- Providing incentives for minimum cost in the actual provision of infrastructure.

The problem of investment in regulated firms has not been ignored, though the discussion has focussed mainly on specific aspects. Two of these are the problem of gaming between the regulated firms and the regulator over investment and allowable prices, and the problem of regulatory commitment over the longer term. Regulators may commit to set prices for a short term, such as five years, but the life of the investment may be much longer, such as thirty years. Firms may be hesitant to invest unless they gain assurances for the long term. Both these problems are recognised here, though they are not discussed further. Another issue which is not discussed here is that of the handling of risk. The form of regulation will determine the riskiness of the investment- for example, the regulator can structure a price cap so that risks to the firm from investing are reduced. Firms, regulators and governments can all be risk averse, in different ways, and an issue to be resolved is who bears what risks.

Regulators' Objectives

Most incentive regulation theory suggests that the regulator has an objective of promoting maximum welfare, which is understood to be the sum of consumers and producers surplus, along with tax revenues when these are not assumed to be paid back to consumer / taxpayers. These amounts may be weighted, with consumers surplus being given a higher weight than producers surplus in some models, and tax revenues being given a higher weight than surpluses which accrue to consumers and private producers (because of the shadow price of government revenue). Welfare maximisation by the regulator is desirable, though it is not always the empirical reality.

Some regulators give greater weight to consumers rather than producers surplus. It is not clear why this is the case. There could be a distributional reason behind this, but consumers need not have lower incomes than the recipients of producers surplus (perhaps people of average income with investments in superannuation funds). However some regulators adopt extreme weights, perhaps giving all weight to consumers surplus. Regulators may see themselves as looking after consumer interests exclusively, and thus producers surplus has no weight in their welfare function. An example of this is the state utility regulator in the Australian state of Victoria (ESC, 2008), which explicitly states that it gives producers surplus a zero weight. In adopting such objectives, regulators could well be interpreting instructions to them from governments to “safeguard the interests of consumers”.

At a more extreme level, some regulators and governments appear to act as if they wish to minimise profits. Profits of regulated monopolies can be politically embarrassing, and regulators may take the cue from their governments to eliminate profits. A profitable regulated firm may be seen as an example of a failure of regulation. Thus some regulators may not only give producers surplus zero weight, but they may go further and be prepared to accept a reduction in consumers surplus in order to achieve a reduction in profit.

Regulators are very much subject to pressure from their governments. In particular, governments can swing between two conflicting pressures that they put on regulators:

- To keep prices and profits low, and
- To ensure that investment takes place, no matter what the cost.

For much of the time, the emphasis of a regulator may be to keep prices and profits low. A regulator which avoids controversy and achieves prices which can be justified by costs may be seen as doing a good job. Indeed, such a regulator may be keeping prices too low and be discouraging investment. Whether for this reason, or for other reasons, the time can come when capacity or quality is inadequate, perhaps seriously so. Inadequate infrastructure becomes a political issue, with talk of an “infrastructure crisis”. The government will then pressure the regulator to offer the infrastructure firms regulated prices which ensure that they invest, no matter what the cost. Regulatory policy will flip from keeping prices and profits low to one of offering whatever prices are needed to keep investment flowing.

These political considerations aside, governments often will have broader public interest objectives than the objectives they set for regulators. A government may instruct a regulator to maximise consumers surplus or consumers plus producers surplus (not usually using these terms directly), but it may have broader objectives. The welfare consequences of infrastructure investments will often be much more extensive than the sum of consumers and producers surplus. Infrastructure investments can create externalities, either positive (such as agglomeration benefits arising from transport investments) or negative (such as noise from transport). Some investments involve shadow pricing problems, such as ones which have employment implications at times of high unemployment. Investments will have impacts on substitute facilities, such as where an investment in a rail link reduces congestion on substitute roads. Typically, when cost benefit analyses of major investments are done, they do not focus exclusively on consumers and producers surplus implications- these other aspects often loom large in the overall assessment. This poses a real problem for handling investment with broader implications within the regulated private firm model. To make matters workable, regulators must be given simple instructions, but these do not capture all the aspects that are of importance. This issue is considered again later.

