

PUBLIC INVESTMENT IN THE UK

*Pietro Toigo and Robert Woods**

1. Introduction

In 1997 the UK adopted a new fiscal and expenditure policy framework, including the requirement to adopt clear fiscal rules enshrined in the 1998 Code for Fiscal Stability and a reformed system of budgetary controls. One of the drivers of the reform was to create a framework through which the historic shortfall in public investment in the UK could be addressed.

Part 2 of this paper lays out some general considerations for public investment policy:

- Section 2.1 introduces the interlinkages between microeconomic policy and efficiency concerns on the one hand and macroeconomic policy and fiscal sustainability on the other;
- Section 2.2 then reviews the case for a separate treatment of capital and current expenditure;
- Section 2.3 considers a range of fiscal rules and their implications for investment policy;
- Section 2.4 looks at how aspects of the micro-economic framework can influence the macro-economics;
- Section 2.5 discusses the use of Public-Private Partnerships as a tool to increase the efficiency and level of investment in the economy;
- Section 2.6 establishes some guiding principles.

Part 3 moves on to consider the policy implications and describes how these considerations have shaped the UK framework, both at the macroeconomic level, through the fiscal rules, and at the microeconomic level, through the system of budgetary controls and capital appraisal procedures.

2. Some general considerations for public investment

2.1 *Public investment and fiscal policy*

Two sets of considerations should inform policy decisions on public investment. On the one hand, there are microeconomic considerations which concern efficiency and the costs and benefits of individual projects. On the other

* HM Treasury. The views expressed here are those of the authors and are not necessarily the views of the UK Treasury or the UK Government. We are grateful for contributions from Dylan Schumacher and Frank Eich.

hand, the macroeconomic dimension focuses on the aggregate level of public investment, its short-term effect on the economy and the long-term sustainability of the public finances.

Microeconomic considerations justify public investment (as opposed to private investment) on the basis of market failures arising from the difference between financial returns¹ and social returns. An investment should be undertaken whenever its social returns exceed the cost of finance. However, the public good nature of some investment goods means that financial returns will be lower than social returns and costs. The private sector cannot internalize social returns and will therefore underprovide for these type of investments. Where governments can internalize the social returns, direct government investment is justified.

The **macroeconomic dimension** introduces two separate considerations. In the short term, as a component of public expenditure, investment has an impact on the cyclical position of the economy. It is the total deficit rather than its distinction between the capital and current budgets that determines the impact of fiscal policy on aggregate demand.² The microeconomic criterion does not take into account the timing of investment expenditure in relation to economic stabilisation objectives.

Second, there are longer-term fiscal sustainability issues. Due to the difference between social and financial returns, a set of public investment projects financed through government borrowing, each of which passed a microeconomic efficiency test, could still lead to an unsustainable fiscal position. A large body of literature has considered the adverse economic impact of unsustainable levels of debt;³ here it will suffice to note that high levels of debt affect *inter alia* the economy via:

- “crowding out” otherwise efficient private investment via higher interest rates;
- increasing the budget resources needed to be diverted to “unproductive expenditure” on debt interest repayments; and
- reducing the room for manoeuvre available to the government to implement stabilisation policies.

Sustainability considerations are important because, while each investment project taken on its own merits could be welfare enhancing, their aggregate impact could put the public finances on an unsustainable path with potentially large welfare losses arising from macroeconomic instability or worsening structural conditions. This process could be thought of as the marginal investment that took debt above the level deemed to be sustainable, despite being socially valuable on its own, having a negative externality on the economy as a whole, for example in terms of its impact on long-term interest rates.

¹ Note that for governments the financial returns include the indirect revenue effects of investment, insofar as they increase through the effect on economic growth for example.

² The composition of expenditure might have some impact (e.g., the multiplier effect of capital expenditure might be different from current expenditure) but this is likely to be a second order effect.

³ See Woods (2004) for a brief overview of problems arising from high levels of debt.

If instead an investment is financed through taxation rather than through borrowing, then the sustainability consideration gives way to a different microeconomic efficiency. The deadweight loss of the distortionary effects of taxation would need to be factored in when weighing up the benefits of a project against its costs. In this case, the aggregate constraint on investment would be the overall sustainable level of taxation.

It is therefore key to reconcile the three criteria of: microeconomic efficiency, fiscal sustainability and stabilisation in a comprehensive framework to guide fiscal and public investment policy.

Part C of the paper discusses how these concerns have shaped the approach in the UK. However, before moving to policy implementation, Section 2.2 takes a step back and reviews the economic case for distinguishing the treatment of public investment when setting fiscal policy.

2.2 *The case for separate treatment of public investment*

There are at least three arguments that have been made which highlight the specific nature of capital expenditure:

- the potential to be self-financing;
- intergenerational fairness; and
- political economy issues leading to a bias against public investment.

First, **public investment can be self-financing** both through the cash flows generated by projects themselves (for example through user charges) or through long-term positive effects on economic growth, the tax base and therefore government revenues. The economic literature has identified a variety of channels through which public investment enhances growth,⁴ it can:

- constitute an intermediate input to private sector production that helps lower costs. This is partly through the effect on transaction costs, increased access to markets and market information and improved competitiveness in import/export markets;
- raise the productivity of other factors (labour and other capital) by allowing use of complementary technologies, improving access and information flows, as well as may induce crowding-in of additional private resources;
- have a structural impact on demand and supply, for example public infrastructure contributes to the diversification of an economy (especially for open source technology such as communications, which allows the application of modern technologies to a wide range of sectors).

⁴ For a more comprehensive discussion on this see Kessides (1993).

A significant and growing body of empirical literature has examined the potential impact of public capital investment on output, productivity and factors of production. The Appendix provides a brief survey.

It is theoretically plausible that investment could be self-financing. However, a number of qualifications apply. First, a project could be socially valuable because it raises economic growth, but, depending on the effective tax rate, the government's financial return might still be lower than the opportunity cost of the funds (including the distortionary costs associated with either debt or tax finance). Moreover, the estimate of the GDP impact of some investment projects will be highly uncertain due to long lead times, and sensitive to the discount rate and interest rate assumption, which may change over time. When planning for the public finances, a prudent approach would suggest discounting uncertain projects heavily.

Second, even when a project raises welfare without generating economic growth (for example, by decreasing travel times or by providing an educational facility such as a museum),⁵ there would be the theoretical possibility to extract users' willingness to pay for the service. However, the ability to apply user charges depends on the nature of the investment. If the investment generates an asset or a service that is a public good, the characteristic of non-excludability makes it impossible to charge for its use. Even when the investment is not a public good, considerations of other market failures, for example asymmetric information (such as the consumers' difficulty in deciding on the right amount of health services to consume), merit good arguments or distributional concerns might lead policymakers not to charge users for the service generated by public investment.

A third caveat is that growth-enhancing properties do not solely apply to those components of public expenditure classified as investment in national accounting. Some current expenditure items can also generate financial returns so as to be self-financing. For example, expenditure in human capital accumulation (e.g. skills, education, etc.) can have a beneficial effect on long-term growth and on the tax base, but a large part is classified as current expenditure. This might point to distinguishing more broadly "growth enhancing expenditures" rather than solely capital expenditure.⁶

Some commentators have suggested that a fiscal framework that treated capital expenditure separately from current would result in a bias in favor of physical assets, overlooking other productive expenditures.⁷ However, there is a trade-off between taking full account of this consideration and preserving the transparency of a fiscal framework. It is difficult to agree on a robust definition of growth enhancing expenditure once generally accepted accounting standards are departed from. By contrast, the national accounts provide a clear, workable

⁵ Notwithstanding the fact that cultural institutions have sometimes been at the heart of successful regeneration projects that have led to increased growth.

⁶ See Hoppner and Kastrop (2004) for a more detailed discussion.

⁷ See for example Balassone and Franco (2000).

definition.⁸ (There may also be other political economy reasons for preferring this definition, discussed below).

It should also be noted that some capital projects are not self-financing simply because they are of poor quality, and their effect on growth, or user charge yields, are overestimated or misjudged. A fiscal framework cannot drive the quality of investment by itself; therefore, to underpin a special treatment for investment at the macroeconomic level, a rigorous capital appraisal system needs to be implemented.

Second, the **intergenerational impact** of capital expenditure is different from current expenditure. Large infrastructure projects such as roads produce a flow of services over the investment's effective life, which might be in excess of 40 years, while the benefits generated by current expenditure materialize at the time the expenditure is undertaken.

The principle of intergenerational fairness implies that the cost incurred to generate a flow of services should be spread across the generations that benefit from it. Empirical evidence, for example, suggests that returns to public capital investment tend to be significantly greater in the long run (see Box 1). Hence, current expenditure should be financed through current tax revenue, while capital expenditure should be financed through current and future tax revenue. The easiest way for a government to spread the cost of capital expenditure over different generations is to finance at least part of it through raising debt. This debt can then be repaid by future generations which also benefit from the investment.

The concept of intergenerational fairness is a relatively simple one, but its application can be complex. Public expenditure funds a vast range of public services, which are used by different age groups at any one time. In order to judge the intergenerational impact of public expenditure, the mix of goods and services provided, and not only the distinction between current and capital expenditure is important.

Therefore, a recognition of the different impact of current and capital expenditure over time is only one of the elements that help achieving intergenerational fairness, but there are also rather complex dynamics that affect the distribution of expenditure across cohorts within one generation. A fiscal framework needs to balance these complexities with the need for clear and simple rules.

A third argument for treating public investment differently concerns the **political economy considerations**. Since the benefits of capital expenditure materialize in the longer term, public investment tends to receive an unfavorable treatment *vis-à-vis* current expenditure in times of fiscal retrenchment. As the literature on the political economy of fiscal policy emphasizes,⁹ pressure groups and

⁸ Take the example of current education expenditure. Although it gives rise to a stream of benefits overtime, the capital value of education and its depreciation is not something that can be estimated easily or reliably.

⁹ See Alesina and Perotti (1994).

Box 1**What is intergenerational fairness?**

There are many ways to think about generational fairness. The UK Government's approach to distinguish between current and capital spending provides one option.

