

**SCOTTISH EXECUTIVE ECONOMIST GROUP  
DISCUSSION PAPER SERIES  
PREFACE BY DAVID PATEL, HEAD OF FINANCE AND CENTRAL SERVICES  
DEPARTMENT: ANALYTICAL SERVICES DIVISION**

This paper is a welcome addition to the Scottish Executive Economist Group *Discussion Paper Series*. The series provides a forum for articles which provide more detail than the shorter articles which appear in the Scottish Economic Report.

The paper is on 'Infrastructure Investment & Economic Growth' and has been produced by William Page of the Analytical Services Division in the Scottish Executive Finance and Central Services Department. It draws attention to the empirical debate that has been taking place in economic circles about the relationship between investment in the capital stock and economic growth – a relationship that has a very long theoretical presence within the study of economics. Of course, we need to properly acknowledge that economic growth is only one of a number of ways in which infrastructure investment provides a useful social benefit - public infrastructure investment serves a number of direct objectives such as providing better school buildings or improved health facilities – and the paper covers such points. Nonetheless, the economic debate has been interesting, both in increasing awareness about the link, and in showing that estimates about the strength of the link often vary, while generally being positive. We hope that the paper will make a useful contribution to the discussion on this subject in Scotland.

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December 2005**

# **Infrastructure Investment & Economic Growth**

## **Discussion Paper<sup>1</sup>**

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### **Abstract**

The Infrastructure Investment Plan sets out the Executive's longer-term intentions to improve Scotland's infrastructure. This related paper begins by assessing evidence from HM Treasury and the Institute of Fiscal Studies of the historical trend of investment in the UK. It highlights how a pattern of underinvestment is now being addressed. Following on from this, the paper considers the academic evidence on the complex link between infrastructure investment and economic growth. Although the public infrastructure debate raises important questions in terms of the definition of infrastructure capital and the direction of causality, the research still suggests that infrastructure investment has a significant impact on output. The paper then concludes by considering how a series of recent initiatives help to ensure that investment decisions are managed better. Ultimately, investment in infrastructure can be seen as having a positive effect on economic growth, but investment decisions need to be appraised, managed and evaluated on a case by case basis in order to deliver value for money.

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<sup>1</sup> The points raised in this paper are intended to contribute to an open and comprehensive discussion. They are not intended to express a Scottish Executive or UK government policy position and should be quoted accordingly. The paper will make frequent reference to policy documents and statistical data on Scotland, however all opinions expressed and conclusions drawn are those of the author.

## INTRODUCTION

1. *The Framework for Economic Development in Scotland (FEDS)*, refreshed in September 2004, highlights increased productivity in enterprises and the public sector as the key to improving Scotland's competitiveness and its economic growth rate. It identifies five key drivers of productivity, including the electronic and physical infrastructure – joining businesses to businesses, consumer to business and ensuring the movement of goods, people and ideas to the right places at the right times. This paper sets out the economic case for Executive investment in infrastructure, and highlights progress made over recent times – including the publication of the Executive's first Infrastructure Investment Plan.

### *Recent trends in public investment in Scotland*

2. The Scottish Executive has taken steps to prioritise infrastructure investment. In June 2004, the Minister for Finance and Public Service Reform announced a target of increasing net investment by at least 5 per cent per annum in real terms over the Spending Review period 2005-2008. This target was designed to lock in for the longer term the improvement in infrastructure needed to grow the economy and provide the first class public services that Scotland deserves. The subsequent publication of *Building a Better Scotland: Infrastructure Investment Plan* in February 2005 confirmed that the target would be exceeded over that period, as set out in Table 1 (which excludes spending under Public Private Partnerships).

