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# The case for ex post regulation of energy networks

## Final

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# Contents

# 1 Executive Summary

## 1.1 Introduction

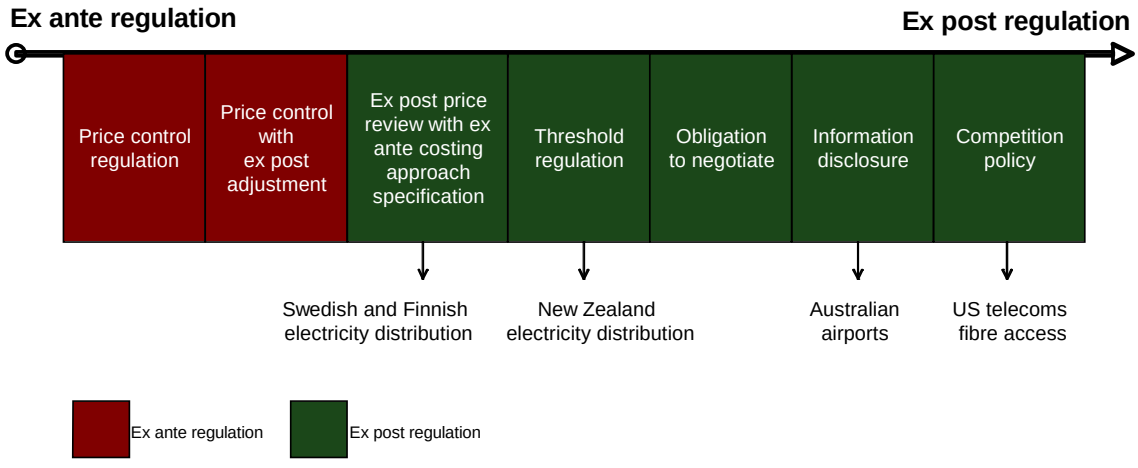
1.1 As part of its RPI-X@20 review, Ofgem has commissioned LECG to consider the pros and cons of ex-post regulation and its possible applications to energy network regulation in Great Britain ("GB"). This study is motivated by concerns that the existing regulatory system may need to evolve to meet the challenges currently facing the energy sector. These challenges include the need for energy networks to facilitate the transition to a low carbon energy sector.

1.2 We have reviewed the relevant economic literature on ex post regulation and have considered the application of ex post regimes in network industries. Our research provides the theoretical and empirical context for our assessment of the pros and cons of applying ex post regulation to GB energy networks.

## 1.2 Definition of ex post regulation

1.3 Ex post regulation does not have a single definition, as different forms of ex ante and ex post regulation lie on a spectrum, as illustrated in the figure below.

**Figure 1: Ex ante to ex post regulatory spectrum[1]**




Source: LECG

[1] Figure 1 shows the case studies considered in this report and their location on the regulatory control spectrum.

1.4 For the purposes of this study, we show the existing DCPR4 regime of price control regulation at one end of the spectrum. In simple terms, under this form of ex ante regulation, price and quality controls are imposed prior to the observation of market behaviour during the price control period. Of course, performance may be reviewed ex post, but for the most part this informs future regulatory decisions.

1.5 At the other extreme, the most "light-handed" regulatory approach would be to rely on competition policy alone. That is, to rely on a combination of competition law (in particular Article 82 or its national equivalent) and, in practice, sectoral/market reviews (which might provide an implicit threat of future regulation).

1.6 Regimes that fall in between the two extremes include but are not limited to:

- **Ex ante regimes with ex post adjustment mechanisms**, to allow prices to change in response to factors deemed outside the control of management. Such ex post mechanisms are common in the UK. However, for the most part these regimes can be considered to be ex ante, as prices are still essentially set prior to the price control period.

- **Ex post price control with an ex ante specification of approach to cost.** Under this type of regime, the regulator does not approve prices ex ante. The company is left to determine prices. At the end of the period, the regulator considers whether the prices were reasonable and whether to intervene in the price setting process. Prior to the regulatory period, the regulator sets out its approach for assessing costs or returns. We investigate this type of approach in our review of electricity network regulation in Sweden and Finland.

- **A 'thresholds regime'**. Under this type of regime, the regulator sets a price 'threshold'. The threshold is not binding on the firms, but where a firm sets prices above the threshold, they are subject to regulatory review and potentially to full price control. We investigate this type of regime in our review of electricity network regulation in New Zealand.

- **Information disclosure and negotiation.** Under this type of regime the regulated firm must provide information to customers and to the regulator, and must undertake good faith negotiations with its customers according to a prescribed process. This approach attempts to restrict the application of

market power by enhancing the countervailing power of large customers. However, it still leaves prices to be determined by the market.

## 1.3 Literature review and case studies

1.7 Ex ante and ex post regulation are not well defined in the literature. In our discussion below, we refer to the broad definition of ex ante and ex post regulation, as discussed in the previous section. Our findings apply generally to ex ante and ex post regimes, but given the continuum note above, our findings do not apply equally to all forms of regulation.

1.8 Ex ante regulation is typically applied in sectors where firms have persistent and significant market power. We found that the literature strongly supports the application of ex ante regulation in these markets, if the main goal is to ensure that consumers are protected from excessive pricing and other market abuses. The evidence shows that ex post regimes are not so successful at restraining excessive pricing and other abuses when firms have significant market power.

1.9 Ex ante regimes can provide firms with incentives to invest. However, they do not provide firms with strong incentives to innovate or to efficiently invest when the demand for new services is uncertain. We found that certain ex post regimes, though not all forms of ex post regime, provide firms with better incentives to innovate.

1.10 We found that the countries that have adopted ex post regimes to regulate networks with significant market power, typically did not regulate the sector prior to the application of the ex post regime (hence there was no transition from an ex ante regime to an ex post regime). The academic literature promotes ex post regimes as a way to reduce the level of regulatory burden, and this may have been the motivation for regulators to adopt an ex post approach. However, in practice, these regimes have not been very successful at reducing the level of regulatory burden.

1.11 Where regulators have adopted ex post regimes for firms with significant market power, they have progressively refined the regimes with ex ante features. This has moved the ex post regime towards the traditional ex ante form of regulation. In some cases, regulation has simply changed to an ex ante form of control.

1.12 As sectors become progressively competitive, there has been a move from ex ante to ex post forms of control. In general, these conditions required to move towards ex post forms of control relate to the reduction in market power of incumbent monopolies, from either new entrants or the threat of entry. For example, in the communications sector, Ofcom has deregulated some retail and wholesale fixed line markets as effective competition has developed.[2]

1.13 In non-competitive settings, few regulators have moved from ex ante to ex post.[3]

## 1.4 Assessment of ex post regulation

1.14 Our assessment framework is discussed in detail in Section 3. In summary, we have assessed ex post regulation against the following criteria:[4]

- preventing excessive pricing;
- promoting efficient and timely investment and innovation;
- promoting operating efficiency;[5]
- minimising regulatory burden; and
- providing a stable and predictable regulatory process.

1.15 In the table below, we summarise our assessment of the merits of ex post regulation compared to ex ante regulation. While, there are many variants of ex post regulation, we believe that the main insights can be obtained by focusing on the threshold and competition policy approaches.

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2 Ofcom, "Review of the fixed narrowband services wholesale markets - Statement on the markets, market power determinations and remedies including further consultation", 15 September 2009.

3 The regulation of airports in Australia is a notable exception to this statement. See Section 5.

4 In addition, we discuss in the main paper the vertical issues around foreclosure by networks that are vertically integrated with generation or supply. In our view, this issue is primarily related to the unbundling of networks rather than a choice between ex ante or ex post price regulation. However, ex ante regulation will be more effective than ex post regulation in preventing vertical abuse, in any context except for full ownership unbundling.

5 Ofgem is concerned about efficient delivery of outputs, through efficient operating, investment and innovation decisions. We have distinguished between efficient investment and operating efficiency as this is consistent with the separate economic definitions of dynamic and productive efficiency. However, investment and operating efficiency are not necessarily distinct independent activities.

**Table 1: Overall assessment**

| | Ex ante | Ex post (thresholds) | Ex post (competition policy) |
|---|---|---|---|
| Preventing excessive pricing | ✓✓✓ | ✓ | ×××  |
| Efficient and timely investment and innovation | ✓ | × | ✓✓ |
| Operating efficiency | ✓✓ | ✓ | ✓ |
| Regulatory burden | × | × | ✓ |
| Predictability and stability of regulatory process | ✓✓ | × | ✓ |

Source: LECG. Note: ✓ denotes relative strength of benefit and × denotes relative strength of weakness.

1.16 We summarise our findings in more detail below, including the implications for GB energy network regulation. Our analysis varies somewhat between electricity and gas, owing to the different challenges faced in each sector.

1.17 Our economic analysis does not address the legal issues that would arise if GB were to move towards an ex post regime. The "Third Legislative Package" requires Member States to ensure that charges or the methodologies for setting charges for electricity and gas transmission and distribution networks are approved and published prior to their entry into force[6], and this would seem to limit the scope for ex post regulation.

### 1.4.1 Preventing excessive pricing

1.18 The available evidence shows that ex ante price controls have led to significant real reductions in price across regulated sectors. It is clear that ex ante regulation can effectively protect consumers from excessive pricing.

1.19 A threshold regime will provide some level of protection to consumers by providing an explicit threat of regulation should prices exceed a pre-determined level. However, the pre-determined level, which might be based on current prices plus a general productivity saving factor, is unlikely to be as close to cost as an

[6] Article 32.

ex ante price control. This is in part because threshold regulation is inherently asymmetric. That is, if the threshold price is set below cost, the firm can choose to breach the threshold and trigger a favourable reset. However, if the threshold price is above cost then the firm can price at or just below the threshold and earn excessive profits.

1.20 The regulator can mitigate this problem by resetting the threshold periodically or by modifying the methodology, but such measures add complexity and bring the regime closer to an ex ante form of control, thereby reducing any advantage in terms of lower regulatory burden.

1.21 Experience with competition policy regimes in New Zealand and Germany strongly suggest that in the absence of competitive constraints these regimes are ineffective in preventing excessive prices. This is perhaps the biggest weakness with this form of regime.

1.22 In conclusion, prices are likely to be lower under ex ante regulation, unless there are competitive constraints or thresholds are modified frequently. The weakness of ex post regulation in constraining excessive pricing is a key finding that applies to all energy networks in Great Britain. To move away from ex ante regulation would therefore require strong evidence of countervailing benefits to match the dis-benefit to consumers of higher prices.

### 1.4.2 Efficient and timely investment and innovation

1.23 Utilities in Great Britain have undertaken significant network investment under the existing regime of ex ante regulation. However, there have been ongoing concerns that the regime provides incentives for under-investment, spending to budget and over-investment (by substituting capital for operating spending), and hence 'gaming' in relation to capex forecasts. Ofgem has attempted to mitigate these problems through the adoption of menu regulation, and in DPCR5 is proposing a significant shift towards more detailed scrutiny of outputs and the equalisation of capex and opex incentives.[7]

1.24 Ex ante regimes aim to prescribe appropriate levels of investment by basing the price control, in part, on the amount of expected efficient capital spending required. However, the difficulty of estimating the efficient level of spending will

[7] Ofgem, "Electricity Distribution Price Control Review Initial Proposals", 3 August 2009.

vary over time and between sectors, and is greater in an environment with high levels of uncertainty.

1.25 We believe that this uncertainty point is important. We find below that ex post regimes create their own uncertainties and, all other things remaining constant, this uncertainty will increase the cost of capital and make it harder for firms to secure financing. Part of benefit of ex ante is the reputation and commitment in the Regulatory Asset Value ("RAV")[8] that provides assurances about the future to investors.

1.26 Ex ante regimes provide strong incentives for certain types of innovation, in particular relating to cost-saving innovations during the price control period. However, they do not provide regulated firms with strong incentives to develop socially beneficial and/or value enhancing innovations. Nor do they reward firms for taking risks. A firm will bear the full cost of a risky investment, but not the full benefit if it succeeds, because price controls restrict firms to charging customers the cost of a service rather than its value to consumers. In the telecommunications sector many observers therefore question whether ex ante price controls provide an appropriate regulatory framework for investment in new fibre access networks.

1.27 A thresholds regime also restricts returns in a similar fashion to ex ante regulation. Consequently, this form of regime also limits the incentive to innovate. It also has the additional problem that funding above the long run average level of investment may require a price increase above the threshold. "Lumpy" investment profiles are common for energy networks. This uncertainty may lead the firm to defer investment to avoid breaching the threshold, especially if the firm is unsure how the regulator will set prices following the breach. To the extent that an ex post regime increases uncertainty for investors about whether the regulator will allow the recovery of cost and exposes them to the potential for regulatory opportunism, this will increase the returns required by investors.

1.28 In theory, a competition policy regime provides firms with incentives to develop products that meet customer needs, as they can earn superior returns by

[8] Also known as Regulatory Asset Base ("RAB") and Regulatory Capital Value ("RCV"). This represents the value ascribed by Ofgem to the capital employed in the networks regulated business. It is the asset base on which a return is allowed.

delivering what customers value.[9] Firms are able to charge what customers are willing to pay and so are able to earn "monopoly" profits, at least for the short run.[10] The threat of competition is also a stimulus for innovation in competitive markets. In a market with no competitive constraint, the incentive to innovate will be diminished. However, these innovation benefits are driven by consumer demand. The evidence suggests that where innovation is required to address externalities such as carbon emissions, a competition policy regime alone would be insufficient to incentivise innovation.

1.29 The implications for GB networks might differ between electricity and gas. Electricity networks face the greatest challenge in terms of new investment and innovation and a potential shift in roles with the transition to smart networks. In contrast, gas networks may face steady or even declining demand in the long term due to the transition to low carbon energy sources, although they still require significant replacement capital spending.

1.30 However, while unregulated markets may be good at delivering what consumers want, a key requirement of energy markets is to promote sustainability and the interests of future consumers, and this may differ from meeting the desires of current consumers. As a key example, we note that the deregulated market for metering has not delivered smart metering. We doubt that an ex post regime would deliver the investment and innovation required for decarbonisation of the GB energy system.

1.31 In conclusion, ex ante regulation provides reasonable investment incentives but it is more difficult to incentivise timely and innovative investment. Threshold regimes are less likely to incentive investment unless thresholds are set significantly high (i.e. to allow a buffer above cost for unknown future investments). Competition law can provide a sound framework for investment and innovation in consumers' interest, provided the implicit threat of regulation does not undermine the credibility of the regime. However, this benefit is of less relevance to GB energy networks, as investment needs and innovation are

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9 In accordance with case law, it is not in itself illegal for an undertaking to be in a dominant position and such a dominant undertaking is entitled to compete on its merits. Hence, a dominant firm can price above costs. However, the undertaking has a special responsibility not to allow its conduct to impair undistorted competition.

10 In some circumstances, a monopoly may fail to produce the efficient level and mix of products, due to "X-inefficiency". This may be addressed by competitive markets for corporate control that enhance the incentive for managers to act in shareholders' interests.

required to address sustainability and the interests of future consumers (i.e. the need for decarbonisation), rather than meet current demand. Further, the strong market power of networks, uniform nature of network services and the low price elasticity for electricity networks will tend to diminish the incentives to innovate under competition law.

### 1.4.3 Operating efficiency

1.32 Ex ante regulation provides strong incentives for firms to make operating savings, in part because prices are set to fall in line with the efficiency target and in part because firms retain a significant part of the savings achieved beyond the efficiency target. The evidence shows that there have been significant operating cost savings in all GB energy networks since the commencement of RPI-X regulation.

1.33 Both forms of ex post regulation provide strong efficiency incentives, in that they also allow the firm to retain operating cost savings over time. However, the efficiency gains under ex post regulation may not be passed through to consumers, which is clearly a disadvantage in relation to excessive pricing (though not to operating efficiency per se).[11]

1.34 With regard to GB networks, our conclusions imply that there is no advantage to ex post regulation in regards to operating efficiency. Although quantification is outside the scope of this study, it seems clear the existing system already provides strong incentives. Moreover, incentivising operating efficiency at the expense of consumers seems inconsistent with Ofgem's statutory duties.

### 1.4.4 Regulatory burden

1.35 Theoretically, we might expect ex ante regulation to have the greatest regulatory burden due to the resource and time intensive process of developing complex price controls. However, these costs are relatively small in the context of multi-billion pound investment decisions.

1.36 Moreover, it is worth noting that ex ante forms of control include significant "set-up costs", which are now effectively sunk. In Great Britain, the cost of developing the price control framework and defining and implementing regulatory reporting requirements has already being incurred. While additional costs may be required,

[11] In the absence of an effective market for corporate control, monopolies may operate at less

if the ex ante framework is modified, these are likely to be relatively modest. The benefit of moving to an ex post regime would only apply to the regulatory costs that can be avoided. We would expect, for example, that many of the annual reporting requirements would not be avoided. In addition, one would need to consider the costs of establishing an ex post regime, which would be a significant change for the sector.

1.37 Our study has found that, in practice, threshold regulation results in the lengthy and resource intensive investigation of breaches. In practice, therefore, such regimes may offer little advantage in terms of regulatory burden.

1.38 An ex post competition policy regime would avoid the cost of setting price controls or thresholds, but it still may lead to a considerable number of complaints. A competition breach would entail lengthy investigation by the relevant competition authority or regulator with concurrent powers. The development of 'private enforcement' could also lead to extensive litigation.

1.39 Our conclusions imply that there is relatively little scope for lowering the regulatory burden of network regulation in GB by a shift towards an ex post regime. Moreover, Great Britain has a relatively small number of networks, and has already invested significantly in 'sunk costs' in setting up the regime (the development of price control methodologies and reporting protocols). As such, the costs that could be avoided by moving to another form of regime might be modest compared to other countries where there are a large number of distribution networks, and where ex ante processes are less mature. These cost savings would in any case be undermined if Ofgem were required to impose a price control on one network, due to a breach of threshold.

#### 1.4.5 Predictability and certainty of the regulatory process

1.40 Ex ante regulation has provided a stable framework for networks and consumers in Great Britain and is well understood by investors. Experience to date suggests that there is scope to adapt the framework as new challenges emerge over time, without unduly damaging certainty to investors.

1.41 Threshold regimes in other jurisdictions have been subject to continuous change and do not appear to be durable over time. There have been complaints that such regimes cause too much uncertainty for investors and other market participants.

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than efficient levels due to "X-inefficiency".

1.42 Competition based approaches for firms with high degrees of market power are also somewhat unstable, as in order to provide a threat of regulation, the market and regulatory framework are subject to frequent review or are affected and distorted by the threat of regulatory intervention. This form of "implicit regulation" may be inferior to explicit regulation in terms of process and outcomes.

## 1.4 Conclusions

1.43 Based on our findings, there do not appear to be significant benefits to consumers from moving from an ex ante form of control to an ex post form of control. A move would be more beneficial if consumer price signals were required to incentivise innovation. However, in the energy sector, it is not consumer demand that drives the fundamental changes required of the sector, but the need to address climate change. Secondly, the monopoly nature of networks and low price elasticity and uniform nature of networks is likely to diminish the opportunity and incentive to innovate under ex post regulation.

1.44 A shift away from ex ante regulation would raise the level of uncertainty investors faced and this may require a higher cost of capital to compensate investors for the additional level of uncertainty.

1.45 We are not convinced that a move to ex post regulation would lead to a lower level of regulatory burden.

1.46 Concerning GB electricity networks, we therefore do not see a strong case for any material shift away from ex ante regulation. The need to prevent excessive pricing remains a key factor. Innovation and investment are extremely important to the future of electricity networks however, this innovation is required to address climate change[12] rather than to deliver new products to consumers. This is in contrast to sectors such as telecommunications where consumer demand of higher speed broadband services is a key driver for investment decisions. In practice, ex post regulation may provide little or no real gain in terms of innovation for electricity networks. It should be possible to design ex ante regulation to provide some incentive for innovation, although this may require a trade off with short-term benefits from lower prices.

[12] In economic terms, carbon emissions are an externality of energy generation, transmission and distribution (i.e. they are an unwanted by-product).

1.47 For GB gas networks, retaining ex ante regulation to prevent excessive pricing appears desirable. If in the next decade, if it becomes clear that gas use is declining and there are relatively few complex regulatory issues, then Ofgem could consider simplifying the current price control approach. In doing so, however, it would need to bear in mind the potential trade off relating to loss of consumer benefits under the present regime.

# 2 Background

## 2.1 Context

2.1 Ofgem is undertaking a comprehensive review of the RPI-X framework that has been used to regulate transmission and distribution energy networks in Great Britain over the past 20 years.

2.2 The energy sector is facing a number of important challenges and is experiencing significant change. Importantly, the sector now faces the challenge of moving to a low carbon economy. The Government's low carbon transition strategy proposes that by 2020 around 40% of the UK's electricity will come from low carbon sources and by 2050 all electricity will come from renewables, nuclear or fossil fuels where emissions have been captured.[13] The Government is proposing a five-fold increase in renewable generation by 2020. There is a move towards increasing demand side participation and distributed generation in the energy market and encouragement of energy efficiency.

2.3 There are also some concerns about maintaining security of supply over this period, as the North Sea oil and gas supply runs down .the transition to low carbon fuels and the flow-on implications of the credit crisis for investment in generation plant.[14]

2.4 These changes create a number of significant challenges for energy networks in Great Britain.[15] For example, the connection of major new sources of renewable energy, such as off and onshore wind in remote parts of Great Britain will require significant investment in electricity transmission. Electricity distribution networks will also need to adopt smart metering and will need to facilitate the connection of distributed generation. Other investments will be required.

2.5 To ensure these challenges are met, Ofgem is considering the current form of price control regulation, in part because ex ante forms of price control regulation

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13 DECC, "The UK low carbon transition plan", July 2009.

