Adaptive regulation, market risk and the cost of capital[1]

Paul A. Grout, University of Bristol

Ania Zalewska, CGR&IS, School of Management, University of Bath

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Executive Summary[2]

Investment in UK regulated networks is already substantial. Investment by energy networks has been running at circa £10bn pa, for example, and the regulated water industry at around £5bn pa. However, looking forward, it is widely expected that these figures will need to increase substantially. Climate change alone will have a significant impact. The Committee on Climate Change has suggested that investment in energy will need to double in order to meet a target of net zero by 2050, and the water industry will need to increase investment substantially to improve resilience. Away from climate change, there are also other drivers of significant infrastructure requirements. For example, the Government's Future Telecoms Infrastructure Review estimated that an investment of £30bn will be needed just to roll out a full fibre broadband network in the UK.

However, at the very time that the need for greater investment is emerging, there has also been growing concern around the regulation of the sectors that are expected to deliver much of the additional investment. At the heart of these concerns lies the idea that the regulated companies have been too profitable and that a shift in the regulation/provider relationship may be needed. Calls for voluntary returns, a 'painshare and gainshare' relationship between

[1] 'This paper was commissioned by the NIC, to inform their analysis on cost of capital issues in the regulated sectors. The NIC approached Professors Grout and Zalewska given the research that they have published on the impact of regulatory change on the cost of capital. The NIC asked Professors Grout and Zalewska to write a briefing paper on the implications of their research (and any additional research they wished to undertake) on the question of what the empirical evidence says about how changes in regulation may impact on the cost of equity and the cost of capital, and the relative scale of any such effects compared to other factors that impact on the cost of equity and cost of capital of the utility companies.' (NIC, October 2019)

[2] The briefing note has been prepared by Professors Grout and Zalewska acting in a personal capacity. The views expressed in this note should not be interpreted as expressing views of any body which Professor Grout and Professor Zalewska are connected to.

regulated companies and consumers, far more emphasis on helping vulnerable customers and meeting climate change targets, and other suggestions requiring a more adaptive form of regulation have emerged in the last few years. The Labour Party have even suggested nationalising some of the regulated companies.

Alongside these calls for change, there are already structural reasons to think that in the longer run regulation may have to become more adaptive in the future. For example, in the growing 'tech' world, with uncertain and ever more changing environments, companies cannot expect that the regulatory backdrop to their investments will remain static while the world, technologies and markets change rapidly. In the longer run, regulation may have to change more frequently (e.g. greater use of conditional review clauses, mid-term reopeners, etc.). A world of more 'adaptive regulation' may become the norm and, whilst regulators should be expected to stick to core principles, it may not be beneficial to stick to fixed, narrow rules for long periods.

There are voices suggesting that these two directions of travel (greater investment and more adaptive regulation) are incompatible. Namely, changing regulation, increasing regulatory flexibility, use of conditional review clauses and raising further requirements on regulators (and hence regulated companies) will increase the cost of capital just at the time when more investment is needed, making it harder for companies to invest in the necessary infrastructure. This briefing note addresses this question.

It looks at empirical evidence on the relative cost of equity capital of regulated companies during four periods. Specifically, it examines:

(i) changes in the cost of equity of the utility sector relative to the cost of equity of similar, but unregulated, companies during the early years of the New Labour government of 1997;

(ii) changes in the relative cost of equity of energy and water companies during the period that the RIIO model of regulation was introduced in the energy industry;

(iii) differences in the cost of equity between retail and network energy companies during the period when the Default Energy Tariff was mooted and introduced, and

(iv) post financial crisis changes in the cost of equity of regulated sectors relative to industry sectors across the G13 countries.

Clear messages appear from investigating these case studies. In general, (i) the regulatory changes we examine appear to have a limited effect on the difference between the cost of equity of the companies that were the subject of the regulatory changes and those that

were not, and (ii) that changes in the difference between cost of equity of the companies that were the subject of the regulatory changes and those that were not are small relative to other changes in the cost of equity which are common to both sets of companies. The cost of capital depends on the relative weight of the cost of equity and the cost of debt, so it depends on the relative weight of debt to equity. Taking this into account, we also suggest that the limited effect on cost of equity also carries over to the cost of capital.

That is, the evidence suggests that the cost of capital of the regulated companies does indeed change over time but the difference between the cost of capital of the different sectors remains surprisingly stable even though some of the regulated sectors are facing significant regulatory change (e.g. the introduction of RIIO, the introduction of the Default Tariff Cap for energy supply) whilst others are not.

The evidence does not suggest that the implementation of, and uncertainty around, more adaptive regulatory policies, such as more explicit profit sharing, utility companies explicitly putting more emphasis on the their public interest in their day to day decisions, or more generally, there being more of a social contract between utility companies and their customers (including perhaps greater emphasis on helping vulnerable customers, awareness of ESG, and such like), will (other broader factors remaining constant) necessarily increase the cost of capital of these companies. Indeed, there are sound reasons to suggest that it may often reduce the cost of capital of the utilities facing such regulatory changes, since any potential increase in the cost of capital is likely to be offset by a decline that arises from a decline in overall volatility of return.

We wish to emphasise, however, caveats that should be noted.

Although there was uncertainty around the specific changes in regulation in the case-studies we consider, the direction of 'regulatory' travel was clear, i.e. the precise form of the regulation was not obvious, but where it was heading was. This makes it easier for companies to plan and may well be an important factor in mitigating against increases in the market risk arising from the changes. The implication is that it is important for regulators to adhere to longer-lived specific principles. If regulators have specific principles which give firms confidence in judging how a regulator is likely to respond to unforeseen events, adaptive regulation can bring benefits without bringing costs.

Second, it is important to remember that a lower cost of capital is not necessarily an end in itself. If a company has been given too high a cost of capital in a price review, then reducing this to a more appropriate rate is an obvious benefit for consumers. But if a cost of capital is reduced because the regulator has taken risks away from the company that could

sensibly be managed by the company, then the aggregate effect depends on the balance between the benefit of the lower cost of capital against any impact arising from the dampening of the company's incentives to reduce cost. The picture is similarly nuanced with indexing. Indexing as much as is possible may reduce the cost of capital and the potential for abnormal returns of regulated companies, but, in some cases, this may imply a reduced risk for companies and an increased risk for consumers, which may well indicate a degree of loss for consumers. The welfare impact is the balance of the two forces.

The caveats mentioned above emphasise how retrospective judgements can be presented as obvious errors, but which were at the time far more nuanced. Having said that, it is difficult to argue with the general thrust of the recent report by Citizens Advice which suggests that regulators have historically been conservative and overly concerned to avoid shortfalls in investment, and hence set the allowed regulated prices to be higher than were necessary[3].

[3] Citizens Advice 'Monopoly Money: How consumers overpaid by billions', 2019.

