A Report for the National Audit Office on Regulatory Risk

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Appendix 4: Report for the National Audit Office by NERA on regulatory risk

1. Introduction

This report for the National Audit Office (NAO) surveys existing literature on "regulatory risk". The report distinguishes between two types of regulatory risk. The first type of regulatory risk, which we refer to as "regulatory system risk", is related to the form of regulation (e.g. price-cap, rate of return). A second notion of regulatory risk that we refer to as "regulatory intervention risk", concerns the risk associated with particular "events" or action by the regulator.

2. Measuring risk: CAPM and APT

This section discusses the basic principles of asset-pricing models, the Capital Asset Pricing Model (CAPM), and the less widely used Arbitrage Pricing Theory (APT), both of which have been used to estimate the impact of regulatory risk on the cost of capital of regulated utilities in the UK

2.1.1. Capital Asset Pricing Model

The standard Capital Asset Pricing Model (CAPM) determines required post corporate tax returns for investment in the equity capital of a firm as:

$$E[r] = E(r_f) + \beta(E[r_m] - E(r_f))$$

Where $E(r_f)$ is the current risk-free rate of return; beta (equity beta) is the covariance between returns on the risky asset and the market portfolio, divided by the variance of the market portfolio; and $E[r_m]$ is the expected rate of return for the market.

A key tenet of the CAPM is that an investor diversifies his or her stock holdings by combining risky securities into a portfolio. The effect of this diversification is to eliminate risks known as specific risks (also known as non-systematic risks). Specific risks arise from all those events that are unique to a particular share and have nothing to do with general market or economic factors. Because specific risks are not related, CAPM holds that an investor holding a diversified portfolio does not need a premium to reward this type of risk.

Complete diversification of risk is not possible since securities all move together to a certain extent, a result of the influence of economy wide factors such as interest rates, inflation, and macro economic demand. The risks that cannot be eliminated through diversification are described as "market" risks (or "systematic" risks).

A further key assumption of the standard CAPM model is that investors are risk averse and base their portfolio decisions only on the first two moments of the distribution of possible returns, the expected return and the variance of return, implying that returns are symmetrically distributed. This is important in the context of regulatory risk, an issue we will return to.

In studies that examine and attempt to quantify the importance of regulatory risk on the cost of capital, the CAPM has been widely used. In some studies, described below, the impact of regulatory system risk is measured by examining the difference in the measured beta coefficients across regulatory systems. Correspondingly, the impact of regulatory intervention risk is measured by examining the change in the measured beta coefficient pre and post regulatory announcements.

Other studies use amended versions of the CAPM to include dummy variables as a way of identifying the effect of regulatory events at specific points in time.

2.1.2. Arbitrage Pricing Model (APT)

The arbitrage pricing model (APT) is an alternative asset pricing model to the CAPM developed originally by Ross (1976, 1977). The APT expresses required rates of return as a function of a number of economic factors (eg. oil price shocks, inflation etc), each of which has its own risk premium.

The APT is used occasionally to measure the importance of regulatory system or regulatory intervention risk but has not been used to date by UK regulators as a primary tool for estimating the cost of capital for UK utilities. Cooper and Currie (1999) argue in a paper that assesses the cost of capital for the UK water sector that APT models might be the appropriate type of models to estimate the impact of regulatory risk *"...there may well be other systematic sources of regulatory risk that are related to APT factors. For instance, regulators often do not set returns correctly relative to interest rates. This error is a source of risk that will be related to the level of interest rates. As such it is almost certainly a source of risk that affects returns in the APT model and should be included in any assessment of the impact of the cost of capital*".

Whilst there is strong evidence that the APT gives a more complete description of risk than the CAPM, a key problem with the APT in practice is that the theory does not state what factors and how many should be included in the model specification. Practical applications of the APT to estimate the cost of equity for utilities, whilst limited, have produced no consensus on the key variables that should be included in the model specification. A recent study by Goldenberg and Ashok (2001) which applies the APT to US utilities is found to produce significantly different estimates depending on the number of factors specified and the set of firm factors analysed.

Since the APT is more contentious and rarely used in the UK as a tool for measuring the cost of capital, our review places less emphasis on the results of studies that estimate the importance of regulatory risk using an APT framework by comparison with studies that use a CAPM framework.

