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Agenda

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Where has the innovation gone? R&D in UK utility regulation

If current trends continue, the UK economy may suffer as the effects of reduced R&D effort in key infrastructure sectors feed into lower productivity growth throughout the economy. Liberalisation, the design of the regulatory regime, and changes in utility financing may all help to explain the trend for falling R&D intensity across most utility sectors. This article examines several options for regulatory reform to address these challenges

What are the issues?

- **Falling R&D intensity across several utility sectors could indicate that long-term productivity gains will be less likely**
- **The economic characteristics of R&D expenditure make it difficult to regulate**

Is incentive regulation in the UK sustainable? When this question is posed, it is most frequently considered in the context of providing sufficient incentives for regulated firms to invest in tangible assets. There are concerns that RPI – X regulation places too much emphasis on incentivising firms to deliver operating expenditure efficiencies and that insufficient attention is paid to the delivery of capital investment programmes.

However, another dimension to the issue of sustainability is expenditure on (or investment in) research and development (R&D). This is expenditure that has the potential to generate new long-term cost-saving or benefit-enhancing technologies. There is evidence to suggest that the amount of R&D expenditure being undertaken by UK utilities has fallen significantly over the past 15 years. This article explores the links between RPI – X regulation and incentives for R&D expenditure, and outlines a number of potential regulatory reform options which could help reverse the declining trend.

Ofgem's incentives for greater R&D in electricity distribution

During the most recent distribution price control, Ofgem instituted two incentive mechanisms to encourage greater investment in distribution network design, operation and maintenance. The objective of the innovation funding incentive (IFI) and registered power zone (RPZ) mechanisms is to achieve greater overall spending on R&D by allowing a proportion of research costs for approved projects to be passed through to customers.

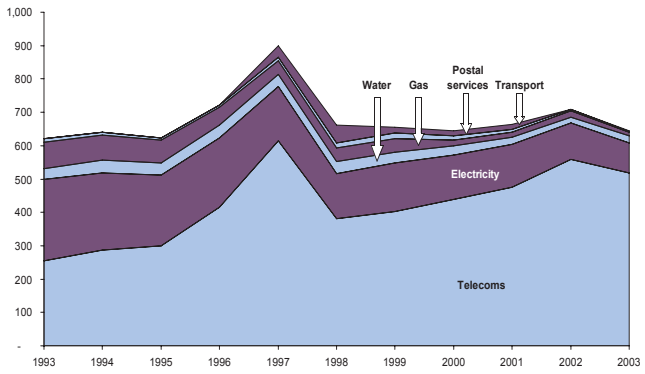
In developing these mechanisms, Ofgem has recognised that the innovation incentives under the RPI – X regime are unlikely to be adequate. Assuming that an innovation provides benefits for 20 years, takes five years to develop, and the distribution network operator (DNO) only retains the cost-reducing benefit for five years, the net present value (NPV) of the project could be negative. Given the expected increase in distributed generation (DG) and the potential for active management of flows over what were previously passive distribution networks, Ofgem has also recognised that greater innovation is ultimately of benefit to consumers.

The IFI mechanism provides a ring-fenced amount of price control revenue (up to 0.5% of allowed revenue) on a use-it-or-lose-it basis, subject to prior regulatory approval of individual R&D projects. Innovations must be part-funded (20%) by DNOs, with the additional price control revenue providing the remainder of the necessary funding. The profile of cost pass-through is designed such that individual projects are NPV-positive, thereby countering the disincentive otherwise inherent in the RPI – X regime.

The RPZ mechanism operates by allowing DNOs to recover a greater amount of revenue from DG customers for the first five years within approved localities where new DG-related innovations are being developed. Greater revenue recovery will be subject to connection of new DG customers within the RPZs.

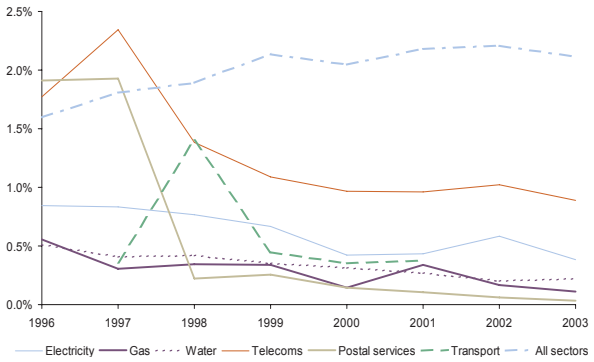
Source: Ofgem (2004), 'Distribution Price Control Review: Further Details on the Incentive Schemes for Distributed Generation, Innovation Funding, and Registered Power Zones', June.