14 Ofgem, "Ofgem pushes on with scrutiny of security in GB energy supply", 26 June 2009.

15 For a detailed discussion of future scenario for electricity networks, see Graham Ault, et al, "Electricity network scenarios for Great Britain in 2050" Final Report for Ofgem's LENS project, November 2008.

have been criticised for failing to provide sufficient incentives to invest or innovate.[16]

2.6 Ex ante forms of price control have been seen as an effective means of encouraging effective use (i.e. "sweating") existing assets and removing monopoly inefficiency.[17] However, questions have been raised as to whether these forms of control are appropriate in the context of the challenges facing the energy sector in Great Britain.

2.7 It has been suggested that ex post forms of regulation may allow greater freedom for network companies to make investment decisions and potentially provide better incentives to invest and innovate. This report explores whether ex post regulation would provide a suitable framework for regulating energy networks in the context of the wider changes in the energy sector in Great Britain. It is one part of the RPI-X@20 review.

## 2.2 Terms of reference

2.8 Ofgem has commissioned LECG to study the pros and cons of ex-post regulation, and how ex post regulation might be used to regulate energy networks in Great Britain in the future. Our study draws on both the theoretical and actual application of ex post regulation in other countries and sectors. Our study identifies the conditions under which ex-post regulation is expected to work well.

## 2.3 Structure of report

2.9 Our report is structured as follows. In Section 3, we outline our approach, our definition of ex post regulation and our assessment framework for determining when ex post regulation may be effective. In Section 4 and Appendix 1, we summarise our literature review. In Section 5, we present a number of case studies covering where ex post regulation has been used in practice. In Section 6, we draw our analysis together and summarise our key findings. Finally, in Section 7, we analyse the implications of our study for the regulation of energy networks in Great Britain.

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16 Dieter Helm, "Credible Energy Policy, Policy Exchange, 2008, page 41.

17 Dieter Helm, see above.

# 3 Approach

## 3.1 Introduction

3.1 This study is intended to contribute to Ofgem's thinking in the RPI-X@20 review. As a starting point for the study, we provide a definition of ex post regulation and consider some of its potential variants. We then develop an assessment framework to consider the advantages and disadvantages of ex post regulation. Based on this analysis, we assess whether ex post regulation could be successfully applied to electricity transmission and distribution networks and gas transportation and distribution networks in Great Britain.

3.2 We have reviewed the economic literature on ex post regulation (see Section 4). We have also considered the application of ex post regulation to network industries (see Section 5). These case studies describe the application of ex post regulation to energy networks in Sweden, Finland and New Zealand, in the US telecommunication sector for next generation access networks and for airports in Australia.

3.3 The case studies illustrate the use of ex post regulation within energy markets. The telecommunications case study illustrates the application of ex post regulation to incentivise new investments. The Australian airports study provides an example of a move from ex ante to ex post regulation.

3.4 Our findings are brought together using an assessment framework, which is summarised in more detail at the end of this section.

## 3.2 Definition of ex ante and ex post regulation

3.5 Before we can discuss the merits of ex post regulation, we need to define what we mean by both ex ante and ex post regulation. Ex ante and ex post regulation are frequently used terms in the regulatory literature, however, the terms are not well defined.

3.6 In literal terms, ex ante is a Latin term for "before the event", while ex post refers to "after the fact".

3.7 In the context of competition law and economic regulation, ex ante regulation normally refers to the intervention by a regulator to control prices prior to or regardless of the evidence of the abuse of market power. Ex post regulation normally refers to intervention following some evidence of the abuse of market power.

3.8 Ex ante and ex post regulation are terms also used in environmental regulation to describe the choice between setting environmental standards and the use of litigation for damages following an environmental incident.[18] The terms are also used in the banking literature to describe alternative approaches to the regulation of bank capital requirements.[19]

3.9 With the exception of merger control, competition law is a type of ex post regulation. Under this type of regime, the law prohibits a number of behaviours such as price fixing, predatory pricing, excessive pricing and foreclosure. A competition authority may investigate potential breaches of competition law and if a firm has breached the law, they may be fined and/or required to take action to remedy the breach.

3.10 In contrast, price control regulation, such rate of return or price cap regulation is an ex ante form of intervention, whose primary purpose is to restrict the exercise of market power by a firm, which is often a natural monopoly. Under this type of regime, the regulator or the Government determines that a firm has market power and imposes requirements up front on the level of prices (and often on other outputs, such as the quality of service).

3.11 In Great Britain, network utilities were privatised with licence conditions that provided for price control regulation.[20] Price cap regulation was intended to protect consumers from monopoly pricing and to provide strong incentives for networks to make efficiency gains.[21]

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18 Yolande Hiriarty, David Martimortz and Jerome Pouyet, “Ex Ante Regulation and Ex Post Liability, *Economics Letters*, Volume 84, Issue 2, August 2004”.

19 Arup Daripa & Simone Varotto, 2004. "Ex Ante versus Ex Post Regulation of Bank Capital," ICMA Centre Discussion Papers in Finance icma-dp2004-12, Henley Business School, Reading University.

20 David Newbery, “The relationship between regulation and competition policy for network industries”, CWPE 0631 and EPRG 0611, March 2006.

21 At the same time, the delegation of regulation to an independent regulator with appropriate statutory duties was intended to provide comfort to investors that governments would not in

3.12 Unfortunately, the polar cases of competition law as a form of ex post regulation on the one hand and price cap regulation as a form of ex ante regulation on the other do not capture the variety of regulatory arrangements which lie between these two extremes. For example, requirements on firms to disclose cost information or to negotiate with customers to provide services fall short of price regulation, but are at least in some sense a form of ex ante regulation.

3.13 Clearly, there is a broad range of regulatory obligations from price controls to information disclosure and for the purpose of this study, it is necessary to consider the differences between ex post and ex ante in more detail.

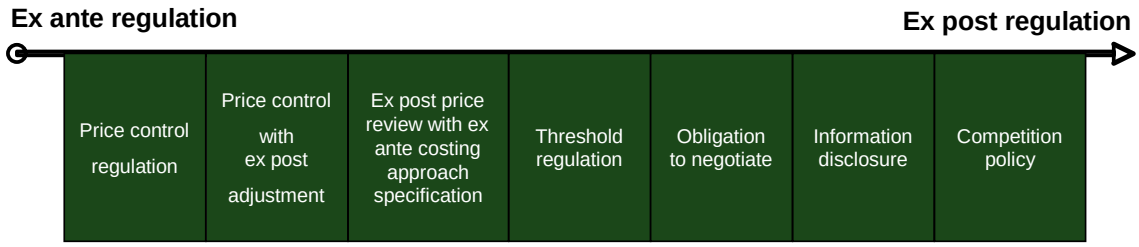
3.14 In our experience, when people discuss ex post regulation they often mean something more than the sole reliance on competition policy. Typically, they are referring to a regime that:

- focuses on delivery of outputs;
- has the ability to be light-touch or hands-off until a problem arises;
- has transparent rules on what will happen if the regime does not provide a credible threat to curbing the exercise of market power;
- provides scope for other players to be involved in delivery; and/or
- will still drive efficiency and innovation.

3.15 In the figure below, we set out a continuum of ex ante to ex post forms of regulation with 'pure' competition law at one end, and 'classic' price control regulation at the other end. In between there is a range of ex post regimes with increasing levels of regulatory intervention. These ex post regimes do not have an ex ante specification of prices but do include the various elements described in the last paragraph.

future appropriate their sunk investments by imposing unreasonable price controls.

**Figure 2: Ex ante to ex post regulatory continuum**




Source: LECG

3.16 Ex ante price controls present restrictions on the price of the regulated service that are set in advance of the price control period. These may take the form of a price ceiling or average revenue control. Typically, in the UK an RPI-X regime has been used, which specifies a formula for the maximum price (or revenue) with reference to inflation and an efficiency factor ("X") over a period.

3.17 Some ex ante regimes determine initial price limits but allow for ex post redetermination of a price cap in certain exceptional circumstances. These circumstances might include significant variation in demand forecasts or cost shocks outside the control of management. We refer to this as ex ante price control regulation with an ex post adjustment. We consider that this is the border case between ex ante and ex post regulation, as the types of regime to the right of this in the figure above do not set regulated prices on an ex ante basis.

3.18 An ex post price control with an ex ante specification of the approach to costs refers to a regime where the regulator sets out its approach to the consideration of prices but actually lets the company determine its own prices. Hence, the regulator does not approve prices ex ante. At the end of the period, the regulator considers whether the prices were reasonable and whether to intervene in the price setting process. Prior to the regulatory period, the regulator sets out its approach for considering reasonable prices. For example, the regulator may set out its approach to costing by either specifying a reference cost model or by setting out the principles it will use in the determination of cost. Clearly, this type of regime has a significant ex ante element. However, as the determination of the allowed price takes place following the regulatory period, this type of regime is typically considered to be ex post.

3.19 Under threshold regulation, the regulator specifies minimum outputs in the form of thresholds. These thresholds typically relate to price and/or quality. Potentially, thresholds could be applied to outputs or levels of investment. The thresholds are not binding on the regulated firm. If a threshold is breached, the regulator then investigates the breach and determines whether a price control needs to be applied. Whilst this is an ex post form of control, the regulator needs to determine the thresholds on an ex ante basis. The thresholds may need to be revised periodically.

3.20 Information disclosure and negotiation regimes (such as those proposed for medium sized airports in the UK[22]) require the regulated firm to provide information to customers and the regulator. The regime also prescribes the required interaction between the regulated firm and customers. This approach attempts to restrict the application of market power but still leave prices to be determined by the market.

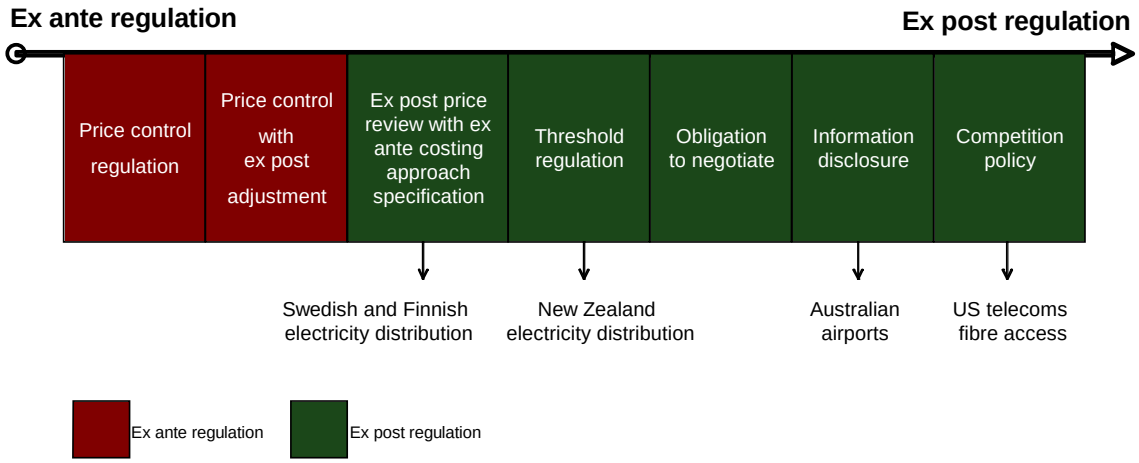
3.21 As noted above, for the purposes of this study, we define ex ante regulation as a regime where the regulator determines the price limit of a service prior to the regulatory period. All other forms of intervention are a form of ex post regulation. Hence, a decision to control prices after observing market behaviour is considered to be an ex post regime.

3.22 One feature of ex post regulation is that intervention depends on the behaviour of the firm (e.g. the price that the firm sets). In the case of competition law, a competition authority only intervenes if a breach of competition law is suspected. In the case of a thresholds regime, the sectoral regulator only intervenes if the firm sets prices that go beyond the threshold. Therefore, under ex post regulation the degree of intervention by the regulator is a function of the firm's behaviour.

3.23 Our definition of ex post regulation is depicted in Figure 3.

[22] Department for Transport, "Reforming the framework for the economic regulation of UK airports", March 2009. DfT proposes that those airports with more than 5 million passengers per year will have to consult on airport charges, and provide financial information.

**Figure 3: Ex ante and ex post regulation**




Source: LECG. The figure shows the case studies considered in this report and their location on the regulatory control spectrum.

## 3.3 Proposed assessment framework

3.24 To evaluate the pros and cons of ex post regulation and its application to energy networks in Great Britain, we have developed an assessment framework. Ofgem published its initial thinking on the assessment framework for the RPI-X@20 review in a working paper published in June 2009.[23] Ofgem structured its approach to the assessment framework in terms of the following.

- the outcomes that Ofgem wanted energy networks to deliver, such as efficiency, quality of service, environmental objectives and security of supply;
- the behaviour that Ofgem would expect the regulatory process to reward to achieve these outcomes, such as innovation and network engagement with consumers; and
- the desirable characteristics of Ofgem's regulatory process and frameworks for the future, such as openness to stakeholders and ensuring financeability of networks.

[23] Ofgem, "Regulating energy networks for the future: RPI-X@20 Working Paper 1"; 10 June 2009.

3.25 Whilst we have developed the framework to be consistent with Ofgem's framework, we have tailored it to the needs of this assignment. The basis for our assessment framework is drawn from the following the dimensions of "efficiency" and minimising regulatory burden:

- **the restraint of market power.** That is to protect consumers by aligning prices with costs;[24]
- **operational efficiency.** That is where the operating cost of producing the network service is minimised;[25]
- **efficient and timely investment and innovation.** That is to incentivise the optimal timing and level of investment and innovation.[26] This is not just about incentivising investment but also covers the right level of investment. Innovation is about improvements to processes and services that either provide additional value to consumers or reduce cost. The move to a low carbon energy system is likely to depend crucially on investment and innovation by networks. This criteria therefore reflects includes both of these elements;
- **regulatory burden.** That is the cost of implementing regulatory regimes to Ofgem, the energy networks and other stakeholders; and
- **stable and predictable regulatory process.** That is a stable and predictable regulatory framework, which provides a secure environment for long-term decision-making. This criteria also includes the requirement that the regime can be understood by investors and other market participants.

3.26 Our assessment framework, therefore, can be summarised as follows:

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[24] This is consistent with the economic concept of allocative efficiency, where the price of a good reflects its marginal cost. It is also consistent with maximising consumer welfare.

[25] Ofgem is concerned about efficient delivery of outputs, through efficient operating, investment and innovation decisions. However, we have distinguished between efficient investment and operating efficiency as this is consistent with the separate economic definitions of dynamic and productive efficiency. Hence, investment and operating efficiency are not necessarily distinct independent events.

[26] This is akin to what economists refer to as dynamic efficiency.

**Table 2: Assessment framework**

| Criteria | Dimensions |
|---|---|
| Protect consumers | Align prices with cost of network and protect consumers from the exploitation of market power by energy networks |
| Operational efficiency | Minimise operating cost of networks subject to delivering required outputs |
| Efficient and timely investment and innovation | Sufficient investment to delivery required quality of service and security of supply to consumers |
| | Network investment and innovation to meet and facilitate transition to low carbon economy |
| | Avoid excessive investment or gold-plating |
| Regulatory burden | Minimise costs to Ofgem, networks and stakeholders of regulation |
| Stable and predictable regulatory process | Provides certainty to stakeholders and can be understood by market participants and investors. |

Source: LECG

3.27 In Section 6, we apply the assessment framework to ex post regulation in general. In Section 7, we analyse the implications of our study for the regulation of energy networks in Great Britain. Prior to this assessment, we summarise the relevant economic literature and describe five case studies covering the actual application of ex post regulation in regulated networks.

# 4 Literature review

## 4.1 Introduction

4.1 In this section, we summarise the key themes in the economic literature on ex post regulation. Our literature review covers the debate on the application of ex post regulation in network industries. A detailed discussion of the literature is attached at Appendix 1.

## 4.2 Regulation and competition policy

4.2 Economic theory views regulation as a mechanism designed primarily to control natural monopolies. The purpose of regulation is to ensure socially optimal outcomes when the invisible hand of competition cannot be relied upon to produce reasonable prices and profits.

> *"Regulation, it is said, is a substitute for competition. Hence its objective should be to compel a regulated enterprise... to charge rates approximating those which it would charge if free from regulation but subject to the market forces of competition."*[27]

4.3 It is clear that, in circumstances where an incumbent is dominant and has market power, and where there are significant barriers to entry, the safeguarding of effective competition will require the regulation of the incumbent's prices, since these can in principle be used to deter competitive entry.

4.4 In economic terms, a dominant firm can take advantage of its market power to "extract" rents from customers that could not have been obtained by a non-dominant operator. Absent regulatory oversight, it is open to an incumbent to reduce prices in potentially competitive areas of business, and to raise prices in those areas less competitive. These issues arise not just in markets that are protected but also in markets in which competition has yet to develop fully.

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[27] Bonbright. 1966. Page 93.

4.5 The literature generally suggests that ex ante regulation is the best approach to protect consumers from firms that have enduring market power.[28]

4.6 Market power is a necessary although not a sufficient condition to warrant the imposition of ex ante forms of regulation. In all cases, the benefits of price control regulation should always be considered against the costs of regulation.

4.7 The literature notes that a major drawback of the competition law approach to regulation of networks is the dependence on the courts to resolve disputes.[29] Courts may be ill placed and slow to address pricing disputes.[30] There are many examples that prove this point. For example, an interconnection dispute took over four years and three rounds of court hearings to resolve in New Zealand under a competition law approach. Further examples are provided in Section 5.

## 4.3 The threat of regulation

4.8 The literature discusses the extent to which the threat of regulation (often under a form of light-handed regulation) is an effective form of ex post regulation. The threat of regulation relates to the introduction of ex ante price control under certain conditions. The theory is that the mere threat of regulation may restrain the exercise of market power by a monopoly and that this will avoid the need for intrusive ex ante regulation.

4.9 The effectiveness of this threat was first studied in the context of the intervention by competition authorities against collusion by firms. The research found that the threat of intervention by a competition authority could affect the behaviour of market participants.[31]

4.10 A number of studies have considered this approach in the context of price regulation.[32] For example, Cowan considered light-handed regulation in the New

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28 Damien Geradin and J.Gregory Sidak, "European and American approaches to antitrust remedies and the institutional design of regulation in telecommunications*", Handbook of Telecommunications Economics*, Volume 2, 2005 and Department for Transport, "Decision on proposed designation and de-designation criteria for airports", May 2007.

29 In the absence of ex ante regulation, this may lead to weak regulatory institutions, and hence the reliance on courts to resolve disputes.

30 David Newbery, "The relationship between regulation and competition policy for network utilities", June 2005.

31 Michael Block, Frederick Nold and J. Gregory Sidak, "The Deterrent Effect of Antitrust Enforcement, *Journal of Political Economy*, 1981.

32 Simon Cowan, "Alternative approaches to regulation: an economic analysis of light handed

Zealand telecommunication and energy sectors and in the Australian airport sector. He concluded that light-handed regulation avoids certain resource costs and the perverse incentives that may occur with heavy-handed regulation. He found that the threat of regulation might be sufficient to secure some of the desirable outcomes of regulation without the cost of regulation.

4.11 The literature also suggests that if the probability of regulation rises with price increases, then the actual price will be below the price that maximises unregulated profits. The probability of regulation and the elasticity of the probability with respect to price (i.e. how the probability of being regulated changes as prices change) will affect how cautious a firm is about raising prices above cost. However, it is found that prices will be above the prices set under ex ante forms of price control.

## 4.4 Experience with ex post regulation

4.12 In chapter 5, we present case studies on the selected use of ex post regulation. In this section, we summarise the literature on the use of ex post regulation in other cases. There are a number of studies on the effectiveness of regulatory threat in constraining prices in energy networks in Germany and New Zealand.[33]

4.13 A critical issue that has been identified relates to the credibility of the regulatory threat. If the threat of regulation is not credible, a light-handed regulatory regime amounts to leaving monopolistic firms unregulated. The failure of threat-based regulatory systems results from a potential free-rider problem associated with good corporate behaviour and a lack of credibility due to the weakness of the enforcement authorities or political constraints.

4.14 The free rider problem occurs when the same regulatory regime is applied to many firms in the same industry. The free rider problem occurs because there is little incentive for a single firm to constrain its behaviour, as its individual

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regulation", Paper for Australian Competition and Consumer Commission Regulatory Conference, July 2007 and Elliott CF and Acutt MZ, 2001, 'Threat-based regulation and endogenously determined punishments', Lancaster University Management School Working Paper.

33 Justus Haucap, Ulrich Heimseshoff and Andre Uhde, "Credible threats as an instrument of regulation for network industries, *Regulatory change, innovations and investment dynamics in the digital world economy*, Berlin, 2006 and Geoff Bertram and Dan Twaddle, "Price-cost margins and profit rates in New Zealand electricity distribution networks since 1994: the cost of light handed regulation", *Journal of Regulatory Economics*, 2005, and Gert Brunekreeft, "Regulatory threat in vertically related markets: the case of German electricity", CMI Working Paper 10, Cambridge-MIT Institute, August 2002.

behaviour will have little impact on the approach to regulation of the industry as a whole. Therefore, it has been found that individual firms will not be constrained by the threat of regulation.

4.15 The experience with light-handed regulation also suggests that the threat of regulation has often been in practice insufficient to constrain monopoly pricing in regulated networks.

## 4.5 Competition and innovation

4.16 The traditional industrial organisation literature predicts a negative effect of competition on innovation and economic growth. This is because competition reduces the monopoly rents that reward successful innovation. On the other hand, a common view from Adam Smith to Michael Porter is that competition enhances growth because it puts pressure on firms to cut costs, reduce slack and innovate in order to maintain market position, by introducing new products or new production processes [34].