<b>Table 1 Spending Review 04 – Net Investment Plans by Portfolio (£m)<sup>2</sup></b>				
Portfolio(All figures are nominal)	2004-05 Budget	2005-06 Plan	2006-07 Plan	2007-08 Plan
Communities	411	415	448	483
Finance and Public Service Reform	386	396	414	421
Enterprise and Lifelong Learning	230	292	323	366
Transport	353	400	539	575
Health and Community Care	350	426	458	532
Education and Young People	102	108	116	114
Justice	46	78	132	130
Crown Office and Procurator Fiscal Service	3	4	7	6
Tourism, Culture and Sport	13	16	37	26
Environment and Rural Development	303	292	335	345
Administration	11	10	12	12
Capital Modernisation Fund	50	60	-	-
Other	32	3	3	3
<b>Total</b>	<b>2,290</b>	<b>2,500</b>	<b>2,824</b>	<b>3,013</b>
Scottish Executive (2005) 'Building a Better Scotland: Infrastructure Investment Plan – Investing in the Future of Scotland'.				

3. Following on from the Spending Review, the Executive's first Infrastructure Investment Plan<sup>3</sup> (*IIP*) was published in February 2005, setting out how the increased investment will be delivered across all the relevant ministerial portfolios over the Spending Review period and beyond. The *IIP* provides a longer term vision of investment plans, enabling the private sector to plan ahead and gear up to take advantage of the opportunities available.

<sup>2</sup> The Scottish Executive's definition of net investment for purposes such as the net investment rule incorporates spending within capital DEL as well as grants made to support capital spending (asset creation or enhancement) by private sector organisations such as Higher and Further Education Institutions. It does not include the capital element of PPP deals.

<sup>3</sup> *Building a Better Scotland: Infrastructure Investment Plan – Investing in the Future of Scotland*

4. The objectives for the *IIP* include:

- improving the efficiency of how services are being delivered;
- improving the standard of our infrastructure, such as the transport network and school building estate;
- improving liaison with the private sector and secure a mixed economy of investment; and
- going forward, helping facilitate improved co-ordination of our infrastructure investment by geographical area and between portfolios in order to secure extra value from our existing investment and infrastructure programmes.

5. Whereas the Spending Review proposals covered the next three years, the Infrastructure Investment Plan sets out the Executive's longer-term intentions to improve Scotland's infrastructure and explains how these record levels of investment will help to improve people's lives across Scotland

6. The Scottish Executive adopts a 'mixed economy' approach to infrastructure investment in Scotland, aiming to maximise investment potential whilst always ensuring that programmes and projects deliver the best value for money. Public Private Partnerships (PPPs) are a key element in the Scottish Executive's policy priority to deliver effective public services, delivering on a larger scale and in a shorter timescale than would be possible under conventional procurement. PPP plays a part in a balanced investment portfolio in which conventional capital investment remains dominant. The key point is that all appropriate delivery routes are appraised and that the selected path represents the best approach for the taxpayer.

7. Listed below are some examples of areas of investment (including PPP schemes):

- transport infrastructure will benefit from £3 billion in capital investment over a 10-year programme;
- education will benefit with over £3 billion to help secure the target of renewing and modernising 300 schools by 2009;
- enterprise will benefit with over £420 million being spent over 3 years to improve and modernise Scotland's colleges and universities;
- environment will benefit with one of the largest ever investment programmes in the Scottish water industry to meet EU and regulator standards;
- the environment will also benefit from an investment of more than £500 million in to the Strategic Waste Fund to finance local authorities' recycling and waste treatment facilities up to 2008.

8. The purpose of this paper is to explain the economic case that underlies the decision to increase the level of infrastructure investment in Scotland. The paper begins by assessing evidence from HM Treasury and the Institute of Fiscal Studies of the historical trend in investment in the UK, and then considers the academic evidence on the complex link between infrastructure investment and economic growth – the Executive's number one priority. The paper concludes by considering how a series of recent initiatives should help to ensure that investment decisions are appraised, managed and evaluated on a case by case basis in order to deliver value for money.