1. Introduction

Investment in UK regulated networks is already substantial. Investment by energy networks has been running at circa £10bn pa, for example, and the regulated water industry at around £5bn pa. However, looking forward, it is widely expected that these figures will need to increase substantially. Climate change alone will have a significant impact. The Committee on Climate Change has suggested that investment in energy will need to double in order to meet a target of net zero by 2050, and the water industry will need to increase investment substantially to improve resilience. Away from climate change, there are also other drivers of significant infrastructure requirements. For example, the Government's Future Telecoms Infrastructure Review estimated that an investment of £30bn will be needed just to roll out a full fibre broadband network in the UK.

However, at the very time that the need for greater investment is emerging, there has also been growing concern around the regulation of the sectors that are expected to deliver much of the additional investment. At the heart of these concerns lies the idea that the regulated companies have been too profitable and that a shift in the regulation/provider relationship may be needed. Calls for voluntary returns, a government review, a 'painshare and gainshare' relationship between regulated companies and consumers, far more emphasis on helping vulnerable customers and other suggestions requiring a more adaptive form of regulation have emerged in the last few years. The Labour Party have even suggested nationalising some of the regulated companies.

Alongside these calls for change, there are already structural reasons to think that regulation may have to become more adaptive in the future. For example, in the growing 'tech' world, with uncertain and ever more changing environments, companies cannot expect that the regulatory backdrop to their investments will remain static while the world, technologies and markets change rapidly. In the longer run, regulation may have to change more frequently (e.g., greater use of conditional review clauses, mid-term reopeners, etc.). A world of more 'adaptive regulation' may become the norm and, whilst regulators should be expected to stick to core principles, it may not be beneficial to stick to fixed, narrow rules for long periods.

There are voices suggesting that these two directions of travel (greater investment and more adaptive regulation) are incompatible. Namely, changing regulation, increasing regulatory flexibility, use of conditional review clauses and raising further requirements on regulated companies, such as helping vulnerable customers, will increase the cost of capital

just at the time when more investment is needed, making it harder for companies to invest in the necessary infrastructure.

This briefing note addresses this question.

2. Models of utility regulation

Although there are many models of regulation, price cap (incentive) regulation and rate of return regulation have been the most prominently used throughout the world over the last hundred years.

The primary feature of the price cap regulatory model is that the future path of a utility's prices is set for a fixed period, typically five years, at a level such that the expected return of an efficient company making reasonable efficiency improvements over the period would be equal to its cost of capital. At the end of the period, efficient costs are reassessed, and new prices set for another period. The core justification is that the utility is incentivised to reduce delivery costs since the company retains the full benefit of cost reduction during the period up to renewal of the price cap. While this has strong incentive properties, an obvious disadvantage is that there is also a strong incentive to fool the regulator into believing that potential efficiency gains are much lower than they really are. This does not reduce the incentives to reduce costs but can deliver returns to the utility that are above the cost of capital, or to put it another way, the utility may end up keeping a larger share of the gains than would be 'ideal' because of asymmetry of information between the regulator and the utility. Similarly, there are incentives to shave on the quality of services, if possible, since there is no offsetting price effect. This type of regulation has been the dominant model for UK regulation post privatisation.

In contrast, rate of return regulation fixes an allowed return for a utility. This ensures the utility does not earn undue profit but provides little in the way of incentive to increase efficiency and reduce costs since there is limited gain arising from reducing delivery costs. Since the utility's return only increases when the size of the regulated asset base increases, companies have an incentive to gold-plate the system by engaging in unnecessarily high quality and expensive assets. This model was the main model used in the US for the second half of the twentieth century but has been slowly replaced by price cap regulation.

Combinations of these two models have been discussed but are not frequently implemented. For example, in the period running up to, and for a period after, the 1997 election, the Labour Party talked of introducing an explicit sharing factor for all utilities so that

deviations from the target return would be explicitly shared between customers and the utility. In the end the Labour Party did not follow the policy but did implement a windfall tax to clawback historical abnormal returns. The impact on the risk of UK utilities is analysed in Grout and Zalewska (2006) and is discussed in some detail below. An informal equivalent to this form of sharing was suggested by the CEO of Ofwat in 2017, 'painshare and gainshare', where companies voluntarily moderate their returns when they are fortunate beneficiaries of higher returns driven by events outside their control in exchange for a quid-pro-quo when events they cannot control lead to unexpected lower returns.

Probably the biggest change in the regulatory model since privatisation has taken place in energy network regulation, where the so called RIIO model has been adopted. RIIO is an acronym for Revenue = Incentives + Innovation + Output, indicating the core feature of the regime, namely that revenue is earned through achieving various targets for outputs and being innovative. This is shift away from cost cutting towards incentivising specific outputs and innovation investment. Another unusual feature is that the RIIO price control was set for eight years in the first series of price controls (RIIO-1, covering electricity distribution networks, gas distribution networks and gas and electricity transmission networks). With the benefit of hindsight, this has been deemed too long and the next set of RIIO price controls, RIIO-2 (currently being developed) propose a more conventional time horizon. Finally, the RIIO process also included a significant number of sharing factors where gains from delivering better than expected outputs are shared with customers. Below we look at the relative risk of energy network companies and water companies from 2005 to 2019. This covers the period when the RIIO approach was developed, RIIO-1 was implemented and when the proposed changes to RII0-2 were announced.

3. Measuring market risk, the cost of equity and the cost of capital

Utility regulators in the UK have consistently used the Capital Asset Pricing Model (CAPM) to calculate the cost of equity (although other approaches, such as dividend growth models and market value to asset base, are used as cross checks). The CAPM indicates that the cost of equity of company i, r_i, is a sum of the risk-free rate of return, $r_{risk\text{-}free}$, i.e. return investors can expect if they do not take any risk, and of the company specific fraction (known as ' beta', β) of the market risk premium. The market risk premium is defined as the expected difference

between the return earned by the market and the risk-free rate of return, $r_{market} - r_{risk\text{-}free}$. More formally, the cost of equity of company i can be expressed by as:

$$r_i = r_{risk\text{-}free} + \beta(r_{market} - r_{risk\text{-}free})$$

The difficulty in estimating the cost of equity arises from uncertainty around the market risk premium (opinions can differ from 1% to as high as 9%), the market risk of the company (i.e. the beta) and the value of the risk-free rate. Hence, companies and regulators end up spending large amounts of their time (and large amounts on consultancy fees) disagreeing as to what the relevant number is. However, the market risk premium and the risk-free rate is the same across all companies. Hence, although participants can disagree enormously on their view of the appropriate level of the cost of equity of a company, it is far easier to agree on changes in the relative cost of equity between companies since this almost entirely comes down to relative changes in the market risk (i.e. beta) of the companies being compared. This is one of the benefits of looking at relative market risk that we exploit in the paper. If we are looking at the impact of a change in regulation on specific utilities compared to those that did not face a regulatory change, then we need only address the relative difference in betas (i.e. the relative difference in market risk).