4.17 Recent development in economic theory suggests that both approaches are right, to some extent. The promise of monopoly rents does incentivise innovation by firms. This is exemplified by patent protection, which provides a temporary monopoly to the inventor of the patented design. On the other hand, the threat of competition also motivated firms to seek out innovation to protect or enhance their position in the market.

4.18 The overall effect of competition on aggregate innovation is an inverted U shape. Innovation increases as competition increases to a point, then the level of innovation falls away as competition increases further.

## 4.6 Investment, innovation and regulation

4.19 Economic research suggests that price controls could reduce welfare even when the price is set well above marginal cost. This is because price regulation limits profits that act as a stimulus to the development of innovation. It also suggests that price cap and "light touch" regulation are more positively associated with innovation than rate of return regulation.[35] We discuss both innovation and

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[34] Philippe Aghion and Rachel Griffith, *Competition and Growth – Reconciling Theory and Evidence*, MIT Press, 2005.

[35] James Prieger, "Regulation, Innovation, and the Introduction of New Telecommunications

investment, as the discussion about the impact of regulation applies to both issues and for the telecoms sector discussed both issues are intrinsically linked.

4.20 The impact of ex ante price control regulation on both investment and innovation incentives have been considered in the telecommunications sector. Copper access has generally been subject to ex ante forms of price control regulation. However, there are concerns that such regimes do not adequately incentivise fibre or next generation access (NGA) investment.

4.21 One concern is that ex ante price regulation limits upside returns to the firm in the event that demand is high, while the firm retains the risk of not recovering cost if demand is low. The RAB approach used in energy networks in Great Britain may mitigate this risk if all investment is allowed to enter the RAB. In contrast, NGA investment must be recovered from users of the NGA. If demand is low, the network may be unable to recover its cost, even if it were allowed to charge higher prices, as higher prices will reduce demand.[36] A second issue is that an ex ante control does not provide the NGA with the ability to price above cost at the customers willingness to pay.

4.22 A number of regulatory approaches have proposed for next generation access regulation. These include regulatory holidays (in effect competition law), allowing a risk premium in determining the regulated price and allowing the regulated firms the freedom to set prices subject to a non-discrimination requirement.

4.23 The debate about pricing NGAs illustrates the difficultly of balancing the concern of promoting efficient and timely investment and protecting consumers. Regulatory holidays have been criticised for providing insufficient protection to consumers and allowing the re-monopolisation of access networks.[37] There are concerns that ex ante regulation will delay investment.

4.24 The approach being debated for NGAs may be relevant in energy networks if significant new investment is required and there is a high level of demand uncertainty. The RAB approach may lower the risk of deterring investment in the

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Services", *Review of Economics and Statistics*, Vol. 84, No. 4, November 2002, 704-715. James Prieger, "Telecommunications Regulation and New Services: a Case Study at the State Level", *Journal of Regulatory Economics*, Vol. 20, No. 3, November 2001, 285-305.

36 Gans, J.S. and S. P. King, 2004. "Access Holidays and the Timing of Infrastructure Investment." *Economic Records,* Vol. 44: 925-972.

37 EU Business, "EU challenges 'regulatory holiday' for Deutsche Telekom", 26 February 2007

energy sector. Consumers' willingness to pay for new investment may also be less of an issue in energy networks, especially if investment is driven by environmental concerns rather than providing new innovative services to consumers. This suggests that we need to be cautious about reading across the NGA regulatory debate to energy networks.

## 4.7 Conclusions

4.25 In summary, the literature review highlights the following points:

- ex ante regulation is typically applied in sectors where firms have persistent and significant market power. We found that the literature strongly supports the application of ex ante regulation in these markets, if the main goal is to ensure that consumers are protected from excessive pricing and other market abuses;

- the threat of regulation is an alternative to ex ante price regulation. It can protect consumer interest to some extent and exerts a lower regulatory burden than ex ante regulation. However, the level of consumer protection will depend on the credibility of the regulatory threat. In practice it may be difficult to design an ex post regime which provides the same level of consumer protection as ex ante regulation; and

- ex ante regimes can provide firms with incentives to invest. However, they do not provide firms with strong incentives to innovate or to invest when the demand for new services is uncertain. Certain ex post regimes, though not all forms of ex post regime, provide firms with better incentives to innovate.

4.26 We now review the application of ex post regulation to understand how these points may apply in practice.

# 5 Case studies

## 5.1 Introduction

5.1 In this section, we provide five case studies on the application of ex post regulation in practice. The case studies highlight the potential issues of ex post regimes and provide evidence on the performance of firms subject to ex post regimes.

## 5.2 Overview

5.2 We have considered the application of ex post regimes in electricity distribution in three different countries. Each regime contained a mix of ex post and ex ante provisions. The ex ante provisions included the determination of non-binding price limits and the specification of how costs and prices would be considered in the event of a dispute. Each ex post regime was itself an evolution from a less intrusive form of ex post regulation. However, these earlier, and arguably purer, forms of ex post regulation failed to protect consumers from the abuse of monopoly power. The evidence suggests that whilst the more intrusive ex post regimes were more effective at constraining market power, they also resulted in significant regulatory uncertainty and burden. Both Sweden and New Zealand have now moved to a more traditional form of ex ante regulation.

5.3 The experience with ex post regulation in telecommunications in the US and airports in Australia is more positive. Our case studies in these sectors provide examples of moving from ex ante to ex post regulation. The telecommunications case study demonstrates the attractiveness of ex post regulation when there is some network competition (e.g. from cable infrastructure) and when significant new investment is required. The airport case study demonstrates that the threat of regulation can constrain the monopoly behaviour of airports, at least partially.

5.4 In the table below, we summarise the key features and outcomes of the ex post regimes we have considered.

**Table 3: Summary of ex post regulation case studies**

| Case study | Type of regulation | Benefits | Problems | Future regulation |
|---|---|---|---|---|
| Sweden electricity distribution networks (1996 to present) | Ex post assessment of prices with detailed ex ante specification of regulatory approach to costing | Some protection of consumers from monopoly power | Uncertainty with respect to allowed prices and treatment of investment<br>Lengthy appeal process on whether prices were reasonable and so considerable regulatory burden. | Sweden to move to ex ante price control from 2012 |
| Finland electricity distribution networks (2005 to present) | Ex post assessment of prices with detailed ex ante specification of regulatory approach to costing. | Protection of consumers from monopoly power | Uncertainty on whether the regime incentivised efficiency | No proposed change |
| New Zealand electricity distribution networks (2002 to 2008) | Ex ante non binding price and quality thresholds | Some protection of consumers from monopoly power | Considerable number of disputes and uncertainty about treatment of threshold breaches | New Zealand moved to an ex ante price control in 2008. |
| US telecommunications fibre access networks (2002 to present) | Competition law | Considerable investment in new fibre access network | Higher broadband prices | Regime to be continued |
| Australian airports (2002 to present) | Competition law plus regular review | Productivity improvements and investment | Prices likely to be above cost | Regime reviewed in 2008 and to be continued |

## 5.3 Sweden

5.5 The current regulatory regime began in 1996 with the liberalisation of energy markets in retail and energy generation. The retail market was partially opened at this time and fully open for retail competition in 1999.

5.6 Prior to 1996, Sweden's energy markets were regulated through a 'light touch' ex post regime that was mostly self-regulatory in nature. In 1996, a more intensive ex post regime was introduced under which the regulator undertook an annual review of tariffs. The regulator has now decided to adopt an ex ante approach to price controls from 2012. We understand this change also complies with EU legislation requiring ex ante approval of tariffs or charging methodologies.[38]

5.7 In this section, we first provide some general background on Sweden's electricity market. We then explain how these markets are regulated. We then summarise the outcomes under the existing ex post regime in terms of price, investment, efficiency, and regulatory burden. Finally, we draw some conclusions on Sweden's ex post experience.

### 5.3.1 Background

5.8 The regulator in Sweden is the Energy Markets Inspectorate ("EMI"). The EMI has a number of roles, including: the supervision of the electricity, district heating and gas markets; the general development of energy markets; setting ground rules for active participation by consumers and SMEs; and the dissemination of information and promotion of transparency in energy markets.

5.9 The Swedish electricity transmission and distribution network is divided into three levels: the national grid; regional grids; and local distribution networks. The national grid (Svenska Kraftnat) is owned by the state. The regional grids are mostly owned by Vattenfall AB, E.ON Sverige AB, and Fortum Power and Heat AB. The local distribution networks are mainly owned by the large power companies and local authorities.

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[38] The EC has initiated legal action against Sweden for failing to adopt the appropriate measures to implement Article 23(2)(a) of Directive 2003/54/EC to provide for ex ante regulatory approval of charging methodologies. *Commission of the European Communities v Kingdom of Sweden*, Case C-274/08.

5.10 The distribution companies are required to unbundle in legal and functional terms (i.e. they are not permitted to generate or trade electricity). There are approximately 170 local network companies.

### 5.3.2 The ex post regulatory regime

5.11 The EMI does not approve network tariffs on an ex ante basis. Instead, it reviews network charges on an ex post basis by determining whether the returns of a firm are reasonable. The EMI performs an annual review of returns. The EMI takes action against companies that have unreasonably high returns.

5.12 Since 2003, the EMI has assessed tariffs using a Network Performance Assessment Model ("NPAM"). The EMI uses the model to estimate a network's efficient level of cost. The EMI compares actual revenue with the hypothetical cost estimated by the model. Firms with higher actual revenues are then subject to detailed regulatory scrutiny and investigation. If the EMI determines that returns are excessive then it requires tariffs to be adjusted in subsequent years.

5.13 NPAM is a reference network model. That is, it is used to design a virtual reference network based on the locations of supply, delivery and boundary points between the network and other networks. The design of the network in NPAM is based on building a new network (i.e. a Greenfield approach). The technical data required for this model is provided annually by the network operators. In addition, data is collected on transmission quality, such as the number of interruptions and their length. The model also takes account of exogenous criteria such as the location of connection points, the energy supplied, the number of costs, the cost of third party suppliers and the weather. The model is not intended to represent the efficient frontier or best practice but rather a reasonably efficient network.[39]

5.14 The NPAM model derives a reference network based on the amount of electricity transferred across a network in each year. In effect, the network is "rebuilt" every year, as the model designs an optimal network to meet demand based on current technology and equipment. This can lead to highly varying results from year to year. For example, if demand varies between years, then the design of the network may be adjusted in line with the change in demand. In early 2009, the EMI decided to cease use of the NPAM model.

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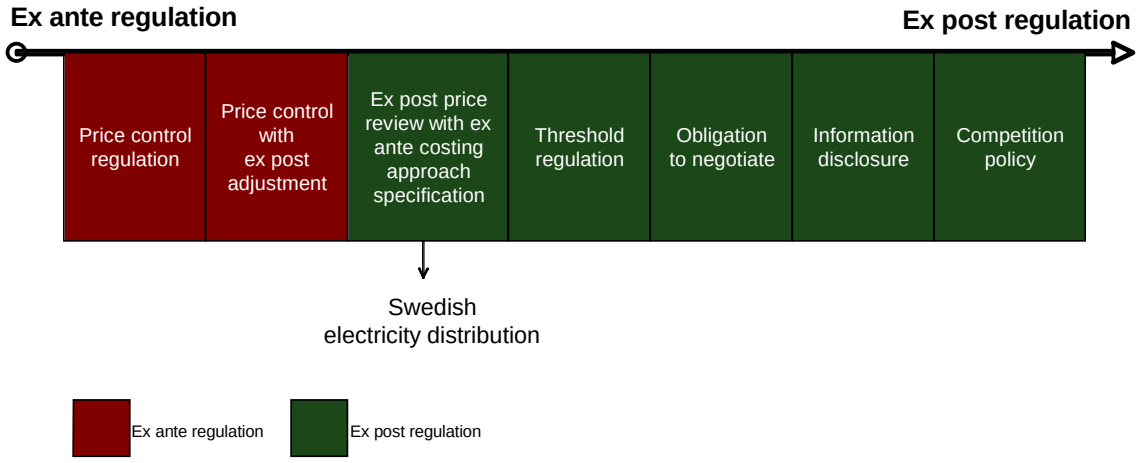
[39] Tooraj Jamasb and Magnus Soderberg, "Yardstick and ex post regulation by norm model: empirical equivalence, pricing responses and firm performance", 5 January 2009.

5.15 The Swedish regime incorporates a mixture of ex ante and ex post features. While regulatory prices are not determined on an ex ante basis, the approach does include the extensive ex ante specification of allowable cost.

5.16 In our ex post regime continuum, therefore, we place Sweden as an ex post price review with ex ante cost specification.

**Figure 4: Swedish regulatory approach to electricity distribution 1996-2012**



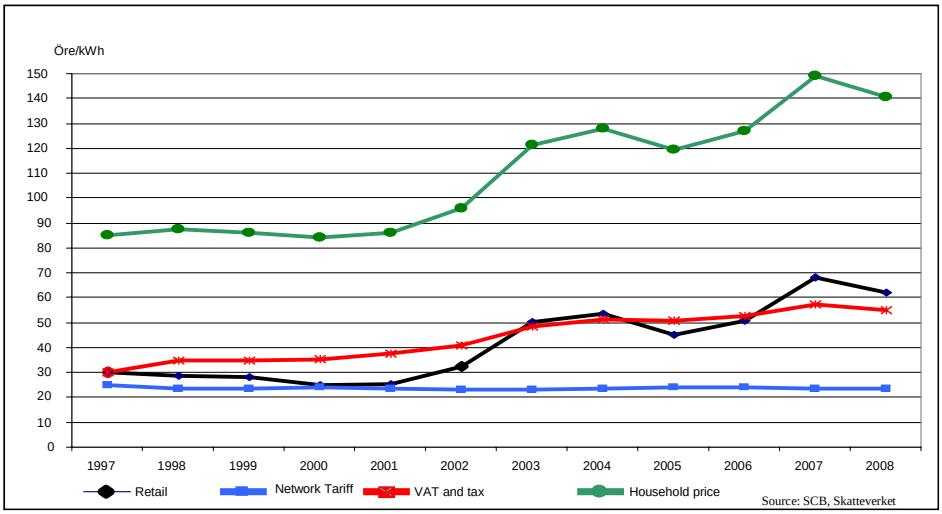

Source: LECG

5.17 We now review the outcomes under this regime.

### 5.3.3 Preventing excessive prices

5.18 Network tariffs have remained relatively constant over time, as shown below.

**Figure 3: Swedish electricity prices: 1996-2008**




Source: EMI

5.19 There has not been a significant increase in network prices above the rate of CPI over the period 1996-2008.[40] The regulator considers that the ex post regime has helped to hold tariffs down.

5.20 We note below that there has been prolonged process of network appeals against EMI's determinations. It has been suggested that networks may have held back price increases due to the uncertainty of the appeals process. If some of the appeal decisions go in favour of the firms, there may be a risk that this will set a precedent for future years, and for other firms, and prices may increase.[41]

### 5.3.4 Efficient and timely investment

5.21 The Swedish regulatory approach has been criticised because the annual assessment of costs makes investment with up-front costs and longer-term payoffs unattractive.[42] It has been found that efficiency improvements that require increased investment for longer-term gain are not incentivised. It is feared that investments will increase costs and may result in regulatory intervention.

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40 Statistiska centralbyrån (Statistics Sweden) website, www.scb.se. This excludes refunds arising from determinations of overcharging.

41 Correspondence with Energy Markets Inspectorate, 7 August 2009.

42 See Jamasb and Pollitt.

5.22 The complaint has been that the practice of evaluating network tariffs each year does not provide certainty for long term network planning and investment. The network businesses are run on a long-term basis and active decisions regarding the business operation are aimed at the long term. The EMI also considers that annual ex post reviews and the NPAM model are too short term oriented.[43]

### 5.3.5 Efficiency

5.23 Allowed revenues are based on a reasonable level of operating costs as determined by the NPAM model. They are not based on a firm's actual operating cost. This means that a network can retain the benefits from efficiency gains arising from reduced operating cost. However, for investments, efficiency gains that result in short term increases in operating (or capital) cost will be unattractive, as efficiency is assessed on an annual basis.

5.24 Efficiency incentives are dependent on the model providing an accurate reflection of each network's cost. Independent review of the NPAM model found that the model did not accurately predict the cost of smaller networks serving rural areas[44].

5.25 Research suggests that investor owned networks did make efficiency gains under this form of regulation. Networks that were deemed less efficient by the model subsequently reduced their cost. The quality of services incentives, however, appeared to be ineffective.[45]

### 5.3.6 Regulatory burden

5.26 EMI's review of network tariffs has been subject to considerable litigation[46] and many of the original review decisions have been partly reversed by settlement following appeal by the network companies. There are three levels of appeal, and cases may take up to 12 years to complete.

5.27 Between 2003 and 2007, the EMI investigated whether returns were too high in approximately 50 to 75 cases, following the annual ex post revenue process. In 2003, nine network companies were ordered to refund substantial amounts to

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43 Correspondance with Tony Rosten, see above.

44 See Jamasb and Soderberg

45 See Jamasb and Soderberg.

46 Tooraj Jamasb and Michael Pollitt, "Reference models and incentives regulation of electricity distribution networks: an evaluation of Sweden's Network Performance Assessment Model",

customers. All of these decisions were appealed, and have lead to protracted litigation. With these outstanding, the EMI decided against determinations between 2004 and 2007.

5.28 Once it became clear to the EMI that the ex-post regime was to be abandoned, the cases from 2003 were settled out of court. The companies agreed to pay back approximately €14 million to customers. Following this, a similar settlement process was used to close all cases between 2004 and 2007.

### 5.3.7 Conclusion

5.29 The table below provides a summary of our review of the Swedish ex post regulatory approach. In conclusion, we consider the approach has not been successful due to the level of regulatory burden and uncertainty it created. For these reasons, and others, the regulator has decided to adopt an ex ante approach to price controls from 2012.

Cambridge Electricity Policy Review Group (EPRG), September 2007.

**Table 4: Summary of Swedish experience of ex post regulation**

| Criteria | Comment |
|---|---|
| | Prices have been held down since implementation in 2003, though there has not been a notable decline. |
| Preventing excessive pricing | All outstanding cases have been settled with the move to ex ante regulation from 2012.<br><br>In theory and practice, this form of control has restrained market power. |
| Efficient and timely investment | The effectiveness of the regime depends on the robustness of the bottom up model. No major issues have been noted, but the annual review process and the theoretical model could discourage long term investment planning. |
| Operating efficiency | There is evidence that this approach incentivised efficiency gains. |
| Regulatory burden | Considerable level of regulatory burden in terms of regulatory reviews, the development and implementation of the model and a significant number of disputes. |
| Regulatory certainty and transparency | Limited certainty and transparency of appeals process. The ex post process was not stable, and the regime is moving to an ex ante form of control. |

Source: LECG

## 5.4 Finland

5.30 The Finnish electricity market was liberalised for large customers in 1995 and for all customers in 1997. Prior to 2005, the distribution and transmission networks were controlled by a light handed ex post regulatory regime. There was no ex ante setting of prices, no guidance on pricing methodologies, and investigations into overcharging were only triggered by complaints or on the regulator's own initiative. There were about 20 investigations between 1997 and 2005. In 10 of these investigations, the companies were found to have made excessive profits and were required to lower prices. In 2005, Finland moved to a more intensive system of ex post regulation.

5.31 In this section, we first provide some general background on the electricity market in Finland. We then explain how these markets are regulated. We then summarise the outcomes under the existing ex post regime in terms of price,

investment, operating efficiency, and regulatory burden. Finally, we draw some conclusions on the Finnish ex post experience.

### 5.4.1 Background

5.32 Electricity transmission has been legally and functionally unbundled from supply and generation. Fingrid is the monopoly responsible for transmission over the national grid on 400 kV, 220kV and most 110kV lines. The company also owns cross-border lines into Sweden, Norway and Russia. Fingrid is mostly privately owned, with one eighth of its shares owned by the Finnish state.

5.33 There were 13 regional network companies and 88 distribution companies at the beginning of 2009. Most of these are in municipal ownership. All distribution companies are for profit companies.

### 5.4.2 The ex post regulatory regime

5.34 The current ex post regime has a four-year regulatory period.[47] Before the start of each period, the Finnish energy regulator, the Energy Market Authority ("EMA") issues the methodology to be used over the next period for pricing of network services. The methodology includes:

- the principles to be followed for the valuation of capital invested;
- the permitted rate of return; and
- an efficiency and quality of supply goal and the principles for applying that goal to prices.

5.35 The efficiency target includes company specific differences, which are calculated by benchmarking networks using a DEA-model (Data Envelopment Analysis) and a SFA-model (Stochastic Frontier Analysis).

5.36 The regulator considers allowable costs on a replacement cost basis.[48] The replacement cost is based on the quantity of equipment, which is supplied by the network, and a price schedule determined by the regulator. The EMA determines

47 The first period was two years between 2005 and 2007.

48 Satu Viljainen et al, "Regulation of electricity distribution businesses", Lappeenranta University of Technology, 2004.

the level of reasonable return and notifies the operator during the financial year.[49] Networks are allowed to earn a higher rate of return in any single year, provided that returns over the regulatory period do not exceed the permitted level of returns. Operating costs (excluding depreciation) are drawn from the firm's financial statements and adjusted by the DEA/SFA process discussed above.