## EVIDENCE OF UNDERINVESTMENT

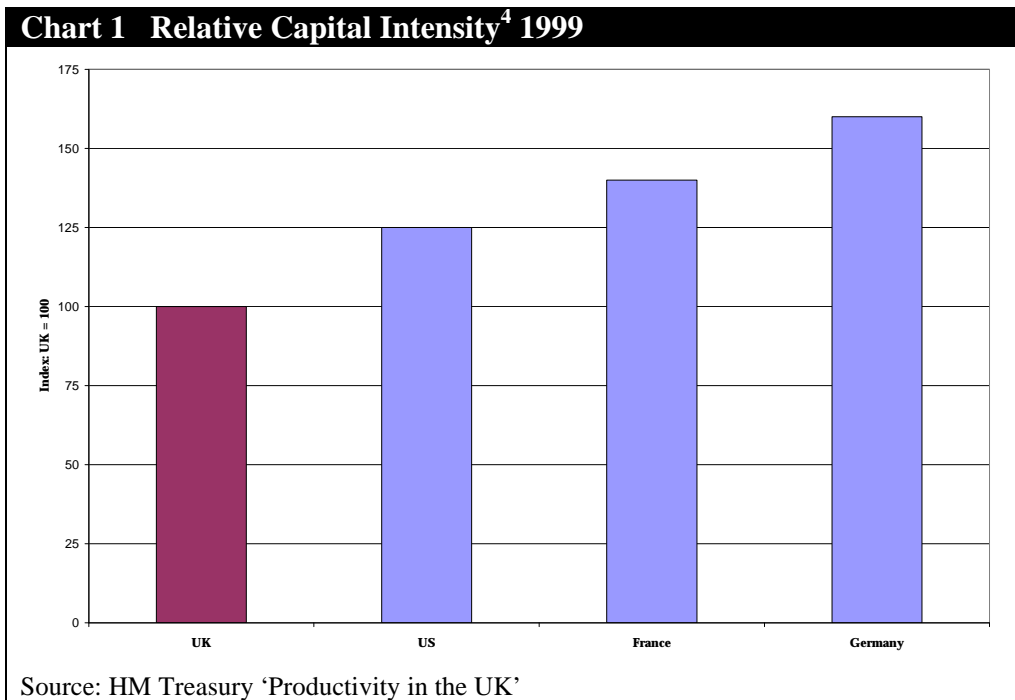
9. The background to the Infrastructure Investment Plan is a perception that over the previous 30 years long-term investment has been neglected. This section draws on research by the Institute of Fiscal Studies and HM Treasury to show how public sector investment across the UK declined sharply during the 1970s and 80s, as well as UK's relatively weak international position in terms of its capital-to-worker ratio. However, the recent evidence shows that both the UK government has significantly increased the level of public sector investment; and that this increase will continue to be carried forward by the Scottish Executive's own capital spending program.

10. In a paper titled 'Trends in British Public Investment' by the Institute of Fiscal Studies, the authors Clark, Elsbey and Love (2002) shows that UK public investment has declined sharply both as a share of GDP and as a share of government spending since the 1970s. According to the authors, only part of this decline is explained by privatisation, which transferred some public investment to the private sector. More important was the very large and permanent reduction in public house-building between the mid-1970s and the early 1980s.