Figure 1 Actual R&D spend by sector (£m)



Source: DTI 'R&D Scoreboard' and Oxera analysis.

Figure 2 R&D intensity by sector (%)



Note: R&D to gross sales.
Source: DTI 'R&D Scoreboard' and Oxera analysis.

Are current trends sustainable?

The trend is clear in the case of R&D effort across the major utility sectors: it is falling, with the only exception being telecoms. While Figure 1 shows a fairly constant level of overall, utility-wide nominal R&D spending, this masks substantial differences between telecoms and the other sectors.[1] The second largest share of utility R&D is in the electricity sector—yet this share has been falling. R&D in the transport sector has shown a marked decline, with negligible amounts in 2002 and 2003.

It is important to note that the above comments relate to *nominal* R&D spending, which does not take into account the impact of inflation.[2] Real expenditure is likely to have fallen even more substantially.

The electricity, gas and transport sectors reduced R&D budgets by 34–88% over the period 1993–2003. In contrast, the telecoms sector experienced a doubling of R&D in this period. Figure 2 shows the level of R&D spending relative to sales, also referred to as R&D intensity. The electricity, gas, and water sectors consistently show an R&D intensity of less than 0.5%, with telecoms achieving a level of 1%. However, compared with all the R&D-intensive firms in the sample, the utility sectors as a group have less than half the R&D intensity of the most innovative firms in the UK, which is close to 2%.

It is difficult to say with certainty what the optimal level of R&D expenditure by any company, or in any sector, might be. R&D activity would ideally take place until the expected marginal benefit of the expenditure is equal to the marginal cost—and obtaining information on either of these elements can be difficult. However, the fact that expenditure in most utility sectors has fallen to such an extent over this period does suggest that there is a realistic possibility that R&D expenditure is at a sub-optimally low level. The regulatory treatment of R&D is therefore a relevant policy concern.

These findings suggest that there are at least two important risk factors for continued productivity growth in the regulated network utility sectors in the long run.

— Given lower levels of R&D intensity, there may be limited scope for continued productivity gains once today's 'best practice' and technologies are fully incorporated into utilities' asset bases. Without continuing R&D effort, the development and dissemination of new technologies could be held back.

— Sustained reductions in R&D effort could make the adoption and adaptation of externally developed new technologies more difficult. To the extent that falling behind in the development of technologies results in higher costs of appropriating 'next generation' technology developments, the current trend for falling R&D budgets could be inefficient.

The combined effect of these risk factors suggests that the UK economy may suffer in the long run if key infrastructure sectors do not step up their R&D effort.

Is regulation to blame?

What could explain the trend for falling R&D effort and intensity? It is commonly recognised that R&D spending has a number of characteristics that could exacerbate the tendency for firms to undertake less expenditure of this type compared with what might be considered optimal for society. The factors principally responsible for this are the relative riskiness of returns to R&D and the presence of spillover benefits to other firms in the industry or wider economy, which mean that the firm undertaking the investment may not be able to appropriate the full value of any returns. In short, the

possibility that competitors or other related industries may 'free-ride' could reduce the overall level of market supply. Typically, granting intellectual property rights (IPRs) increases the private value of innovation by mitigating this effect.

Despite these difficulties, it is clear that some firms undertake significant levels of R&D. As shown in Figure 2, the R&D intensity of the most innovative UK firms is nearly twice that of the telecoms sector, and over four times that of other utility sectors such as gas, electricity and water. It is also important, therefore, to consider how the market structure and regulatory regime may be affecting the level of R&D expenditure across the regulated utility sectors.

Much of the academic research in this area focuses on the impact of market structure on outcomes such as profitability, capital investment and technical innovation. Given that wide-ranging policy goals, such as liberalisation and sector-specific regulation, affect the number, size, and conduct of firms in the utility sectors, outcomes such as investment in R&D would be expected to be highly sensitive to the particular form of economic regulation and the detailed design of the regulatory regime.

Factors likely to influence the trends in R&D expenditure by firms in the regulated utility sectors in the UK are as follows.