Assuming that capital is financed by debt and equity, the (weighted average) cost of capital (WACC) is the weighted average of the cost of equity and of the cost of debt. Formally, for any company

$$\text{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D,$$

where r_E and r_D denote the cost of equity and the cost of debt respectively, E and D denote the market value of equity and the market value of debt respectively.[4]

Utility companies can have very different debt/equity ratios but tend to have similar costs of raising debt at any given time (since the market risk of debt is quite small (typically close to zero)).[5] Although the cost of debt is also lower than the cost of equity, this does not imply that reducing equity in favour of debt will reduce the cost of capital. This is because the

[4] A technical point surrounds how taxation affects the cost of debt relative to equity. This depends on what is believed about the equilibrium of the financial system (e.g. Modigliani-Miller, Miller or other types of equilibrium) and the nature of the tax system (notably classical or imputation). We do not delve into these issues since these differences are common to the market and so do not affect relativities between companies, which is our primary concern.

[5] Of course, at any time companies may pay very different historical debt rates, since they will have raised debt at different times.

change will make the remaining equity riskier (since the smaller equity base must bear the risk of the larger fixed debt obligations that have to be met). The greater market risk increases the cost of equity, hence mitigating any benefit that arises by having a larger proportion of the company's capital consisting of the relatively cheaper debt. Indeed, the Modigliani-Miller Theorem suggests that a decision by a firm to increase its debt-equity ratio (assuming that the overall business environment remains the same) will raise the market risk of equity exactly enough to offset the benefit of having more of the cheaper debt finance and less of the expensive equity finance, so the cost of capital does not change.

Of course, if regulators change regulations, then the regulator is potentially changing the business conditions under which a company is operating. Consequently, it is possible that the cost of equity and/or the cost of capital of a company will change. A major problem is to identify whether the changes in cost of equity/capital arise because of the change in regulation or are due to other factors.

This suggests a second benefit that arises from focusing on relative rather than absolute changes (i.e. comparing changes for a company where regulations have changed, say company A, relative to another company, say company B, that has not faced a regulatory change). For example, if the relative market risk of company A and company B remains roughly constant when regulations change for company A, then the cost of capital of company A is only likely to increase relative to that of company B if the debt equity ratio of company A relative to B's increases as a result of the regulatory change. We can also infer that if the regulatory change is expected to decrease the share price of company A, then A's relative cost of capital is unlikely to increase unless there is a significant increase in the market risk of company A relative to company B.

The above suggests that assessing the empirical evidence of the relative changes in market risk, and hence relative change in cost of equity, around changes in regulation is central to understanding how likely it is that changes in regulation have increased the relative cost of capital and the relative cost of equity.[6] To this end, we look at empirical evidence on the relative cost of equity capital of regulated companies during four periods. Specifically, we examine:

[6] In this regard it is also worth noting Antoniou and Pescetto (1997), who look at the effect of regulatory announcements on the cost of equity of British Telecom. The find many announcements are associated with a change in market risk but conclude 'many individual announcements are significant, but they affect beta in opposite directions and thus no prediction can be made on the sign of their aggregated impact'. The failure to find any systematic effect emphasises the importance of focussing on relative changes to help identify which effects can be purely attributable to regulation.

(i) changes in the cost of equity of the utility sector relative to the cost of equity of similar, but unregulated, companies during the early years of the New Labour government of 1997;

(ii) changes in the relative cost of equity of energy and water companies during the period that the RIIO model of regulation was introduced in the energy industry;

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(iv) post financial crisis changes in the cost of equity of regulated sectors relative to industry sectors across the G13 countries.

4. Empirical evidence

4.1 *International comparisons of rate of return and price cap regulation*

Formal theoretical analysis and basic intuition both indicate that rate of return regulation should be a lower market risk form of regulation than price cap regulation.

There have been several studies addressing the differences in the market risk of companies facing rate of return regulation to those facing price cap regulation. There are two caveats one should note when interpreting this literature. First, these studies tend to use data from the 1980s and early 1990s. This is to a large degree because of the shift away from rate of return regulation towards the end of the century. Second, rate of return was favoured in the US whilst price cap regulation was the dominant form of regulation chosen in the UK to apply to post-privatisation utilities, which was then exported as the privatisation wave spread throughout the world. Consequently, the studies tend to compare the market risk of rate of return regulation in one country with the market risk of price cap regulation in another. So, one needs to be cautious in attributing all the difference in market risk to differences in regulation since some of this may be attributable to country effects. Despite these caveats the evidence points, fairly conclusively, to a lower level of market risk with rate of return regulation than price cap (see for example, Alexander, Mayer and Weeds (1996) and Alexander and Irwin (1997)).

Before moving on, it is worth emphasising at this juncture that the research above is looking at the market risk faced by the utility, and that if market risk is not sitting with the utility then, unless the degree of market risk has been transformed by regulation, it must be

sitting somewhere else. The most likely place is with the consumer. Hence, lower utility market risk and lower cost of capital for a utility do not automatically imply a better outcome for society. We have already noted that higher incentive structures tend to go hand in hand with higher market risk and greater incentives to reduce delivery cost but, even if incentives have no impact on cost choices, one may still want higher market risk for utilities if this creates a sufficient offsetting reduction in risk faced by the consumer. We return to this point later in the note.

4.2 The impact of potential changes in regulation

Understanding the impact of potential regulatory changes (and political uncertainty) on market risk is of considerable relevance given the current climate surrounding regulation and infrastructure in the UK. Here we analyse several episodes which may help to inform the debate.

4.2.1 The New Labour profit sharing proposals and the windfall tax

An interesting period that throws insight into these questions is the period around the New Labour election victory of 1997 (here we look at mid-1993 through to the end 2000). During this period New Labour announced the possibility of a windfall tax in their manifesto and implemented one when in power. In addition, for a significant period after the election victory, there was consideration by the Party of introducing a profit-sharing form of regulation for utilities whereby deviations from the target return set in the price cap would be explicitly shared between customers and the utility. This latter proposed policy was never implemented and was finally put to bed about two years after the election. Grout and Zalewska (2006) give a detailed analysis of the data from this episode and discussion of the policy. The results provided here are based on that research.