Incentive regulation theory does have some messages about regulatory objectives and outcomes which tend to be forgotten. In particular, incentive regulation theory recognises that, if an efficient overall solution to the regulatory problem is to be implemented, firms will gain rents due to their superior knowledge about key parameters, such as costs. In order to ensure that the firm continues to produce, the regulator will have to offer it a price which is at least as high as costs if costs turn out to be high. This means that the firm will earn profits if the cost which is actually achieved is low and in turn this means that the firm will earn expected profits. There is no reason why these might not be quite high, especially when there is considerable uncertainty about actual costs. However, as noted above, real regulators often like to keep prices close to actual costs, and ensure low profits. This poses a particular risk for investment adequacy. Regulators do not know how much new capacity will cost, but to ensure that investments are made, regulated prices which enable the firm to cover costs even when the cost of capacity is high must be offered to the firm. Such prices will enable the firm to make high profits when costs of investment turn out to be low. By emphasising low prices and profitability, regulators run a distinct risk that investments will not be made, and inadequate capacity will emerge.

Price Regulation and Incentives for Investment

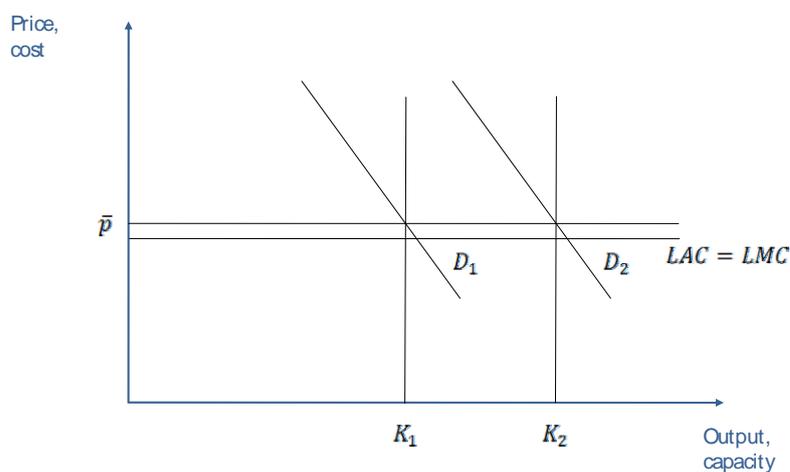
There is a widespread view that, in contrast to cost plus regulation which can encourage excessive investment, price cap regulation leads to under-investment. There is some justification for this view, though the issue is not as simple as it seems. In some contexts, price caps provide incentives for an efficient level of investment, while in others, what is ostensibly price cap regulation can lead to excessive investment. This latter situation is not at all unlikely.

For most of this section, it will be assumed that there is an infrastructure facility for which demand is growing. Current capacity is more or less sufficient, but at some stage in the future, more capacity will be needed, as demand shifts from D_1 to D_2 . For simplicity, an incremental, indivisible change in capacity from K_1 to K_2 is considered (though continuous long run average and marginal cost curves are shown).

Two kinds of “price cap” regulation are examined. The first is a fairly pure, unconditional price cap, where a maximum allowable price is set by the regulator, and this price is not conditional on investment. The second is a price cap which is set by the regulator, but which can be altered if the firm invests. Thus if the current price cap would not give the firm sufficient revenue to cover costs if it invests, the price cap can be increased. This approximates regulatory mechanisms which have been used in the UK and Australia, amongst other countries (see CAA,2008).

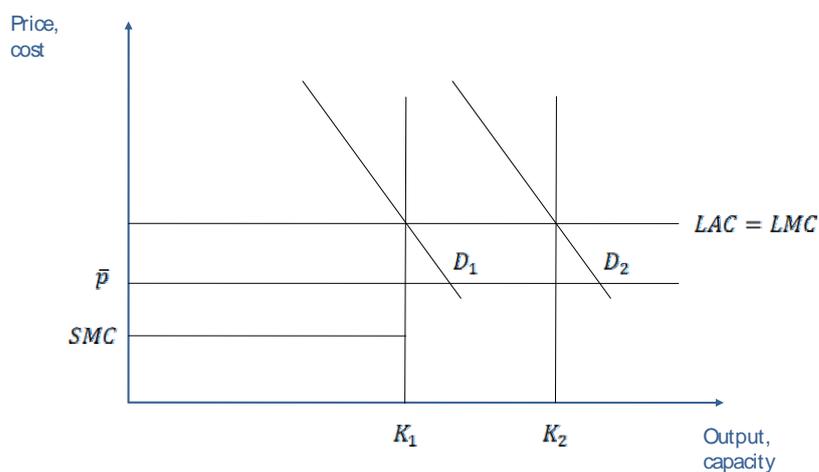
One possibility is that the long run average and marginal costs are constant over the output range- constant returns to scale prevail. This situation is shown in Fig 1. If the regulator sets the price cap at p , which is equal to or slightly above the $LAC=LMC$ level, the firm will have an incentive to add to capacity in order to meet the new demand. A price cap is consistent with incentives for efficient investment.