3. Regulatory System Risk

This section examines the relationship between the regulatory system and the cost of capital.

3.1. Regulated v's Competitive Markets

It is widely accepted that the design of regulatory systems can impact on the degree of market risk to which a firm is exposed.

Papers on regulatory risk by Peltzman (1976, 2001) propose that regulation provides a "buffering" effect on a firm's profits by limiting both upside and downside earnings variability. Peltzman argues that this buffering effect occurs as a result of regulatory price reviews that aim to ensure that total costs are recovered through the price limits that are set. By contrast, Peltzman argues that companies operating in competitive markets face more volatile cashflows that occur as a result of such factors as stranded costs, classic externalities and increased demand volatilities. In the context of electricity deregulation in the US, Peltzman (2001) argues that increased demand volatility will occur under competitive conditions as companies will be forced to set prices in accordance with marginal cost which will lead to greater price variability and hence greater profit variability. A related argument often made in UK regulation is that because continuity of service is so important, regulators will not want regulated companies to become bankrupt, except where this is necessary to emphasise the responsibility borne by the firm's managers, and so will buffer returns on the downside.

Some recent empirical papers have supported Peltzman's earlier observation of a buffering effect of regulation on profits, and a reduction in the cost of capital (Binder and Norton, (1999) Nwaeze (2000)). For example, Nwaeze examined the US electricity sector over time, as the determinants of earnings changed from a rate of return regulatory regime to arrangements involving more competitive markets. Nwaeze found that pro-competition reforms in the US electric power industry corresponded to increased earnings volatility and risk, consistent with phasing out the "buffering"

effect of regulation.

It has also been argued, however, that there are a number of reasons why Peltzman's theory on the "buffering" effects of regulation may not hold but, rather, that regulation can actually increase a company's cost of capital relative to that which would be observed under competitive conditions.

First, the issue of "regulatory lag" is considered important in considering the effect of regulation on a firm's systematic riskiness (see Armstrong et al. (1999), Morin (1994)). Regulatory lag refers to the period between price or rate case reviews which in the UK is generally a period of 5 years. Through efficiency gains, utilities can realize greater rates of return than those anticipated and hence earn greater returns than would be earned under competitive conditions. Correspondingly, should costs be higher than was originally assumed, then the utility will earn less than the cost of capital until prices are realigned.

Second, it has been argued that regulation can increase the degree of market risk to which a utility is exposed as a result of imperfect indexation mechanisms that are used to adjust prices at regulatory review periods. Williamson (2000) argues in the context of the water and electricity price reviews in 1999 and 2000 respectively that the regulators' use of price caps which are adjusted to changes in the retail price movements but not input prices may mean that "(U)tilities with regulated output prices are more exposed than their counterparts in competitive markets, since companies in competitive markets can and do adjust their output prices in response to changes in input prices".

Third, regulators operate without full information about the regulated firm, and must therefore estimate the relevant parameters used to set prices such as efficient operating and capital costs, and the cost of capital. A complicating factor in UK regulation is that forward looking prices are set on the basis of observed operating costs for previous accounting year as current data is not available. Such imperfect information will lead to more volatile returns relative to companies operating in competitive markets where prices would be expected to re-align continuously to cost changes.[1]

Fourth, there is the issue of the fairness and predictability of the price review process itself. In his textbook on regulatory finance, Morin (1994) argues that "regulatory risk generally refers to the quality and consistency of regulation applied to a given regulated utility…regulation can compound the business risk premium if it is unpredictable in reacting to rate hike requests both in terms of the time lag of its response and its magnitude". With regard to UK regulation, there have been many suggestions that inconsistencies in the actions of regulators at price reviews since privatisation may lead to increases in the cost of capital (Helm, (1995), Bishop, Kay and Mayer (1995), Cooper and Currie (1999))

Overall, whilst the conventional wisdom may say that price regulation reduces the market risk to which a utility is exposed, recent literature on regulatory risk exposes such factors as regulatory lag, imperfect price adjustment mechanisms, imperfect information and inconsistency that it is argued can actually increase the cost of capital for regulated utilities above that which would be observed in competitive conditions.

3.1.1. Differences between Regulatory Systems: Price-cap and Rate of return Regulation

This section looks at the key features of price cap and rate of return (or cost of service) regulation that can impact on regulatory risk as a result of the factors suggested above that include buffering of profits, regulatory lag, indexation mechanisms, informational asymmetries and predictability and consistency.