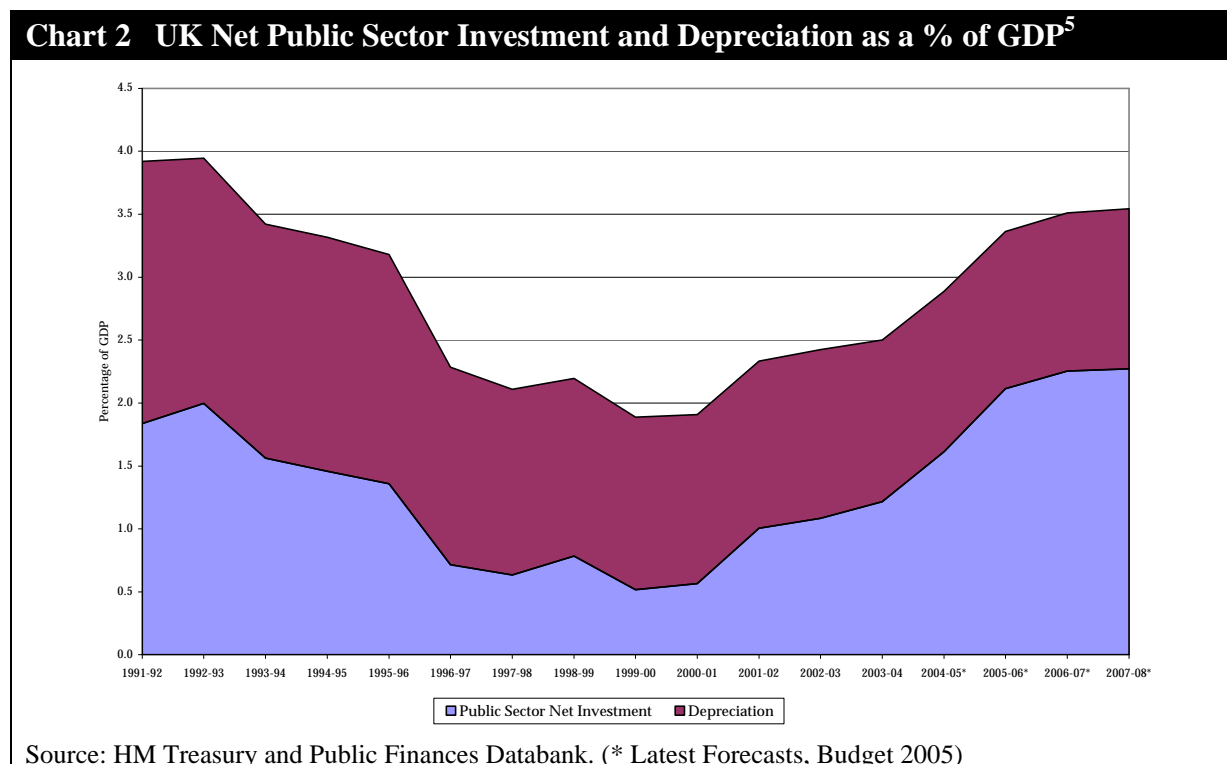
11. The paper goes on to report that between the late 1980s and the early 1990s, the rate of public investment recovered somewhat, but after that time it declined again, reaching a record low in 1999. This decline in public investment affected a range of central government programmes, and it was not significantly offset by increased investment in Public Private Partnerships (PPPs). The paper also offers an interesting EU comparison, stating that, in 2001, the UK: *'spends less of its national income on public investment than all other EC countries apart from Belgium'*.

12. Another strong piece of evidence of past underinvestment comes from the HM Treasury (2001) report titled 'Productivity in the UK', which highlighted the productivity gap between the UK and France, Germany and the US. Critical to their explanation of the 'gap' is that growth in an economy relies heavily on investment in physical capital to augment the productivity of labour.

13. The HM Treasury report states that, in the past, the capital stock of firms and the stock of public infrastructure in the UK has been well below that of its main competitors. This shortfall has been a major part of the explanation for relatively poor UK labour productivity, and reflects years of low investment in both the public and private sectors. Chart 1 sets out estimates of the UK's capital to labour ratio relative to the US, France and Germany. The chart illustrates the UK's weak position on capital per worker.



14. More recently, Emmerson, Frayne and Love (2004) published an IFS Briefing Note titled '*A Survey of Public Spending in the UK*'. As mentioned briefly in the prior IFS report, the Briefing Note highlights how there was a 'squeeze' in central government expenditure which began in 1991 and has only recently come to an end (See Chart 2). The authors note that the UK government has argued that this decline in investment has resulted in an accumulation of overdue maintenance work on the public sector's assets.