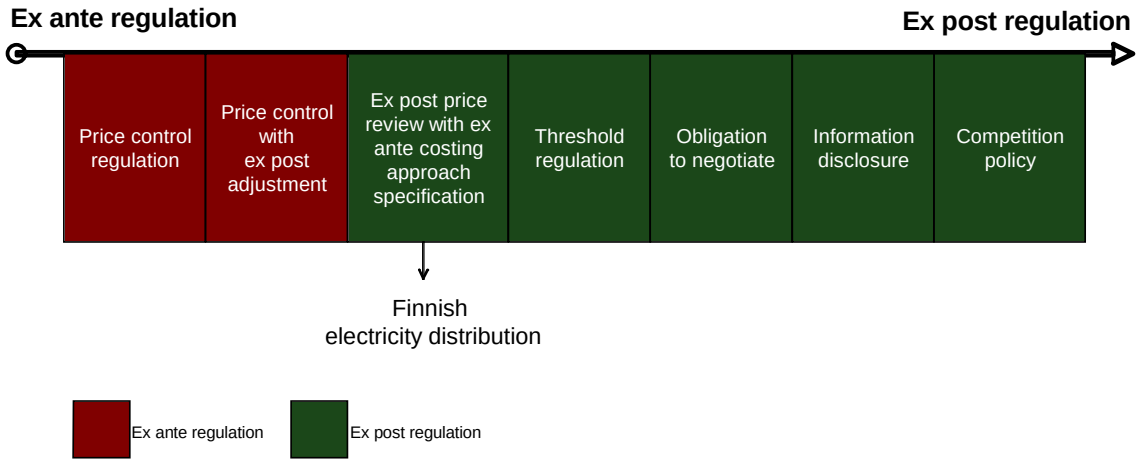
5.37 On an annual basis, the EMA calculates the actual profit earned by firms from the financial statements. After the regulatory period, the EMA makes a decision, for each ENO, on whether their earnings have exceeded or fallen below the reasonable return over the regulatory period as a whole. Any required adjustments will be applied to the following regulatory period. These decisions can be appealed by the network.

5.38 In theory, networks are free to determine their prices. However, in reality they are constrained by the process of ex post review and the ex ante setting of costing principles, the rate of return and the efficiency target. The ex post element of the regulation comes from the ability of the regulator to assess the reasonableness of the charges made at the end of each regulatory period.

5.39 However, this regime is ex post regulation with a considerable ex ante component. In terms of the regulatory continuum, we place the Finnish ex post model in a similar place to the Swedish approach. It is interesting to note that despite the similarities with the Swedish approach, the EC has not challenged Finland as to the compliance of this approach with the requirement for ex ante approval of network tariffs or methodologies.

[49] EMA, "Appendix 1 Method for determining the return on electricity networks during the regulatory period starting on 1 January 2008 and ending on 31 December 2011."

**Figure 5: Finnish regulatory model**




Source: LECG

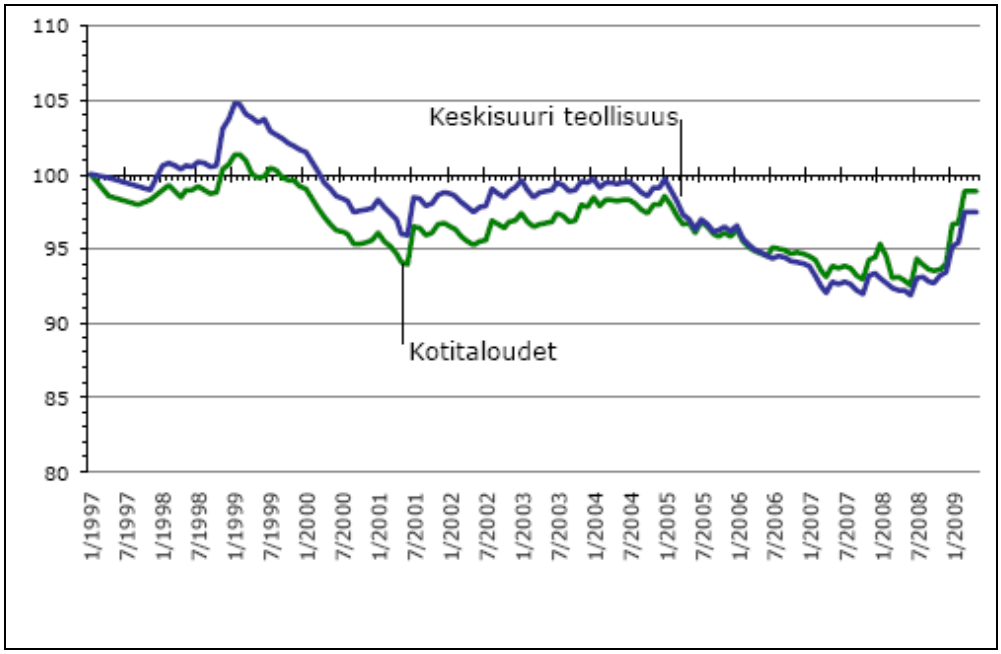
5.40 We now review the outcomes under this regime.

### 5.4.3 Preventing excessive pricing

5.41 As the ex post regime has been operating for a short period, there is a short period of time to assess pricing outcomes. In 2008, the network charge for standard customers excluding taxes rose by between 3 and 3.6 per cent. In the period from 2005 to 2006, 91 of the 102 electricity networks set prices below allowed prices.

5.42 The figure below shows distribution charges for Finnish electricity networks in real terms between 1997 and 2009. The green line is for households and the blue line for small and medium enterprises (SMEs). They show that since the new ex post regime was introduced in 2005, real prices have fallen and then increased and overall remained relatively constant. Overall prices also remained constant under the previous ex post regime between 1997 and 2005.

**Figure 6: Finnish distribution charges for households and SMEs**




Source: EMA.

5.43 We would expect the significant ex ante specification of this regime to restrict prices.

### 5.4.4 Efficient and timely investment

5.44 The regulator claims to encourage investment through the regulatory model. The regulated asset value is based on replacement costs. The EMA determines allowable costs (standard cost) for key cost items such as plant and equipment.

5.45 New investment is included in the asset base, which influences the allowable return of the network. The regulator may accept higher investment costs than the standard cost but these costs have to be justified by the network company. If a firm's actual costs are lower than the standard cost, it is able to retain the benefit.

5.46 Investments for lines above 110 kV are agreed ex ante by the regulator. In general, investment projects have been allowed by the regulator. Generally, larger investment projects are purchased through public tender.

5.47 Significant investment is taking place in the transmission network. Fingrid is investing up to €1,600 million in the grid and reserve power over the next 10 years.[50]

5.48 The previous ex post regime was criticised as providing incentives for over-capitalisation as there was little incentive for efficient capital investment.[51] The new regime does impose limits on the costs accepted by the regulator and this may provide greater incentive for efficiency. It is too early to tell whether this incentive is effective. Transmission investment (above 110Kv) is approved ex ante and hence it is not effectively subject to the ex post regime.

### 5.4.5 Operating Efficiency

5.49 The incentives for efficiency are somewhat unclear. On the one hand, the regulator's use of a standard costing methodology provides some incentives for firms to meet or outperform the standard. On the other hand, it is not clear how demanding these standards are, or whether the ability for firms to justify higher cost will undermine the incentives to be efficient.

5.50 Operating efficiency gains will be dependent on the DEA/SFA process. Experience with DEA under the previous ex post regime resulted in a high level of inconsistency between networks and large annual variations.[52]

5.51 However, if implemented properly, the regime should provide framework for ongoing efficiency gains, as new efficiency targets are set for each regulatory period.

### 5.4.6 Regulatory burden

5.52 The new framework is in its second price control. In the first period, almost all firms complied with the allowed prices. While there would appear to be some potential for extended litigation, with two levels of appeal court for EMA decisions, in practice, there have been few appeals.[53]

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50 Fingrid Stock Exchange release, 17 February 2009, http://www.fingrid.fi/portal/in_english/news_and_releases/stock_exchange_releases?bid=850

51 Satu Viljainen, see above.

52 Satu Viljainen, see above.

53 Correspondance with EMA, 18 September 2009.

5.53 The move to the new ex post regime was in part motivated by the inability of the regulator to complete investigations within a four-month period as required by EU legislation.[54]

5.54 The revised process requires the regulator to assess network prices and form a view as to whether prices are reasonable. It is unclear whether this process is more burdensome than an ex ante form of control.

### 5.4.7 Conclusion

5.55 The table below provides a summary of our review of the Finnish ex post regulatory approach. The Finnish ex post regime has been in place for a relatively short period of time. It represents an evolution of the previous ex post regime with a significantly enhanced ex ante component. The Finnish regulator performs a rigorous determination of returns and so implicitly prices on an ex post basis using actual data, as opposed to determining allowable returns on an ex ante basis using forecast data. However, the regulator still determines many of the pricing building blocks on an ex ante basis (e.g. allowed returns, efficiency, investment, etc).

[54] Satu Viljainen, see above.

**Table 5: Summary conclusion: Finland**

| Criteria | Comment |
|---|---|
| Preventing excessive pricing | Too short a period to evaluate. However, the regime helps to align prices with cost.<br><br>Transmission subject to ex ante agreement with regulator. |
| Efficient and timely investment | Previous regime criticised for encouraging over investment.<br><br>Incentives for efficient investment still appear relatively weak under the new regime. |
| Operating efficiency | Previous experience with DEA unreliable. Unclear the effectiveness of DEA/SFA in revised regime.<br><br>If implemented correctly, the regime should provide incentives to make efficiency gains. |
| Regulatory burden | The four yearly ex post review process appears similar to a traditional ex ante price control. |
| Regulatory certainty and transparency | First ex post review appears to be successfully completed.<br><br>Evolution from ex post towards ex ante regulation over time. |

Source: LECG

## 5.5 New Zealand

5.56 In this section, we consider New Zealand's experience of threshold-based regulation, which operated between 2001 and 2008 for electricity distribution businesses ("EDBs").

5.57 We first provide some general background on electricity markets in New Zealand. We then summarise the success of the ex post regime in terms of price, investment, operating efficiency and regulatory burden. Finally, we draw some conclusions on New Zealand's ex post experience.

### 5.5.1 Background

5.58 New Zealand's economy, including its regulatory institutions, underwent wide-ranging reforms from the mid 1980s to the early 1990s. Infrastructure businesses from the early 1990s were subject to various forms of regulatory monitoring regimes, all of which incorporated some degree of information disclosure and the application of general competition policy. None of these regimes required a regulator to determine prices for infrastructure services.

5.59 In the electricity sector, New Zealand was one of the earliest countries to adopt a competitive model in generation and in retail. The removal of retail franchise areas occurred in 1992 and the establishment of a wholesale electricity market occurred in 1995.

5.60 The EDBs were not state-owned and their ownership arrangements evolved differently. They were owned in the early 1990s variously by municipalities, consumer or regionally based trusts, or a combination thereof. Currently there are 29 EDBs.

5.61 In 1998, the Electricity Industry Reform Act was passed. The principal focus of the Act was to require ownership (or structural) separation of electricity distribution from retail and generation. The Act did not impose regulatory controls on electricity distribution prices. However, the EDBs were subject to enhanced information disclosure requirements.

5.62 In 2001, following a change of government and a Ministerial Review of the electricity sector,[55] a thresholds regime was legislated for (Part 4A of the Commerce Act).

5.63 The ex post thresholds regime was modified into an ex ante price control from 2008.

### 5.5.2 Description of New Zealand's ex post regime

5.64 Under the thresholds regime (which was superseded in 2008),[56] the regulator was the Commerce Commission ("Commission"), which is New Zealand's competition authority. The regime applied to all EDB services inclusive of and related to

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55 "Inquiry into the Electricity Industry", Report to the Minister of Energy, June 2000 http://www.med.govt.nz/upload/29766/final.pdf

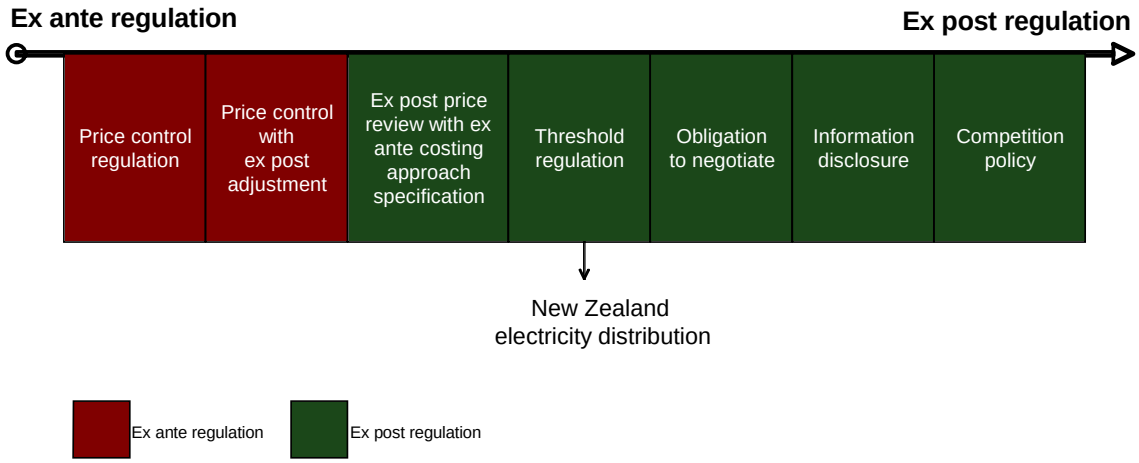
56 This regime was set out in Part 4A of the Commerce Act.

electricity lines services, with discretion on the part of the regulator to exclude such services that it considered were provided in workably competitive markets.

5.65 The thresholds aspect of the regime incorporated three steps. First, the Commission established a threshold for price, service quality and customer consultation. It was lawful to breach these thresholds, but each EDB was required to report compliance or otherwise against the thresholds annually. Second, the Commission was required to investigate an EDB following any breach of a threshold, though the Commission had the discretion not to investigate. Finally, the Commission had the ability to place an EDB under price control, following an investigation. If an EDB was placed under control (none were), the Commission had the powers to set its prices and service quality requirements.

5.66 We place the New Zealand thresholds regime on the regulatory continuum in the figure below.

**Figure 7: New Zealand thresholds regime on the regulatory continuum**




Source: LECG

5.67 The primary task of the Commerce Commission until 2001 was to enforce New Zealand's competition law. It also had the responsibility to undertake any investigations as to whether certain goods and services should be placed under regulatory control, but had undertaken only one such investigation (into airport services) since its establishment in 1986 and no goods or services had been placed under control. Hence by 2001 the Commission had little expertise or experience in administering any form of price regulation.

5.68 The first task for the Commission under the threshold regime was to set the thresholds (for price, service quality and customer consultation) for each EDB. The first set of price thresholds were set relative to each EDBs' prices at the time the relevant legislation was passed. Price was defined as a weighted average of the various tariffs of an EDB, with the volumes for each tariff held constant from year to year, thus resulting in a price cap as opposed to a revenue cap, with the EDB carrying volume risk (up and down). [57]

5.69 The service quality thresholds were set to ensure no material deterioration below the average service level from the previous five years. This was measured in terms of a System Average Interruption Duration Index (SAIDI) and a System Average Interruption Frequency Index (SAIFI). The thresholds for customer consultation were less prescriptive, with the Commission just requiring EDBs to demonstrate that they had undertaken the required consultations.

5.70 The Commission undertook considerably more analysis of EDB performance in the lead up to resetting the thresholds to apply from April 2004.[58] It commissioned a total factor productivity (TFP) analysis of EDBs, individually and as a sector, and reset the price thresholds for each EDB based on three results from the TFP analysis:

- an industry-wide TFP historical trend analysis, relative to the TFP trends in the wider economy (a B factor);
- an EDB's productivity relative to other EDBs (a $C_1$ factor); and
- an EDB's profitability relative to other EDBs (a $C_2$ factor).

5.71 The resulting price thresholds commenced with the starting prices of those of the previous thresholds as at March 2004, with a CPI – X change formula, with the "X" for the EDBs ranging from 2 to -1.

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57 Commerce Act (Electricity Lines Thresholds) Notice 2003: Pursuant to Section 57G and 57T of the Commerce Act 1986, New Zealand Gazette, 6 June 2003 - Issue no. 62. Available from: http://www.comcom.govt.nz/IndustryRegulation/Electricity/ElectricityLinesBusinesses/TargetedControl/ContentFiles/Documents/TheCommerceAct6June2003.PDF

58 Commerce Commission, "Regulation of Electricity Lines Business Targeted Control Regime: Threshold Decisions (Regulatory period beginning 2004)". Available from: http://www.comcom.govt.nz//IndustryRegulation/Electricity/ElectricityLinesBusinesses/TargetedControl/ContentFiles/Documents/Final%20Threshold%20Decisions%20Reissued%20with%20Gazette%20Notice%20(Regulatory%20Period%20Beginning%202004).PDF

5.72 The service quality thresholds were again set at "no material deterioration", and the average values for SAIDI and SAIFI of the previous five years were used as the baseline to assess whether this threshold had been met.

5.73 The customer consultation threshold remained relatively unprescriptive, requiring EDBs to demonstrate they had undertaken appropriate consultations.

5.74 These thresholds were set for a five-year period. The Commission had the discretion to determine the period over which thresholds were to apply. It was thought that the selected period provided a reasonable balance between the certainty required by EDBs to have incentives to operate their businesses efficiently, and cost reductions to be passed to consumers periodically. The Commission was also guided by the use of five-year regulatory periods in other jurisdictions (e.g. in Australia and the UK). The reset of thresholds turned out to be the last reset under the thresholds regime as the empowering legislation was changed in 2008.

5.75 The Government reviewed the thresholds regime in 2008. The EDBs argued for an ex ante control regime due to the lack of certainty under the threshold regime and the absence of an appeals process.[59] The Commission on the other hand submitted a preference for continuance of the thresholds regime.[60] The government was convinced of the need for change to ensure a sufficiently certain regulatory environment that would be conducive to investment in the sector.

5.76 The new regime has a thresholds element, but prices are determined ex ante. The new regime:[61]

- imposed regulatory price control on all EDBs except those owned entirely by a consumer of regional trust (such governance arrangements were perceived as an adequate substitute to control);
- required the Commission to set out in advance the "input methodologies", which are the methods the Commission uses to determine price caps for

59 Electricity Distribution Lines Businesses in New Zealand, ibid.

60 Commerce Commission, "Review of Regulatory Provisions under the Commerce Act 1986: Submission on MED's Discussion Document", 6 July 2007. Available from: http://www.med.govt.nz/upload/48550/commercecommission.pdf

61 Now Part 4 of the Commerce Act.

EDBs. This requirement was in response to the EDBs concern of a lack of certainty under the targeted control regime;

- required the Commission to set "default price/quality paths" in a relatively low cost manner, and to use productivity analysis in the setting of these default paths. The Commission is currently in the process of setting the first of these default paths; and

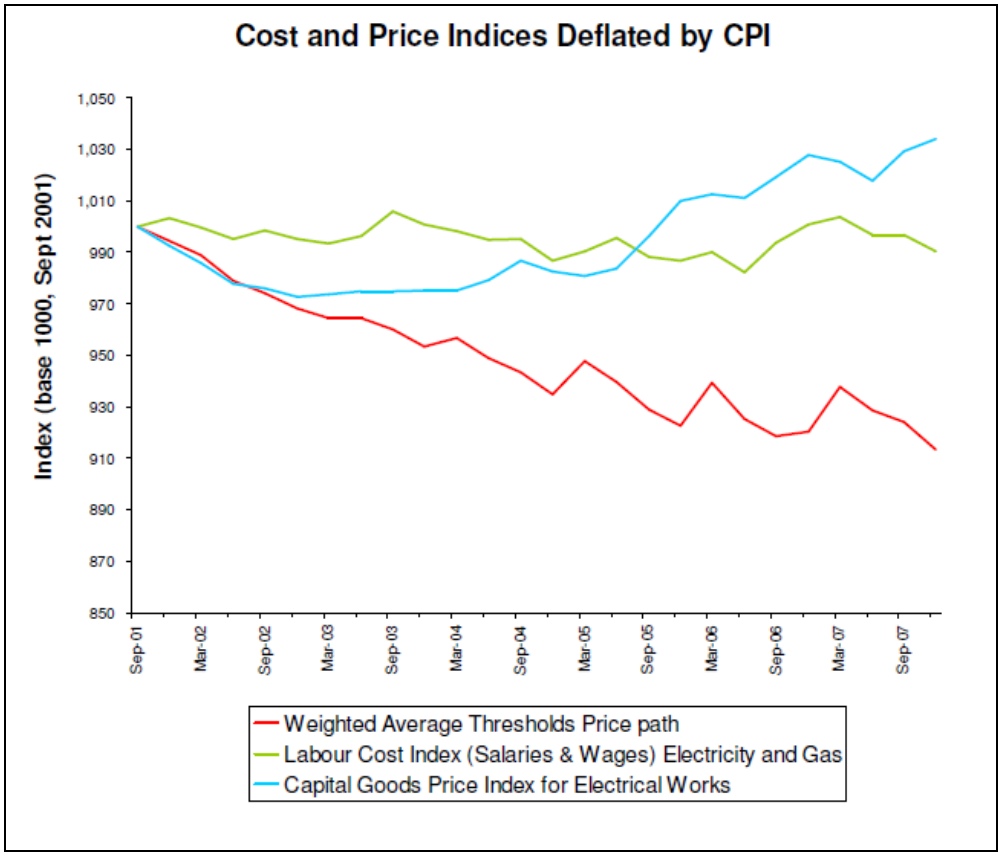
- enabled an EDB to apply for a customised price/quality paths if it is dissatisfied with its default path.

### 5.5.3 Prices

5.77 The figure below shows that EDB threshold price path declined in real terms during the period (see weighted average threshold price path). Prices moved in line with the threshold caps except for two or three small EDBs who lifted their prices above the threshold caps. This might suggest that the thresholds regime was reasonable successful in restraining prices over the period. The price reduction was not at the expense of quality, as performance against quality thresholds improved compared to earlier periods.