The empirical approach is roughly as follows.[7] We constructed a sample consisting of the UK regulated companies quoted on the London Stock Exchange (LSE) and a control sample of 'old-economy' companies also quoted on the LSE. Using a technique called Kalman Filter, using daily returns, we produced an estimate of the market risk for the two samples for every single day. This provided thousands of values of beta over the period. These are plotted in

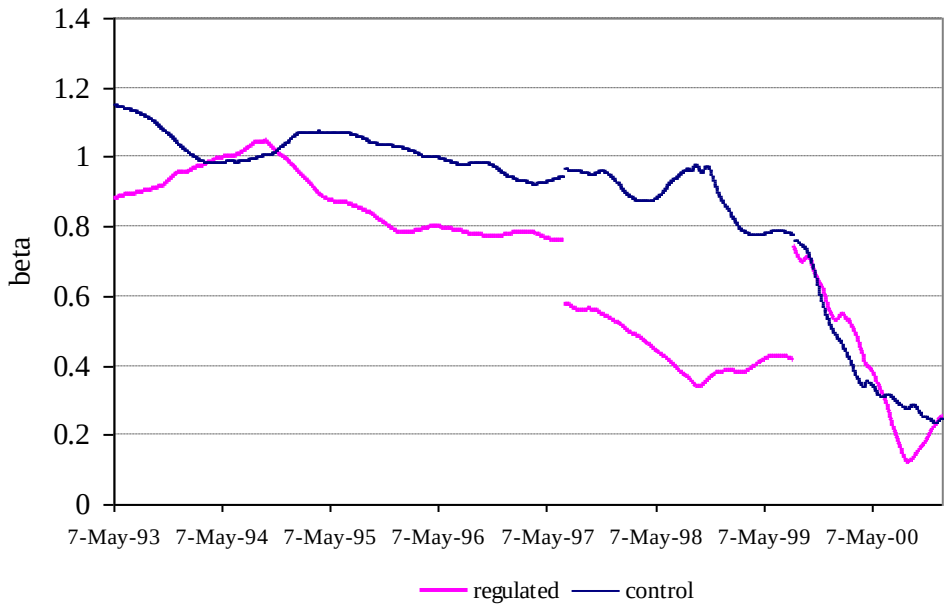
[7] This is an intuitive summary of the approach and the results. See Grout and Zalewska (2006) for formal presentation and discussion of the empirical approach.

Figure 1. In addition, we tested for statistically significant changes in the market risk over time and assessed how these related to the policy changes being discussed (see Table 1 below).

We applied the Kalman Filter separately to three different subperiods: (i) the period before the policy uncertainty about the change in the form of utility regulation, (ii) the period between the date when the political discussion started (taken as two months after the election when the debate on utility regulation opened with a formal consultation document) and when it was finally dropped, and (iii) the period after the idea of the regulatory change was abandoned.

Figure 1.

Kalman Filter estimated time-path of daily betas (market risk) for the portfolio of the regulated utility companies (regulated) and for the portfolio of 'old economy stocks' (control).



First, consider the control sample, the darker, thin (blue) line. Note, the three separate sections plotted on the diagram join up almost exactly. Indeed, the lack of match can be barely seen in Figure 1. Let us focus on the right break point. The estimate of the beta for the first day of the third period is drawn purely from the data throughout that period (i.e. using no information at all from the period running up to that day) and the beta for the final day of the middle period is drawn entirely from the data in the middle period (i.e. using no information at all from the period following that day). Despite this deliberate process of ignoring much of the adjacent, and hence very relevant data, the two lines join almost perfectly showing that there

is no fundamental difference in the control sample around the transfer from one period to another. Furthermore, there is no statistical difference between the middle period's and the first period's estimates of the market risk (shown in Grout and Zalewska, 2006).

Turning to the sample of the utility companies (the thicker, lighter (pink) line) and applying a similar methodology, we see a very different position. Here, there is a clear drop in the line at the start of the period of policy uncertainty and a clear jump up when the period of policy uncertainty ended. The difference between the market risk of the utility companies and the control sample is far greater (utilities much lower in this period) than when there was no policy uncertainty. So, the data is telling us that the regulatory uncertainty had a very clear effect on the market risk of the utilities. However, despite the common view that regulatory and political uncertainty increases market risk, the data shows very clearly that in this case the market risk reduced, rather than increased (relative to the control sample), in the period.

This is confirmed in Table 1 which looks, on an individual company basis, at the changes in the market risk relative to the old economy sample during the period of policy uncertainty. The final column shows the difference between the market risk of the control sample and the company during the period of policy uncertainty. Table 1 shows that the market risk of every utility company declined relative to the control sample. Only two of these drops were not statistically significant (one being BT, which was impacted very differently by the dot-com bubble than all other companies (see below)).

Table 1.

Maximum likelihood estimates of the CAPM model with GARCH(1,1) specification of the standard errors. The '97-97' subscript indicates the change of the intercept (α) and of the slope (β, i.e. market risk) over the period 1 July 1997 - 12 August 1999. The dependent variables are defined as the difference between returns on individual company (indicated by its name) and the return on the control portfolio of the old economy stocks.

	α	$\alpha_{97\text{-}99}$	β	$\beta_{97\text{-}99}$
Anglian Water	0.000	0.001	-0.238***	-0.386***
BAA	0.000	0.000	-0.029	-0.148**
BT	-0.001*	0.002***	0.233***	-0.075
Hyder	0.000	0.000	-0.465***	-0.286***
Kelda	0.000	0.000	-0.323***	-0.385***
National Grid Company	0.000	0.001	0.084	-0.340***
Pennon	-0.001***	0.001***	-0.639***	-0.052
Scottish Power	0.000	0.001	0.008	-0.334***
Scottish & Southern	0.000	0.001	-0.219***	-0.417***
Severn Trent	0.000	0.000	-0.146***	-0.393***
Thames Water	0.000	0.001	-0.186***	-0.144**
United Utilities	0.000	0.000	0.024	-0.455***
Viridian	0.000	0.001	-0.360***	-0.365***

During this period there was also a windfall tax implemented on the UK utility sector. This was founded on the incoming government's opinion that the utilities had earned a significant element of 'undue' profitability arising from the privatisation and regulatory regime at the time. In this view, the windfall tax and the proposed change in the regime to include a sharing factor going forward were part of a single package of reform.

The windfall tax proposal was in the Labour Party manifesto and had been discussed in the period running up to the election. The tax was indeed implemented (spread across two dates, December 1997 and December 1998). Thus, in terms of Figure 1, the discussion around the windfall tax arose in the months at the end of period 1, and the actual parliamentary discussion and decision to implement it occurred in the last two months of the first period and the opening few months of the middle period. There is no evidence in Figure 1 that this led to any increase in the market risk of the utilities. Indeed, it might appear that the market risk was slightly drifting down in that period, but such changes are so small that they are not statistically significant. So, the conclusion from this data would be that the windfall tax had no discernible effect on the market risk of the utilities.

What is going on?