– *Liberalisation*—policies aimed at facilitating supply competition, privatisation, and regulation of networks have resulted in major structural reform across utility markets. Vertical and horizontal (ie, geographical) separation along legal or ownership lines has radically changed the number, size, and scope of utility firms' activities. Research has shown that, in many cases, this has had a negative impact on R&D effort and intensity.[3] Whereas vertically integrated monopolies were able to spread the costs of R&D over a larger cost base, smaller, more competitive firms are less able to do the same. Moreover, a broader scope of activity undertaken by large monoploy utility companies in the past is likely to have made them more able to apply new innovations in a variety of contexts, thereby internalising the benefits of R&D investment to a greater extent.

  However, the results presented in the academic literature are not conclusive, since there are also positive effects. Reforms such as those associated with liberalisation in the UK and EU have changed both the amount and quality of the research undertaken by firms (eg, the split between basic and more applied forms of research).[4]

– *Regulation*—the widespread use of price cap regulation with five-yearly reviews would also be expected to have an impact on the ability of firms to invest in R&D, as well as on the incentives for doing so. The relatively short review periods within which firms aim to outperform the regulator's targets, compared with the potential long-term benefits of greater R&D effort, could have a negative impact on R&D. In contrast, an unregulated firm could have up to, for example, 20 years to reap the benefits of R&D that is protected under patent. Moreover, under RPI – X regulation, any benefits that may be gained from undertaking a large amount of R&D expenditure need to be weighed up against the fact that a regulated firm stands to benefit in the first place from reducing its R&D expenditure allowance against that assumed (either explicitly or implicitly) by the regulator in setting prices—ie, the incentives to reduce costs apply just as much to R&D costs as to any other type of cost.

– *Utility financing*—since the mid-1990s, the observed trend across a number of infrastructure sectors has been to increase gearing levels, partly as a result of the need to finance higher capital investments, but also to achieve an 'optimal' capital structure such that the required rate of return is lower than the regulatory cost of capital.[5] To the extent that increased gearing reduces free cash flows, this would be expected to reduce the ability of regulated firms to finance greater R&D. This is broadly supported by evidence in the academic literature that has tracked trends in R&D in unregulated sectors.[6]

Policy responses

The above discussion suggests that the regulatory regime may have an impact on the level of R&D effort undertaken by infrastructure firms. However, widespread use of incentives targeted at R&D or innovation does not typically feature in the regulatory regime. One exception is the innovation funding incentive introduced by Ofgem in 2004, summarised in the box on p. 1.

However, there are other responses that regulators could consider.

– *Capitalisation of R&D expenditures into the existing regulatory asset base (RAB)*—the economic rationale for capitalising the value of R&D is that it is likely to generate benefits beyond the year in which these expenditures are made. In this respect such expenditure is like investment in any physical, tangible asset and could be capitalised into the RAB. Intangible assets also depreciate over time. For R&D, depreciation primarily occurs through technical

obsolescence, although, where protected by IPRs, it can be due to expiry of these rights.

There are regulatory precedents for the capitalisation of spending on other intangible assets. In its inquiry into the services provided by retail banks to small and medium-sized enterprises, the Competition Commission recognised that an economic assessment required a different set of criteria for determining whether an expenditure should be capitalised or expensed compared with the approach that might be taken by accountants.[7] The criteria used to determine whether to capitalise certain expenditures are that the expenditure must:

- be incurred now, primarily to obtain earnings in the future;
- be additional to that necessarily imposed at the time in the running of the business;
- be identifiable as creating an asset that is separate from those arising from the general running of the business.

As a result, in this inquiry, the Competition Commission capitalised some of the expenditure undertaken by banks for the purposes of marketing, staff training and IT systems. It seems plausible that applying the same criteria to R&D expenditure would also suggest that part of this expenditure should be capitalised. Interestingly, Ofgem has also stated that it would reconsider capitalisation of some R&D expenditures as part of the review of the IFI and RPZ mechanisms to be completed in 2007.[8]

Nonetheless, there are likely to be several challenges to implementing the R&D capitalisation approach. Most notably, it is not clear that this approach would necessarily incentivise any additional research effort. Capitalising or expensing expenditures should not have any present-value effect for the firm if the allowed rate of return is set at the level of the cost of capital (determined by the regulator). Therefore, any additional R&D spending could reflect a generous cost of capital, and it would be difficult to determine whether these additional expenditures were 'efficient'.