5.78 It is likely that EDB prices were above cost at the beginning of the thresholds regime. Bertram and Twaddle (discussed in Appendix 1) found evidence that prices were above cost under the previous light-handed regulatory regime. Hence, even though prices fell in line with the threshold, it is likely that prices were still above cost.

**Figure 8: NZ Electricity Distribution Prices: 2001-2008**




Source: Electricity Distribution Business of New Zealand, "Submission to the Commerce Commission's Reset Discussion Paper" 29 February 2008.

### 5.5.4 Efficient and timely investment

5.79 The EDBs were concerned about the lack of certainty as to the actions the Commission would take subsequent to a breach of a threshold, and the basis on which the Commission would determine an acceptable price path in the event an EDB was placed under control. This lack of certainty influenced the ability of networks to take long-term investment decisions. However, the lack of certainty may arise, at least in part, from the Commission's approach to the implementation of the regime rather than as a function of the ex post regime itself.

5.80 EDB investment levels increased over the period of the targeted control regime and are continuing to increase. This reflected growth in demand, and the stage in the EDBs' investment cycle and age of assets. Much of rural New Zealand was reticulated for electricity in the 1950/60s under a government-sponsored scheme and many of those systems are entering their renewal phase. There was one case where investment was deferred by one year due to uncertainty raised by the

Commission investigating a breach of thresholds The Commission decided to issue a notice to "intend to control" Vector's electricity distribution business. Vector, as part of its response, deferred all discretionary capital expenditure for about one year while it negotiated an administrative settlement with the Commission. It has subsequently re-instated its capital expenditure programme.

### 5.5.5 Operating efficiency

5.81 There is little evidence on operating efficiency under this thresholds regime, aside from the high-level observation that prices declined while quality of service improved. In theory, we would expect the regime to provide some incentive to make efficiency gains, as networks are able to retain the benefits at least over the threshold period.

### 5.5.6 Regulatory burden

5.82 A large number of EDBs breached their thresholds following the reset in 2004, with most breaches arising for one or more of the following three reasons:

- inadvertent breaches of the price threshold due to a mismatch in the level of transmission charges levied by the transmission operator in any year and the amount recovered by the EDB. The thresholds allowed transmission charges to be "passed through" to consumers each year, but also required any reductions in these charges to be passed through in the year they arose. In practice, it was difficult to match these amounts precisely;

- intentional breaches of the price threshold by EDBs raising their prices. It was lawful for EDBs to intentionally breach the threshold and a small number did so, on the basis that they considered their existing prices did not adequately compensate them for required investment in their networks; and

- inadvertent breaches of the service quality threshold, mainly arising from severe storms giving rise to higher than average SAIDI or SAIFI values. The service quality threshold did not have a "dead band" around the average value.

5.83 When an EDB breached a threshold, the Commission was required to either commence an investigation, or state that it would not be taking further action. In practice, it was slow in processing threshold breaches. As of 2007, there were

127 breaches, of which only 25 had been resolved, leaving 102 unsettled. Many of these unsettled breaches were over two years old.[62]

5.84 The Commission issued guidelines for investigations,[63] which were largely procedural in nature. In practice, the Commission undertook only two investigations of the 127 breaches, both related to breaches of price thresholds (one intentional arising from prices increases, the other inadvertent). In both cases, the Commission reached an administrative settlement that included the EDB returning to its original price threshold levels.

5.85 There regulatory burden under the threshold appears to be substantial, and perhaps as burdensome as an ex ante regulation approach.

### 5.5.7 Conclusions

5.86 The New Zealand experience provides an interesting example of the evolution of an ex post regime from regulatory threat and competition law (1995-2003), to a threshold ex post regime (2003-2008) and now to an ex ante control regime.

5.87 We summarise our assessment of the ex post threshold regime below.

62 "Response to MED Review of the Regulatory Control Provisions under the Commerce Act", From the Electricity Distribution Lines Businesses in New Zealand, 6 July 2007, p. 12. Available from: http://www.med.govt.nz/upload/48550/edlb.pdf

63 Commerce Commission, "Regulation of Electricity Lines Businesses, Targeted Control Regime, Assessment and Inquiry Guidelines" 19 October 2004.

**Table 6: Summary: New Zealand Thresholds regime**

| Criteria | Comment |
|---|---|
| Preventing excessive pricing | Threshold was effective in holding down prices during the period it was operational.<br><br>However, a thresholds regime is unlikely to align prices to cost, unless thresholds are reset to cost periodically. It they are, then this approach moves towards an ex ante form of control. |
| Efficient and timely investment | Criticism of the regime for providing insufficient certainty for investment.<br><br>Limited evidence of actual impact. |
| Operating efficiency | Little evidence of outcome – some incentive to make efficiency gains. |
| Regulatory burden | Extensive investigation and review process required. |
| Regulatory certainty and transparency | Process appeared to break down under the weight of investigations required. |

Source: LECG

## 5.6 United States next generation access regulation

5.88 Under heading 4.5 of the literature survey section, we noted the debate in the telecommunications sector on the role of ex ante and ex post regulation. The roll out of next generation access networks has reinvigorated that debate. The United States has opted for an ex post regime, in contrast to developments in Europe. In this section, we briefly outline the developments in the United States. We have not discussed the developments in Europe as decisions are still being made on the European regulatory framework for fibre access.

### 5.6.1 Ex post regulation

5.89 The United States moved away from wholesale access based competition in 2003 and has pursued a policy of forbearance and de-regulation of wholesale access, relying instead on the competition between cable and fixed operators. The United States has reversed its approach to unbundling facilities and there are no obligations on the telecommunication operators rolling out NGA to provide access to third parties. Unbundling in this context refers to a regulatory obligation on the

incumbent networks to lease wholesale access lines to competitors at cost-based prices. Unbundled access allows competitors to offer a full range of broadband and narrowband retail services to consumers.

5.90 This outcome was the result of protracted litigation regarding the unbundling regulation on the copper network since 1996.

5.91 In 2003, the FCC decided not to require unbundling in next-generation networks using fibre-based local loops.[64] These rules should, according to the FCC, "*strike the appropriate statutorily required balance between ensuring competitive access and maintaining incentives to invest in next-generation networks*".[65] The FCC argued that the decision not to demand unbundling of incumbent local exchange carriers (LECs) next-generation networks would stimulate facilities-based deployment in the following ways:

- it would promote investments in and the deployment of NGA networks since incumbent LECs would have the opportunity to reap benefits of delivering these broadband services to the market; and
- it serves as an incentive for competitors to seek innovative network access options to compete with the incumbent for end-users (as wholesale unbundled access is not mandated).

5.92 The FCC argued that ultimately, consumers would benefit from investments in building NGNs and from the increased competition in the market for delivery of broadband services. Later in 2005, the FCC extended the de-regulation of access products from NGA to copper loops for broadband provision.[66]

5.93 In the figure below, we place the US fibre access regime at the competition law end of the continuum due to the absence of ex ante regulation obligations and ex post prices reviews by the regulator.

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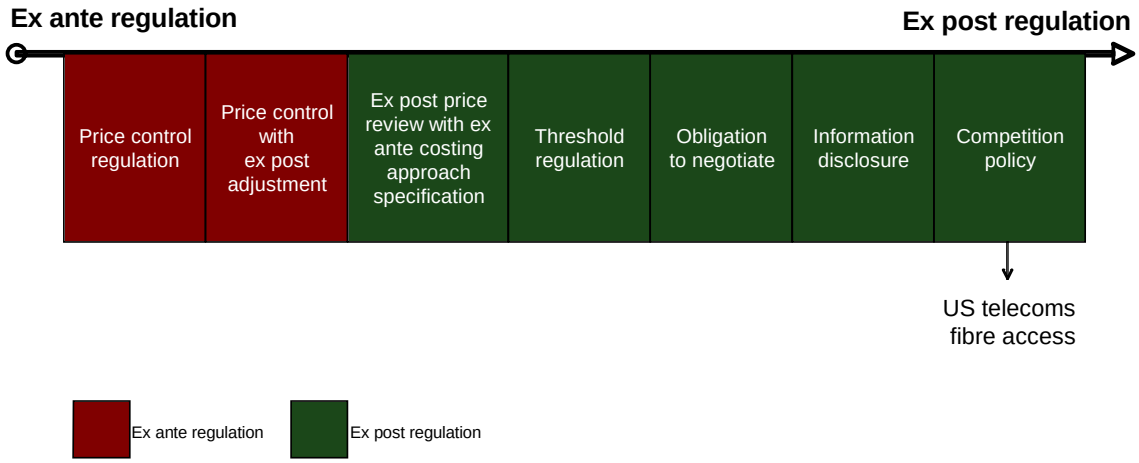
64 Federal Communications Commission. 2003. "Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (CC Docket No. 01-338), Implementation of the Local Competition Provisions of the Telecommunications Act of 1996 (CC Docket No. 96-98), and Deployment of Wireline Services Offering Advanced Telecommunications Capability (CC Docket No. 98-147): Report and Order and Order on Remand and Further Notice of Proposed Rulemaking." para. 272.

65 Ibid, para. 213.

66 Thomas Hazlett and Anil Kaliskan, Natural Experiments in U.S. Broadband Regulation, *Review of Network Economics*, Vol.7, Issue 44, December 2008.

**Figure 9: US telecommunications fibre access regulation**




Source: LECG

### 5.6.2 Price

5.94 It is difficult to interpret outcomes in the US broadband market. Deregulation applies to wholesale fibre (and copper) lines. However, pricing data is only available for retail markets. Of course, there are many factors affecting developments in retail markets, such as the availability of competing services on cable networks. Hence, one cannot simply interpret falling prices in retail markets as an outcome of wholesale fibre deregulation. Comparisons of international telecommunications services are fraught with difficulty due to the variety of products that are available.

5.95 Since the removal of ex ante access regulation, the take up of broadband in the US has slowed relative to other developed countries, probably reflecting the weakened competition in downstream broadband markets and higher prices. In December 2008, the US was ranked 15$^{th}$ in the OECD with 25.8 broadband subscribers per 100 inhabitants. The US was ranked 13$^{th}$ in terms of broadband pricing in the same period. This compares to a ranking of fifth in the OECD for broadband take up in December 2002, prior to de-regulation.[67]

5.96 These outcomes might suggest that reduced wholesale regulation resulted in comparatively higher prices in the US. Some have argued that the continuation of

[67] OECD Broadband Portal, May 2009.

the ex ante regulatory regime would have resulted in lower prices and higher take up of broadband services.

### 5.6.3 Efficient and timely investment

5.97 There is some evidence of more aggressive fibre roll out plans by incumbent operators in the US compared to Europe. The US has more fibre broadband subscribers than Europe – around 5 million compared to around 2 million.[68] The US was ranked ninth in the OECD for fibre broadband penetration as at December 2008. This would suggest that the US may have traded off short term gains from lower broadband prices to consumers for longer term higher roll out of fibre networks.

5.98 There are a range of factors that drive fibre roll out in each country such as the cost of roll out (lower with higher population density), public funding, extent of network competition and the state of pay TV market. Hence, again, care must be taken when interpreting the data. There are also a number of European countries with high fibre take up rates, such as Sweden, Norway and Denmark.

5.99 There is, however, empirical evidence that supports the proposition that ex ante copper access regulation has reduced investment in European telecommunications networks.[69]

### 5.6.4 Operating efficiency

5.100 There is little empirical evidence on the impact on operating efficiency from deregulation. This has not been an issue in the debate about fibre regulation. We would expect that US operators to have strong incentives to make efficiency gains under competition law, partly due to competitive pressures from cable and mobile networks.

### 5.6.5 Regulatory burden

5.101 The US regulatory process was subject to considerable litigation at both a Federal and state level, which resulted in significant costs. Regulatory process costs were also high. These costs have been avoided under the move to ex post competition law.

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68 ETNO, "High speed broadband: A strategy to stimulate private investment urgently needed in Europe, media release", 24 June 2009.

69 Michał Grajek and Lars-Hendrik Röller, "Regulation and investment in network industries: evidence from European telecoms", SFB 649 Discussion Paper, 2009.

5.102 It is thought that the framework provides sufficient stability and predictability for networks to make large-scale investment decisions.

### 5.6.6 Conclusion

5.103 Our summary the US regulatory experience with ex post regulation in telecommunications is set out below. Overall, the regime appears to have been successful in promoting investment, although there may have a been a trade-off with reduced competition and higher prices in retail markets.

**Table 7: United States telecommunication access**

| Criteria | Comment |
|---|---|
| Preventing excessive pricing | Some evidence that move to ex post has resulted in higher retail prices. |
| Efficient and timely investment | Some evidence of increased investment in fibre networks. |
| Operating efficiency | No evidence of any impact. |
| Regulatory burden | Significant reduction. |
| Regulatory certainty and transparency | Appears robust. |

Source: LECG

## 5.7 Australian Airports

5.104 The regulation of Australian airports provides a rare example of a network industry outside of the telecommunications sector that has moved from ex ante regulation to ex post regulation.[70]

### 5.7.1 Background

5.105 A system of light-handed regulation for major Australian airports was introduced in 2002. Previously, a form of CPI-X regulation was used. This previous form of ex ante regulation was reviewed after five years by the Productivity Commission, the government's main microeconomic advisor. The Productivity Commission was critical of price regulation because they considered it was likely to degenerate into cost plus regulation with poor incentives for efficiency.

[70] Peter Forsyth, "Light-handed regulation of airports: the Australian experience", IATA, April 2007.

5.106 The government broadly accepted the Productivity Commission's recommendations[71] and implemented the light-handed form of regulation from July 2002. The system would be reviewed after 5 years.[72]

5.107 The new system adopted a monitor, review and sanction approach. Seven major airports, including Sydney, had their prices, costs, and profits reviewed annually by the competition authority, the Australian Competition and Consumer Commission ("ACCC"). If the review determined that an airport had performed unsatisfactorily, it could recommend the imposition of ex ante regulation. In addition, airports would be subject to general competition regulation, including Part IIIA of the Trade Practices Act, which governs access to essential services.

### 5.7.2 The ex post regulatory regime

5.108 In Australia, cities are widely separated. Most cities have only one airport capable of serving airline traffic, with the closest alternative airport often being hundreds of kilometres away. In this situation, airports have market power. Airlines do not have much bargaining power in negotiations with airports. Under the new regime, however, it is the threat of re-regulation, and the threat of Part IIIA, that have been used to restrain airport prices.

5.109 The figure below places Australian airport regulation towards the competition law end of the continuum. There is no formal price threshold determination or ex ante determination of the approach to airport costs. However, airlines are required to disclose cost information and the ACCC does monitor prices, costs and profits.

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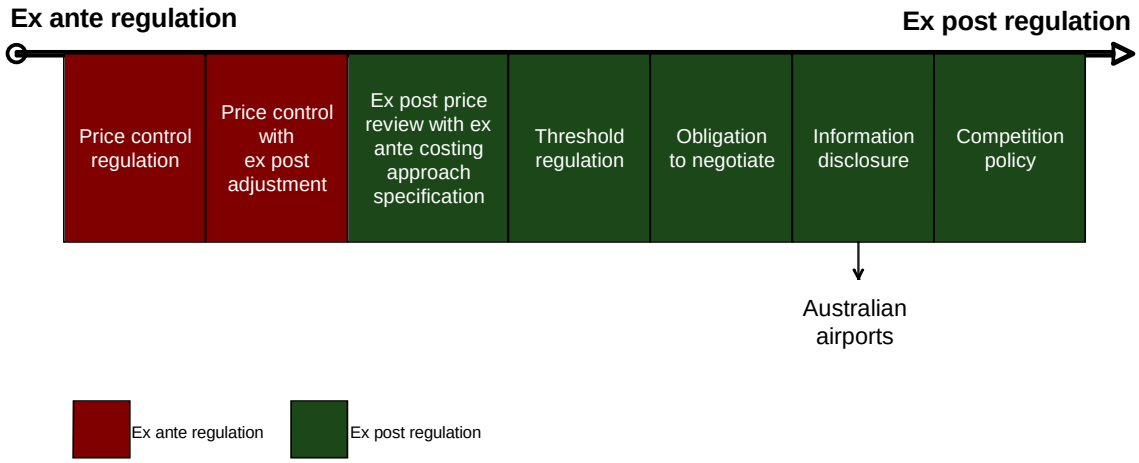
71 Productivity Commission, "Price Regulation of Airport Services", Report No 19, 2002.

72 Peter Forsyth, "Replacing Regulation: Airport Price Monitoring in Australia" in P Forsyth, D Gillen, A Knorr, O Mayer, H-M Niemeier and D Starkie (Eds) *The Economic Regulation of Airports: Recent Developments in Australasia, North America and Europe*, 2004.

**Figure 10: Australian airport regulatory**




5.110 In 2006, the Productivity Commission undertook a review of airport performance under the new regime. Generally, the airports supported the current arrangements, while the airlines argued that it did not restrain the use of market power sufficiently.

5.111 The ACCC was also critical of the arrangements, agreeing with the airlines that restraints on the use of market power were unspecific and too weak.[73] Suggestions were made for an airport specific dispute resolution mechanism, providing for arbitration of airport charges.

5.112 The Productivity Commission concluded that performance had been satisfactory, given the guidelines that had been set, and recommended that the arrangements continue, subject to some small changes.[74] The Australian Government accepted the Commission's recommendations. We discuss the Commission's finding in more detail below.

### 5.7.3 Other regulation

5.113 In parallel with the monitoring regime, other developments may have influenced the effectiveness of airport regulation. Airports are subject to general competition law, including conditions with respect to access provisions (i.e. Part IIIA). This

[73] Forsyth, 2007, see above.

[74] Australian Productivity Commission, 2006, see above.

makes it possible for a firm seeking access to essential infrastructure to request the ACCC to arbitrate on charges.

5.114 Australia's second largest airline, Virgin Blue, has used these provisions to ask the ACCC to arbitrate on charges at Sydney airport. This led to a protracted series of court hearings that concluded in Virgin Blue being granted the right to arbitration. Virgin Blue then asked the ACCC to arbitrate. However, Virgin Blue later withdrew its application for arbitration, as it had resolved its issues with Sydney Airport.[75] It is considered that the threat of regulation under Part IIIA has provided a further constraint on airport behaviour.

### 5.7.3 Prices

5.115 The ACCC indicates that average revenues per passenger increased considerably for several, though not all, airports during the period. The Productivity Commission found that airport charges also rose immediately prior to the ex post regime. These charges were either formally approved by the ACCC under the ex ante regime or closely followed its regulated charges template. Since then the price increase at most of the airports has been modest.[76] It has been suggested that pricing has been restrained, but not to the minimum level consistent with cost recovery. The Productivity Commission also noted that the effectiveness of the ex post approach to constraining the misuse of market power by airports had yet to be fully tested.

5.116 The Productivity Commission was also concerned about non-price outcomes (such as allocation of departure gates to airlines) and the strained relationship between airports and their customers. It found that the countervailing power of airlines was weaker than expected. The Commission was concerned about the lack of regulatory guidance on the valuation of airport assets. This lack of guidance was a major source of dispute between airports and airlines that impeded the development of commercial relationships.

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75 ACCC, ACCC welcomes commercial resolution of access dispute between Virgin Blue and Sydney Airport, media release, 24 May 2007.

76 Productivity Commission, 2006.

### 5.7.4 Efficient and timely investment

5.117 The Productivity Commission found that investment was easier to undertake under this form of ex post regulation.[77] There have major investments at some airports, but it is unclear whether these investments were efficiently incurred.

### 5.7.5 Operating efficiency

5.118 The Productivity Commission found that airport productivity was high by international standards under this less intrusive regulatory approach.

### 5.7.6 Regulatory burden

5.119 The Productivity Commission found that regulatory compliance costs were modest for larger airports under the ex post regime. It has proposed some additional monitoring elements for the regime. These include a process whereby the Minister for Transport and Regional Services would publicly indicate following each annual monitoring report whether any further investigation of the airport's conduct was required.

5.120 These changes move in the direction of ex ante regulation, although they fall well short of price regulation.

### 5.7.7 Conclusion

5.121 The assessment of light-handed regulation depends on what it is expected to achieve. From a broad efficiency perspective, it has performed well. If the objective is to keep prices close to cost, and minimise the use of market power, the system may have been less successful. As the regime has only been implemented for a reasonably short period, the performance of the regime has yet to be fully tested.

[77] Australian Productivity Commission, "Review of price regulation of airport services", July 2006.

**Table 8: Australian Airports**

| Criteria | Comment |
|---|---|
| Preventing excessive pricing | Some restraint, but it is likely that prices are above cost. |
| Efficient and timely investment | It is easier for airports to invest. Unclear whether investment would be different under ex ante regulation. |
| Operating efficiency | Productivity is high indicating operating efficiency. |
| Regulatory burden | Regulatory burden is relatively low, although some scope for arbitration. |
| Regulatory certainty and transparency | Regulatory threat is dependent on monitoring and regular review by the Productivity Commission. Process appears to be workable, though airlines clearly concerned by the process. |

Source: LECG

# 6 Key findings

## 6.1 Introduction

6.1 In this section, we review the key findings from our literature review and case studies and discuss the pro and cons of ex post regimes compared to ex ante price control regimes in general. While there are many variants of ex post regulation, we believe that the main insights can be obtained by focusing on the threshold and competition policy approaches, and we focus on these in particular.

6.2 The table below provides a high level albeit crude summary of our assessment of the merits of ex post regulation compared to ex ante regulation.

**Table 9: Overall assessment**

| | Ex ante | Ex post (thresholds) | Ex post (competition policy) |
|---|---|---|---|
| Preventing excessive pricing | ✓✓✓ | ✓ | ×××  |
| Efficient and timely investment and innovation | ✓ | × | ✓✓ |
| Operating efficiency | ✓✓ | ✓ | ✓ |
| Regulatory burden | × | × | ✓ |
| Predictability and stability of regulatory process | ✓✓ | × | ✓ |

Source: LECG. Note: ✓ denotes relative strength of benefit and × denotes relative strength of weakness.