The answer given in Grout and Zalewska (2006), and the one that most economists seem to have agreed with post-publication, is that the outcome is exactly what economic theory and finance theory would predict.[8] A sharing regime can be viewed as a mix of price cap regulation and rate of return. Price cap regulation is at one extreme, with no sharing, and rate of return regulation is at the other extreme, i.e. everything is clawed back to ensure constant rate of return for the utility. Hence, at the time of political and regulatory uncertainty, when someone bought a share in one of the utilities they were purchasing the right to the future profits of a company that, with some probability, would be regulated with a regime that was a mix of rate of return and price cap. The theory implies that the market risk would be a mix of the market risk of rate of return and of price cap, hence lower than the market risk before and after the period of policy uncertainty. The evidence shows that this is the case. Had the existing regulation model been a rate of return model and had the proposal under consideration been a move to the price cap model, then one would anticipate, from this evidence, that the market risk of utilities would have risen. The central point suggested by the evidence here, and in the examples using more recent policy changes which are analysed below, is that any increase

[8] There have been suggestions that the impact is related purely to the water industry but Figure 1 shows quite clearly that this is not the case.

would be attributable to the underlying economic theory not the political and regulatory uncertainty.

Also, the theory would indicate that if a windfall tax is seen as a one-off shock, then it would have no or limited impact on the market risk. If it was seen as something that could arise again in the future but with very low probability (and could possibly work in both directions, as the treatment of banks in abnormal crisis circumstances might suggest), then again this would have no or limited effect. Thus, the failure to find any impact of the windfall tax on the market risk of the utilities is again quite consistent with economic theory.

This research suggests that the implementation of, and uncertainty and 'political' discussion around, policies such as more explicit sharing (Ross[9]), utility companies explicitly putting more emphasis on the their public interest in their day to day decisions (Helm[10]), greater use of conditional review clauses or more generally there being more of a social contract between utility companies and their customers (including perhaps greater emphasis on helping vulnerable customers (National Audit Office (2019), awareness of ESG, and such like) will not necessarily increase the market risk of these companies. Indeed, it is perfectly possible for it to reduce the market risk.[11] Assuming such changes do not lead to a major decrease in the utilities' relative debt-equity ratios, then we can be confident that this would not increase the relative cost of capital but reduce it.

There is an additional feature of the empirical evidence that is relevant. The period covered included the so called 'dotcom bubble' and the early collapse of it. This is the reason that the control sample was chosen to be an 'old economy' sample (hence a better sample to compare the UK utilities with during the dotcom bubble, albeit with the probable exception of BT, as opposed to a random sample of UK companies). Figure 1 documents a dramatic fall in the market risk of the utility sample and the old economy sample in this period. It appears to affect both samples in a similar way. Grout and Zalewska (2006) show that this effect is exactly replicated by analogous utility and 'old economy' samples in the US. This is a good example of a general point, namely that factors external to the sector are likely to have more impact on the market risk of utilities than any change or potential change in regulation.

[9] https://www.ofwat.gov.uk/wp-content/uploads/2017/09/CCWater-Customer-Matters-speech-
[10] http://www.dieterhelm.co.uk/assets/secure/documents/RIP-RPI-X-regulation-OFWAT-and-OFGEM-nail-down-the-coffin-17.04.18.pdf
[11] ESG is the acronym for 'Environmental, Social and Governance'.

4.2.2 Energy transmission companies and water companies since 2005.

The biggest single change in utility regulation in the last decade has probably been the introduction of the RIIO model for energy networks. Here, we use techniques similar to those described in the section above to see whether there is any apparent relationship between the market risk of regulated energy network companies (referred to as the energy companies hereafter) quoted on the LSE (National Grid and SSE) and the introduction of the RIIO model, using daily data from January 2005 to July 2019. Figure 2 plots the Kalman Filter estimates of daily betas (i.e. market risk) over this period for the energy companies, the UK regulated water companies quoted on the LSE and the difference between these two.

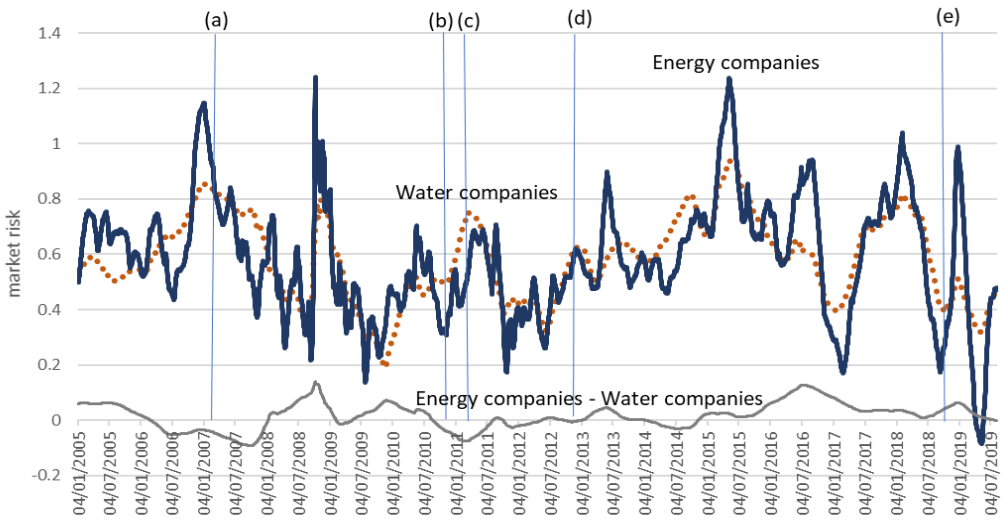
Figure 2 shows 5 key dates in the RIIO process, from the decision by Ofgem in March 2008 to review the traditional RPI-X (i.e. price cap) model to the sector specific consultation for RIIO 2 in December 2018. Although the market risk of both the energy companies and of the water companies have moved around during this period there is little association between the development of the RIIO model and changes in the market risk of the energy companies, and no evidence that the current level of the market risk of the energy companies is higher than it was before the financial crisis.

Even more interesting is to look at the Kalman Filter estimates of the difference between the market risk of the energy companies and the market risk of the water companies. The difference in the market risk between the two sectors is quite stable. Indeed, investigation of the confidence intervals, not shown on the figure, indicates that the difference between the energy and the water companies shown in Figure 2 is not statistically significantly different from a constant difference throughout the period.

The empirical evidence shows that the changes we observe in market risk are common to both sectors, i.e. the market risk may have changed but the difference between them is not statistically significantly different from a constant value. The implication being that changes are not related to any changes in regulation in one sector that is not present in the other, or to put in another way, the uncertainty surrounding the assessment of the tradition price cap and the consequent introduction of the RIIO model does not appear to have had a significant impact on the market risk of the energy companies. Similarly, there is no evidence that the debt-equity ratio of the portfolio of the energy companies decreased relative to the water companies during the development and introduction of the RIIO process (indeed, it appears to have increased), so there is no evidence that the regulatory change increased the relative cost of capital.