Another approach has been advocated in the *generational accounting literature*. According to this approach, intergenerational fairness is established when different generations pay the same net lifetime tax transfers (as a share of their incomes) to the government.

The *sustainable development literature* provides an alternative interpretation.¹ Policies are considered to be fair if they satisfy the needs of the present without compromising the needs of the future. In addition to pure financial transactions, these ideas capture, for example, the environmental effects of current policies, which could lead to future generations being worse off, such as through climate change and the depletion of fossil fuels.

These factors can be brought together under the idea that the government will pass on a "portfolio" of assets, which includes, *inter alia*, public and private physical capital, the public debt stock, human capital, stock of technology and knowledge and natural resources, to the next generation. Some of these factors are included in alternative indicators such as the index of sustainable economic welfare (ISEW) and living standards measures.

¹ *The United Nations Commission on Environment and Development: Our Common Future*, Gro Harlem Brundtland, 1987.

Box 2**Fiscal adjustment and investment: empirical evidence**

A significant body of evidence supports the conjecture of an inbuilt policy bias against capital expenditure, showing that a disproportionate amount of fiscal adjustment generally falls on public investment. Blanchard and Giavazzi (2003) note that net investment fell by 0.8 per cent of GDP in the 12 EMU countries in the run-up to the euro between 1993 and 1997, a period marked by pronounced fiscal consolidation. Balassone and Franco (2000) show that the adjustment to investment was particularly marked for high debt EMU countries (Italy, Belgium and Ireland).

In its 1988 World Development Report, The World Bank found that during periods of fiscal adjustment, government cut capital spending on average by 35 per cent against 10 per cent for current expenditures. In a successive study The World Bank (1994) notes that structural adjustment policies in Africa in the Eighties coincided with cuts in capital budgets. This is supported by Hicks (1991), who identifies a fall of 27 per cent in capital expenditure against 7 per cent in current expenditure over the Seventies-Eighties in a range of developing countries.

The result also holds for Latin American countries, where Calderon, Easterly and Serven (2003) find that even after controlling for country-specific factors, a small but statistically significant negative association between the change in primary balances and infrastructure investment could be found. The study also finds that in the same sample the fall in public investment was not offset by a surge in private investment.

These results are replicated for OECD countries by Roubini and Sachs (1989) and de Haan *et al.* (1996). Lane (2003) also shows that investment is the most pro-cyclical component of government expenditure.

There are obviously different explanations for the decline in capital investment observed in developed countries since the Seventies, such as privatization decisions and a long-term trend to reduce public investment (a view taken by Galí and Perotti, 2003).

vested interests tend to create a bias in favor of current expenditure. As Hemming and Ter-Minassian (2004) note, it is operationally easier to reduce capital than current expenditure, simply by allowing capital assets to depreciate more quickly by reducing maintenance expenditure, or by stopping a few large infrastructure projects. Current expenditure instead tends to be focused on entitlement-based programmes, public sector employment, wages and pensions, which are politically harder to reduce. Box 2 overleaf surveys the main findings of the empirical literature on the relation between fiscal adjustment and investment policy.

This focus on short-term political economy considerations over long-term efficiency leads to welfare losses, as genuine growth-enhancing investments are foregone, but the effects of the neglect of investment in public infrastructure only materialise after a long time.

The costs of short-sightedness are significant, however. A lack of planning and a stop-and-go approach to public investment leads to deadweight costs, as unfinished projects are left to depreciate before they can yield economic benefits. Once the public capital stock is run down it can take many years of sustained public investment to build it up again. Moreover, sharp cuts in public investment programmes not motivated by efficiency concerns can have a “hysteresis effect”, in terms of loss of project management and capital appraisal skills in the public sector. When necessary investment is resumed, there may be a lack of people with the right skills, making it hard to build up capacity quickly.

A fiscal adjustment based on curtailing efficient public investments, rather than controlling current spending or strengthening receipts, could also lead to a misleading assessment of a county’s structural fiscal position.¹⁰ Hard choices are deferred to a later date when the investment will need to be resumed in order to respond to the political and economic consequences of the history of under-investment in public capital.

A similar misjudgement could be made for the impact on intergenerational fairness. If the impact of a fiscal tightening were only assessed in terms of its deficit and debt implications, it might appear to favour future generations as public liabilities are reduced. However, a fiscal consolidation which cut public investment might actually worsen the inheritance of future generations due to the loss of welfare-enhancing investment. This suggests that the balance between assets and liabilities (net worth) rather than just liabilities (debt) may have advantages in estimating the impact of policy on generational fairness. This is considered further in the next section.

2.3 *Fiscal rules and public investment*

In the recent past, a number of countries have moved towards the adoption of explicit rules and targets for the fiscal aggregates. By adopting fiscal rules,

¹⁰ See Easterly (1999).

governments have sought to overcome the time-inconsistency problem in fiscal policy, pre-committing to a course of action and then working to establish a reputation for meeting their fiscal rules.

To achieve this, fiscal rules need to be reasonably simple, understood by the wider public and easy to monitor. In order to commit policy credibly, the fiscal rules need to be assessed on the basis of independently defined fiscal aggregates (e.g., by an independent statistical office).

The most straightforward type of fiscal rule is one that targets the total level of borrowing and the total stock of debt¹¹ – the rules underlying the Stability and Growth pact (SGP) adopted by EU member states are a well-known example.

Targeting debt and overall borrowing does not distinguish between capital and current expenditure, however. In order to incorporate the considerations discussed above, an increasing number of commentators have been arguing for an approach that targets the current budget (see Blanchard and Giavazzi, 2003) and net worth.¹² A borrowing rule leads to a steady state debt outcome that is independent of choices about the desirable amount of capital. Depending on the deficit ceiling chosen and on nominal GDP growth, the rule could potentially drive the debt ratio to zero, which could be argued to be a sub-optimal policy in terms of tax smoothing objectives and in terms of intergenerational equity.

Borrowing rules are not necessarily inconsistent with an investment-oriented fiscal policy. They do not, however, build in positive incentives for investment. If one accepts the political economy explanation for a bias against investment, there is a strong case for introducing a distinction between capital and current expenditure in the fiscal framework (such as in the UK's "Golden Rule").¹³

In the case of a current budget target ("Golden Rule"), deficits will be allowed only to be equal to the amount of net (or gross) investment. It can be shown that, under a Golden Rule, there would be a direct link between total amount of capital and debt in the steady state. Therefore, the golden rule is consistent with positive levels of debt backed by capital assets.

As noted by Buiters (2001), a Golden Rule does not ensure the sustainability of the public finances, because it puts no constraints on the total level of public debt

¹¹ A rule targeting a level of debt implicitly targets a path for public borrowing as well. Therefore, an explicit borrowing rule may be unnecessary alongside a debt rule. One reason for considering the addition of a specific borrowing rule is for the policymaker to commit to a fiscal adjustment within a specific time frame.

¹² Recent, high profile contributions to the debate have been the proposals by Brazil's President Lula da Silva and Mexico's President Vicente Fox, who argued that the growth enhancing properties of public investment made a case for excluding investment from the fiscal targets that developing countries need to meet to qualify for assistance from International Financial Institutions. Buiters and Grafe (2002) also called for: "priority in government spending for public investment".

¹³ There is some recognition of the importance of public investment in the SGP framework, Article 103(4) of the EC Treaty states that the assessment of whether a country's deficit is excessive should take into account: "...whether the government deficit exceeds government investment expenditure".

while investments do not necessarily yield a sufficient financial return to cover their costs.¹⁴ The considerations made in the first section would therefore suggest the need to combine a Golden Rule with an overall debt target.

The Golden Rule has a clear link to the concept of net worth, defined as the difference between total assets and liabilities accumulated to date held by a government. The main difference between net worth and net debt is therefore that the former also includes illiquid assets such as roads or school buildings.¹⁵ For a given level of steady state inflation and real growth, the steady state level of capital stock will determine the level of debt, and implicitly the level of net worth.

Targeting **net worth** or **changes in net worth** instead of debt has been proposed as a desirable feature of a fiscal framework so as to better incorporate the asset-creating nature of public investment. Net worth is a useful guide to fiscal policy, because it incorporates the beneficial effects of investment on government's asset position, and therefore puts further emphasis on the importance of capital expenditure.¹⁶

However, there are well-known drawbacks in adopting net worth (or changes in net worth) as the main target for fiscal policy. A key problem is the lack of robust data. Many government assets, especially illiquid assets, are difficult to measure accurately. Estimates of tangible assets for example are dependent on broad assumptions, which might not be appropriate in every case, and are subject to fluctuations from year-to-year due to revaluations of their market value. It could be hard to explain that a fiscal target has been missed because of revaluations and this could dilute the credibility of the framework.

Another drawback is that net worth could give a misleading impression of a government's solvency. This is because illiquid assets cannot be disposed of quickly to offset short-term liabilities. Indeed, many of the assets concerned are likely to be highly illiquid. The government could not, for example, sell off schools, hospitals and roads to offset the negative impact of high debt on interest rates and interest

¹⁴ Creel (2003) takes a different view, arguing that a golden rule poses an implicit constraint on debt levels. As the share of interest rate payments in the current budget increases, the fiscal authorities will find they need to reduce debt to make room for necessary non-capital expenditure. Interest payments will therefore create an implicit constraint to debt and public investment growth. However, the objective of a fiscal framework should be to avoid the risk of getting to the point where the interest/debt dynamics become so binding that a sudden fiscal retrenchment becomes necessary. At that point, capital expenditure would bear the burden of a sudden adjustment, with detrimental effects on microeconomic efficiency.

¹⁵ There are two concepts of debt. Gross debt includes only the liabilities in the government's balance sheet, while net debt also includes liquid financial assets. Net worth provides a more comprehensive coverage of government's balance sheet. The national accounts measure of net worth does not, however, include any future liabilities arising from past activities, such as public service pensions (see discussion in Chapter 3 of the *2003 Long-term Public Finance Report: Fiscal Sustainability with an Ageing Population*, HM Treasury, December 2003, for a further discussion). However, these are included in GAPP-based measures of net liabilities (for example, as shown in the *2004 Long-term Public Finance Report: An Analysis of Fiscal Sustainability*, HM Treasury, December 2004).