The key feature of price-cap regulation is that a fair rate of return on the capital base is set *ex ante,* on the basis of the regulator's perception of efficiency savings and input prices over the control period. Because companies are allowed to retain efficiency gains in the form of higher profits if they beat the regulatory price-cap, a company has the incentive to bear down on costs. However, the desirable incentive properties of the price-cap have a cost in terms of the risk to which the company

[1] Ergas et al (2001) show that even when the average regulatory error is zero, the concavity of the firms profit function means that there is a net loss of profit as a result of imperfect regulation.

is exposed. Under pure price cap regulation, outperformance or underperformance of the regulatory cost targets and/or demand changes including those which the company has no control will impact directly into profits. Where expected earnings volatilities cannot be diversified they will require compensation from investors through an increased cost of capital.

By contrast, "pure" rate-of-return (cost of service) regulation sets a nominal price to ensure a fair rate of return on a company's capital base. The key difference is that, where RPI-X regulation sets a price-cap to ensure a fair rate of return on the basis of *ex ante* expectations, rate of return regulation ensures a fair rate of return *ex post*. In theory, this means that a company can pass through all genuine additional costs to consumers in the form of higher prices, to ensure that a fair rate of return is gained. Under this system, if the price review process was continuous, the company's earnings volatility would be zero and the rate of return on its asset base would be constant.

In practice, pure forms of price cap or rate of return regulation do not exist. Price cap regulation requires periodic price reviews, and often is often implemented to allow for prior pass through of certain cost items deemed to be beyond the control of the company. Providing such cost pass through provisions are implemented in an symmetric manner this will reduce the exposure of the utility to risk. Rate of return regulation in practice, does not allow for instantaneous cost pass through of all costs and capital expenditures in particular are generally subjected to prudency tests, so ex post full recovery is not guaranteed.[2]

A study examining the relationship between regulatory structure and risk was undertaken by Alexander et al (1996). They classify regulatory regimes according to the strength of cost-efficiency incentives: RPI -X and revenue-cap regimes involve high powered incentives, rate of return regulation is low-powered, while European discretionary regimes are classified as intermediate. Estimating betas for a wide range of utilities worldwide, the study presents cross-country averages for the three types of regime by sector, and, a single average figure by regulatory regime (see Table 1 and Table 2).

Both the sectoral averages and the overall regime estimates show a clear trend: high-powered incentives appear to be related to higher systematic risk, while low powered incentives imply low systematic risk.

Table 1
Average Asset Beta Values by Regulatory Regime and Sector

Incentives	Electricity	Gas	Energy	Water	Telecoms
High-powered	0.57	0.84	-	0.67	0.77
Intermediate	0.41	0.57	0.64	0.46	0.70
Low-powered	0.35	0.20	0.25	0.29	0.47

Source: Alexander et al, 1996

Table 2
Average Asset Beta Values Across Regulatory Regimes

Incentives	Average Beta
High-powered	0.71
Intermediate	0.60
Low-powered	0.31

Source: Alexander et al, 1996.

[2] For example, since the mid-1970's the ex-post rates of return achieved by a number of US utilities have been eroded as a result of inflation coupled with a regulatory lag in adjusting nominal prices, and by regulatory decisions to disqualify some assets from the rate base on the grounds that they were not "used and useful"

The results of Alexander, Mayer and Weeds (1996) are in line with other research at that time by Gandolfi, Jenkinson and Mayer (1996) and more recently by Alexander et al. (2000) that found a similar relationship between the regulatory regime and beta risk in the transport sector. The results seemed to confirm the hypothesis that companies under RPI - X regulation (as practised in the UK) are viewed by the markets as being exposed to higher levels of systematic risk in comparison with those under rate-of-return regulation (as practised in the US), and that the cost of capital for those companies was therefore likely to be higher.

However, as Alexander, Mayer and Weeds (1996) noted in their report:

"…the observed difference may be due to any number of alternative factors and cannot be said to prove the existence of higher regulatory risk in the UK"

Additional factors that could cause changes in betas as well as the regulatory regime include: the political environment, the operating environments, variations in the level of competition, market risks, geographical composition and non-utility activities. The alternative regulatory systems may not be the sole cause, therefore, of the difference in the asset betas.