## 6.2 Preventing excessive pricing

6.3 A key finding of the economic literature is that in the absence of competitive constraints, price regulation is required to prevent excessive pricing and other forms of abuse. In circumstances where an incumbent is dominant and has market power, and where there are significant barriers to entry, the safeguarding of effective competition will require the regulation of the incumbent's prices, since these can in principle be used to deter competitive entry. In economic terms, a

dominant firm can take advantage of its market power to "extract" rents from customers that could not have been obtained by a non-dominant operator. The literature generally suggests that ex ante regulation is the best approach to protect consumers from firms that have enduring market power.

6.4 Energy networks are currently subject to limited competitive constraints. Of course, there may be some substitution from gas to electricity, the use of auto-generation for transmission in some contexts, the bypass of gas transmission lines and the use of independent distribution networks for new developments. In addition, competition may develop in distribution networks from microgrids and energy service companies.[78] However, at this stage and in the immediate future, it seems reasonable to suppose that energy networks will have a substantial degree of market power and that competitive constraints will remain weak.

6.5 The evidence on the ability of ex post regulation to prevent excessive pricing depends on the type of ex post regime. Generally, competition law regimes struggle to restrain the use of market power leading to prices being set above cost. Competition authorities and courts are reluctant to address an abuse that relates purely to pricing, except in rather unusual circumstances. [79] It is a fact that excessive pricing claims are hard to resolve.

6.6 Moreover, the threat of regulation is often tenuous and in any case is less effective when applied to a number of 'local monopolies' due to a free rider problem. The free rider problem occurs because if an individual firm raises prices, they gain the full benefit of higher prices, while the impact of any response by the Government to introduce regulation will be experienced by all firms.

6.7 The evidence from our case studies generally supports this view, though not uniformly so. The threat of regulation appeared to be insufficient to constrain market power under the early form of ex post regulation applied to energy networks in New Zealand and Germany. However, the experience with Australian airports shows that in some circumstances a strong threat of regulation can be effective in restraining prices, although some level of excess returns are still likely to occur.

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78 Pollitt (2009),

79 Indeed under US law there is no prohibition on a monopolist setting high prices. David Evans and Jorge Padilla, "Excessive prices: using economics to define administrable legal rules", *Journal of Competition Law and Economics*, 2005.

6.8 Threshold regimes are more effective in restricting prices. The experience with Swedish ex post regulation and the threshold regime in New Zealand electricity networks provides evidence of this form of regime constraining prices.

6.9 A threshold regime will provide some level of protection to consumers by providing an explicit threat of regulation should prices exceed a pre-determined level. However, the pre-determined level, which might be based on current prices plus a general productivity saving factor, is unlikely to be as close to cost as an ex ante price control. This is in part because threshold regulation is inherently asymmetric. That is, if the threshold price is set below cost, the firm can choose to breach the threshold and trigger a favourable reset. However, if the threshold price is above cost then the firm can price at or just below the threshold and earn excessive profits.

6.10 Hence, these outcomes must be compared with large cumulative real price reductions obtained under ex ante price controls of energy networks in the UK.[80]

6.11 Overall, we believe that competition law regimes are likely to be ineffective in restraining the exercise of market power by energy networks. A process of regular review will provide some constraints, but in general will be significantly less effective than ex ante regulation. Threshold regimes are more effective in restraining prices to cost but have some undesirable asymmetric properties. It is unlikely that threshold regulation would be as effective as an ex ante regime, because ex ante price controls are based on the firm's efficient level of cost and are reset periodically.

6.12 A thresholds regime could be modified to correct for this disadvantage, by requiring the threshold to fall over time. For example, the threshold could be required to fall based on an estimate of Total Factor Productivity gains. However, the threshold regime would still include some of the asymmetry described above.

## 6.3 Efficient and timely investment and innovation

6.13 A key concern about the impact of any regulatory regime is whether the framework provides a sound framework for investment and innovation. In this section, we consider the impact of ex post regulation on investment, in general

[80] Ofgem, "Regulating energy networks for the future: performance of the energy networks under RPI-X", February 2009.

and in relation to innovation more specifically. It is important to consider whether a regulatory framework can incentivise the right quantity of investment and to consider quality of investment (i.e. investing to provide the right services at the appropriate time).

### 6.3.1 Quantity of investment

6.14 We have found that ex ante regimes provide strong incentives for investment. Ex ante regulation provides a high degree of certainty to investors about recovery of cost. It may transfer risk from investors to consumers, once an investment is added to the RAV, it will be recovered from regulated charges. However, the move toward ex post regulation for next generation access in the US (and the debate about regulatory holidays in Europe) is in part motivated by the belief that ex post regimes will provide better incentives for investment. Where demand is highly uncertain, ex post regulation gives the right risk/reward mix, by allowing firms to earn high profits if demand is high, thus offsetting the risk of losses if demand is low.

6.15 Competition law regimes are more effective than thresholds regimes in this regard. Under a threshold regime there is less certainty about allowed rates of return, particularly, if it is likely that the price threshold is breached. In New Zealand, the electricity networks preferred an ex ante price control regime arguing that ex post regulation provided insufficient certainty to invest. Moreover, a practical issue with energy networks is that investment demand may be "lumpy" and so periods with major investment are likely to result in a breach of the threshold by the network.[81]

6.16 In comparing ex post with ex ante, we need to consider the impact of ex ante regulation on investment. This is a complex issue, but it is clear that ex ante regulation provides some incentives for firms to engage in 'gaming' of the regulatory process by providing the regulator with exaggerated estimates of its capital investment programme and then economising on investment during the price control period. The latter effect may be mitigated by the regulator's treatment of under-investment (i.e. the extent to which the firm is allowed to retain the benefits). The effect may be further mitigated by using a regulatory asset

[81] In principle 'lumpiness' can be smoothed out by allowing a long period for price recovery, but this may make it difficult to obtain debt financing which may raise the cost of capital.

approach to regulation, which will restrict the gains of under investment.[82] Ex ante regulation may also provide incentives to substitute capital for operating expenses, if the relevant cost can shifted into the RAV and allow the firm to retain the benefits of reduced operating expenses.

6.17 The evidence in Great Britain with ex ante price controls is rather mixed. On the one hand, it is clear that significant investment can take place under ex ante price controls.[83] Moreover, the framework of license conditions and potentially large fines provides a powerful 'stick' for Ofgem to apply in ensuring networks do not allow services to degrade.

6.18 On the other hand, the problems of gaming and under-spend are real, and have led Ofgem to adopt the 'menu' approach and (in the current DCPR5 proposals) to propose improved monitoring of the firm's activities.[84]

6.19 Finally, while this study focuses on the RPI-X type regulation that is most relevant in Great Britain, there are also well-known effects of inefficient over-investment in traditional 'cost-plus' regulation (the 'Averch-Johnson effect').

### 6.3.2 Quality of investment (efficient and timely innovation)

6.20 In general, a significant advantage of competition law regimes is that they allow the "right" investments to be made, because an unregulated firm will build the infrastructure that consumers and users demand.[85] Firms will have the incentive to take risk and innovate. Firms will invest in new products even where demand is uncertain, as they may earn higher returns to compensate for this additional uncertainty. There is an inverse "*u*" relationship between competition and innovation. This suggests that in a market with a high degree of monopoly power, innovation is likely to be insufficient. In this case, a competition law regime will not promote the level of innovation.

6.21 In contrast, under ex ante regulation, consumer price signals are masked as regulators restrict prices to cost. That is, firms will not earn additional returns from

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82 The firm will only gain in the regulatory period, as the regulatory asset base will be reset at the start of the new price control.

83 Ofgem, see above.

84 Ofgem, "Electricity Distribution Price Control Review Initial Proposals", 3 August 2009.

85 Of course a monopoly also has some incentives to under-produce so as to raise prices, but this might be less of an issue for energy networks, because of the very low elasticity of demand and also the possibility of 'price discrimination'.

innovation. The price control may also be based on the regulator's view about the demand and the types of products to be offered. This may limit the regulated firm's ability to offer new services.

6.22 However, in the energy sector, the "right" investments may be quite different from what consumers and users demand, because their demands are unlikely to match the decarbonisation agenda, or reflect fully the interests of future consumers. This is because carbon emissions are an externality in economic terms or a by-product of electricity generation, transmission and distribution. It is well recognised in economics that consumer prices will not provide the right signal to firms about the efficient level of investment in the presence of significant externalities. This is in contrast to other sectors such as computing or telecommunications, where consumer preferences will be reflected in their demand for new services. This means that ex post regulation may offer little advantage over ex ante regulation in ensuring that the right investment decisions are made in energy networks in Great Britain.

6.23 Rather than relying on consumer and user demand to align network investments with the needs of decarbonisation, it is more likely that some degree of planning or guidance will be required, and there are ongoing discussions as to how this might best be provided (the 'guiding mind' debate). If the Government or an industry body determines the investment path, then the incentives provided by a regulatory framework for determining the timing and quantum of investment in line with consumer interest will be less important. If however, individual networks remain responsible for determining investment decisions and market incentives are provided to generators to build new generation to reduce emissions, then a competition law regime may have some advantage over ex ante regulation or threshold based regimes, because networks would be able to earn higher returns from anticipating demand and developing their networks accordingly.

6.24 In addition, it is worth noting that it is harder for energy networks to meet consumer demands than for telecoms networks, because energy networks services are generally common to all users or groups of users in a distribution area. It is not possible for an individual user to demand a less reliable supply of electricity or a different voltage level as reliability standards and voltage is common to all users on the distribution network. In contrast, investment in NGA networks will be partly determined by consumer preferences for speed of service.

It is possible for broadband network to offer different speeds to the different users on the network. Therefore, efficient broadband network roll out will require understanding and aggregating consumer preferences.

6.25 In conclusion, an ex ante form of regulation will provide investment incentives, but may restrict the level of investment in innovative new services. Threshold regimes are less likely to incentivise investment unless thresholds are set significantly high (i.e. to allow a buffer above cost for unknown future investments). Competition law based regimes are effective at incentivising both investment and innovation to meet consumer demand, provided the implicit threat of regulation does not undermine the credibility of the regime and there is some degree of competition. However, this benefit is of less relevance to energy networks in Great Britain for a number of reasons. First, we understand that in the gas sector innovation is not a key goal. Second, in both the gas and electricity sectors innovation in the interests of current consumers may not be fully consistent with the sustainability and the interests of future consumers. Third, the Government or an industry body may ultimately determine the future investment path in Great Britain, not consumers. Finally, both markets are characterised by high degrees of market power.

## 6.4 Operating efficiency

6.26 The evidence suggests, and most commentators appear to agree, that ex ante price cap regulation provides strong incentives for firms to make operating efficiency gains. Indeed this incentive is the key to RPI-X regulation, which allows firms to retain the gains from efficiency savings for a significant period.

6.27 The table below sets out the operating efficiency targets for energy networks since the establishment of RPI-X. It shows targets that consistent efficiency targets have been set over time. Other evidence below shows that energy networks have responded well to these targets.

**Table 10: Operating efficiency targets for GB energy networks**

| Electricity Distribution | Electricity Transmission NGET | Electricity Transmission SPTL/SHETL | Gas Distribution | Gas Transmission |
|---|---|---|---|---|
| | 3.0% (1996-00) | 2.0% (1994-00) | 2.5% (1994-97) | 2.5% (1994-97) |
| 3.0% (1995-99) | 4.0% (1997-01) | 0.0% (2000-06) | 3.8% 1997-02 | 3.8% 1997-02 |
| 2.8-6.0% (2000-05) | 3.5% (2001-07) | 2.5% (2006-07) | 2.5% (2002-07) | 2.5% (2002-07) |
| 1.5% (2005-10) | 3.0% (2007-12) | 1.5/1.1% (2007-12) | 2.5% (2008-13) | 2.5% (2007-12) |

Source: Ofgem, Performance of the energy networks under RPI-X.

6.28 The table below provides an example of operating efficiency gains under price cap regulation in the UK across a variety of sectors.

**Table 11: Annual real unit operating expense (RUOE) reductions**

| Regulated firm | Period | OPEX RUOE |
|---|---|---|
| E&W water industry | 1992/93–2006/07 | 1.8 |
| E&W sewerage industry | 1992/93–2006/07 | 1.7 |
| Scottish Water (water) | 2002/03–2005/06 | 8.8 |
| Scottish Water (sewerage) | 2002/03–2005/06 | 14.3 |
| Electricity distribution | 1990/91–2006/07 | 4.0 |
| Gas distribution[1] | 2008/09–2012/13 | 2.3 |
| NGC | 1990/91–2006/07 | 4.9 |
| BT, using call minutes | 1996/97–2006/07 | 6.2 |
| BT, using exchange lines | 1996/97–2006/07 | 4.8 |

Sources: Network Rail's scope for efficiency gains in CP4, Prepared for The Office of Rail Regulation, Oxera, February 2008

6.29 Some commentators believe that after almost 20 years of regulation under an RPI-X mechanism, most efficiency gains in the energy sector have now been

exhausted, at least the savings required to place firms on or near to the efficiency frontier. If this is true, then perhaps less weight can be placed on this dimension.

6.30 In theory, networks also have a strong incentive to extract efficiency gains under ex post regulation, as they retain the benefits (in theory, all of the benefits, as opposed to the partial retention under ex ante regulation).[86]

6.31 The nature and strength of this incentive will depend on the nature of the ex post regime. A threshold type regime may exert pressure for efficiency from the threat of regulation and from the benefits to the firm of retaining gains from lowering cost below threshold levels. However, this may be offset by the resetting of thresholds, if the resetting of thresholds is determined by the firm's actual costs.

6.32 It is often suggested that monopolies tend to pay little attention to cost cutting. This problem is called "X-inefficiency". This is because a firm's shareholders may find it difficult to monitor and control the activities of a firm's managers and workers. Managers and workers naturally seek to maximise objectives other than profit maximisation and unless shareholders are able to perfectly observe the technological environment and employee behaviour, the firm is likely to engage in X-inefficiency. These factors affect monopolies more due to the lack of competitive benchmarks from other firms in the same industry, which makes it more difficult for shareholders to observe the effectiveness of management.[87] X-inefficiency may undermine operating efficiency performance of monopoly networks under an ex post regime.

6.33 There is some evidence from New Zealand that the electricity networks made significant operating efficiency gains under ex post regulation.[88] The New Zealand telecommunications operator also made significant operating efficiency gains following liberalisation of the market under ex post regulation.[89] The experience with ex post regulation of Australian airports suggests reasonable productivity under ex post regulation, but it is unclear the direction or extent of change, if any,

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86 David Ehrhardt, "Practical experience with price cap regulation", Report for the New Zealand Treasury, August 2000.

87 Jean Tirole, *The Theory of Industrial Organisation*, MIT Press, 2003.

88 Paul L. Joskow, "Incentive regulation in theory and practice: electricity distribution and transmission networks" EPRG 0511 and CWPE 0607, February 2006.

89 David Boles De Boer and Lewis Evans "The Economic Efficiency of Telecommunications in a Deregulated Market: The Case of New Zealand", *Economic Record*, Vol. 72, 1996.

following the move to ex post regulation. We have not found further evidence on actual efficiency savings outside of these examples.

6.34 As noted in the previous chapter, under the Swedish form of ex post regulation, it is questionable whether firms have appropriate incentives to trade off capital investment for operating savings. There is little evidence on actual efficiency gains under ex post regulation in either Sweden or Finland (section 5.3 and 5.4).

6.35 Our conclusions imply that a move towards ex post would continue to provide incentives for operating efficiency. However, it seems clear the existing system already provides strong incentives. Moving to a new regime that might limit the passing through of efficiency gains to consumers would need to be considered carefully by Ofgem.

## 6.5 Regulatory burden, transparency and stability

### 6.5.1 Regulatory burden

6.36 An expected theoretical benefit of ex post regulation is a lower regulatory burden. However, our study suggests that the regulatory burden can still be significant under ex post regimes and in particular under a thresholds regime.

6.37 A thresholds regime still requires an industry regulator. The regulator and market participants will still incur costs to determine and revise thresholds, and to undertake regulatory reviews following any breach. Typically, the regulator will still require the regulated firms to provide regulatory accounts. Both the Swedish and the New Zealand regimes resulted in significant litigation following threshold breaches. Consequently, it is debateable whether such ex post regimes actually lower regulatory costs. Clearly, an ex post regime will have lower compliance costs if many of the regulated firms do not breach the threshold. However, if many firms breach the threshold, then compliances costs are likely to be similar to or possibly greater than the costs of ex ante regulation.

6.38 An ex post regime based on competition law may result in the lowest level of regulatory burden, although the actual level of this cost is not certain. Costs will be limited to the cost of litigation/competition authority review. Periodic reviews on the form of regime will also be required to ensure the threat of regulation is real. However, it is still possible that these costs will be significant as there may be considerable enforcement activity. In Sweden, for example, the postal incumbent,

Posten, has been investigated over 100 times for breach of competition law since the markets opened in 1993.[90]

6.39 In conclusion, we consider that the evidence suggests that an ex post thresholds regime will not avoid significant levels of regulatory cost. There is also uncertainty as to whether a competition-law based regime will reduce regulatory costs.

### 6.5.2 Regulatory transparency and stability

6.40 Ex ante regulation is well established and has provided a stable framework for regulating energy networks and consumers in Great Britain over the last 20 years, even though it has been the subject of considerable modification via evolution over successive reviews. Clearly, there is scope to continue to adapt the ex ante framework as new challenges arise.

6.41 Our case studies show that thresholds regimes have been subject to continuous change and do not appear to be durable over time. As such, they do not provide a stable framework for long-term investment. In New Zealand, it was found that such regimes provided insufficient certainty to market participants.

6.42 Competition law is an enduring framework, but a competition law regime would be less stable when applied to firms that are monopolies or quasi-monopolies. In such contexts, there is an ever-present threat of regulation, so that in effect the regime comprises competition law with some form of 'implicit regulation'. This makes the regime inherently uncertain for investors in long life assets.

6.43 No regulatory framework is immune from change, nor is it desirable that it should be. Otherwise, the framework would not respond to changes in circumstances. However, the regulatory framework should not be a cause of undue certainty for investors. The history of ex ante regulation in the UK provides a degree of assurance to investors with respect to how the regulator will treat the recovery of operating costs and investments. A major shift to an ex post regime would create uncertainty and would take time to settle down. In addition, there would be additional uncertainty as the ex post regime changed over time. All of these aspects would concern investors and other market participants.

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[90] LECG, Ensuring that consumers benefit from opening postal markets to competition, October 2007.

## 6.6 Conclusions

6.44 A summary of our findings is presented in Section 1 and at the beginning of the next section. For brevity, we do not provide a summary of section here.

# 7 Assessment of implication for GB energy networks

## 7.1 Introduction

7.1 In this section, we consider the case for applying ex post regulation to gas and electricity transmission and distribution networks in Great Britain. First, we summarise applicable findings from the previous section. We then outline the relevant characteristics of GB gas and electricity networks (looking forwards over the kind of timeframe relevant to investment decisions and in particular to decarbonisation), and then we assess the likely implication of the adoption of ex post regulation for these networks. Finally, we discuss potential adjustments to the current ex ante regime in light of our findings.

## 7.2 General assessment framework findings

7.2 As set out in Section 6, we found the following with regard to ex post regulation:

- prices are likely to be lower under ex ante regulation. Threshold regimes are able constrain prices but not to the same extent as ex ante regulation. To be effective, a competition law approach requires a strong competitive constraint from competing infrastructure;

- ex ante regulation incentivises operating efficiency gains and can ensure that a significant proportion of those benefits will be passed onto consumers. Under ex post regulation, firms may make efficiency gains, but they will retain the benefits;

- there are strong incentives for investment and the delivery of capital expenditure under ex ante regulation, but it is more difficult to incentivise timely and innovative investment. This is because, for example, the price control suppresses price signals about the consumers' willingness to pay for services. There have been ongoing concerns at different points in time and in different sectors, that ex ante regimes have variously provided incentives for under-investment, spending to budget and over-investment (i.e. by substituting capital for operating spending). A thresholds regime is less likely to incentivise lumpy investment, unless the threshold is set very high. Competition law can provide a sound framework for investment that

matches the demands of current consumers, provided the implicit threat of regulation does not undermine the credibility of the regime and there is some degree of competition. In a market with high degree of market power and low levels of price elasticity, a competition law framework will be less effective at incentivising innovation, as the firm may gain little additional value from their investment or innovation;

- incentives to invest under competition law are driven by consumer price signals, rather than by regulatory mechanisms. A network might invest to increase reliability if it believed it could profitably charge a higher price as a result. However, it would not invest to reduce GHG emissions (beyond the point where those investments paid for themselves) unless it believed that consumers would be willing to pay more as a result.[91] This holds true to some extent even under monopoly conditions, because if the consumer is willing to pay for the increased reliability, then the monopoly can raise prices. However, for products with very inelastic demand, the marginal gains to the firm may be minimal and therefore incentives for innovation weak;

- similarly, incentives to innovate could be assisted by competition law approach, as firms have incentives to discover new products and take risks to earn higher returns. Cost savings innovations are incentivised under price cap ex ante regulation, as firms are able to retain gains from innovation;

- in practice, regulatory burden is likely to be significant under threshold regulation. It might still be lighter than under ex ante regulation, but this is not guaranteed. It is likely to be lighter under a competition law approach, although this is dependent on the level of activity required to enforce competition law and maintain an implicit threat of regulation; and

- ex ante regulation has provided a stable framework for networks and consumers in Great Britain and is well understood by investors. Experience to date suggests that there is scope to adapt the framework as new

[91] In a competitive market, firms will supply services in response to demand which is indicated by price. Prices signal consumer willingness to pay or value of service. Efficient outcomes will occur when firms provide services up to the point that the cost of providing service is equal to consumers' willingness to pay.

challenges emerge over time, without unduly damaging certainty to investors. Threshold regimes in other jurisdictions have been subject to continuous change and do not appear to be durable over time. There have been complaints that such regimes cause too much uncertainty for investors and other market participants.