Fig 1



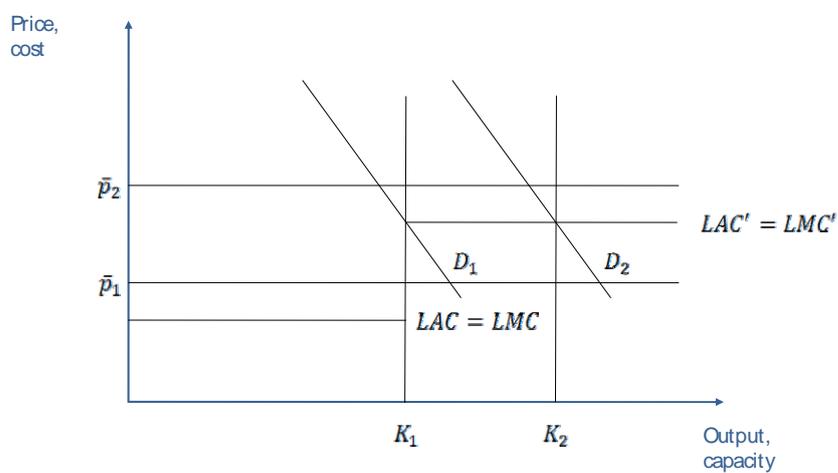
It is possible that a regulator will set a price which is above short run marginal and variable cost, but which is below LMC and LAC. This is shown in Fig 2. Investments will be sunk, and perhaps valued at historical cost. A price cap set below $LAC=LMC$ will appear to yield the firm profits, though it would not be covering the long run costs of the investment. Such a firm would not have an incentive to make investments to increase capacity to handle the increase in demand (nor would it have an incentive to replace its capacity). This is a situation which regulators may find themselves in. Even if they do not wish to destroy investment incentives, they will not have good information about the replacement cost of capacity, and will be under pressure to keep prices and profits low- thus they may unintentionally set prices which are unsustainable in the long run. It is also possible that a regulator will be opportunistic, and knowingly set price caps too low – gaining plaudits for being tough on monopolies, and leaving the problems for successors to sort out (see Ergas, 2008).

Fig 2



Another scenario which is very common is that in which the cost of additions to capacity are higher than the costs of current capacity. Adding an extra track to a rail line, and extra wharf to a port, or extra cables in a telecommunications system can be very costly, and the cost of the additional capacity can exceed that of the original capacity. Thus, in Fig 3, the LMC rises from LMC_1 to LMC_2 beyond the current capacity level.