¹⁶ This might be important in a situation where the debt ceiling was binding, for example. In such a case, total borrowing rather than just current spending would be directly constrained, and for the marginal investment the distinction in the framework between capital and current spending would be weaker.

payments, without causing unacceptable disruption to the provision of essential public services. This suggests that net worth should be seen as complement to debt in a fiscal framework rather than a replacement for it.

One might argue about the extent to which solvency should apply to government. After all, government has the right to tax in the future, which is a fundamental difference from the private sector. However, even if the risk of insolvency is a lesser issue for governments than for companies, the level of debt affects long-term interest rates in the economy.¹⁷ Indeed, some evidence points to a non-linear relationship between debt and interest rates: the higher the level of debt, the higher the marginal impact on an increase in debt on interest rates.¹⁸ Therefore debt remains a key fiscal indicator.

2.4 The interaction between the macroeconomic and the microeconomic dimension

The need to reconcile fiscal sustainability with microeconomic efficiency considerations suggests a comprehensive policy framework, allowing for the interaction of the two policy perspectives. There are a number of ways in which the macroeconomic dimension (fiscal framework) and the microeconomic dimension (budgetary controls, capital appraisal systems) could interact.

A stylized description of a possible mechanism is as follows. First, the micro dimension ranks new projects by each department on the basis of capital appraisal techniques and costs/benefit analysis. Risk factors are generally incorporated into the monetary evaluation of projects through conventional appraisal techniques. Then the role of the macroeconomic dimension is to provide a cut-off point (e.g. through the debt ceiling) that determines which projects can be implemented. This cut-off implies taking a view on the level of debt that can be sustained without triggering the negative macroeconomic effects discussed above, and it can be interpreted as the point at which the marginal investment, albeit efficient, starts having a negative externality on the economy.

The microeconomic dimension can also feed back to the macroeconomic level. For example, suppose there are decreasing returns to capital and consider the case of a country that has a high capital to GDP ratio but low levels of debt. A macroeconomic sustainability assessment might suggest a relatively high total level of capital that could be financed through borrowing. However, an effective system of budgetary controls would capture the low returns and value for money of the additional project, which would fail the efficiency test. In such a case, it would be

¹⁷ See Brooks (2003) for a survey of the empirical evidence of the link between debt and interest rates.

¹⁸ Conway and Orr (2002).

the microeconomic considerations – the lack of worthwhile projects – rather than the debt ceiling that posed the binding constraint on the level of investment.¹⁹

Note also that there is a link between good micro-economic decisions and macro sustainability. While not necessarily true (many socially valuable projects do not bring financial returns by nature), strong budgetary controls should lead to better value for money decisions and better quality projects, which in turn is likely to raise the financial returns of the investment, thus improving fiscal sustainability.

Rigorous capital appraisal will also reinforce generational fairness of fiscal policy, by ensuring that the future returns, financial or social are actually realized. This will increase future generations' welfare, and the political acceptability of shifting some of the cost of today's decisions to them.

2.5 *Involving the private sector in investment decisions*

The generally positive effect of investment on growth has also led to consideration of how the private sector could be involved more actively in delivering public investment projects. The use of private capital to fund public infrastructure through Public-Private Partnerships (PPPs), and more specifically in the form of Private Finance Initiatives (PFIs) has recently emerged as a means of increasing value for money in public investment by injecting specialist project management skills from the private sector into public capital projects.

Moreover, if fiscal sustainability is considered to be about the overall amount of risk that the public sector can bear without endangering macroeconomic stability. To the extent that PFI projects shift the balance of financial risks from the public to the private sector, their adoption can release extra resources for investment. However, in order to ensure that this risk transfer is real, and that there is a clear efficiency case for use of PFIs rather than standard procurement, a robust framework of independent controls needs to be enforced. Hence, the assessment of the accounting treatment of PFI projects needs to be conducted independently and on the basis of clear and transparent criteria that take account of the balance of risks between the private and public sector and that are backed by robust reporting standards. This will prevent PFIs being used to shift fiscal demands off-budget that should really be scored in the public finances.

In addition, in order to guarantee that the decision to undertake a PFI is based on efficiency considerations, competitive tendering procedures, and robust processes for project appraisal and prioritisation are needed. Another important requirement is

¹⁹ This obviously assumes away the political economy problem. It will be much harder for a government to pre-commit to a rather complex appraisal system, rather than to a clear and high profile fiscal rule. But the signals coming from the capital appraisal system can be incorporated in the fiscal framework by informing the desirable level of the debt target.

that the quality of the service is contractible, or that at least the contract covers a broad range of contingencies.²⁰

2.6 *Conclusions: some guiding principles*

On the basis of the considerations above, some guiding principles for managing public investment can be established:

- Build an environment conducive to overall fiscal discipline. The need for sudden fiscal adjustment is the primary cause of retrenchments of capital investment. At the macro-economic level, fiscal policy must be set in a forward-looking manner within a framework addressing sustainability concerns. This allows more efficient planning of individual public investment projects.
- In addition to this there is a strong case for removing the bias against capital expenditure by targeting the fiscal indicators that recognize the different nature of current and capital expenditure.
- The microeconomic benefits of investment depend on the quality of expenditure undertaken. An approach focused on the aggregate level of capital expenditure is not sufficient to guarantee that the right projects are selected. Therefore the macroeconomic-fiscal framework needs to be integrated with a budgeting framework that offers the right microeconomic incentives, and makes extensive use of cost/benefit analysis.
- Microeconomic efficiency concerns should include consideration of the provision of capital by the private sector through appropriate risk-sharing arrangements with the government that do not endanger fiscal sustainability.

3. **Public investment in the UK**

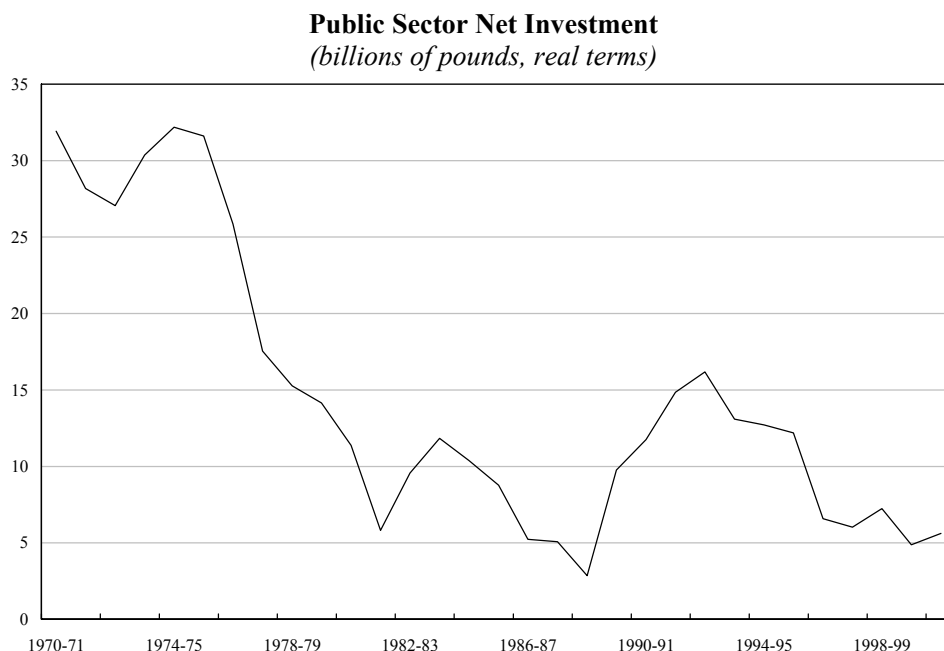
3.1 *Historical trends*

Figure 1 shows the trend in real public sector net investment (PSNI) in the UK between 1970 and 1999. PSNI is defined as gross investment minus depreciation, and therefore measures the change in total public sector capital stock. The figure shows a sharp decline of public investment in real terms in the second half of the Seventies, before more or less stabilising at a low a level (or at a declining level as a share of GDP).

Part of the fall reflects decisions to shift some activities from the public sector to the private sector. These included privatisation decisions, affecting the amount of investment undertaken by public corporations (which were reduced in number), and

²⁰ The incomplete contracts literature (see Grossmann and Hart, 1986) highlights the difficulties of writing contracts that cover all states of nature. A clear definition of ownership rights however can solve most of the inefficiencies deriving from contract incompleteness.

Figure 1



the disposal of a large part of local government's housing stock. However, decisions on the size of the public sector do not fully explain this decline.

Figure 2 shows gross fixed capital formation (measuring net acquisition of capital assets) by government sector as a share of GDP. The figure highlights the decline due to the reduction in the number of public corporations over the Seventies and Eighties, but also an ongoing decline in general government investment expenditure (Central Government plus Local Authorities) as a share of GDP.

The relatively low level of public investment in the UK is also apparent in comparison with other EU15 countries.

These relatively low levels of investment were partly caused by the inbuilt bias against capital expenditure discussed above. Previous arrangements focussed on a cash measure of net borrowing (the PSBR, now termed the public sector net cash requirement), which did not distinguish between current and capital expenditure.²¹

²¹ In the early Nineties the fiscal policy objective did begin to recognize the different nature of capital expenditure as a subsidiary objective, for example: "...to ensure that when the economy is on trend the public sector borrows no more than is required to finance its capital spending" (*FSBR*, November 1995). However, this did not help promote public investment rather it was an additional constraint on the medium-term deficit path.