Figure 2.

Kalman Filter estimated time-paths of daily betas (market risk) for the portfolios of the water companies (brown, dotted line), of the energy companies (dark blue, continuous line), and the difference between them (grey, thin, continuous line) for the period 01 January 2005 – 31 July 2019. The vertical lines ((a)- (e)) mark regulator events as discussed in the main text.



(a) Announcement of the RPI-X@20 Review

(b) RPI-X@20 Decision Document

(c) Decision Strategy Document for RIIO-T1

(d) RIIO-T1 Final Proposals

(e) RIIO-T2 Sector Specific Consultation

4.2.3 Centrica and the introduction of the Default Tariff Cap for the electricity and gas supply market

Another recent period of regulatory uncertainty and consequent change in utility regulation arose in the electricity and gas supply market where a default tariff cap was implemented in January 2019. In this subsection we consider the market risk of Centrica, one of the leading gas and electricity suppliers, and the difference between the market risk of Centrica and the market risk of the water and energy companies.

Centrica has been the centre of considerable disruption in last decade. Iain Conn, the chief executive, has said that in recent years the group faced a "huge number of headwinds". These and other changes have included the recent default tariff cap in the UK, problems with the US supply business, reduced gasfield production, working towards shifting the company to one in tune with a lower carbon economy, several of its nuclear power plants being offline, and launching a partnership with Ford (the carmaker). The share price has fallen relatively

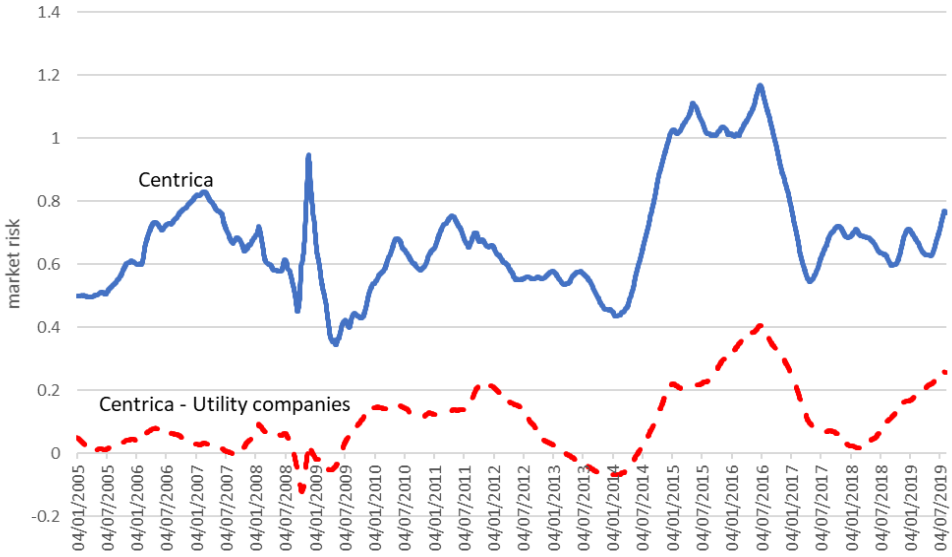
consistently from over 400p in 2013 to 65p in early August 2019. Recently, following a halving of its share price in the last five months, Mr Conn indicated that he will resign from his position as CEO.

Since the disruption has, to a significant degree, been company specific we cannot expect the approach of focusing on relative differences to isolate the questions we are interested in and this needs to be borne in mind when interpreting the evidence. However, despite these problems there are some cautious conclusions that can be drawn.

The Kalman filter results for the market risk of Centrica and the difference between the market risk of Centrica and the market risk of the portfolio of water and energy companies used in the previous subsection (referred to here as 'utility companies') are shown in Figure 3(a) for the period 1 January 2005 - 31 July 2019. This clearly indicates that there is considerable volatility in the market risk of Centrica over time and that some of this translates into changes in the relative market risk. This is consistent with the suggestion that there are significant changes happening to Centrica over this period that are not reflected in the utility companies.

Figure 3(a).

Kalman Filter estimated time-paths of daily betas (market risk) for Centrica (dark blue, continuous line), and the difference between Centrica and the portfolio of the utility companies (red, dashed line) for the period 01 January 2005 – 31 July 2019.

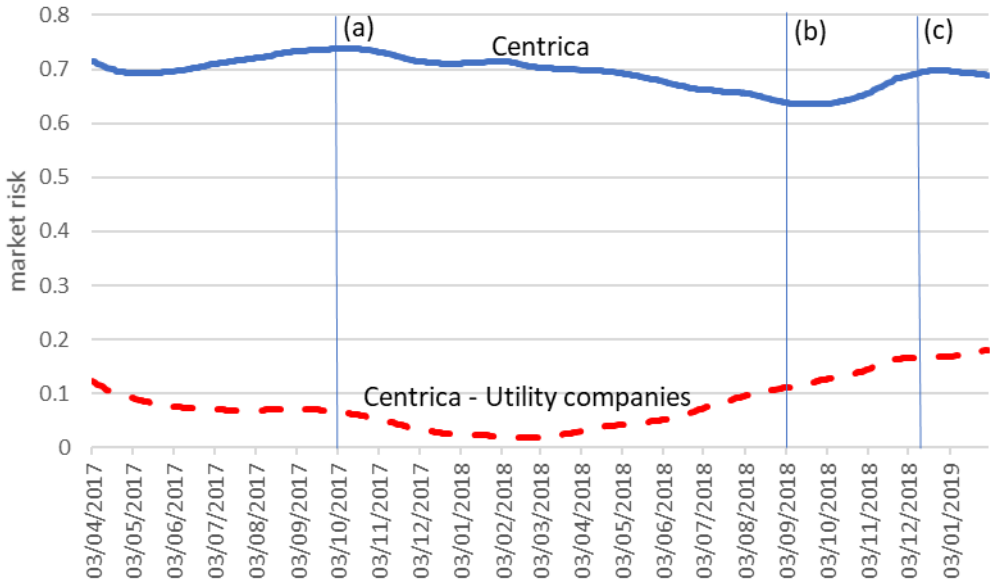


However, if we focus on a period covering the six months running up to the announcement by the Prime Minister that there would be a Default Tariff Cap retail until just

after the first cap was implemented, then we may be able to focus on the main announcements of regulatory changes and their implementation whilst hopefully limiting the possibility of impact of non-regulatory Centrica events impacting on the data. The results for the market risk of Centrica and the difference between the market risk of Centrica and the market risk of the portfolio of utility companies are shown in Figure 3(b) for the period 1 April 2017 to 31 January 2019. The figure also shows three key dates. The first relates to when the Prime Minister announced that there would be a price cap. The second is when Ofgem published its proposals on the methodology, and the third relates to when the specific price cap levels for the initial cap were announced. The cap came into force on 1 January 2019, a month before the end of the data in Figure 3(b).