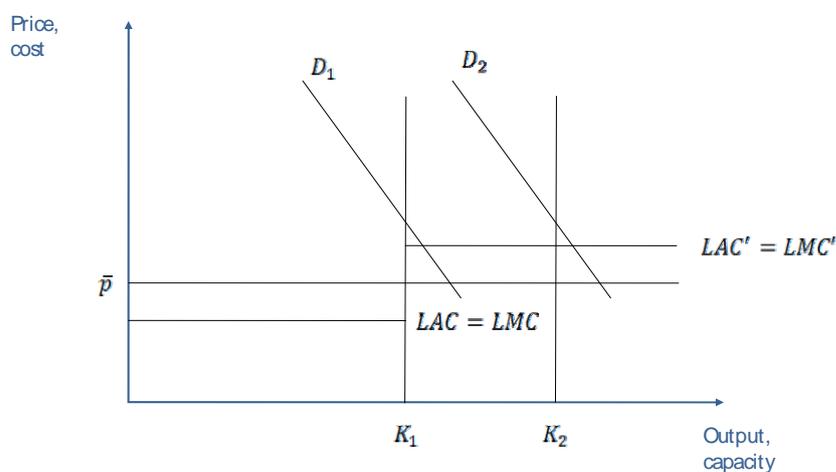
Fig 3



If the price cap is set at p_1 , which allows the firm a small profit at outputs below K_1 , the firm will not invest, since it will not be able to cover the cost of the investment. However, if the price cap is set higher, at p_2 , the firm will invest. Such a price cap will enable the firm to earn high profits both before and after the expansion of demand and capacity, if offered unconditionally. Granted that new capacity is often much more expensive than existing capacity, price caps which are consistent with efficient investment will also allow very high profits to the firm. As noted, regulators will typically be very uncomfortable with this solution.

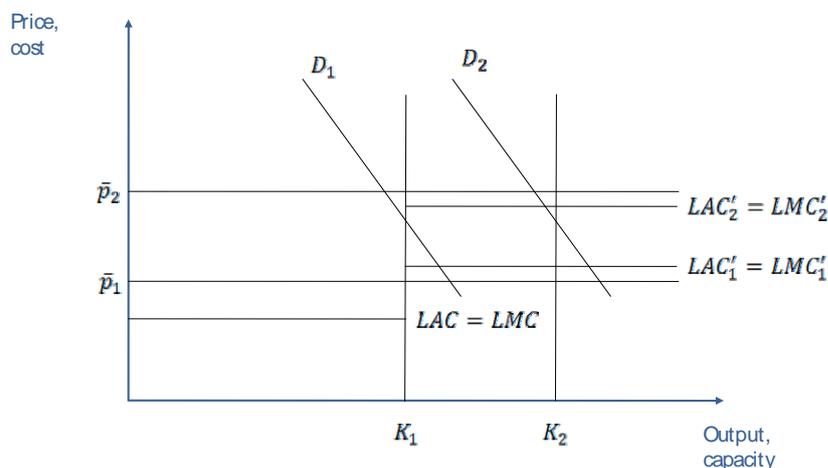
Regulators recognise this problem, and get around it by using conditional trigger mechanisms. Under these mechanisms, regulators offer to increase the price cap if and only if the firm makes a specified investment. The regulator adjusts the price cap so that the addition to revenue is slightly greater than the additional costs to the firm, including the costs of the investment. Thus, in Fig 4, a price cap below p will be set before the investment is made, but when it is made, it will be set at p . If the firm does not deliver on the investment, the old price cap prevails. It is profitable for the firm to invest. If the regulator is perfectly informed about the cost of investment and operation, then this will be an efficient solution to the problem.

Fig 4



However, this will often not be the case. If the regulator is imperfectly informed about operational costs of the firm (which is the reason why it is employing incentive regulation such as a price cap), then it is unlikely to be perfectly informed about the cost of the investment. Firms will argue that additional capacity is very expensive, in the hope of getting a high price cap. The problem is shown in Fig 5.

Fig 5



The actual cost of the investment is not known to the regulator- costs might be as shown by LMC'_1 or LMC'_2 , and costs could be high because the firm is inefficient or because of factors beyond the control of the firm. One option for the regulator is to offer a conditional trigger price cap of \bar{p}_1 , which would be based on the firm's cost estimate and would result in revenues which cover the new level of costs whatever they happen to be. The investment would go ahead, but the firm would have little incentive to minimise the cost of the new capacity. This would be especially so if the regulator signalled that price caps would be set close to cost outcomes in the longer run, and that any profits made through achieving low costs on increasing capacity would be taken away. This is the same problem as normally occurs with what is essentially cost based regulation.