Figure 2

Gross Fixed Capital Formation by Government Sector, 1970-97
(percent of GDP)

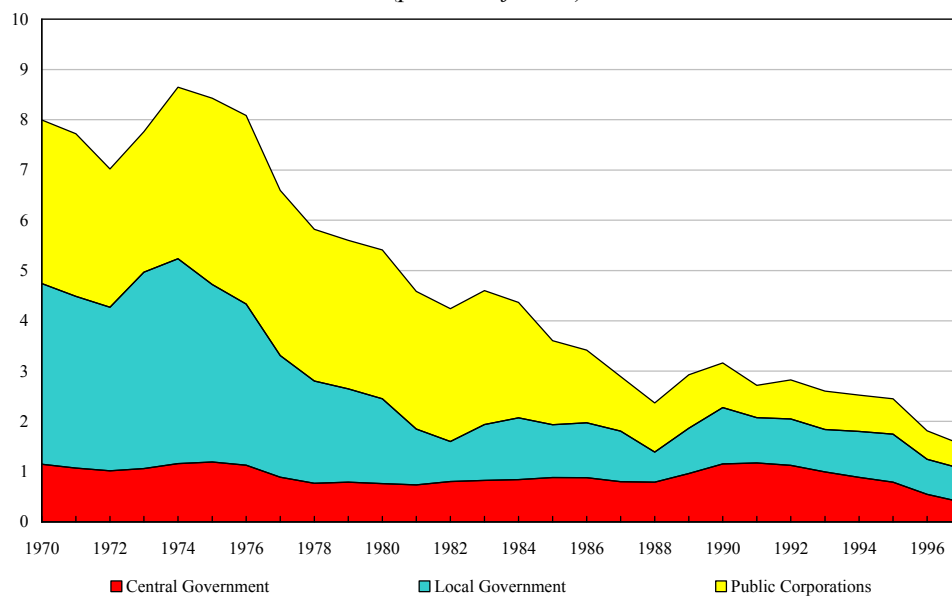


Figure 3

Public Investment, 1971-2000
(average percent of GDP)

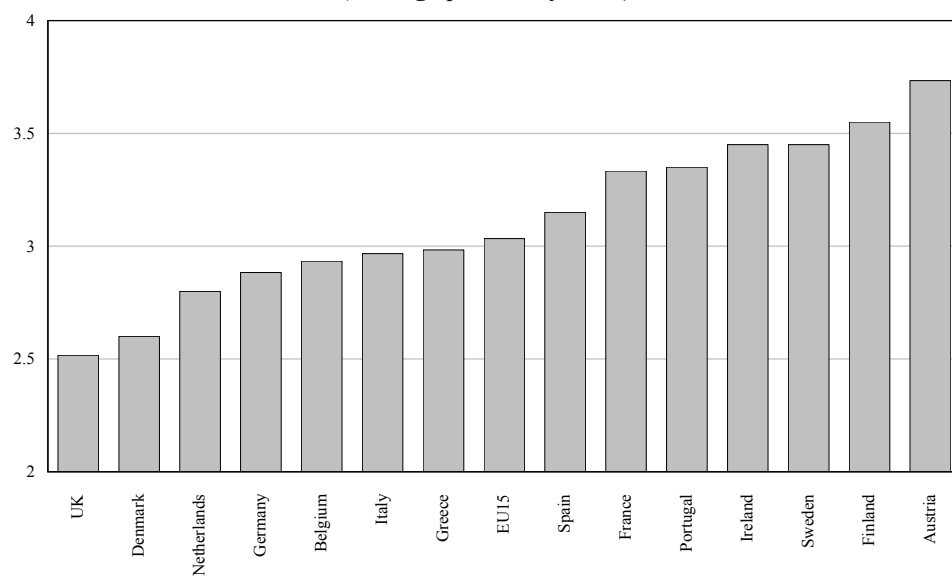
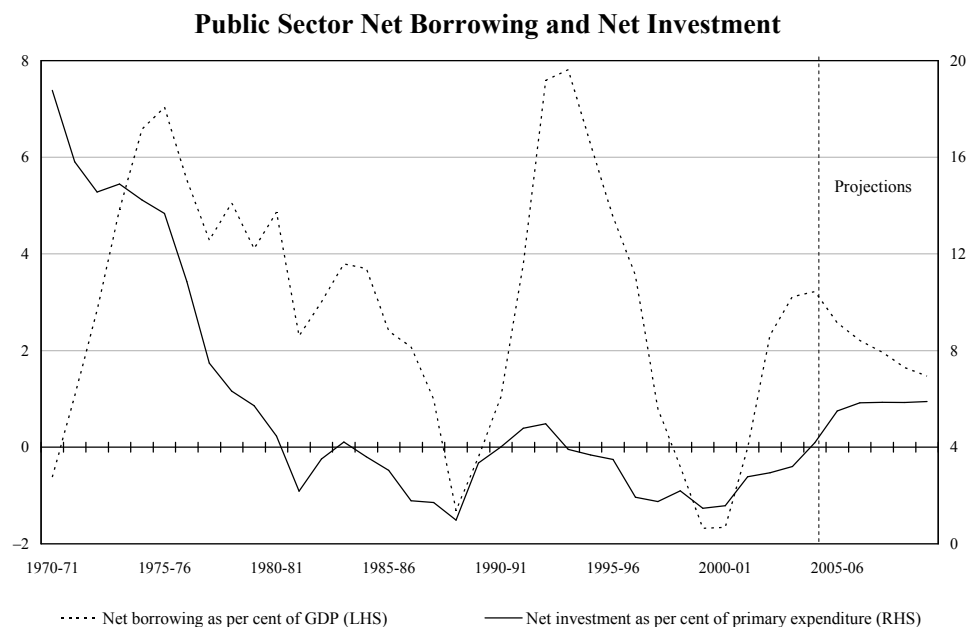


Figure 4



When a sharp fiscal retrenchment was needed (for example, net borrowing was reduced by 8 percentage points in cyclically adjusted terms between 1976 and 1982), capital expenditure tended to be sacrificed in favour of current spending. This is shown in Figure 4, that plots net borrowing and the share of investment over primary expenditure (that is total expenditure net of interest payments).

The figure highlights a striking correlation between borrowing and the share of investment, suggesting that investment tended to bear most of the adjustment in times when fiscal policy was tightened (and conversely, it tended to be expanded more than other expenditure in times of fiscal expansion).

Part of the decline in general government asset base has been due to a reduction in maintenance expenditure, confirming the tendency to reducing capital expenditure “by inertia”. In 1997 government departments estimated a backlog in maintenance of around £7bn (0.9 per cent of GDP) in schools, £3bn in National Health Service buildings (0.4 per cent of GDP), £7bn in roads (0.9 per cent of GDP) and £10bn in council housing (1.2 per cent of GDP) – implying a maintenance backlog of around $3\frac{1}{4}$ per cent of GDP in total.

Moreover, investment policy did not incorporate a long-term perspective, and therefore did not give departments the planning horizon needed to pursue effective long-term investment strategies. Budgets were set and revised on an annual basis and unspent resources were usually clawed back by the Treasury. This led to a

wasteful end-of-year spending surge, as departments saw no benefit in delaying spending for efficiency reasons. Indeed, the way plans were set meant that unspent budgets were often the first to be scaled back.

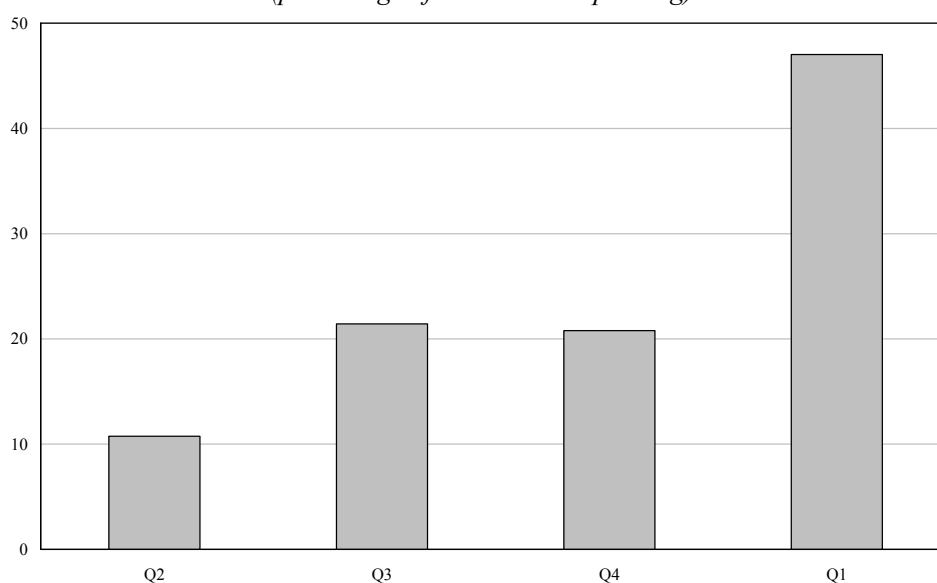
Figure 5 highlights this trend. It plots the average quarterly profile of investment expenditure between 1970 and 1998, it shows that on average over 45 per cent of annual spending was in the final quarter of the financial year (Q1 for the UK) and only just over 10 per cent in the first.

3.2 *The current UK framework for public investment*

The framework that guides public investment in the UK is based on two key elements: a set of fiscal rules that underpin the Government's commitment to sound public finances and guide the macroeconomic management of the economy; and

Figure 5

Quarterly Investment Expenditure, 1970-98
(percentage of total annual spending)



budgeting rules and procedures that create the right incentives at the microeconomic level.

3.2.1 *The fiscal rules*

The current UK Government has adopted two fiscal rules:

- **the golden rule:** over the economic cycle, the Government will borrow only to invest and not to fund current spending; and
- **the sustainable investment rule:** public sector net debt as a proportion of GDP will be held over the economic cycle at a stable and prudent level. Other things being equal, net debt will be maintained below 40 per cent over the economic cycle.

The Government adopted the fiscal rules as part of a commitment to a sound and prudent fiscal policy. One of the drivers for the design of the fiscal rules was also to overcome the historical trends towards under-investment in the public services.

The golden rule adopts the current balance as the key fiscal aggregate. This allows fiscal policy to incorporate the key distinction between capital and current expenditure discussed above. The key objective of this distinction is to ensure intergenerational fairness: acknowledging the different intergenerational implications of capital expenditure, borrowing is allowed only to fund public investment, the benefits of which will accrue partly to future generations.

The golden rule is assessed over the economic cycle, so that fiscal policy can support monetary policy to achieve short-term stabilisation objectives through the full operation of the automatic stabilisers allowing cyclical fluctuations in current revenue and spending. By contrast, investment policy needs to be planned for the long term, on a different timeframe from short-term fluctuations of the economy.²² This gives greater certainty to departments that their capital allocations will not be altered over the planning period.