Research which looks to update the 1996 analysis of Alexander et al., and investigate why the relative riskiness of companies in different regulatory regimes may have changed, is no apparent and would be useful.[3]

3.1.3 Regulatory Risk and Political Risk

The regulator and the regulatory regime are, in turn, influenced by political change. In the UK, utility regulators have been empowered independently by statute at the time of privatization, arguably minimizing direct political direction of their decisions. There remains, however, the fact of their ultimate control by Parliament and the potential for influence from Departments and Ministers of State. This may introduce the factor of *political* risk: that is, that the regulator's guiding statements, instructions or stance will shift to alter the systematic relationship of returns in the utility with those in the market as a whole.

Some research has examined the behaviour of utility shares with regulatory and political uncertainty. Antoniou and Pescotto (1997).suggest that there is evidence of political risk in the statistical significance of dummy variables standing in for the association of the 1987 and 1992 UK General Elections with the beta of *British Telecommunication plc*'s (*BT*) equity.[4] Francis, Grout and Zalewska-Mitura (2000) show that betas for regulated utility stocks fell during the period of 1 January 1998 to 12 August 1999, which they attributed to political and regulatory uncertainty government proposals for a move towards profit sharing regulation in the UK.

4. Regulatory Intervention Risk

4.1 Introduction

This section presents empirical work that has examined the relationship between regulatory behaviour or events and the regulated firms' price volatility and cost of capital.

4.2 Regulatory Conduct and Cost of Capital

The existing literature on regulatory risk and cost of capital effectively focuses on two broad issues: (i) the impact of discretionary, unpredictable actions of a regulator on share price volatility; and (ii) the effects of the price review process on cost of capital.

[3] Since 1996 there has been a noticeable decline in asset betas for the UK casting some doubt on the World Bank conclusions.

[4] A positive coefficient is uncovered for 1987, when the (losing) Labour party promised renationalisation of BT were they elected to government; a negative coefficient is found for 1992, where this policy was absent (Antoniou and Pescotto, 1997).

4.2.1 Predictability of Regulatory Behaviour

There are number of papers examining whether the use of a regulator's discretionary power, in the form of unpredicted regulatory interventions, increases the volatility of a companies returns and a regulated company's cost of capital.

Robinson and Taylor (1998a) examine the intervention of the then Director General of Electricity Supply, on March 7 1995, when he unexpectedly announced a re-visiting of the price review process that had thought to have been concluded in the previous August, and was supposed to come into effect in April 1995 for a five year period.[5] In particular, the authors examine whether the intervention increased the volatility of stock prices for the twelve regional electricity companies (RECs), by examining the companies' share price variances before and after the event.

Robinson and Taylor discover that for eight of the twelve REC's, there is a marked impulse increase in share price volatility after 7 March 1995, and this increased volatility displayed some "persistence".

Robinson and Taylor (1998b), in a separate study, use the same methodology to examine regulatory risk in UK electricity distribution industry for a wider set of regulatory "events". For two thirds of the 58 regulatory events they examined, the authors found evidence for an increase in the firm's variance of returns, and a significant degree of persistence in the period following.

It is necessary to point out that neither study tests for the effects of a change in systematic risk. Both studies highlight the impact of regulatory events on share price volatility. Of particular importance is the study of Littlechild's unexpected intervention in 1995 that suggests that events increasing perceptions of unpredictability of a regulatory regime can increase volatility of returns. These unanticipated events could have implications for a company's cost of capital. The authors conclude that if the standard deviation of an individual asset's returns affects its cost of capital, such as some APT modelling has found, then regulatory intervention would have impacted upon a company's cost of capital.

Antoniou and Pescetto (1997) using an alternative methodology, directly examine the impact of unanticipated regulatory announcements on beta risk for BT, over the period 1984 to 1993. They hypothesise that:

-announcements or events that enhance competition in the telecom sector will increase beta risk (and therefore the cost of capital), whereas restrictive legislation will decrease CoC;
-events that facilitate an increase in prices will decrease BT's cost of capital, and vice versa; and
-events that enlarge the scope of services that BT can offer will decrease beta risk, and vice versa.