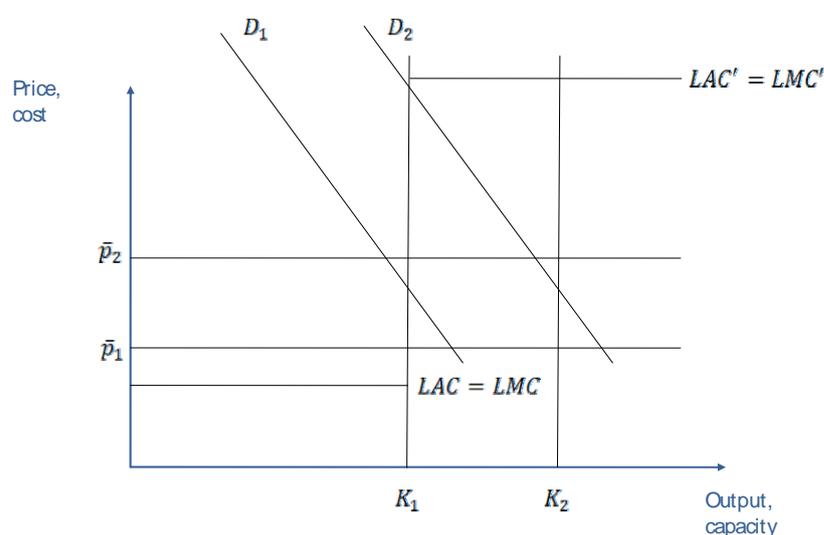
Alternatively, the regulator could offer an unconditional price cap of \bar{p}_2 . There are two options. One is where the regulator increases the price cap regardless of the investment takes place to a level which is above the highest estimate of the cost. The firm would invest, and would make very high profits even before it makes the investment. It would have an incentive to minimise the cost of the new capacity.

Alternatively, the regulator could increase the price cap conditional on the firm making the investment, but not link the cap in any way to the cost of the investment. It would need to offer a cap at a level at least of \bar{p}_2 , to ensure that investment goes ahead. The firm would make the investment, and it would seek to minimise the cost of the investment. The firm would be quite profitable if the cost outcome is lower than the maximum.

Another possibility for a non cost linked conditional price cap is that the increase in demand may not be as great as shown in Fig 5, and the investment might be worthwhile if costs are at LMC_1 , but not if they are at LMC_2 . The regulator can then set a price cap which is below LMC_2 , and which gives the firm discretion over whether it invests. If the cost is likely to be LMC_1 , the firm will invest, but if it is LMC'_2 , it will not.

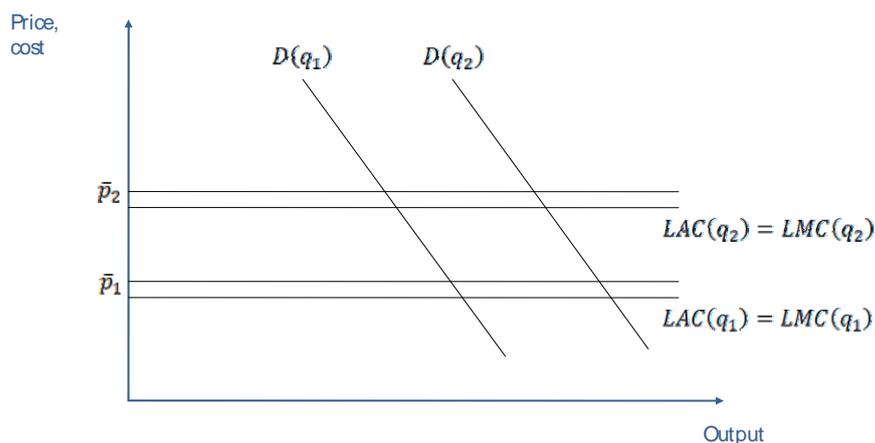
The properties of conditional triggers are very dependent on how the regulator uses them. It is easy for a regulator to use them to encourage excessive investment. This possibility is shown in Fig 6. In this case, demand is growing, but additional capacity is very expensive. The additional benefits from an increase in capacity from K_1 to K_2 are less than the costs, and thus such investment would be inefficient. However, if the regulator offers to increase the price cap from p_1 to p_2 conditional on the investment going ahead, it will be profitable for the firm to invest. In a monopoly, the regulator is able to raise prices and capture monopoly profits to subsidise unprofitable investment. A similar result could come about when the regulator allows prices such that one part of the firm is able to cross subsidise another part of the firm (see Starkie, 2006). By contrast, there is no unconditional price cap which the regulator could set which would encourage the firm to invest.