As discussed above, a balanced current budget does not by itself ensure fiscal sustainability, as public investments often do not generate sufficient financial returns to offset the Government's cost of capital. Thus the Sustainable Investment Rule is designed to "close the system" by putting a ceiling on the total amount of net debt at a level that is considered to be consistent with a prudent approach to fiscal sustainability. The 40 per cent of GDP ceiling puts an overall constraint on the total level of public investment.²³

²² While the decision to go ahead with investment decisions should be guided by efficiency considerations, the timing of the investment might nevertheless take into account the cyclical position of the economy – especially if a large component of government spending is made up of capital expenditure, investment could be delayed or anticipated in order to avoid pro-cyclical effects.

²³ There is no clear consensus in the literature about the optimal level of public debt, with estimates ranging widely. The UK debt ceiling (which has however been set with an objective to ensure prudence and *(continues)*

Another operational feature of the fiscal framework is the explicit margin of caution applied to the fiscal projections. This is built in by budgeting for expenditure reserves, stress testing the fiscal projections and applying some explicitly cautious assumptions in key areas of the forecast (such as applying a lower trend growth assumption than the central estimate for the main fiscal projections). This margin of caution helps insulate investment plans from forecast errors, and therefore guarantees a further degree of certainty to the planning process.

3.2.2 The UK budgetary control and appraisal framework

In addition to the fiscal rules, that make an important distinction between current and capital expenditure at the aggregate level, and ensure the overall affordability of spending plans, controls at the microeconomic level are needed in order to ensure that specific investment decisions are taken on the basis of efficiency and value-for-money considerations.

Longer budgeting horizon

One of the problems with the spending framework in place before 1997 was that the budgeting horizon was too short to allow Departments to plan their investments properly. Under the framework introduced in 1997, Departments were allocated fixed three-year budgets which are reviewed every two years. In July, the Chancellor announced that the next Spending Review would be in 2007 and it would cover the three years, 2008-09 to 2010-11.

Capital budgets are set separately from current budgets, and only switches from current to capital expenditure are permitted, avoiding the incentive in the past for departments to defer capital expenditure when budgets were tight. In the case of particularly complex and large investment programmes, where a comprehensive view of a sector is needed, such as health and transport, the budgetary framework allows for longer time horizons than three years.

The introduction of “End of Year Flexibility (EYF)”, under which Departments can carry forward unspent funds from one year to the next, aims to remove the perverse incentives to accelerate expenditure towards the end of the budgeting year (as illustrated in Figure 5). This, combined with the three-year budgeting horizon, shelters investment plans from the uncertainty of a annual budgeting round, giving Departments a flexible timeframe to undertake expenditure, consistent with the lumpy nature of capital investment.

Since 1998, departments have also been asked to produce Departmental Investment Strategies (DIS), setting out the plans to deliver the agreed level of

sustainability rather than optimality) falls within these estimates, and in general is set at a conservative level by international standards. See Balls and O'Donnell (2001) and Woods (2004) for a more detailed discussion.

public services and the capital stock needed to underpin their objectives. The DIS cover three years and are revised every two, in line with the budgeting horizon. They include information on Department's plans to manage its existing capital stock, the strategic approach to new investments and the plans to ensure the delivery of investment programmes.

Incentives to improve asset management

As is clear from the Departmental Investment Strategies, the current framework is concerned not only with better planning of new investment, but also with more effective management of existing assets. In this area, the framework seeks to:

- improve the quality and availability of information on government assets; and
- build the right incentives for asset managers, by ensuring that they directly enjoy the benefits (or pay for the costs) of their decisions.

The first step was the creation of a comprehensive register of all assets owned by government departments and sponsored bodies, the **National Asset Register (NAR)**. The NAR was first published in 1997 and then updated in 2001.

The move towards a full **resource accounting and budgeting (RAB) framework**, incorporating accrual-based measures according to generally accepted accounting practices (UK GAAP), is another important tool. RAB implies disclosure of all liabilities, providing a better guide to future costs and risks of present decisions.

Accrual accounting prices into departments' budgets the cost of poor asset management. From 2003-04, Departmental Expenditure Limits have included a charge for future liabilities (e.g the cost of cleaning up a contaminated site). Moreover, Departments pay capital charges on their capital assets, reflecting depreciation and an estimate of the opportunity cost of capital, reflecting the cost of Government borrowing. Charging the true cost of holding capital to departments will encourage better decisions on whether an asset is put to its best use or whether the asset should be disposed of. In order to further encourage asset disposal when economically efficient, departments are allowed to retain receipts from asset sales for future reinvestment, rather than returning them to the Treasury. This creates an immediate return from seeking the best disposal strategy.

Capital appraisal

A budgeting framework that aims to deliver efficient capital investment needs to be complemented with the right analytical tools and processes for managers to carry out decisions.

In the UK, the framework for undertaking project appraisal in government is set out in the guidance issued by the Treasury (the so-called *Green Book*). The *Green Book* provides Departments with a consistent tool to evaluate investment

decisions. The latest version of the *Green Book*, published in 2003,²⁴ introduced some important changes to the approach to project appraisal:

- the government discount rate was lowered from 6 per cent to 3½ per cent in real terms. By putting a higher weight on future costs and benefits, the lower discount rate encourages forces decision-makers to take greater account of the long-term consequences of policies. This provides a better approach to assess investment decisions that span long time frames,²⁵
- in order to maintain a prudent approach to costing of new policies, an explicit adjustment for optimism bias is now required, to take into account the tendency to underestimate costs (overestimate benefits). While the higher discount rate somewhat counterbalanced the tendency towards optimistic projections previously, the new approach requires appraisers to account directly for it, and allows for some variation according to historical experience with the project type, see Box 3.

Box 3

Optimism bias: how is it calculated?

The Green Book provides guidelines to departments on the parameters to use when calculating the optimism bias of a project. Optimism bias is applied both to cost overruns and to completion times (and benefits, where information is available, otherwise sensitivity analysis should be carried out). The recommended approach¹ to costs and time overrun is based on a study of past experiences and different ranges of optimism bias are recommended for different types of project depending on how advanced the business case is. For example, non-standard civil engineering has quite large recommended adjustments associated with it (a range between 66 and 6 per cent of estimated costs).

However, appraisers in each Department are actively encouraged to substitute guidelines with case-specific estimates when they are available.

¹ See Mott-McDonald (2002), "Review of Large Public Procurement in the UK", July, http://www.hm-treasury.gov.uk/media/A00/D3/greenbook_mott.pdf

²⁴ HM Treasury (2003).

²⁵ The change is also in line with the observed decline in long-term real interest rates.

The internal capital appraisal system, which is applied ahead of the decision to undertake an investment, then needs to be followed by a mechanism that monitors the implementation of the project as it progresses. It is important to ensure that lessons from previous projects are assimilated through the promotion of best practice. In the UK, this is particularly important in order to consolidate the public sector's project management skills as investment levels pick up again, and to minimise inefficiencies.

Two institutions have been set up to fulfill this role. The **Office of Government Commerce (OGC)**, created in 2000, has the remit to improve the efficiency and effectiveness of public sector procurement. It operates across the civil service to promote improved procurement and management. The OGC also operates the Gateway reviews, which is a process that tests investment projects through a series of procurement gates, see Box 4.

Partnership UK (PUK) was created in 2001 to support the public sector to develop PPP projects. PUK is a PPP developer, providing finance for PPPs where this will achieve better value for the public sector, and working with public bodies to identify and structure new opportunities for cooperation with the private sector. PUK is itself a PPP, with the public sector owning a minority interest and the private sector a majority stake.

Box 4

OGC Gateway reviews: how do they work?

An OGC review involves a thorough examination of the project, including its management structures, at initiation and then at the key decision points in its development. There are five review stages in the process: three before the contract is awarded and two looking at service implementation and confirmation of the operational benefits. A project is reviewed by the OGC Gateway Review according to the point reached in its lifecycle.

The review process applies to all acquisition or procurement processes in central civil Government, although Departments can decide not to subject some low risk projects to the review. The judgement on risk to the project is formulated using a standardized Risk Potential Assessment tool, which takes account of a broad range of risks.

Over 500 projects, covering proposed spending in excess of £40bn, have been reviewed to date.

Box 5
**How a hypothetical project would be treated
in the budgeting and appraisal system**

Assume that a Department considers undertaking a £100m capital project. The Department's appraisers will use the Green Book's guideline to produce a cost-benefit analysis of the project in order to decide whether it should go ahead.

As the value of the project is above the delegation limit (that is, the maximum value on which the Department can commit funds without the Treasury's authorization), the project would need the Treasury's approval before funds would be committed. The relevant spending team in the Treasury would scrutinize the project on the basis of the cost-benefit analysis, and therefore its expected outcomes and value for money. The Treasury would also consider the project from the point of view of its funding structure, its impact on the Departmental allocation and, for larger projects, its wider fiscal impact. If all these aspects were satisfactory, the Treasury would then sign it off.

At the same time, the Department would need to decide whether to enter an OGC Gateway Review process by compiling a risk assessment. Assuming that the Department defers the project to the OGC, the first step of the review would assess the project before the contract was awarded to a constructor. The focus of the review would be to promote professionalism in the department's management of the project. Each gateway in the review would emerge with recommendations based on a "traffic light system", recommending remedial actions if needed.

The full OGC Gateway process covers implementation and management of the contract, and finally, benefit realization after the implementation. The Department would be recommended to conduct the final stage of Gateway review repeatedly until the project was closed.

*PFI*s

As discussed in Section 2, policy-makers have looked with increasing interest at Public Private Partnerships (and specifically PFIs) as a means of improving the delivery of public investment and at the same time reducing the risk to the public finances. The UK has been at the forefront of using PFIs to deliver public investment projects. There are two key advantages to PFIs:

- they bring private sector expertise into the management of investment projects and, when appropriately designed, this provides the right incentives to higher performance by putting private money at risk; and

- provided that the appropriate risk-sharing arrangements have been implemented with the private sector, it reduces the risk to the public finances, freeing resources for other policy objectives.