7.3 In summary, there does not appear to be significant benefits to consumers from switching from an ex ante to an ex post regime, except possibly in circumstances where either the relevant markets are competitive, or consumer price signals are required to incentivise innovation and these incentives are significantly more important than preventing excessive pricing. However, in these circumstances, the choice would be from moving from ex ante, to a more competition-based policy, not a threshold based policy.

## 7.3 Key characteristics of energy networks

7.4 The table below summarises the key characteristics of energy networks relevant for our assessment. We focus on the level of market power of each network and the need for innovation and investment in each sector, as these are the key economic issues for the assessment of the regulatory framework.

**Table 12: Market characteristics**

| Sector | Market power | Need for innovation and investment |
|---|---|---|
| Electricity transmission | High | High level of investment and innovation may be required to connect low carbon generation but significant uncertainty around timing and amount. |
| Electricity distribution | High | High level of investment and innovation may be required to facilitate distributed generation and microgrids. More active role as local system operator may be required. |
| Gas transmission | High | Stable or potentially shrinking overall demand so may not require major investment but potential greater peak demand. Potential role as transport for CCS. |
| Gas distribution | High | Stable or potentially shrinking demand so may not require major investment, but potentially greater peak demand. Hence, significant replacement capital expenditure required. Potential for use of biogas. |

Source: LECG

7.5 Electricity transmission networks have considerable market power. While it is possible for generation in some cases to substitute for transmission both existing and new generation will require access to the grid. Similarly, consumers depend on grid connected generation to provide electricity. Electricity has a very inelastic demand.[92] Transmission networks could raise price significantly above cost if not subject to ex ante regulation.

7.6 Significant new investment in transmission capacity is likely to be required to connect new renewable and low carbon generation over the next ten years and the move to smart grids. There is some uncertainty as to how much new capacity and when it will be needed as renewable and low carbon generation faces

[92] One survey/"meta-study" suggests elasticities of around 0.2 in the short run and 0.7 in the long run. See Espey, James A., Espey, Molly, "Turning on the Lights: A Meta-analysis of Residential Electricity Demand Elasticities," *Journal of Agricultural and Applied Economics*, April 2004, 36:1, pp. 65-81.

considerable uncertainty in the planning approval process.[93] The role of the transmission grid has the potential to change in the long term if there is a shift towards energy efficiency, microgrid and distributed generation and a shift away from large grid connected generation.

7.7 Electricity distribution has many of the same characteristics of electricity transmission such as low elasticity of demand and the requirement for significant investment. In addition, electricity distribution faces a greater potential change in role with a move to smart metering, distributed generation and micro grids. This may require DNOs to act a local system operator. They also need to facilitate the connection of distributed generation.

7.8 While there is much uncertainty around the future of gas demand, it does appear that gas demand may well decline rather than increase over the long term. The Government Low Carbon Transition Plan proposes that net UK gas demand will reduce by 29% by 2020. It notes that there may be scope for using parts of the gas transmission and distribution networks for other purposes such as carbon capture and storage. The expected increasing reliance on imports in the future will mean a significant change in flow patterns. The increase in imports is likely to require some investment in "deep reinforcements" of the network, even if the actual import infrastructure investment (interconnectors, LNG terminals, associated additional storage facilities) is undertaken on a merchant basis.

7.9 The issues facing gas distribution are similar to gas transmission, although the potential for decline in demand for pipelines could be less than transmission, if the reduction in gas usage focuses on electricity generation and industrial use. There may also be the potential to use the network to distribute biogas. Secondly, improvements in domestic energy efficiency may reduce the volume of gas used. However, households will continue to use some level of gas and so require continued connection, while sustainability considerations may also lead to extension of the network to new areas.

## 7.4 Assessment of ex post for regulation in energy networks

7.10 We now assess how ex post regulation compares against ex ante regulation for electricity and gas networks. The table below summarises our assessment for

[93] See Graham Ault et at, "Electricity network scenarios for Great Britain in 2050 – Final report for Ofgem LENS project, November 2008.

electricity and gas networks. We have assessed transmission and distribution jointly due to the high level of commonality between the issues facing the networks in each sector. We discuss the differences where relevant in the text below.

**Table 13: Assessment of ex post for GB electricity networks**

| | Ex ante | Ex post (thresholds) | Ex post (competition policy) |
|---|---|---|---|
| Preventing excessive pricing | Yes | Yes, to some extent | No |
| Efficient and timely investment and innovation | Some incentive can be provided, if outputs are clearly specified. | Threshold unlikely to provide sufficient certainty to invest or to take risk. | Provides greater incentives to invest but consumer price signals unlikely to provide appropriate indications of where to invest. Insufficient competition to promote innovation. |
| Operating efficiency | Yes | Yes, but gains may not pass through to consumers. | Yes, but gains may not pass through to consumers. |
| Regulatory burden | Significant | Significant | Reduced |
| Predictability and stability of regulatory process | Yes | No | Uncertain, likely to be future pressure to regulate due to market power issues. |

Source: LECG

### 7.4.1 Electricity networks

7.11 We now discuss our assessment of ex post regulation for electricity networks. An approach reliant on competition law will result in a significant risk of substantial price increases for electricity network services as networks have a significant

degree of market power. This risk can be mitigated under a thresholds regime. For example, the evidence from New Zealand suggests that the price threshold, while not always binding, does tend to discourage increases in price above the threshold level. However, this constraint raises questions about the effectiveness of threshold regulation to encourage investment. A large increase in investment is likely to lead the network to breach its price threshold. This raises uncertainty for the grid owner as to how their investment will be treated and the possibility that some of their costs will be disallowed. It may incentivise the grid owner to defer investment in order to stay within their price threshold.

7.12 Moving away from ex ante regulation would remove the certainty under the current mechanism for recovering approved costs and may discourage investment or increase the returns required by investors. We also consider that it is possible for Ofgem to amend the current ex ante control to provide stronger incentives for investment. Moving away from ex ante regulation would have implications for consumers (e.g. higher prices), but if the long-term benefits to consumers are sufficient then the approach would be justified. Innovation is more difficult to incentivise under ex ante regulation. To the extent that desired outcomes become clearer such as level of distributed generation, then it would be possible to provide greater incentive under the current price control by rewarding the delivery of desired outcome and penalising failure.

7.13 An issue for the DNOs is the potential role change to act as local system operators. This raises the question whether this role change would best be facilitated by ex ante or ex post regulation. In theory, ex post allows DNOs to capture the benefits of innovation, however, it is not clear that this will improve the level of innovation in practice. For example, if the price control does not constrain charges to distributed generation, these may well increase and so reduce the amount of distributed generation.[94] Changes in the role of the distribution networks will require co-ordination with other market participants. This along with the market power of the distribution networks is likely to imply some role for Ofgem in the process. Competition policy approach would not in itself appear to provide the right framework for changes to the role of distribution networks.

[94] A cost based ex post regime could address this issue, however, such a regime is likely to have less uncertainty for the network about allowed returns and therefore is not likely to incentivise the appropriate level of innovation.

7.14 The regulatory burden is still likely to be significant under threshold regulation, as the regulator will be required to determine price and quality threshold. Experience in New Zealand and Sweden with ex post regulation would suggest that the regulatory burden of more interventionist ex post regimes is considerable. A breach of threshold will then trigger an investigation by the regulation and potentially the application of price control. A competition law regime will avoid the need for determination of thresholds or price controls. There may be allegations of excessive pricing or abuse of market power to investigate. The competition law around excessive pricing is complex and difficult to apply.[95] Investigation may be expensive and time consuming for the competition authority and the parties.

7.15 A further point with regard to regulatory burden is that the countries that have adopted ex post for energy networks did so in the absence of any prior regulatory regime. Some of the costs associated with ex ante regulation such as the development of specialist expertise by Ofgem and the networks have already being incurred. The potential to avoid regulatory burden is therefore more limited for GB energy networks.

7.16 The level of consumer engagement can be addressed under both ex ante and ex post approaches by the design of the regulatory process. Ofgem is discussing how consumer engagement could be improved in the future. Under the threshold regime, it is possible to set requirements for engagement with consumers as a threshold. The scope is limited under a competition law approach, although it is possible to impose additional regulation requiring information disclosure and engagement. Consumer engagement does not therefore appear to be a distinguishing factors between the approaches.

7.17 Our view is that the ex ante price control regulation should not be replaced with ex post regulation for electricity networks. If an ex post approach was preferred for some element of new investment, we would recommend that a full ex ante specification of both the approach to determining thresholds and how Ofgem would respond to a breach of the threshold and how it would set a price control if required. This would provide clarity to the grid owner and reduce the uncertainty around the threshold regulation.

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95 David Evans and Jorge Padilla, "Excessive prices: using economics to define administrable legal rules", *Journal of Competition Law and Economics*, 2005.

### 7.4.2 Gas networks

7.18 We now discuss the application of ex post regulation to gas networks. A summary of our views is set out in the table below.

**Table 14: Summary assessment for gas networks**

| | Ex ante | Ex post (thresholds) | Ex post (competition policy) |
|---|---|---|---|
| Preventing excessive pricing | Yes | Yes, to some extent | No |
| Efficient and timely investment and innovation | Yes, particularly for clearly defined investment requirements such as replacement capital expenditure. | Threshold unlikely to provide sufficient certainty for investment. | Little advantage when desired outputs are well defined. |
| Operating efficiency | Yes | Yes, but gains may not pass through to consumers | Yes, but gains may not pass through to consumers |
| Regulatory burden | Significant | Significant | Reduced |
| Predictability and stability of regulatory process | Yes | No | Uncertain, likely to be future pressure to regulate due to market power issues. |

Source: LECG

7.19 A threshold regime might be effective for gas networks, as they may not face the same investment pressures as electricity networks. Hence, a threshold regime may be more suitable for gas networks compared to electricity networks.

7.20 If future demand is steady rather than growing then the role of the regulatory framework in incentivising new investment and innovation is less important for gas networks. However, this may not be the case in gas networks. There remain issues concerning the alternative use of the networks for carbon capture and

storage and the use of biogas. It has also been argued that peak demand may not decline even if total demand declines due to increases in energy efficiency. Hence, although household consumers may use less gas, they will still use gas in extreme conditions.

7.21 Both threshold regime and competition law are likely to provide incentives to find alternative uses to the network (i.e. if these uses produce increased returns for the networks). Competition law will provide the greatest incentive, as there is a risk that thresholds could be reset to take account of the earnings of using the network for alternative use. On the face of it, ex ante regulation may not provide strong incentives, as the network can recover its cost from gas pipelines services and will have face little pressure to seek alternative sources of revenue, if this is offset against the price control revenue. It may be difficult for Ofgem to determine to what extent, if any, the pipelines should be used for alternative purposes and so to build this allowance into the price control.

7.22 However, we are not persuaded that Ofgem should move to ex post regime for gas networks. Firstly, there is considerable uncertainty as to whether or when demand may reduce for gas pipelines. As noted above, significant investment may still be required in the near term (i.e. see current price control). Secondly, a competition law will provide inadequate protection to consumers with respect to prices. Thirdly, the experience of excessive litigation stemming from breaches of ex post threshold regimes make us wary about moving to such a regime. It is not clear that the regulatory burden would reduce under such an arrangement. Further, it would appear possible to adjust the ex ante framework to provide incentives for alternative uses of the networks.

## 7.5 Possible modifications to ex ante regulation

7.23 We are not persuaded that moving from ex ante to ex post regulation would improve outcomes for gas and electricity network consumers. However, as discussed above, there are potential questions around the ex ante approach currently applied to GB energy networks:

- Can it provide a suitable framework to incentivise the innovation needed to best position electricity networks in the low carbon transition?

- Can the regulatory burden of the ex ante regime be reduced, particularly in the steady state or potentially declining demand faced by gas networks?

7.24 Here we briefly consider possible modifications to ex ante regulation as currently applied to GB energy networks, that could help address these two questions. This is not intended as an exhaustive analysis, but as an overview of some possible approaches.

### 7.5.1 Incentivising innovation

7.25 One potential change to stimulate innovation would be to treat new investment in an ex post manner, while the existing investment remained under ex ante price control. This approach would offer the advantage of preserving the certainty around the treatment of the existing RAB and be less risky than completely changing the regulatory framework. It could also be consistent with an approach of tendering for new projects.

7.26 Under this approach, Ofgem would determine the allowable charges to recover these costs after the new investment had been made (i.e. ex post)[96]. This would allow Ofgem to take into account the use of the assets and whether the investment was required[97]. Note that incentivising investment in this way is likely to require a higher *allowed* rate of return under ex post, as the firm faces the risk that regulator will not permit it to fully recover its cost after the investment has been made.[98]

7.27 The advantage of this approach is that it places a greater onus on the firm to ensure that the investment is required and that the investment is undertaken in an efficient manner. However, there are some significant disadvantages to this approach. As the New Zealand case study indicated, networks may be reluctant to invest in an environment of significant uncertainty. The networks face both market risk (e.g. demand and cost uncertainty) and regulatory risk (e.g. the

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96 Potentially, the assets could enter the RAB following Ofgem's ex post assessment. This would depend on the type of ex post regulation.

97 We note that due to the nature of the assets, this could potentially take place a considerable time after the investment has been made.

98 The expected returns of the network will consist of the product of the following: the return if the investment is successful (i.e. recovery of cost allowed by the regulator) and the returns if their investment is not successful (i.e. cost not fully recovered). The network will take account the probability of each outcome and the returns under each scenario. The return in the successful scenario needs to be higher to compensate for the potential loss in the unsuccessful scenario. Otherwise, the expected return from the investment will fall below the required return for the network.

regulator may not allow the network to recover the cost). At the least, this is likely to raise the required rate of return and at worst, it may result in investment not taking place. If outputs can be completely specified, then the uncertainty may be reduced for the network. However, there is still a fundamental uncertainty about the prices of outputs, which will affect investment.

7.28 A second disadvantage would be the risk of appeals around the regulator's decision. Evidence from both Sweden and New Zealand suggests that ex post may result in significant disputes between the regulator and the network. While the GB appeal process to the Competition Commission is well established and better placed to cope with challenges, an increase in the number of appeals would raise costs for all parties.

7.29 Another means of enhancing the scope for innovation under the ex ante approach is to better define the outputs required from the regulated firm. Experience with ex ante price cap regulation suggests that it is able to incentivise cost-saving innovation ie for a given output, the regulated network optimises its inputs to deliver that output at a lower cost.

7.30 Similarly, if environmental outputs are required, then networks can be incentivised to deliver these outputs. For example, DNOs are incentivised to connect distributed generation. For gas networks, they could be allowed to retain the revenues from alternative use of the network without any offset against price control revenues. The limitation of this approach is that Ofgem is required to define the required output, often with relatively little information on cost and demand. The difficulties with setting the losses incentive mechanism in DPCR4 illustrates the impact of defining reasonable expected outcomes in the face of considerable uncertainty.[99] However, a benefit of price caps is that Ofgem can observe network behaviour in the previous price control and adjust incentives in future price controls accordingly. Overall, we believe that improved definition of outputs is a promising means of incentivising innovation.

### 7.5.2 Reducing regulatory burden

7.31 An alternative to moving to ex post regulation would be to simplify the current ex ante regime. At one extreme, Ofgem could move away from a building block

[99] Ofgem, "Electricity Distribution Price Control Review: Initial Proposals", August 2009.

approach[100] to price control determination to a Total Factor Productivity (TFP) based approach[101]. Under a TFP approach, Ofgem would set the X factor based on some estimate of future TFP growth (e.g., derived from historic industry-wide growth, and/or from other sectors/countries).[102] This approach could be supplemented by allowing the network to apply for a building block based price control determination, if they considered the TFP approach was not a fair reflection of cost. Note this approach would result in asymmetric outcomes, as networks would seek a cost based determination where it was in their interest to do so.

7.32 This approach would have aspects of a threshold regime, but without the uncertainty around ex post setting of prices. If such an approach were to be applied, it would seem to make sense to apply it to gas distribution as well as transmission (it does not seem worth the complexity and cost of change if applied only to the single gas transmission network). The merits of TFP may be worthy of a more detailed study, but this would be a project in its own right. However, we are cautious about the potential for the use of TFP, as there are real practical difficulties with estimating TFP growth rates.[103] It is not clear that this approach would produce a "short cut" for the regulatory process or be sufficiently reliable.

## 7.6 The prospect of ex post as an incentive for networks

7.33 One possibility might be to employ the prospect of ex post regulation as a potential incentive for good behaviour for networks under an ex ante regime. Ofgem would monitor performance and outcomes under the ex ante regime and relax ex ante regulation on networks delivering good outcomes.

7.34 There are a number of potential drawbacks with such an approach. Firstly, the networks might not view the move to ex post as a reward, if this is perceived to increase uncertainty. In order to provide certainty, Ofgem would have to clearly define the ex post regime it had in mind. Secondly, as discussed above, there are

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100 The current approach of estimating the level of efficient cost from projected efficient operating cost, depreciation of the RAV and a reasonable return on capital employed.

101 Ofgem does use TFP as part of its assessment of operating efficiency in its current determination of price controls. What we propose to use a TFP approach in place of the current approach to cost determination.

102 Ofgem already uses TFP estimates, but only as one input into its "building blocks" price control.

103 See discussion, Toby Brown and Boaz Moselle, "Use of Total Factor productivity analysis in network regulation: case studies of regulatory practice", October 2008.

a range of potential problems with the use of ex post regimes for both gas and electricity networks, such as high levels of market power and issues relating to promoting the investment and innovation required for energy networks. Finally, we note that the relaxation of regulation can be used as an incentive without moving to an ex post regime. Ofgem could, for example, relax some of its regulatory requirements but still maintain ex ante price controls on networks.

## 7.7 Conclusion

7.35 We do not recommend that ex post regulation be used in place of ex ante regulation for any of the GB energy networks. This is partly because of the inherent problems with ex post regulation in our study such as poor protection of consumers from monopoly pricing under competition law and the litigation costs associated with a thresholds regime. It is also because a thresholds regime does not effectively address the key issues currently facing GB electricity networks, in particular the potential need for major investment and innovation. It appears unlikely that ex post regimes will provide significant benefits to incentivise innovation due to the strong monopoly position of network and low price elasticity, which would tend to diminish the gains from innovation for networks. It is possible to modify the current ex ante approach to provide stronger incentives for investment and potentially for innovation, if desired outputs can be specified.

7.36 For gas networks, with less apparent need for investment and innovation, (except for potentially the need to encourage alternative use of the networks), ex post regulation is more attractive. However, the problems with ex post regulation do not outweigh the potential benefits. These benefits may be at least in part obtained from modifying the ex ante regime to allow pipelines to retain the benefits of alternative use of the network. Ofgem may wish to explore the scope for reducing the regulatory burden of ex ante regimes for gas networks to consider the potential for obtaining the current outcomes at a lower cost.

# Appendix: Literature Survey

## Introduction

A1.1 In this appendix, we review the relevant economic literature that we have summarised in Section 4.

A1.2 We first consider the debate about using competition policy to regulate network utilities. We then summarise the literature on the use of regulatory threats, which is a key element of ex post regulatory regimes.

A1.3 We then discuss what the literature says on the actual use of ex post regulation. We highlight some of the issues with ex ante regulation – which we use as a basis for comparing ex ante and ex post regulatory regimes. We do not provide a comprehensive literature review of ex ante regulation.

A1.4 Finally, we consider some of the latest developments in telecommunication regulation, where the merits of ex ante and ex post regulation have been debated in the context of next generation access.

## Competition policy

A1.5 In this subsection, we discuss the role of competition policy. This helps to explain when ex ante regulation might be preferred to ex post competition policy.

A1.6 Newbery considered the relationship between regulation and competition policy for network utilities.[104] In particular, he considered the appropriateness of ex post regimes in the electricity and telecommunications sectors. He found that for utilities where facility based competition was possible, competing network infrastructures lend themselves to the regulatory approach stated in the European Communications Directive. Under this approach, regulators determine whether markets are effectively competitive or have Significant Market Power (SMP). Only in the latter case is ex ante regulation warranted and then only if it is necessary, justified and proportionate.

A1.7 Newbery considered the problems with ex post regulation in the New Zealand telecommunications market. He found that disputes between the incumbent

[104] David Newbery, "The relationship between regulation and competition policy for network

operator and a new entrant took over four years and three rounds of court hearings to resolve.

A1.8 Newbery also considered the benefits of implicit (i.e. ex post) versus explicit (i.e. ex ante) regulation in New Zealand and Germany. Under implicit regulation, network owners can pursue profits that do not violate competition legislation (i.e. they do not abuse their dominant position). He found that there are some advantages to implicit regulation, relating to the avoidance of regulatory inefficiency and capture by special interest groups.

A1.9 Newbery considered that one drawback with an ex post approach is that case law may provide little guidance on some regulatory issues, such as appropriate price or quality. In Britain, the regulator's decisions are appealed to the Competition Commission and thereby suitable precedent about price determination is developed. Without this appeal process and the consequential development of case law, he considered that the Courts might struggle to determine whether prices were economically defensible. He also considered that the process might proceed more slowly and expensively.

A1.10 Geradin and Sidak have considered the application of ex ante regulation and ex post regulation.[105] They describe the rationale for applying ex ante regulation as the following:

- the probability of anticompetitive behaviour in the absence of prior restraint needs to be high;
- the magnitude of harm from such behaviour needs to be great; and
- the likelihood and magnitude of offsetting efficiency justifications for the (unconstrained) behaviour need to be low.