Figure 3(b)

Kalman Filter estimated time-paths of daily betas (market risk) for Centrica (dark blue, continuous line), and the difference between Centrica and the portfolio of the utility companies (red, dashed line) for the period 01 April 2017 – 31 July 2019. The vertical lines ((a)- (c)) mark regulator events as discussed in the main text.



(a) Prime Minister announces there will be a Default Tariff Cap (DTC)

(b) Proposals on the DCT methodology published

(c) Price levels of initial DTC announced

The line denoting the market risk of Centrica and the line denoting the difference between the market risk of Centrica and the market risk of the water and utility companies are

relatively stable in this period. Indeed, the line showing the difference between the market risk of Centrica and the market risk of the utility companies is not statistically significantly different from a constant value throughout the period. It is difficult to say anything too definitive because of all the changes that have impacted on Centrica in the last decade and the short period we are investigating (making it difficult to collect detailed evidence of debt equity changes for the short period). However, the evidence appears to suggest that the period of uncertainty with regard to whether there would be a default cap or not, the uncertainty with regard to the form that it would take, and what the level would be when it was introduced, had no significant effect on the relative market risk of Centrica.

4.2.4 The market risk of utility stocks following the financial crisis.

Another example of utility wide effects on market risk has arisen in the aftermath of the financial crisis. This is particularly interesting in the context of this note because it relates to what appear, with the benefit of hindsight, to be 'errors' made in the setting of the price caps following the financial crisis. There are many complex effects that may impinge on the market risk of companies since the financial crisis but there are two that are potentially particularly relevant for utility companies, notably in the UK. One is the impact on the relative market risk of sectors because of the post-crisis comparative demise of the banking sector, and the other is the relative attractiveness of utility stocks as a result of the ensuing monetary response pursued by governments. Grout and Zalewska (2016) analyse these effects in the 13 G12 countries in the post-crisis period.

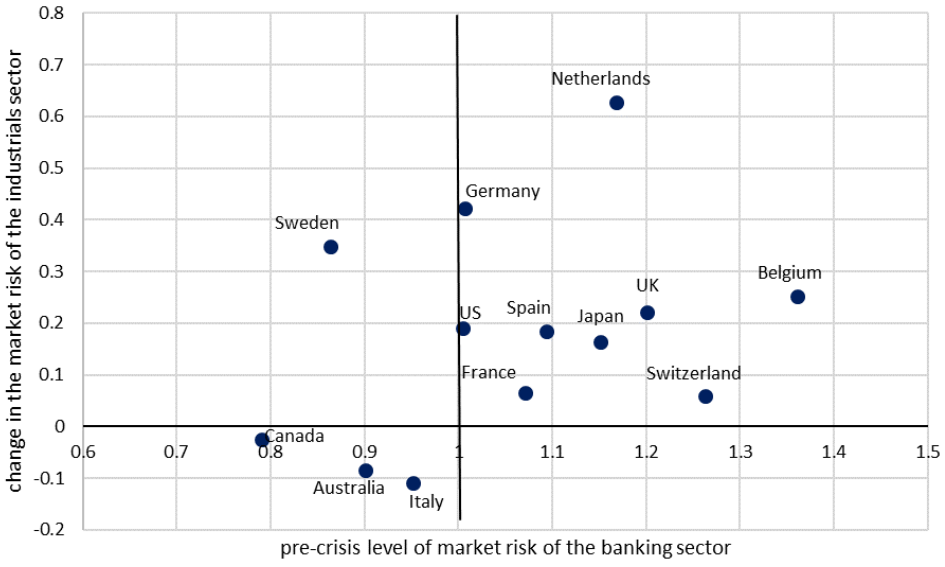
The first effect has a simple intuition. The weighted average of the market risk of all the companies on a market is, by assumption in the CAPM theory, equal to one. If one sector, in this case banking, declines significantly as a fraction of the market (due to share price falls, large players leaving the market, etc.), then, other things being equal, for purely mathematical reasons the other betas of the companies have to change to keep the weighted average at one. The only exception to this is if, by a 'statistical quirk', the beta of the banking sector happened to be one in which case there is no readjustment needed on other betas to keep the weighted average at one. If the banking sector's market risk was above average (i.e. its market risk was greater than one) the decline in the relative size of the banking sector in a market would increase the market risk of other stocks. Conversely, if the banking sector's market risk was below average (i.e. its market risk less than one) the decline in the relative size of the banking sector in a market would decrease the market risk of other stocks.

To investigate this effect Grout and Zalewska (2016) looked at the change in the market risk of the industrial sector in each of the 13 G12 countries and related this to the market risk of the banking sector in that country immediately before the financial crisis. The results are in Figure 4 below. Obviously, there will be many other effects of the crisis across countries but if this particular effect were the sole effect, then one should find that an increase in the market risk of the industrials sector arises where the market risk of the banking sector was above one and a fall in the market risk of the industrials sector where the market risk of the banking sector was below one. In terms of Figure 4, countries would have to lie in either the right hand upper quadrant identified by the two thick lines (i.e. the market risk of the banking sector higher than the average market risk was associated with an increase in the market risk of the industrial s sector) or the lower left hand quadrant (i.e. the market risk of the banking sector lower than the average market risk was associated with a decline in the market risk of the industrials sector).

Figure 4 shows that all countries, save Sweden, sit in these two quadrants (Sweden is frequently seen as an exceptional case in the context of banking because of its response to the dramatic collapse of the Swedish banking in the eighties). Note, the Netherlands display a significantly greater increase than all other countries which helps reinforce the underlying argument given that in the Netherlands the post-crisis market capitalisation of the banking sector was only 3.9% of the pre-crisis figure.

Figure 4.