When a PFI contract is signed, the private contractor enters in a long-term arrangement with the Government, and it is responsible for the quality of the work undertaken throughout the contract period. The service delivered by the investment, rather than the physical asset being built, is the object of the contractual obligation. The compensation or fee paid to the private contractor is dependent on the quality of the service, preventing false economies during the construction period that would worsen the quality of the service delivered.

Clearly, the decision to undertake a PFI project needs to be driven by value for money considerations, and not all projects are undertaken through PFIs. PFI accounts for a relatively limited proportion of the UK government's capital spending, with the majority of investment being carried out through conventional forms of procurement. Figure 6 illustrates the component of expenditure on public services in the UK, including PFIs.

The pick-up of overall investment expenditure has been paralleled by the increase in PFI projects, as shown in Figure 7.

The evidence supports the expectation that the use of PFIs leads to efficiency gains in the delivery of public investment. PFI projects tend to be delivered more

Figure 6

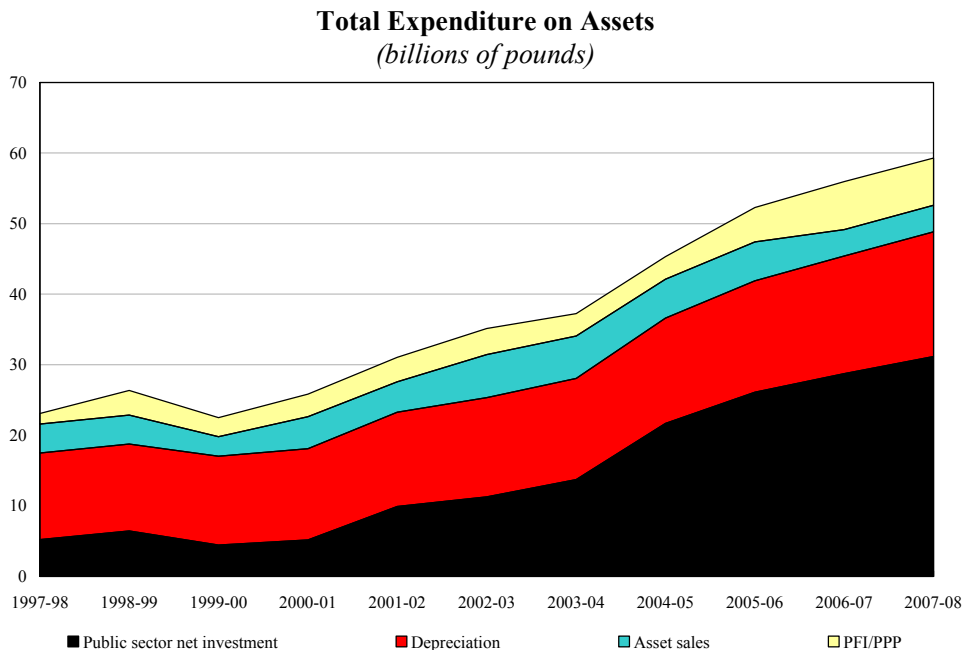
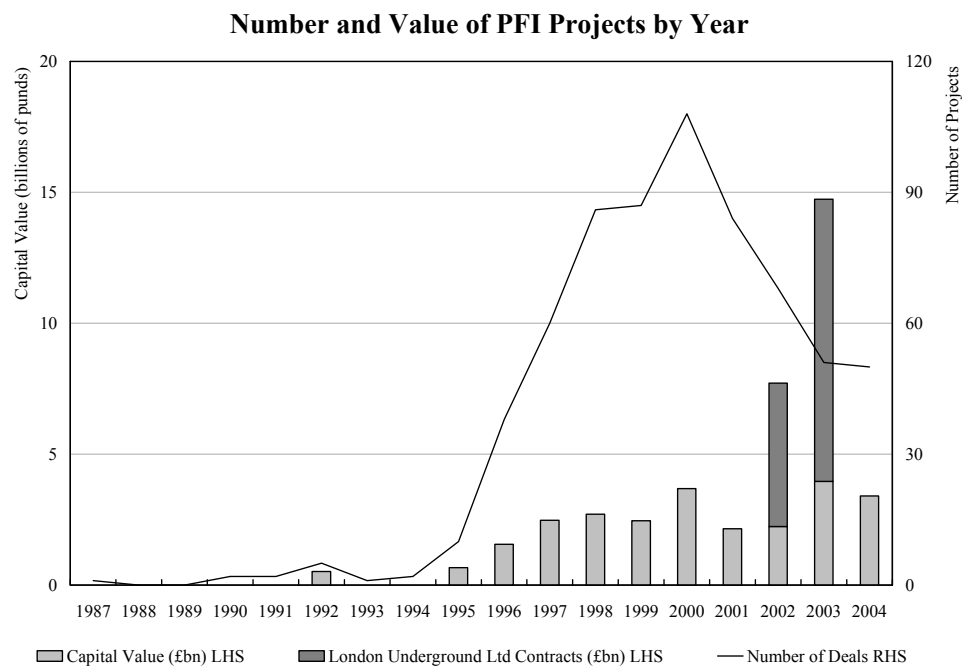


Figure 7



often on budget, providing higher price certainty for the public sector. Figure 8 shows that the percentage of PFI projects that lead to a price change is around 21 per cent versus over 70 per cent for previous non-PFI projects.

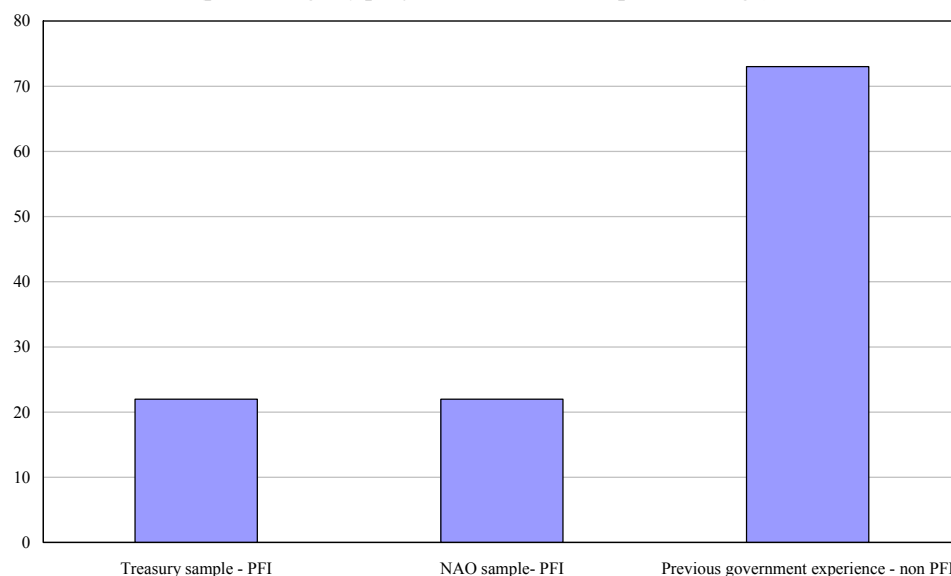
In the same way, the data show that nearly 90 per cent of PFI projects were delivered on time, against only 30 per cent of previous non-PFI projects.

An effective use of the PFI approach requires that an independent assessment of the fiscal risk of the investment (and therefore its accounting treatment) is carried out. The accounting treatment of PFIs follows the generally accepted accounting principles (GAAP) developed by the independent Accounting Standards Board. This is required by the Code for Fiscal Stability and the 2000 Government Resources and Accounts Act, committing the Government to adopt best-practice accounting methods for the public sector. The National Audit Office (NAO), reporting to Parliament, audits the Government accounts, and the treatment of PFIs within them. In particular, the NAO performs a project-by-project assessment of the balance of risks for every PFI undertaken by central government, in order to decide on the balance sheet treatment of the project.²⁶

²⁶ The Audit Commission, another independent auditor, performs the same role for Local Authorities' PFI projects.

Figure 8

Delivering to Budget – Price Uncertainty in Public Procurement
(percentage of projects that lead to a price change)



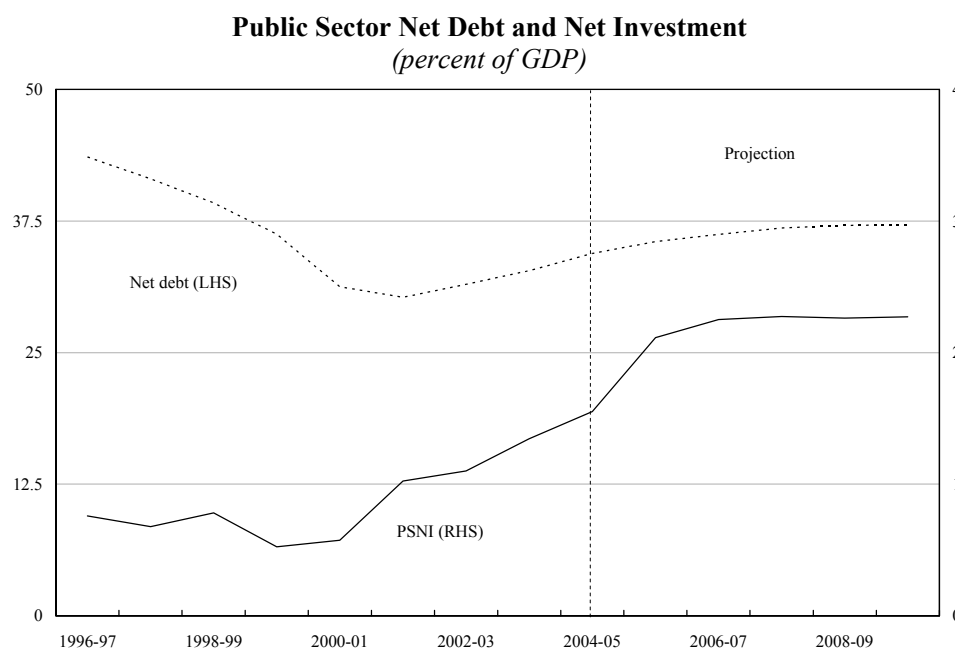
The key principle that drives the accounting treatment of PFIs is that the party bearing the balance of risk of ownership should put the asset (and the corresponding liability) on its balance sheet. Based on this judgment, around 50 per cent of PFI projects by capital value are reported on Departmental balance sheets. Note that ownership risks are only a subset of the risks that a PFI addresses, and even if a project is scored on the government's balance sheet, substantial risks (for example the construction risks) would still be shifted onto the private sector.