Fig 6



Thus price caps are consistent with encouraging investment to increase capacity, though if set incorrectly, they can lead to inadequate or excessive investment. Investment can also be needed to increase quality. The case of investment to increase quality of services is shown in Fig 7. Suppose that the current level of quality results in costs of $LAC(q_1) = LMC(q_1)$, but that investment to raise quality to q_2 will shift the cost curves to $LAC(q_2) = LMC(q_2)$. Suppose that Demand shifts from $D(q_1)$ to $D(q_2)$ if quality is improved. Granted that the vertical shift in the demand curve is greater than that in the cost curve, the willingness to pay for higher quality is greater than its costs, and it is efficient to supply the higher quality. If the price cap is set at p_1 (or even p_2) the firm will gain increased sales if quality is increased, but the margin on extra sales is less than the loss of profits due to the higher costs. Under unconditional price caps, the firm will supply a quality which is too low. However, if the regulator was to offer a higher price cap conditional on the higher quality, the firm would invest (see Rovizzi and Thompson, 1992, on regulation and quality). Thus conditional price caps can work to ensure that the right quality is supplied. However, there is still a large asymmetric information problem, since the regulator has no direct information on how much it costs to supply improved quality, nor on what buyers are willing to pay for it.

Fig 7



A similar problem arises with investment in congestible facilities. Investment in capacity will lower congestion, and will lead to an increase in demand. However, the main beneficiaries of the investment are the users of the facility. Under an unconditional price cap, the firm will not be willing to make the investment even though users are willing to pay for it. The regulator could offer the firm a higher price cap if it invests, and thus it could ensure that efficient investment takes place. To ensure incentives for cost minimisation are preserved, the regulator could make the higher price cap unconditional on the actual cost of the investment. However the regulator does have a problem in that it does not have good information on the willingness of users to pay for lower congestion. There is thus the risk that it will set too high a conditional price cap and encourage the firm to make excessive investments.

Conditional triggers in perspective

Conditional triggers have several advantages, but some disadvantages. They can make sure that it is profitable for the firm to make an investment (whether it is efficient or not). They are consistent with price caps in the short run- price caps can be set and the firm can be given the incentive to minimise operational costs. They can be used to encourage investment while at the same time keeping prices down. While unconditional price caps can be used to encourage investment, they can lead to high profits. If conditional price caps are set but without regard to actual costs, investment can be encouraged and the firm can be given an incentive to keep the costs of investment down. Profits could be moderately large. If conditional price caps are set so as to be closely related to costs, investment will take place but the cost of this investment will not be minimised.

Another assumption that has been implicitly made is that the regulator is as good at forecasting demand as the firm is. This could be the case, but it is also possible that the firm will have better information about demand. If so it is better to give the firm more discretion

over investment than is the case under conditional triggers. If an unconditional price cap is set, the firm can choose to invest if it believes that demand will warrant doing so. Under a conditional trigger, the regulator could overestimate demand and set a price cap which encourages investment even though the likely demand does not warrant it. Again, the trigger approach gives considerable discretion to the regulator and rather little to the firm. This can be costly if the firm possesses better information than the regulator.

Thus conditional triggers can be used in the case where investment serves to increase capacity and output, and they will lead to lower profits than unconditional price caps. They also involve more detailed regulatory intervention in investment decisions. In the case of investments to improve quality or reduce congestion, unconditional price caps will not work; conditional price caps will resolve the problem, but they suffer from the problem that the regulator is imperfectly informed, and cannot set the price cap accurately.

The Evaluation of Investment

The decision as to whether an investment goes ahead is taken by both the firm and the regulator. In principle, it is up to the firm to evaluate whether the investment will yield it a profit or not. The regulator also partly determines whether the investment will be made, and it can be assumed to evaluate it in the terms of its objectives. As noted earlier, a regulator may seek to maximise welfare, though its view of what constitutes welfare may be a narrow one. In addition, the regulator may be subject to various political and other pressures, and it may not seek to maximise welfare even in a narrow sense. Furthermore, as noted, regulator's views of the public interest are likely to be narrower than those of the government.

In principle, major investments should be subjected to cost benefit analysis. This is true of government projects, or projects undertaken by public enterprises. However it should also be so for private regulated infrastructure projects, which typically have wide impacts. The question is who would do this?

The regulator could do a cost benefit analysis to determine whether to set prices which would encourage the project to go ahead. However, there are problems with the regulator taking on this task. As noted earlier, regulators are often set relatively narrow objectives by governments, and thus they do not have the authority to undertake cost benefit analyses. They may not have the expertise, and they may be limited in terms of the information available to them.