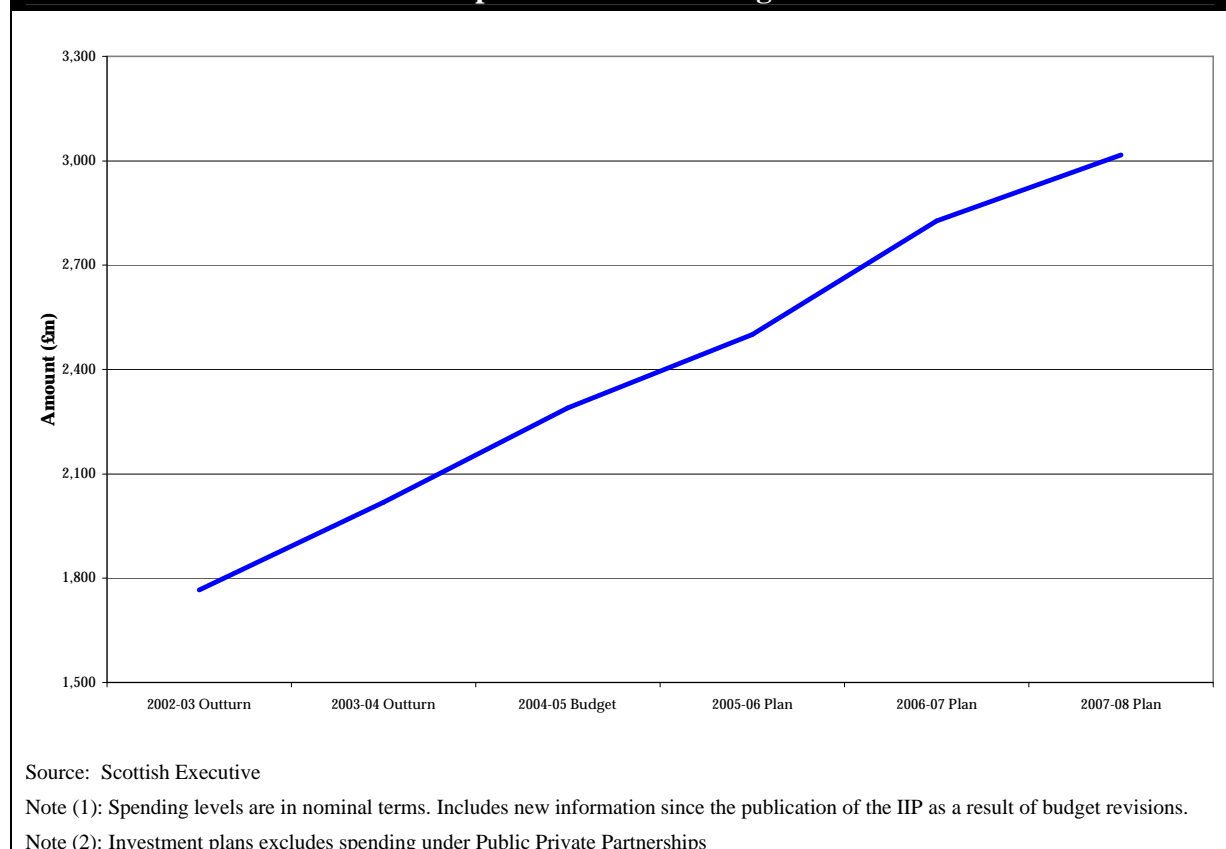
<sup>4</sup> Measured as capital per hour worked, Source: NIESR, (O'Mahony, 2000), UK=100

<sup>5</sup> Public Sector Net Investment in this UK context is equal to Gross Investment less Depreciation.

15. As well as offsetting the depreciation of existing government assets, the UK government has stated that it wants to invest in new assets to fulfil its aim of creating ‘world-class public services’. To this end, the UK government intends to increase significantly the level of public sector investment. Chart 2 also shows that, if the UK Government plans are met, public sector net investment will increase from 0.5 per cent of national income in 1999-00 to 2.0 per cent in 2006-07.