3.3 Public investment strategy, objectives and policy since 1997

In 1997 in order to redress the consequences of the perverse incentives in the budgeting system, the UK Government developed a strategy aimed at improving the delivery of public services by bridging the historic shortfall in public investment. In order to do so, it was necessary to:

- create a fiscal framework that could deliver fiscal sustainability;
- introduce rigorous controls at the microeconomic level to ensure quality and value for money of investment;
- within these limits, deliver a significant increase in public investment.

Figure 9



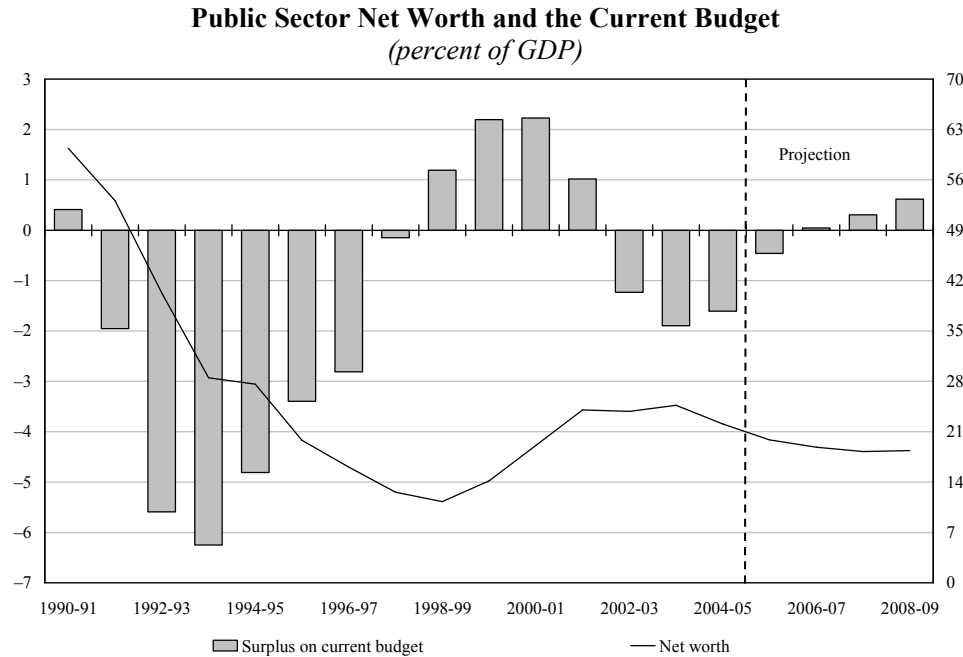
In order to create room for an increase in net investment at a later stage, the Government initially consolidated the public finances. Figure 9 traces the levels of net debt and net investment and it shows that between 1997 and 2001 net debt was reduced from over 40 per cent of GDP to 30 per cent.

Figure 9 shows that, based on Budget 2005 projections, the Government plans to continue to address the historic shortfall in public investment over the coming years, with PSNI projected to amount to 2¼ per cent of GDP until at least 2009-10, while net debt is projected to stabilise around 37 per cent of GDP by the end of the forecast horizon. This is consistent with addressing the ongoing shortfall in public investment that is still identified as a structural burden on the UK economy (for example, see OECD 2003).

As discussed in Section 2, net worth is a useful measure to assess the Government's net asset position. However, it does not play a central role in the UK fiscal framework due to data definition problems discussed earlier in this paper. Figure 10 charts the link between net worth and the current budget, its broad flow equivalent.

Figure 10 highlights how the steep fall in net worth in the first half of the Nineties was stopped by 1997-98 and then reversed, mainly by running down liabilities by running large current surpluses. From 2002, the current budget moved into deficit to counteract the cyclical downturn. This led to a small decline in net

Figure 10



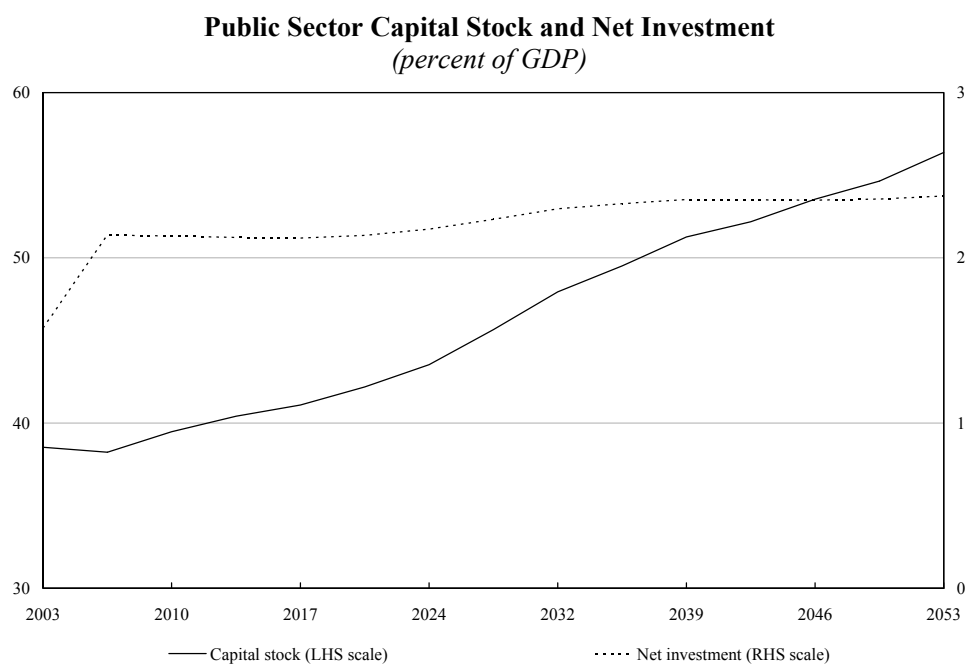
worth, as net borrowing was not backed fully by asset accumulation. Over the forecast horizon net worth stabilises around a level of about 18 per cent of GDP.²⁷

The UK Treasury has published long-term capital stock but not net worth projections.²⁸ The projections are based on a number of assumptions, including that *per capita* capital spending will rise in line with productivity growth beyond the medium term. Being based on the end of the medium-term forecast, the projections lock in historically high levels of investment in the National Health Service and education. Mainly as a result of this, Figure 11 shows that the general government capital stock would rise from just under 40 per cent of GDP in 2002-03 to around 60 per cent by 2052-53. The net investment ratio, which is here defined by what is "needed" to provide for an ageing population given the jumping off point at the end of the medium term, has to rise only modestly – by around $\frac{1}{4}$ per cent of GDP.

²⁷ The 2004 *Long-term Public Finances Report* also published an illustrative historical series for government net liabilities, including provisions (p. 46).

²⁸ 2003 *Long-term Public Finance Report: Fiscal sustainability with an Ageing Population*, HM Treasury, December 2003, p. 52. Note that, using a range of supplementary assumptions, it is possible to project net worth using available information on future capital stock and debt.

Figure 11



4. Conclusions

There are three reasons for designing fiscal frameworks to take account of the specific nature of public investment:

- **public investment can play an important role in facilitating long-term economic growth.** It is not the only definition that could be used for this purpose but it is a clear and tractable one;
- **intergenerational fairness:** public investments are by their nature durable, some are extremely long-lived, and they benefit future generations as well as current generations. This provides a justification for spreading the burden of financing these investments by issuing public debt; and
- **political economy of public investment:** in the short term, running down the public capital stock appears to be easier than cutting current expenditure when there is a need for fiscal retrenchment. Even if this is reversed when fiscal conditions are easier, the resultant stop-go cycle of investment is likely to be inefficient.

While the macro-economic framework is a key factor to correct a bias against public investment, it needs to be underpinned by a robust micro-economic framework. This should ensure that investment decisions are taken on the basis of efficiency considerations and that they deliver the planned benefits. It is also

important that the budgetary framework can provide a regular and predictable flow of resources for investment spending to avoid inefficiencies and capture the benefits.

In the case of the UK, historically low levels of investment made a particularly strong case for designing a macro framework that could sustain an increase in capital formation in the economy. In order to do this, a twin-track approach was adopted:

- at the macroeconomic level, the golden rule allows sustained borrowing for net investment, while the sustainable investment rule, or debt rule, means that when the government does borrow it does so within a debt ceiling that ensures longer-term fiscal sustainability;
- at the microeconomic level, a robust set of budgetary control and capital appraisal processes were established to ensure that investment projects are undertaken on the basis of efficiency and value-for-money considerations. The arrangements also embody incentives to improve the management of existing capital assets;
- the macro and micro reforms acting together have helped ensure a more regular flow of resources to raise public investment, for example at the macro level, by consolidating the public finances at the outset and at the micro level, by ending wasteful end-year investment surges because of the departmental budgetary arrangements.

Within this framework, the UK Government has implemented a strategy to deliver a sustained increase in public investment with net investment rising to 2¼ per cent of GDP, while maintaining a sustainable fiscal position with net debt stabilising around 37 per cent of GDP. Over 2004-05, nominal net investment has increased nearly 40 per cent over the previous year to a level around 1½ per cent of GDP.

APPENDIX
ECONOMIC GROWTH AND PUBLIC INFRASTRUCTURE:
A BRIEF SURVEY OF THE LITERATURE²⁹

Since the late Eighties, academic interest in the role of public investment and economic growth has been revived. This was largely motivated by two factors. First, since the early Seventies the share of public investment to GDP had declined markedly across OECD countries and at roughly the same time productivity growth fell sharply in these countries. Second, following Aschauer (1989), some researchers argued that there were significant linkages between economic growth and public investment, and particularly public infrastructure investment. A third factor was the revival of interest in growth theory, discussed later.