Another possibility is for the government to undertake the analysis, perhaps through a specialist agency. Such a body would be capable of doing a comprehensive study which takes account of externalities, shadow pricing and impacts on substitutes. Sometimes there are agencies which undertake analyses of projects in terms of some of their impacts, for example, planning authorities which conduct inquiries on projects prior to approving them. A difficulty with this option is that the higher level agency may come to different conclusions than the regulator- for example, the regulator may be prepared to offer the firm a price cap which encourages the firm to invest, but an environmental planning body may wish to block the project on environmental grounds. Some mechanism for reconciling conflicts will be needed.

To some extent, this can be done by internalising the effects not considered by the firm or the regulator. Thus, external costs can be internalised by taxes. The greenhouse gas emissions of projects is now regarded as a relevant problem, but if a country has a general emissions mitigation policy, such as a carbon tax or an emissions trading scheme, these aspects of the

project will be internalised. More localised externalities such as noise can be handled by noise charges or limits. Other externalities could be more difficult to internalise- for example, damage to sensitive habitats. Positive externalities such as agglomeration benefits can be handled by subsidies, as could positive effects on substitutes, such as when a rail investment reduces road congestion.

The problem is a real one, because many infrastructure projects have impacts that are much wider than those which will be considered by the firm, or by the typical regulator. There are many large projects which are justified largely in terms of their wider impacts. Thus high speed rail links in Europe are advocated in terms of their ability to reduce greenhouse gas emissions, and public transport investments in cities are justified in terms of their impacts on road congestion. Integrating regulatory mechanisms with ways of taking account of the wider implications of projects in a world where investment decisions are made by firms and regulators which have a narrower focus is a priority for efficient infrastructure investment.

Structural and Institutional Options

The discussion so far has said little on the structural options open and the institutional environment in which the investment is taking place. While the emphasis here is on regulatory mechanisms, some comments are relevant.

One structural option which may be open is that of horizontal separation- the firm may not be inherently monopolistic, but it may be feasible to replace a monopoly by an oligopoly. This has been suggested in the case of the London airports, where the current owner is likely to be required to divest itself of two of its three London airports. It is probable that the airports will continue to be regulated, and given that capacity and quality are both regarded as inadequate, the investment issue is likely to be critical. One objective in separating firms is to promote competition in the long run through investment. This will have implications for the ways investment is regulated. In particular, it makes conditional trigger approaches difficult to achieve. The conditional trigger involves giving the regulator the major say in whether an investment goes ahead. If competition in investment is to be encouraged, firms will need to have much more discretion over their investment plans than is the case under conditional triggers.

Investment regulation aspects also have implications for the relative advantage of different vertical structures of firms. Since it is difficult to regulate investment effectively, then it is desirable to avoid doing this if possible. This could be the case if it were possible to separate out parts of enterprises which have the potential to be competitive. Thus with vertical separation in electricity, it is not necessary to regulate investment in electricity generation, since this can be competitive.

On the other hand, vertical integration can help solve investment problems. Where there are major users of facilities, it may make sense for these to own the facilities (possibly with some requirements to make facilities available to competitors on regulated terms). An integrated firm will make decisions about the quantity and quality of infrastructure that it is willing to pay for- it has an incentive to invest optimally. Thus in Australia, the iron ore supply chain (mine, rail, port facility) which is all under one owner works much better than the coal supply chain, which has different owners and regulators (and which has faced chronic bottlenecks and regulatory gaming) (Export Infrastructure Taskforce, 2005, Forsyth, 2007). Airlines owning their own terminals at airports can work well, as long as there are common user terminals which competitors can use.

It is not possible to be systematic about what structural options will work best- it depends on the industry's circumstances. However, it is possible that in some cases difficult regulatory problems might be resolved or lessened by structural changes.

Light handed regulation is another option with potential to impact on the investment problem. Light handed regulation might involve a threat to impose specific regulation if performance is poor. Firms are willing to invest when they need to have more capacity to earn more profits – there need not be regulatory hold-ups, as firms and regulators game each other. Light handed regulation may also facilitate arrangements between users and the firm – users may be willing to pay extra if investments to increase capacity or improve quality are made. This approach does not eliminate all the problems of regulation. If it is essentially cost oriented (the criterion of good performance being prices close to costs) it can lead to excessive investments. Firms may be subjected to political pressure to make uneconomic investments, and they will do so because they can cover the cost using their market power.