Their research finds evidence for a strong relationship between unanticipated regulatory interventions and systematic beta risk, but not necessarily in the direction expected. For example, measures that resulted in price decreases for some of BT's service were generally found to have decreased beta risk, in direct contrast to their hypothecation. The authors speculate that a price cap on BT services could act as a deterrent to new entrants, who will face higher costs than the incumbent, and therefore effectively reduce the threat of competition. Overall, the authors conclude that regulators can influence a company's systematic risk, and therefore its cost of capital, although the direction of change is not always easy to predict.

4.2.2. Regulatory Asymmetries

It has been argued that the ability of regulators and governments to exercise freedom and discretion when making regulatory decisions can have the effect of reducing returns that are high without commensurately subsidising returns that are low. As an example of this, Cooper and Currie (1999)

[5] Professor Stephen Littlechild released a press statement on March 7, 1995, indicating that he would review the electricity industry's price caps which had been set the previous August. This action was precipitated by reports that one of the regional electricity companies (RECs), Northern Electric, was very well placed financially to fight off a hostile takeover bid from Trafalgar House.

cite regulatory proposals to claw back "excessive" returns through error correction mechanisms (eg. the UK windfall tax). In contrast, external risks, such as exchange rate risk, happen independently of the particular behaviour and position of the firm or industry in question and have a natural symmetry of impact.

The CAPM model in its basic form cannot take account of skewed risks such as downside asymmetric risk. However, Conine and Tamarkin (1985) have suggested that we extend the traditional mean-variance CAPM model to accommodate third moments, reflecting the skewness in a company's returns. The authors studied 60 utilities in the USA over a period of five years, and calculated the expected return using the CAPM, as well as the modified third moment CAPM. Whilst the former gave a nominal return of 15.81%, the latter suggested nominal 17.16%, implying an additional 1.3% to the cost of capital of a typical utility by considering this "third moment risk", although this was not all attributed to regulation.

If the effect of asymmetric regulatory interventions produces an expected return which is less than the actual cost of capital, companies will not invest. This means that the regulatory regime must adjust to these circumstances. This can either be done by removing the regulatory risk, or by promoting another source of returns, e.g. by increasing the parameters in the CAPM, by increasing the operating expenditure allowance, or through retention of higher profits from cost savings (see Kolbe et al. (1993) and Grout (1994)).[6]

4.2.3. The Impact of the Price Review Process

It has been argued that price control consultation procedures are a source of uncertainty by utility companies due to what they see as arbitrary negotiation practices (Robinson and Taylor, 1998b). A seminal paper on the impact of regulatory procedures on the risk to which a utility is exposed was that of Brennan and Schwartz (1982) who defined a consistent regulatory policy "*as a procedure for determining the holding of a rate hearing and setting the allowed rate of return at the hearing such that, when properly anticipated by investors, the procedure causes the market value of the regulated firm to be equal of the rate base at the time the hearing is held*".

Within the context of UK regulation, the market to book ratio is widely regarded as an important tool for bringing market information to bear on the issue of whether allowed rates of returns set at periodic price reviews are adequate. Houston (1996) argues "…if the regulator is doing his or her job properly, the stock market valuation of the utilities should be broadly in line with the regulatory asset base". Morin (1994) argues that regulation can increase business risk if it does not provide the utility with the opportunity to earn a fair rate of return.

An empirical study of the effect of the price review process on utilities' costs of capital by Gandolfi et al (1996) contends that beta will follow a "saw-tooth" cycle over periods of regulatory review, declining as the review approaches, since product/service market risks are passed through to customers in the tightening or loosening of price caps at the time of the review. Gandolfi et al interpret this as consistent with the view that the frequency of price reviews in UK regulation makes the process akin to rate-of-return regulation and reduces variability of earnings.

Bibliography

Alexander, I., Mayer, C. and Weeds, H., "Regulatory Structure and Risk and Infrastructure Firms: An International Comparison", Policy Research Working Paper 1698, World Bank 1996

Alexander I. and Irwin, "Price caps, rate of return Regulation and the cost of capital", World Bank, 1996

Alexander I., Estache A. and Oliveri A., "A few things transport regulators should know about risk

[6] For example, Kolbe at al (1993) suggested that there are two possible responses to accommodate the downside risk so as to ensure that the expected ex ante return is equal to the cost of capital. One is to add a "regulatory risk premium" to the allowed cost of capital. Another option is to add an "insurance premium" to the revenue requirement.

and the cost of capital", World Bank, 1999

Antoniou A. and Pescetto G., "The effect of regulatory announcements on the cost of equity capital of British Telecom", Journal of Business Finance & Accounting, 1997

Armstrong, M., Cowan, S. and Vickers, J. "Regulatory Reform: Economic Analysis and British Experience".