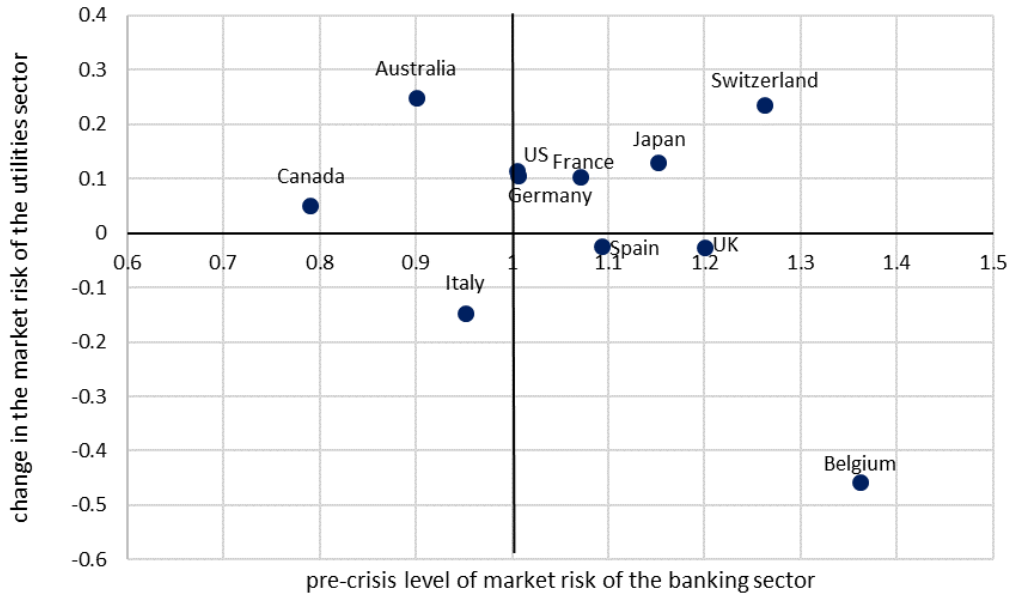
The pre-crisis market risk of the banking sector versus the change in the market risk of the industrials sector for the 13 G12 countries.



The second effect we note above concerns the interaction of the monetary policy post-crisis with the market risk of utilities. On one hand, there is the perception that post crisis it would be harder to fund infrastructure investments than pre-crisis but, on the other hand, the Policy (Central Bank) Rate for most countries was exceeding low. For example, in the case of the UK, Bank Rate was 0.5% or below between March 2009 and August 2018. Money seeking high returns but low risk was attracted to utilities and related infrastructure investments (see Grout and Zalewska (2016) for a discussion of this process including Berkshire-Hathaway's changing view of infrastructure investment). Far from finding it difficult to fund infrastructure projects, utilities were considered one of the few favourable and safe investments. This provided an offsetting force to the underlying direction of travel that we have identified in market risk of the industrials sector.

Figure 5.

The pre-crisis market risk of the banking sector versus the change in the market risk of the utility sector for 11 G12 countries.



The net effect on utilities is shown in Figure 5, which repeats the exercise shown in Figure 4 but now for the change in the market risk for the utility index in each country. On average, the market risk has not risen for utilities as much as for industrials. The average increase in the market risk for industrials was 0.18 compared to an increase of 0.03 for utilities. In the case of the UK the market risk of the industrials sector rose by 0.2 whereas the market

risk for the utility sector fell by 0.03. Post the financial crisis, debt-equity ratios of utilities have not fallen relative to industrial companies and hence the decline in the relative market risk of utilities carries over to a relative decline in the cost of capital.

Thus, the concern that was often present in the discussion around utility markets post-financial crisis, namely, that the crisis may negatively impacted on the ability to fund the major investment programmes going forward, did not materialise. Indeed, utilities have been favoured by a 'halo effect' in the absence of alternative low risk investments. Obviously, the crisis has had many complex effects but the effects we identify here are material. This difference between expectation and experience is manifest in the RIIO-1 price controls which used a market risk of 0.9-0.95 in the RIIO-GD1 and RIIO-T1 price controls despite consultants' reports indicating the number was lower at that time.

5 Closing comments

5.1 *Importance of principles and direction of travel*

The case studies provide a general picture. There is no evidence that the changes (or possible changes) in regulation or the introduction of regulation increased the relative market risk of the companies that were directly affected by the changes. Where we have sufficiently long samples to analyse, there also appears to be no evidence of the change in regulations increasing the cost of capital.

This may appear to be a dramatic result but there are common features of the changes that we consider, which provide a clue as to why this is the case. The evidence is suggestive that the direction of travel, i.e. some degree of predictability in how regulators may respond when changing policy, is likely to be important. For example, companies were aware that New Labour were likely to move towards sharing and an extreme version of this, the windfall tax, which clawed back a slug of what they saw as undue profitability. Similarly, concerns over the competitiveness of the retail energy market, the functioning of the market and levels of customer service had existed for many years and were intensifying. So, even before price regulation of the variable retail energy tariffs was a genuine possibility the direction of travel of any potential regulation was relatively apparent.

Although there was uncertainty around the specific changes in regulation in the case-studies we consider, the direction of 'regulatory' travel was clear, i.e. the precise form of the regulation was not obvious, but where it was heading was. This makes it easier for companies

to plan and may well be an important factor in mitigating against increases in the market risk arising from the changes.

The implication is that it is important for regulators to adhere to longer-lived specific principles. If regulators have specific principles which give firms confidence in judging how a regulator is likely to respond to unforeseen events, adaptive regulation can bring benefits without bringing costs.

5.2 The consumer and utility company risk balance.

During a price control period it is standard for regulated prices of the relevant utility to be indexed to inflation. The simple argument being that the general price level and wages tend to follow a roughly similar pattern. Hence, increasing prices to reflect changes in the RPI, or more commonly now CPI, keeps the real price that the consumer pays constant and does not reflect a change in the consumers welfare. Thus, indexing prices does not reflect an increase in risk for the consumer, indeed, not indexing output prices to retail prices would probably lead to an increase in risk for the consumer. A difficulty arises, however, when the cost of some of the utility's inputs are not anticipated to move in a similar manner to the general price level and are material to the costs of delivery. These are called real price effects. If there is uncertainty as to how the price of these specific inputs will change in the future, there is a question as to who bears any associated risk.

One solution is for the regulator to estimate the expected deviation in the price of the input from the general price level and set prices to reflect this estimate. Deviations from the expected change either provide an unexpected loss or benefit to the utility and the utility shareholders bear this risk. At the other extreme the price of this input could be indexed as time passes, just like all other prices, and the price the consumer pays changes as the input price changes. This limits any abnormal return arising from real price effects but (real) consumer prices then rise or fall as the input price changes.

Estimating real price effects of this type for price controls can be the source of significant outperformance. For example, Cambridge Economic Policy Associates (2018) estimated that not indexing real price effects in RIIO increased the outperformance by 0.8% in RIIO-ET1 (i.e. Electricity Transmission), 0.4% in RIIO-GT1 (i.e. Gas Transmission) and 0.7% in RIIO-GD1 (i.e. Gas Distribution Networks).

Regulators are less likely to estimate real price effects than in the past in a desire to avoid excess performance. However, it is important to recognise that one should not simply view a failure to index real price changes, which subsequently led to 'excess' returns, as a clear

error. There is a genuine debate around who should bear the risk. Things have moved over the years from a position where it was usually assumed that companies should bear the risk and as a result real price effects should be estimated in advance to one where any failure to index is automatically deemed to be an error by the regulator, hence indexing is now becoming standard. Whether consumers have gained as a result of this change is nuanced question that has not been addressed.

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