Moreover, to apply the criteria mentioned above would require the clear identification of R&D expenditures, which could be challenging in practice.

- *Capitalisation of R&D expenditures into an 'innovation RAB'*—a variant on the capitalisation approach would be to create a separate 'innovation RAB', whereby additional R&D spending would be remunerated using a separate rate of return. Assuming that additional and beneficial R&D could be defined, this would give incentives to undertake more R&D, as well as provide certainty for cost recovery. As the cost of capital for R&D could be set independently of the 'tangible' RAB, the regulator could influence the level of R&D effort more directly.

  However, a major difficulty with the 'innovation RAB' approach would be the determination of whether R&D efforts are efficient. This is also a problem for the capitalisation approach mentioned above, but it is likely to be more acute in this case since the incentives are considerably stronger. This option would also need to be accompanied by additional monitoring by the regulator to ensure that R&D effort is 'useful'.

- *Remuneration of R&D outputs*—one way of ensuring efficient R&D would be to remunerate the outputs of innovation, and not simply the inputs (ie, R&D expenditures). There are at least two approaches to achieve this. A pure output-based approach might allow companies to retain the benefits of efficiency savings derived as a result of undertaking R&D for longer than the current five-year period for 'conventional' efficiency savings. (By way of comparison, under the IPR rules, companies are allowed to maintain patent benefits for up to 20 years.) However, the key challenge associated with this approach would be in hypothecating the efficiency savings derived explicitly from the R&D undertaken. An alternative, 'intermediate' output-based approach might involve linking price control revenues to the number of patents that a company secured.

- *Increasing the transparency of reporting of R&D effort*—a final measure that could support the policy options discussed above would be to improve the manner in which R&D is reported. Developing a robust reporting framework for increased transparency could draw attention to those companies that do not invest in R&D. A comparison could be drawn with the recent regulatory policy on pensions expenditure. For this category of expenditure, recent regulatory decisions have explicitly hypothecated a certain amount of operating expenditure to cover these requirements, making it much clearer as to whether firms are adequately and appropriately funding their pension schemes. To the extent that shareholder pressure for greater innovation is present, this may also augment existing incentives under the current RPI – X regime.

Conclusion

This article has reflected on some of the evidence of the decline in R&D expenditure seen across most utility sectors in the UK. It has also considered whether this trend could be, at least partly, the result of sector-specific regulation. A regime of price caps may, at best, insufficiently support and, at worst, actively discourage investment in R&D activity.

To prevent lower productivity in the future caused by falling R&D effort in the present, several measures could be targeted at encouraging these investments. Ultimately, any measure needs either to reduce the risk of recovering R&D expenditures (ie, focusing on inputs) or increase the potential rewards for successful innovation (ie, focusing on outputs). One supporting policy measure may be to increase the reporting of R&D activities by companies.

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[1] Figures 1 to 3 are based on data compiled by the UK Department of Trade and Industry (DTI) as part of its 'R&D Scoreboard', available at http://www.innovation.gov.uk/rd_scoreboard/index.asp. This survey compiles data for the top 700 R&D performing companies in the UK. Therefore, trends shown in the figures are to some extent influenced by the behaviour of other firms in the sample.
[2] Importantly, inflation for R&D inputs is likely to differ from that measured in the wider economy (eg, RPI), and may also vary across sectors.
[3] See, for example, Sanyal, I. and Cohen, G. (2004), 'Deregulation, Restructuring and Changing R&D Paradigms in the US Electric Utility Industry', Department of Economics & International Business School, mimeo, Brandies University.
[4] See Markard, J., Truffer, B. and Imboden, D.M. (2004), 'The Impacts of Liberalisation on Innovation Processes in the Electricity Sector', *Energy & Environment*, **15**:2, 201–14.
[5] See DTI (2004), 'The Drivers and Public Policy Consequences of Increased Gearing', October.
[6] See, for example, Hall, B. (1989), 'The Impact of Corporate Restructuring on Industrial Research and Development', National Bureau of Economic Research working paper, December.
[7] Competition Commission (2002), 'Supply of Banking Services to SMEs', March 14th, p. 85.
[8] Ofgem (2004), 'Regulatory Impact Assessment for Registered Power Zones and the Innovation Funding Incentive', March.