A1.11 European telecommunications regulation provides a framework for the use of ex ante and ex post regulation in the telecommunication sector.[106] Under the 2003 Directive, the EC first establishes a list of markets where ex ante regulation

utilities", June 2005.

105 Damien Geradin and J.Gregory Sidak, "European and American approaches to antitrust remedies and the institutional design of regulation in telecommunications*", Handbook of Telecommunications Economics*, Volume 2, 2005.

106 Martin Cave, "The regulation of access in telecommunications: a European perspective", Beesley Lecture, 2006.

is permissible. The markets are then regulated by national regulatory authorities ("NRAs") with the aim of identifying SMP on a forward-looking basis. Where no SMP is found, then ex ante obligations may not be imposed on any firm in the relevant market. Where SMP is determined, an appropriate remedy may be selected from a specified list (including price control regulation). The outcome is that ex post regulation is used unless the NRA finds SMP and believes that ex ante regulation maximise benefits.

A1.12 The UK Government has recently released its decision on the proposed designation and de-designation criteria for ex ante price control of airports.[107] The criteria have three elements:

- airports have or are likely to acquire substantial market power;
- competition law is insufficient to restrain the airport from increasing prices above competitive levels; and
- designation would have incremental net benefits over competition law.

[107] Department for Transport, "Decision on proposed designation and de-designation criteria for airports", May 2007.

A1.13 The application of ex ante regulation in both the airports and telecommunications sector is based on findings of SMP and where an ex ante price control is believed to be proportionate and will maximise net benefits. This is consistent with Geradin and Sidak's criteria for application of ex ante regulation.

## Can the experience in telecommunication sectors be applied to energy networks?

A1.14 The discussion of ex post regulation in the telecommunications sector raises questions about the relevance of telecommunication regulation to the regulation of energy networks. Regulatory issues in the telecommunications sector are often either related to the extent of competitive constraint from alternative networks such as cable TV networks or about providing regulated access to the "last mile" of the telecommunications network. There are likely to be a number of competing networks in the core of the telecommunications network (which is roughly equivalent to transmission in the electricity sector). This suggests that competition and regulation in telecommunications may be different to the level and type of regulation needed for energy networks.

A1.15 However, Pollitt[108] argues that the likely requirement for innovation in energy networks, such as micro-grids and energy service companies, will require major innovation in the organisation of the sector and that telecommunication models may be useful to consider.

A1.16 The telecommunications sector provides two models of how network competition may proceed. The first model is facilities based competition (based on actual bypass of incumbent networks) and the second model is unbundled local access. Pollitt considers that the underlying economics should determine whether these types of competition emerge in electricity and that development should not be constrained by the inertia of incumbents or the regulatory system. Pollitt believes that facilities based competition should not be dismissed for electricity networks. He suggests that complete deregulation of electricity networks could be envisaged in the long term. This could take the form of removing price controls on DNOs once competition from distributed generation and own generation reaches a threshold level.

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[108] Michael Pollitt, "Does electricity (and heat) have anything to learn from fixed line telecom regulation?", Cambridge Working Paper in Economics, EPRG 0914, June 2009.

A1.17 He considers that electricity networks will develop more slowly than telecoms but suggests that some major experiments in promoting energy service companies and micro-grids would be worthwhile. Where competition develops, network charges could be deregulated (i.e. or move to a form of ex post regulation).

## Light handed regulation and the threat of regulation

A1.18 There has been some discussion of the threat of regulation and light-handed regimes as effective tools for regulating markets. A threat of regulation regime, threatens to introduce an ex ante price control regulation if certain conditions are not met. It is thought that the threat of regulation may restrain the exercise of market power by a monopoly without the attendant cost of ex ante regulation.

A1.19 Light-handed regulation is an alternative term for the threat of regulation. Heavy-handed regulation typically refers to forms of ex ante price control regulation.

A1.20 A seminal paper on the impact of regulatory threat is Block, Nold and Sidak, which covers the deterrent effect of antitrust enforcement.[109] The paper demonstrates that the enforcement of competition law, and in particular, the threat of the imposition of fines affects the behaviour of market participants.

A1.21 Cowan also considers light-handed regulation in the context of its application in the telecommunications and energy sectors in New Zealand and in the airport sector in Australia.[110] He developed a model to compare price cap, rate of return and light-handed regulation. The model considered the asymmetric nature of cost information, controlled for variable management effort to control costs and included random cost fluctuations. The results from the model showed that light-handed regulation was superior to rate of return regulation. Prices were the same under rate of return regulation and light-handed regulation as it was assumed that the regulator was unable to observe management efforts to control costs. Returns to the firm were higher under light-handed regulation.

A1.22 Cowan found that the relative merits of light-handed regulation and price cap regulation depend on the assumptions about cost shocks. In the case of a

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109 Michael Block, Frederick Nold and J. Gregory Sidak, "The Deterrent Effect of Antitrust Enforcement", *Journal of Political Economy*, 1981.

110 Simon Cowan, "Alternative approaches to regulation: an economic analysis of light handed regulation", Paper for Australian Competition and Consumer Commission Regulatory Conference, July 2007.

significant cost shock, then light-handed regulation was superior as the firm was able to respond flexibly to the cost shock. If there were no cost shocks then price cap regulation was superior to light handed regulation.

A1.23 Cowan also reviewed the literature on regulatory threats. The literature suggests that if the probability of regulation rises with the price, then the price will be below the price that maximises unregulated profits. The probability of regulation and the elasticity of the probability with respect to price (i.e. how the probability of being regulated changes as prices change) will affect how cautious a firm is about raising prices above cost.

A1.24 Cowan concluded that light-handed regulation avoids the resource cost of regulation and the perverse incentives that may occur with heavy-handed regulation. He considered that the threat of regulation might be sufficient to secure some of the desirable outcomes of regulation without the cost of regulation.

A1.25 He noted however, that in practice the verdict on light-handed regulation is mixed and that New Zealand has moved away from light-handed regulation. He points towards the apparent success of light-handed regulation of Australian airports but is cautious about the ability to extrapolate this experience to other sector airports or sectors. He notes the specific circumstances of the industry, the characteristics of the regulatory institutions and the rules of the regulatory framework will jointly determine outcomes.

A1.26 Accut and Elliot develop a theoretical model to show that through the adoption of simple regulatory rules, the threat of regulation as well as regulation itself influences a firm's pricing strategy.[111] In the model, they assume that the probability of regulatory intervention increases with the level of price charged, as did the toughness of any regulation intervention. They found that this form of regulation, although not optimal, had the advantage of being relatively simple to apply. The proposed regulatory rules offer a form of transparent regulation that could circumvent fears of regulatory capture.

[111] Elliott CF and Acutt MZ, 2001, 'Threat-based regulation and endogenously determined punishments', Lancaster University Management School Working Paper.

A1.27 In conclusions, the literature suggests that the threat of regulation has the potential to constrain the exercise of monopoly power by firms. However, the degree of constraint will depend on the credibility of the threat.

## Experience with ex post regulation

A1.28 Haucap, Heimshoff and Uhde investigated the use of credible threats as regulatory instruments for network industries.[112] They considered the experience of threat-based regulation in the German electricity network sector and in the New Zealand telecommunications and electricity network sectors. They found a number of problems associated with threat-based regulatory systems. The most significant problem turned out to be the insufficient constraint of market power, which led to significant welfare losses. The critical issue turns out to be the credibility of the regulatory threat. Hence, if the threat of regulation is not credible, a light-handed regulatory regime amounts to leaving monopolistic firms unregulated.

A1.29 This failure of threat-based regulatory systems results from potential free-rider problems associated with good corporate behaviour (as in the case of Germany's electricity market) as well as the lack of credibility of the threat either because of the weakness of the enforcement authorities or due to political constraints. The free rider problem occurs when the same regulatory regime is applied to many firms in the same industry such as distribution networks. In Germany, there are over 700 distribution networks. There is little incentive for a single firm to constrain their behaviour, as their individual behaviour will have little impact on the approach to regulation of the industry as a whole. Therefore, individual firms will not be constrained by the threat of regulation.

A1.30 Bertram and Twaddle reviewed the profitability of electricity distribution networks under the light handed regulatory regime.[113] From 1994 to 2003, New Zealand's corporatized electricity line networks operated with no industry regulator, but under the spotlight of mandatory information disclosure.[114] The authors use the

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112 Justus Haucap, Ulrich Heimseshoff and Andre Uhde, "Credible threats as an instrument of regulation for network industries", *Regulatory change, innovations and investment dynamics in the digital world economy*, Berlin, 2006.

113 Geoff Bertram and Dan Twaddle, "Price-cost margins and profit rates in New Zealand electricity distribution networks since 1994: the cost of light handed regulation", *Journal of Regulatory Economics*, 2005.

114 Prior to 1994, electricity distribution was unregulated but in public or community ownership.

data on the financial performance of these businesses to investigate how the profitability of the business changed under light-handed regulation. They found that price-cost margins widened substantially after deregulation. This was partly due to price increases and partly due to significant reductions in costs. The study did not attempt to estimate the efficiency gains from cost reduction.[115] The authors focused on the estimation of excess earnings compared to prices under a rate of return regulation. They found that light-handed regulation allowed profits to exceed the levels that would have been acceptable under a rate of return basis by $200 million per year (on an ongoing basis).

A1.31 Meran and von Hirschhausen considered corporate self-regulation versus ex ante regulation in the German gas sector.[116] They develop a model of self-regulation where a domestic gas supplier, the network owner and a monopsonistic industrial customer negotiate prices. In the model, there is a competitive fringe of foreign gas producers and household customers were excluded from the price negotiations. They compared the result with price cap regulation. They found that self-regulation led to the exploitation of households. The impact on the competitive fringe of foreign gas producers was unclear. They noted that the comparison with price cap regulation did not take account of information asymmetries and therefore self-regulation might actually be a feasible second best solution.

A1.32 Brunekreeft examined the ex post regulation of German electricity networks, which is an example of a regulatory threat regime in a vertically related market.[117] At the time, Germany had adopted a negotiated third party access arrangement, whereby the electricity network charge was left to industrial self-regulation and ex post control by the Cartel Office. This was in contrast to arrangements in other European jurisdictions, whereby a regulatory agency approved charges ex ante. Brunekreeft derived theoretical results and argued that the results could explain developments in the German market.

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115 This omission is discussed by Paul Joskow, "Incentive regulation in theory and practice: electricity distribution and transmission networks", CWPE 0607 and EPRG 0511, February 2006.

116 Georg Meran and Christian von Hirschhausen, "Corporate self regulation vs ex ante regulation of network access- a model of the German gas market", DIW Discussion Paper No. 436, Berlin, 2004.

117 Gert Brunekreeft, "Regulatory threat in vertically related markets: the case of German electricity", CMI Working Paper 10, Cambridge-MIT Institute, August 2002.

A1.33 Brunekreeft argued that the outcomes in the German market are consistent with expected impact of the threat of regulation. The outcomes were high network access prices relative to comparators abroad and to retail prices, and, perhaps surprisingly, a significant initial fall in retail electricity prices. The author attributes this price fall to the threat of ex ante regulation and in particular, the concern of the EC about the lack of ex ante regulation. This made the incumbent firms keen to demonstrate that the ex post regulatory arrangements were effective, However, the threat appeared to lose its effectiveness; retail prices stopped declining. He attributes this loss of effectiveness to the free rider problem discussed above. In particular, smaller networks have little incentive to restrain prices as their behaviour will have little impact on the assessment of the regulatory framework.

A1.34 The outcome of applied light-handed regulation appears to be that the threat of regulation has often been in practice insufficient to constrain the monopoly power of networks.

## Issues with ex ante regulation

A1.35 There is considerable literature on the properties of ex ante regulation. In this section, we briefly highlight two issues relating to the application of ex ante regulation. This review assists in the assessment of the merits of ex post regimes relative to ex ante regimes. In this section, we discuss the role of ex ante regulation in constraining market power and in providing incentives for productive efficiency.

A1.36 Some commentators question whether ex ante regulation is required to prevent a monopoly from raising its prices above marginal cost (i.e. which would cause what economists refer to as a deadweight loss). Some argue that an unregulated monopoly can use multi part tariffs and price discrimination to maximise profits without restricting output (i.e. the deadweight loss can be avoided). Note, the monopolist will still be exercising market power, it is just that the monopolist does not restrict supply as a result. They are able to maximise profits by price discrimination. However, these conclusions assume that the monopolist is able to efficiently bargain with many small customers. In practice, this is unlikely to be

true. The regulator is likely to be concerned about the distributional consequences of such monopoly pricing, even when it produces an efficient result.[118]

A1.37 A second merit of ex ante regulation is that it promotes productive efficiency (i.e. incentives to minimise cost by the network). However, some commentators question whether ex ante regulation is more effective at promoting productive efficiency than competition law. Firstly, under price control regulation, a network will have to pass on the benefits of efficiency savings to consumers (in the case of a RPI-X price cap, this may take place up to five years after the efficiency gains are made). [119] This may adversely impact the incentives for networks to seek efficiency gains.

A1.38 Secondly, some commentators reject the notion that regulators are better able to assess achievable efficient levels than the owners of the network, i.e. X-inefficiency. X-inefficiency is based on principal-agent problems between shareholders (principals) and managers (agents), where managers exercise limited effort to reduce costs as they pursue other interests that benefit or interest them more. However, if the market for corporate control is efficient i.e. there are no regulatory impediments to takeovers, then the network will be taken over by owners who are best able to align management incentives with their interest. In the long run, this may limit losses due to X-inefficiency.

A1.39 It is important that a comparison of the merits of ex post regulation with ex ante regulation take account of the limitations of ex ante regulation. In this section, we have identified some reasons why the allocative and productive efficiency gains from ex ante regulation may be more limited than often claimed. In the next section, we discuss issues around investment and ex ante regulation.

## Competition and innovation

A1.40 The traditional industrial organisation literature predicts a negative effect of competition on innovation and economic growth. This is because competition reduces the monopoly rents that reward successful innovation. On the other hand, a common view from Adam Smith to Michael Porter is that competition enhances growth because it puts pressure on firms to cut costs, reduce slack and

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118 Simon Cowan, "Network regulation", *Oxford Review of Economic Policy*, Vol 22 No. 2, 2006.

119 Mark Armstrong and David Sappington, "Recent developments in the theory of regulation", *Handbook of Industrial Organisation*, Volume III, 2007.

innovate in order to maintain market position, by introducing new products or new production processes [120].

A1.41 Traditional industrial organisation models include the Hotelling model and the Dixit – Stiglitz symmetric model of monopolistic competition. These show that more intense competition reduces the returns to firms that enter the market, which discourages firms from entering in the first place. In these models, firms incur a fixed cost of entry and must decide whether the net expected returns are adequate. Innovation is proxied by the number of firms that enter the market[121].

A1.42 Similarly, endogenous growth theory predicts that an increase in product market competition has a negative effect on productivity growth by reducing the monopoly rents that reward new innovation.[122] While, these models appear contrary to common thinking about the benefit of competition, they are consistent with the policy of patent protection designed to encourage innovation. Patent protection provides the innovating firm with a temporary monopoly and consequently allows it to recoup its R&D and entry costs.

A1.43 Further developments in the literature suggests that it is important to distinguish between

- pre-innovation rents that arise prior to the development of the innovation – these do not incentivise R&D and may result in lower productivity due to principal/agent problems e.g. managers preferring a quiet life, and
- post-innovation rents which follow the development of the innovation and incentivise investment in R&D. [123]

120 Philippe Aghion and Rachel Griffith, *Competition and Growth – Reconciling Theory and Evidence*, MIT Press, 2005.

121 Aghion and Griffith, see above.

122 Paul Romer, "Endogenous Technological Change", *Journal of Political Economy*, 98 no. 2.

123 Jean Tirole, *The Theory of Industrial Organisation*, MIT Press, 1997.

A1.44 More competition will increase innovation and growth if it reduces a firm's pre-innovation rents by more than it reduces the post-innovation rents. Competition may increase the incremental profits from innovating thereby encouraging R&D investment. This distinction means that patent protection and competition can each incentivise innovation - patent protection increases post-innovation rents while competition reduces pre-innovation rents.

A1.45 The overall effect of competition on aggregate innovation is an inverted U shape - the escape competition effect dominates for low levels of competition, whereas the monopoly rent effect dominates at higher levels of competition.

A1.46 There is some empirical support for this conclusion. Research using patent and accounting data for 461 firms listed on the London Stock Exchange has found a strong inverted-U relationship between innovation measured by the citation weighted patent count and product market competition. [124]

## Innovation, investment and regulation

A1.47 In light of the above findings of competition and innovation, it could be expected that regulation would have an adverse impact on competition. This is because regulation limits returns and therefore the potential rewards from innovation. Evans, Quigley and Zhang develop a model to show that price control could reduce welfare even when the price is set well above marginal cost. This is because price regulation limits profits that act as a stimulus to the development of innovation. They find the potential for welfare to be reduced by price control is the greatest in industries undergoing rapid technological change and where large scale investment is required to produce innovation[125].

A1.48 There is some evidence that price cap or ex post regulation are better for innovation than rate of return of regulation. A number of studies in the telecommunications sector suggest that price cap and "light touch" regulation are more positively associated with innovation than rate of return regulation. [126]

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124 P. Aghion, N. Bloom, R Blundell, R Griffith and P Howitt, *Competition and Innovation: An Inverted U Relationship*, NBER Working Paper No. 9269, 2003.

125 Lewis Evans, Neil Quigley and Jie Zhang, "An essay on the concept of dynamic efficiency and its implications for assessment of the benefits from regulation and price control", New Zealand Institute for the Study of Competition and Regulation.

126 James Prieger, "Regulation, Innovation, and the Introduction of New Telecommunications Services", *Review of Economics and Statistics*, Vol. 84, No. 4, November 2002, 704-715.

A1.49 The impact of ex ante price control regulation on the incentives for investment and innovation is the subject of much debate in the telecommunications sector. Telecommunication access networks (i.e. the copper wires from a customer premises to a telephone exchange) are in the process of replacement by fibre connections. There are a range of fibre access technologies (e.g. some extend fibre to the customer premise while others cover only part of the distance). Fibre access is referred to as next generation access (NGA) as it provides for large increases in bandwidth or broadband speeds to end customers.

A1.50 There is some degree of competition constraint on NGA networks from cable networks and potentially from wireless networks. However, in most European countries, cable networks only cover part of a country (around 45% in the UK). Wireless networks do not have the same capacity as NGA networks and have different cost functions due to their need for additional spectrum to handle increasing quantities of data. These factors are likely to mean that NGA networks will have some degree of market power.

A1.51 One concern is that ex ante price regulation limits upside returns to the firm in the event that demand is high, while the firm retains the risk of not recovering cost if demand is low. The RAB approach used in energy networks in Great Britain may mitigate this risk if all investment is allowed to enter the RAB. In contrast, NGA investment must be recovered from users of the NGA. If demand is low, the network may be unable to recover its cost, even if it were allowed to charge higher prices, as higher prices will reduce demand.[127] A second issue is that an ex ante control does not provide the NGA with the ability to price above cost at the customers willingness to pay.

A1.52 A range of regulatory approaches have been proposed for next generation access regulation:

- regulatory forbearance: either permanent or temporary.[128] There has been some discussion of the role of the threat of regulation under a forbearance approach. This would be ex post regulation;[129]

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James Prieger, "Telecommunications Regulation and New Services: a Case Study at the State Level", *Journal of Regulatory Economics*, Vol. 20, No. 3, November 2001, 285-305.

127 Gans, J.S. and S. P. King, 2004. "Access Holidays and the Timing of Infrastructure Investment." *Economic Records,* Vol. 44: 925-972.

128 We discuss the US experience with regulatory forbearance in the next chapter. For the

- value based pricing: wholesale NGA services are regulated but the regulated firm has some discretion over pricing for new value added services;[130] This is a form of ex ante regulation but prices are not restricted to cost;

- risk sharing contracts and pricing: the network would offer two tiers of wholesale pricing. A lower price reflecting shared risk for wholesale customers who are prepared to share risk of network roll out by a minimum order and contract period. A higher "spot" price for later wholesale customers;[131] This would be a form ex ante regulation, but again the later wholesale customers are paying a price greater than cost; and

- risk premium: a risk premium is added to cost to cover the additional risk to the investor of rolling out NGA services compared to providing copper services. The EC in its draft NGA regulation has proposed that operators should be compensated for project based and non-diversifiable risks.[132]This would be a form of ex ante regulation.

A1.53 These approaches illustrate the difficultly of balancing the concern of promoting efficient and timely investment with protecting consumers by providing regulated cost based wholesale services and the challenge of providing appropriate incentives for efficient investment where returns are uncertain. These approaches may have some relevance for energy networks were significant new investment be required with high levels of demand uncertainty such as connecting distributed generation.

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literature, see Gans, J.S. and S. P. King, 2004. "Access Holidays and the Timing of Infrastructure Investment." *Economic Records,* Vol. 44: 925-972.

129 Ulrich Blum, Christian Growtitsch and Niels Krap, "Broadband investment and the threat of regulation: preventing monopoly exploitation or infrastructure construction?", *Review of Network Economics*, Volume 6 Issue 3, September 2007.

130 Brian Williamson, "Risk, reward and efficient investment in access networks." Ofcom European seminar on regulatory challenges posed by next generation access networks, 27 March 2007.

131 Henning Never, "Risk sharing for next generation access network", Deutsche Telekom.

132 EC, "Draft Commission Recommendation on regulated Access to Next Generation Networks", September 2008. See also, Jeffrey Bernstein and Theofanis Mamuneas, "Irreversible investment, capital costs and productivity growth: implications for telecommunications, *Review of Network Economics*, Volume 6 Issue 3, September 2007.