Binder J. and Norton S., "Regulation, profit variability and beta", Journal of Regulatory Economics 1999

Bishop M., Kay J. and Mayer C. (1995) "The Regulatory Challenge", Oxford University Press, Oxford.

Brennan, M.J. and E.S. Schwartz "Consistent Regulatory Policy Under Uncertainty", Bell Journal of Economics 13(2), 1982, 506-521.

Buckland R. and Fraser P., "Political and regulatory risk: beta sensitivity in the UK electricity distribution", Journal of Regulatory Economics 2001

Conine T. and Tamarkin M., "Implications of skewness in returns for utilities", Financial Management 1985

Cooper, I. and Currie, D. "The Cost of Capital for the UK Water Sector", Regulation Initiative Discussion Paper Series Number 28, May 1999.

Copeland T. and Weston J. F., "Financial theory and corporate policy", third edition, 1988, Addison-Wesley Publishing Company

Ergas, H., Hornby, J., Little, I. and Small, J. "Regulatory Risk", A Paper prepared for the ACCC Regulation and Investment Conference, Manly 26-27, March 2001.

Francis, Grout and Zalewska-Mitura (2000), "The impact on the stock market of changes in regulation of companies", Leverhulme Centre for Market and Public Organisation (CMPO), February 2000

Gandolfi M., Jenkinson T. And Mayer C., "Regulation and the cost of capital", Oxford School of Management Studies, University of Oxford, 1996

Grout, P., "The Cost of Capital in Regulated Industries" in "The Regulatory Challenge", M. Bishop, J.

Helm "British Utility Regulation", Theory Practice and Reform in D.Helm (ed.) British Utility Regulation, Oxford, OXERA. 1995.

Houston, G.. "Regulatory Tobin's Q, Tracking Shares and All That", NERA Topic Paper 18, April 1996

Kay, J. C. and Mayer, C. Oxford University Press 1995

Kolbe, A.L., W.B. Tye, and S.C. Myers "Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries". (1993)

Littlechild, S., Regulation of British Telecommunications Profitability, HIMSO, 1983

Morin, R. "Regulatory Finance: Utilities' cost of Capital", Public Utilities Reports 1994.

Morana C. and Sawkins J., "Regulatory uncertainty and share price volatility: the English and Welsh

water industry's periodic price review", Journal of Regulatory Economics 2000

Nwaeze E., "Deregulation of the electric power industry: The earnings, risk and return effects", Journal of regulatory economics, 17:1 2000

OFWAT, MD167 "Modification of conditions of appointment: Proposal about condition B, Part IV (interim determinations) and other possibilities, January 2001

Peltzman S., "Toward a more general theory of regulation", Journal of Law and Economics 1976

Peltzman S., "Petition for approval of delivery services tariffs and tariff revisions and residential delivery services implementation plan, and for approval of certain other amendments and additions to its rates, terms and conditions", 2001.

Rees, R. and Vickers J., "RN - X Price-cap Regulation", The Regulatory Challenge, Oxford University Press l995

Robinson T. A. and Taylor M. P., "Regulatory uncertainty and the volatility of regional electricity company share prices: the economic consequences of Professor Littlechild", Bulletin of Economic Research 1998

Robinson T. A. and Taylor M. P., "The effects of regulation and regulatory risk in the UK electricity distribution industry", Annals of Public and Cooperative Economics 1998.

Roll R. and Ross S., "An Empirical Investigation of the Arbitrage Pricing Theory", Journal of Finance, 35, 1980.

Ross S.A, "The Arbitrage Theory of Capital Asset Pricing", Journal of Economic Theory, 13(3), 1976, 341-360.

Ross S.A, "Risk, Return and Arbitrage", in I. Friend and J.L. Bicksler eds., Risk and Return in Finance, Vol 1, Cambridge, MA: Ballinger Publishing Company, 1977, 189-218.

Sherman R., "The regulation of monopoly", Cambridge University Press, 1989

Williamson "Under Pressure", Utility Week, May 2000.