Much of the discussion in this paper has taken it as given that the regulator is seeking to maximise welfare, and is able to do this. However, as noted in the third section, regulators often do not behave in this way. Neither governments nor regulators behave as welfare maximisers, and sometimes they have very narrow interpretations of welfare. Ideally they should be taking into account all the costs and benefits of the investment. Designing an institutional environment in which this occurs and regulators have an incentive to pursue welfare maximisation is a particularly difficult task, probably more difficult than that of indicating how welfare might be maximised if governments and regulators seek to do this (see Flyjberg, Bruzelius and Rothengatter, 2003).

Conclusions

This paper has explored how regulatory instruments affect investment in regulated firms which can increase capacity, improve quality or lessen congestion. As noted, regulatory objectives can be diverse, and be quite distinct from welfare maximisation as normally understood. Government and regulator objectives can conflict, especially when the government sets the regulator more narrow objectives than it employs itself. Infrastructure investments often involve a wide range of efficiency aspects, and cost benefit analysis has been developed as the way of handling them in investment assessment. Provision of infrastructure investment by regulated private or corporatised firms subject to regulation does give rise to a problem of how broader efficiency aspects, such as recognition of externalities and shadow prices, can be incorporated into decisionmaking.

The common view that price caps discourage investment by regulated firms is not supported, though it should be noted that price caps as actually implemented will often discourage investment. Regulators often set prices too low, to assist consumers or to avoid controversial profits, and these prices make investment unprofitable for the firm. Price caps can be set at levels which give the firm an incentive to make efficient investments. In addition, it is difficult to set price caps to encourage excessive investment. However, price caps which stimulate investment will often result in high profitability of the firm, and regulators may be uncomfortable with this. In addition, prices which are high enough to encourage investment may also have some short run allocative efficiency costs, which are not considered here.

Regulators have responded to this problem by employing conditional trigger mechanisms. Price caps are adjusted upwards only if the firm makes the investment. The new price cap is designed to ensure that the additional revenues cover the additional costs, so that the firm has an incentive to invest, while at the same time not leading to a significant rise in overall profitability. This mechanism gives the regulator considerable discretion over investment, and the outcomes depend critically on how it is implemented. If the higher price cap is conditional on the actual expenditure on increased capacity being made, the incentive to achieve productive efficiency in investment is weakened. In addition, conditional price caps can easily be used to make excessive investment profitable for the firm – they do this by essentially using the monopoly profits of the firm to fund the extra investment. While inadequate investment by regulated firms is often a problem, it may well be that excessive investment is an even bigger problem sometimes.

References

Civil Aviation Authority (2008) *Economic Regulation of Heathrow and Gatwick Airports 2008-2013 CAA Decision* CAA London March

Czerny A and P Forsyth (2008) “Airport Regulation and Lumpy Investments”, paper delivered at Air Transport Research Conference Athens July

Ergas, H (2008) *Wrong Number: Resolving Australia’s Telecommunications Impasse*, Crows Nest, Allen and Unwin

Essential Services Commission Victoria (2008) *Final Report: Review of Port Planning*, www.esc.vic.gov.au

Export Infrastructure Taskforce (2005) Report to the Prime Minister by the Export Infrastructure Taskforce, May Prime Minister and Cabinet Department, Australia

Flyjberg, B N Bruzelius and W Rothengatter (2003) *Megaprojects and Risk: An Anatomy of Ambition*, Cambridge, Cambridge University Press

Forsyth, P (2007) “Investing in Transport Infrastructure: Institutional Design and Efficiency”, paper delivered at Conference “Gateways and Corridors”, Centre for Transport Studies and Transport Canada, University of British Columbia, May

Guthrie, G (2006) “Regulating Infrastructure: the Impact on Risk and Investment”, *Journal of Economic Literature*, XLIV Dec 925-972

Helm, D and D Thompson (1991) “Privatised Transport Infrastructure and Incentives to Invest”, *Journal of Transport Economics and Policy*, Sept 213-246

Rovizzi Land D Thompson (1992) “The Regulation of Product Quality in the public utilities and the Citizens Charter,”, *Fiscal Studies* 13 3 74-95

Starkie, D (2006) “Investment Incentives and Airport Regulation”, *Utilities Policy*, Dec 14 4 262-265