16. Although the availability of comparable Scottish data is limited, Chart 3 below illustrates the aggregate Net Investment data provided in Table 1 to show that a similar pick up in investment is evident going forward at the Scottish level as well. Investment is projected to increase from £1.7 billion in 2002-03 to £3.1 billion in 2007-08, an increase of 80 per cent in nominal terms. Increases in infrastructure investment for transport are one of the key drivers of this capital spending programme.

**Chart 3 Scottish Executive’s Capital Investment Program 2002-03 to 2007-08**



## THE PUBLIC INFRASTRUCTURE DEBATE

17. During the 1980s and 1990s, there was strong academic interest (particularly in the US), in the link between public investment in infrastructure and economic growth. From the outset, it is interesting to note the trend in which this research has followed, from the initial headline estimates of a production elasticity of 0.4 in 1989 to the more modest assessments of 0.1 in 1997. The purpose of this section is to give an overview of the ‘public infrastructure debate’, drawing on some of the more influential papers.

18. Before exploring this debate it is important to bear in mind that, given the complexity of the subject matter, empirical controversies are to be expected. Many of the benefits of

public investment are difficult to measure, and are not always included in the calculation of Gross Value Added (e.g. improved health and a cleaner environment). As Gramlich (1994) points out: *'it will always be difficult to relate infrastructure investment to its goals, or changes in them'*.

### ***Aschauer***

19. The link between infrastructure investment and economic growth has been a major topic for academics since the publication of Aschauer's (1989) seminal paper which found that public investment in infrastructure was a very important source of economic growth. Aschauer considered the relationship between aggregate output and the stock and flow of government spending variables and concluded that 'core' infrastructure of streets, highways, airports and mass transit systems should be given more weight when assessing the role government plays in the promoting economic growth and productivity improvements.

20. Aschauer's work suggested that the elasticity of output with respect to government capital was highly positive, within a range of 0.38 to 0.56. This implies extremely high returns, with the marginal product of government capital in the region of 100 per cent per annum or more. This would imply that one unit of Government capital pays for itself in terms of higher output in a year or less. Given these results, its not surprising that Aschauer work was to initiate the 'public infrastructure debate' which has resulted in numerous academic studies since.

### ***Munnell***

21. Munnell (1992) provides an excellent assessment of the early literature on the public infrastructure debate. She shows that the main problem with Aschauer's work is that his results do not rule out the possibility that the direction of causality runs from growth to infrastructure (i.e. economic growth might lead to an increase in the need for investment and/or an increase in the availability of funding), or that the correlations that he found are spurious. Nevertheless, in response to the critics who claim that the wide range of estimates of public capital's impact on output *'make the empirical linkages fragile'*, Munnell provides evidence to suggest these claims are misleading. As illustrated in Table 2 below, in almost all cases the impact of public capital on private output has been found to be positive and statistically significant.

<b>Table 2 The Impact of an Increase in the Stock of Public Capital on Output</b>		
Author	Focus of Study	Output Elasticity of Public Capital
Aschauer (1989)	US National	0.39
Holz-Eakin (1988)	US National	0.39
Munnell (1990a)	US National	0.34
Costa, Ellson, Martin (1987)	US States	0.20
Eisener (1991)	US States	0.17
Mera (1973)	Japanese Regions	0.20
Munnell (1990b)	US States	0.15
Duffy-Deno and Eberts (1989)	US Metropolitan Areas	0.08
Eberts (1986, 1990)	US Metropolitan Areas	0.03
Source: Table adapted from Munnell (1992)		

22. Munnell concludes that the evidence suggests that, in addition to providing an immediate demand-side economic stimulus, public infrastructure investment has a significant, positive effect on output and growth. However, she stresses that in a policy-making context '*Aggregate results cannot be used to guide actual investment spending. Only cost-benefit studies can determine which projects should be implemented*'.

### ***Gramlich***

23. Gramlich's (1994) influential paper also unpicks many of the arguments and assertions made by Aschauer, along with the mass of academic literature which followed. Gramlich begins his paper by using the narrow public sector ownership definition as the stock of infrastructure capital – but highlights that a wider meaning could involve private infrastructure capital, human capital investment and research and development spending. This emphasises the importance of definition – what type of investment is being classified as infrastructure and what type is then being linked to economic growth.

24. Gramlich notes that projects such as a new highway might provide a very high return, where as maintenance of rural roads might provide low or even negative economic rates of return; in such areas, investment objectives may be primarily social rather than economic. He applies this by showing that only two-thirds of the capital stock analysed by Aschauer even purports to raising national output – and to varying degrees – making his claims about the major positive influence of infrastructure on economic growth less plausible.

### ***Lau & Sin***

25. Lau and Sin (1997) published an important econometric paper on public infrastructure and economic growth. This was subsequently referred to as being '*the most sophisticated subsequent econometric studies*' by SACTRA (1999) and commended for taking the research some way to circumventing the 'causality' and 'definition' difficulties highlighted by Munnell and Gramlich amongst others. The authors estimate the elasticity of output with respect to public capital to be 0.11. Although this would imply a much lower marginal product of public investment than that indicated by Aschauer's original paper, it still suggests that infrastructure investment has a significant impact on output.

### ***Summary***

26. Despite the fact that the original headline elasticity claims of Aschauer 1989 have been reduced over time, more recent research still suggests that infrastructure investment has a significant impact on output. Perhaps the most important message to draw from all of the academic literature covered here can be found in Gramlich's paper: '*the best approach is not to try and analyse the numbers and tell how short the supply is and how much national or state spending or grants should be increased. A far more sensible approach ...is to find the optimal stock*'. Interpreting this in the context of the IIP would suggest that the issue is not simply about increasing the level of public investment, but investing in the right projects and managing this investment better.

## **MANAGING PUBLIC INVESTMENT**

27. The Infrastructure Investment Plan is part of the co-ordinated process by which the public sector will manage investment plans and projects to promote value for money. This

section begins by considering how the UK and Scottish Governments have introduced reforms which are designed to encourage more effective investment. Following this, an overview of some of the initiatives that have been introduced by the Executive are outlined to show how the intention is not just to invest more, but to manage this increase in public investment better.

### ***Encouraging More Effective Investment***

28. As part of its strategy for public investment, the UK government has introduced a number of reforms to encourage more effective investment. An example of this is the Spending Review process itself, which has seen the introduction of firm three-year rather than one-year budgets. Three-year budgets help to give those managing public services the stability to plan their operations on a sensible time-scale without the fear that resources may be cut back in the following year. Another example of these reforms is the introduction of end year flexibility. This allows the Executive to manage capital spending sensibly, by allowing underspends in capital budgets to be carried forward into the next financial year<sup>6</sup>.

29. The overall aim of these reforms is to create incentives for more effective use of assets, and to ensure that assets are used in a way which allows our resources to be linked to results. Similarly, HM Treasury's Green Book – which the Executive has adopted - has, for many years, provided guidance to departments and executive agencies on how proposals should be appraised, before significant funds are committed. The most recent edition, published in 2003, incorporated revised guidance to encourage a more thorough, long-term and analytically robust approach to appraisal and evaluation.

30. These UK reforms have been matched by the Executive in terms of ensuring that the investment in infrastructure meets the needs of the Scottish people. The Scottish Public Finance Manual provides guidance to the Scottish Executive and other relevant bodies on the proper handling of public funds<sup>7</sup>. The manual covers all areas of Executive spending and focuses on: project management structure, guidance on appraisal and evaluation, preparation of a Project Execution Plan and regular monitoring and review. Whilst these developments are improving the standard of capital investment decision making, the Executive has looked to build upon this by introducing initiatives which help in the management of this public investment.

### ***Pre-Expenditure Assessments***

31. Launched in 2004, the objective of conducting Pre-Expenditure Assessments (PEAs) is to ensure that economic, environmental, and social impacts are routinely assessed before implementing new spending commitments, and to ensure that overall value for money is a key criterion in decision-making. The PEA process involves assessing:

- the Aims and Objectives of the proposal;
- the Options for addressing these objectives;

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<sup>6</sup> Other reforms include prudential borrowing regime, which empower local authorities in relation to borrowing levels in support of infrastructure investment; resource budgeting which encourages the development of Asset Management Plans and disposing of assets that are surplus to requirements; improvements in project review processes and training; distinct capital budgets to protect longer term investment from short-term, current pressures.

<sup>7</sup> Available: [www.scotland.gov.uk/Topics/Government/Finance/spfm/Intro](http://www.scotland.gov.uk/Topics/Government/Finance/spfm/Intro)

- the Evidence Base on the likely economic, social, and environmental impacts and value for money of the proposal;
- the Financial and Management Arrangements for the proposal, including an assessment of the key risks to successful delivery;
- the plans for Monitoring and Evaluation.

32. *Building a Better Scotland* emphasises that Executive spending must deliver a major impact in improving the quality of life in Scotland, and Committees are increasingly interested in value for money across the range of new current and capital programmes. This commitment aids the process.

### ***Gateway Reviews***

33. Gateway Reviews are about applying best practice to the management of high risk / mission critical programmes and projects. The Gateway Review process was developed by the Office of Government Commerce. It involves short, focused reviews of a programme or project at key decision points in its lifecycle by a team of experienced practitioners, independent of the programme or project team. Although originally devised for Procurement, IT and Construction projects, the Executive has adapted the process to include non-procurement projects, business change initiatives and policy delivery. The process involves five gateways that a project can go through during its lifecycle, three before contract award, one looking at service implementation and one to confirm the operational benefits.

### ***Infrastructure Investment Group***

34. An Infrastructure Investment Group has recently been formed within the Scottish Executive. Its remit includes devising a plan to implement the action points identified in the Infrastructure Investment Plan and to identify and consider further areas for improvement. The action points include enhancing the quality and robustness of the figures contained in the Plan, and extending best practice and facilitating improved project delivery throughout the public sector.

### ***National Planning Framework for Scotland***

35. The National Planning Framework for Scotland, issued in April 2004, helps to ensure the contribution of the planning system to economic development is explicitly recognised and taken into account. The framework outlines the potential developments in Scotland's infrastructure up to 2025 to meet the needs of our communities and to grow our economy. It considers key themes such as economic development and community regeneration, transport, waste management, water infrastructure and affordable housing. The Executive intends to publish the first Monitoring Report on the National Planning Framework in Spring 2006.

## **CONCLUSIONS**

36. The publication of *The Framework for Economic Development in Scotland* (2004) highlighted the importance of developing Scotland's physical infrastructure in order to help grow the economy. Following on from this, the Spending Review proposals for 2004-05 to 2007-08 signalled a significant increase in the level of public sector investment in Scotland.

37. This chapter has explored the economic case for increasing the level of public investment. It began by showing how the Infrastructure Investment Plan provides a longer term vision of investment plans across all portfolios. Following this, historical trends in public sector investment were analysed to show why this recent increase should be seen as helping to address previous underinvestment.

38. A review of the academic literature on the link between infrastructure investment and economic growth was then presented. This suggested that investment in public infrastructure has a significant, positive effect on output and growth. Attention was then drawn to a series of initiatives introduced by the Executive which help to ensure that investment decisions managed better. Ultimately, investment in infrastructure can be seen as having a positive effect on economic growth, but investment decisions need to be appraised, managed and evaluated on a case by case basis in order to deliver value for money.

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