In a series of papers Aschauer (1989a, 1989b, 1989c) attributed the US productivity decline in the Seventies to the substantial reduction in infrastructure investment. He argued that, due to the high rates of return on public capital, policy-makers would be well-advised to divert resources to public investment and particularly investment in public infrastructure in order to boost growth.

In the period since then there have been a large number of empirical studies seeking to determine the impact of public investment employing a variety of methodologies, ranging from: production and cost function approaches, time-series econometrics, vector autoregression (VAR) models, cross-country growth regressions, and more recently panel data studies. The results are summarised below.

The first strand³⁰ of empirical research into the effects of public investment on economic growth, led by Aschauer, reported a significant and large impact of public capital on productivity and thereby economic growth.³¹ It was largely based on Cobb-Douglas production functions, estimated with aggregate time-series data, and conducted mostly at the national level. Among other researchers, Munnell (1990a), Eisner (1994), Fernald (1993), and earlier Holtz-Eakin (1988), employing similar Cobb-Douglas production functions, also came up with statistically significant, and similarly large estimates of rates of return to public capital to Aschauer's.³²

Subsequent work questioned these findings and argued that they suffered from serious methodological pitfalls³³ leading to results which critics dismissed

²⁹ By Dylan Schumacher.

³⁰ For a comprehensive review of the earlier research efforts see, for example, Gramlich, E. (1994), "Infrastructure Investment: A Review Essay", *Journal of Economic Literature* (September) or, for a methodological review, Sturm, J.E., G. Kuper and J. Haan (1996), "Modelling Government Investment and Economic Growth on a Macro Level: A Review", CCSO Series, No. 29.

³¹ Aschauer (1989) found that a 10 per cent increase in the public capital stock would raise multi-factor productivity by almost 4 per cent.

³² Munnell (1990a), for example, established an elasticity of 0.34 for the US, implying that a 10 percentage point increase in non-military public capital would increase productivity by over 3 per cent.

³³ Besides excessively optimistic implicit rates of return, methodological problems relating to endogeneity, spurious correlation and causality were prominent.

“pretty stratospheric”.³⁴ A stream of literature emerged that employed alternative methodologies, based mostly on cost-minimisation approaches, more flexible production functions, and error-correction models, to address weaknesses and reappraise the role of public investment. This slightly later wave of empirical literature produced much more modest estimates of the effects of public investment on growth (see, e.g. Munnell, 1990b, Hulten and Schwab, 1991 and 1994, Baffes and Shah, 1993, Tatom, 1991 and 1993, Holtz-Eakin, 1994, Conrad and Seitz, 1994, Dalamagas, 1995 and Sturm and De Haan, 1995), with some reporting insignificant or even negative relationships.

The inconsistency of these findings, coupled with a degree of ambivalence regarding statistical significance, rendered the early literature relatively inconclusive and therefore somewhat unhelpful for policy-makers. However, notwithstanding this, some more general insights could already be drawn and were further reinforced in ensuing studies using more advanced methodologies. The World Bank (1994) in its review of the literature following Aschauer’s work, thus, concluded that while there was no consensus on the magnitude or the exact nature of the impact of infrastructure on growth, a great number of studies showed that the role of infrastructure is: “...substantial, significant, and frequently greater than that of investment in other forms of capital.”³⁵

The World Bank (1994) also noted the importance of the policy and environmental settings surrounding public investment. It reported that the design, implementation, and operation of infrastructure projects are instrumental in ensuring the potential growth benefits of infrastructure spending are realised. In its view: “...infrastructure represents, if not the engine, then the wheels of economic activity”.³⁶ In other words, infrastructure is a necessary but not a sufficient condition for growth.

One of the dominant features of the literature discussed so far has been that initially most of the analyses focused on a select few countries, particularly the US. More recently, however, researchers have reassessed the relationship for a wider group of countries, increasingly employing more modern analytical tools such as VARs and panel data estimation approaches.

Most analyses carried out using VARs establish cointegrating relationships between public capital and output.³⁷ However, some of these studies fail to report a clear direction of causality and come across feedback effects (see, e.g., Clarida, 1993, and Batina, 1998); while other studies do find evidence of positive effects between public capital and output, yet fail to report measures of statistical

³⁴ Op. cit., Gramlich, E.M. (1994), “Infrastructure Investment: A Review Essay”, *Journal of Economic Literature*, September.

³⁵ Op. cit., The World Bank (1994), *World Development Report 1994, Infrastructure for Development*, p. 15.

³⁶ Op. cit., The World Bank (1994), *World Development Report 1994, Infrastructure for Development*, p. 14.

³⁷ For a comprehensive discussion of VAR relating to the interaction between public investment and growth, see Kamps, C. (2004): “The Dynamic Effects of Public Capital: VAR Evidence for 22 OECD Countries”, Kiel Working Paper, No. 1224.

significance associated with the estimated effect (see, e.g., Flores de Frutos *et al.*, 1998, Sturm *et al.*, 1999, Pereira, 2000, Pereira and Roca Sagales, 2001). However, current appraisals of the dynamic effects of public capital, which benefit from more coherent and broader data sets, do suggest that there are positive and significant long-run output effects (see, e.g., Kamps, 2004). These studies also find evidence that public capital and private capital are long-run compliments, whilst results for the short run are more mixed and less definitive.

On a general note, however, most of the estimates derived from VAR analyses are significantly lower than those obtained from single equations (see, e.g., Lau and Sin, 1997, Pereira, 2000, and Kamps, 2004), possibly indicating that the earlier results missed some of the feedback effects.

Investigation of the relationship between public investment and growth was also given further impetus from the early Nineties by the development of endogenous growth models. Original neoclassical growth theory had ruled out any effect from the level of capital investment on long-run growth (as opposed to the level of output), reflecting the presence of a fixed factor of production and hence diminishing returns to reproducible factors. Although investment could have protracted effects on growth rates, they could not persist indefinitely. In contrast, endogenous growth models such as proposed by Barro (1990), King and Rebelo (1990), Sala-i-Martin (1995) and Mendoza (1997) predict that public investment may alter the long-run growth rate. The essence of the endogenous growth models is to assume that there are constant returns to the factors that can be accumulated, including public investment.

Cross-country regressions typically based on the Barro's approach broadly support the notion that public investment, and particularly public infrastructure investment in transport and communication, positively affects output. Earlier analysis tended to find that growth was insignificantly related to the share or the stock of public investment (see, e.g., Barro, 1991 and Levine and Renelt, 1992), but it did establish evidence of a positive and significant link between public investment in transport and communication and economic growth (see, e.g., Barro, 1991 and Easterly and Rebelo, 1993).³⁸ This bottom-line finding also crystallised from research using physical units of infrastructure rather than expenditure in public investment, showing that physical measures of infrastructure networks, such as transportation and telephone systems have large and significant effects on economic growth (see, e.g., Canning and Fay, 1993), with returns initially accruing slowly but ultimately being very large. More recent analyses generally corroborate the finding of significant positive linkages between public investment and output, although its coefficient generally tends to be smaller than that of private investment (see, e.g., Gwartney, Holcombe and Lawson, 2004).

³⁸ Some studies (see, e.g., Devarajan, Swaroop and Zou, 1993) find a negative and statistically significant relationship between government investment on, for example, transport and communications and per capita GDP growth, but highlight that the absence of a meaningful relationship could be due to political factors in decision-making and other complimentary factors.

In endogenous growth frameworks, empirical studies using panel data by authors such as Cashin (1995), Canning and Pedroni (1999), Kneller, Bleaney and Gemmell (1999), Demetriades and Mamuneas (2000) and de la Fuente (2000), among others, point to public investment being able to affect the steady-state growth rate. However, since these studies also separate out the positive growth impact of investment from the adverse growth effects of the distortionary taxation used to finance it, they suggest a saturation point, beyond which further investment would trigger negative effects.

Some of these studies examine whether the neo-classical case with diminishing returns to capital, or the endogenous growth model with constant returns is substantiated by panel data estimation. They find robust evidence of long-run effects of public capital, more specifically public infrastructure, on output growth, lending support to the endogenous growth model (Canning and Pedroni, 1999, Kneller, Bleaney and Gemmell, 1999, and Demetriades and Mamuneas, 2000). However, in some cases the studies found zero long-run growth effects, which may imply that public capital is already at its growth maximizing or optimal level as the productive effects are offset by the detrimental effect of diverting inputs from other activities (Canning and Pedroni, 1999). This is consistent with evidence from The World Bank that suggests an inverted-U shape relationship between infrastructure (transport and communications in this case) and the rate of economic growth.³⁹

In a similar vein, de la Fuente (2000) also shows that, despite there being a positive effect from public capital accumulation, a saturation point is eventually reached. Demetriades and Mamuneas (2000) corroborate this in their broader country study, which finds that mean short-run rates of return for public infrastructure are relatively low, while the corresponding long-run rates are considerably higher, albeit declining over time. Their study also suggests that the knock-on effects to private capital are larger in the long run, while those to labour are more pronounced in the short run. Moreover, Demetriades and Mamuneas (2000) determine that while in the short run, private capital appears to be more productive than public, the opposite is the case in the long run when spillover effects are fully taken into account. Notably, the full long-run benefits of public capital may take up to fifteen years to materialise.

In addition, and consistent with the emphasis on the importance of the macroeconomic environment in the earlier research⁴⁰ these studies also suggest that zero long-run growth effects may stem from either ineffective or distortionary policy-making. A number of studies investigated the policy impact further and found that the structure of taxation and public expenditure can affect the steady-state growth rate.⁴¹ They find that increases in productive government expenditures –

³⁹ De La Fuente (2000) asserts that the returns to infrastructure investment are probably quite high when infrastructure is scarce, but that they diminish sharply thereafter.

⁴⁰ For example, Kessides (1993).

⁴¹ See, for example, Kneller, Bleaney and Gemmell (1999) and Bleaney, Gemmell and Kneller (2001).

which include those devoted to health, education, general public services' expenditure, defence, education, transport and communication and housing – significantly enhance growth; while non-productive expenditure – such as social security and welfare, expenditure on recreation, expenditure on economic services – do not. By isolating the short-run fiscal effects from the long-run effects they find that productive expenditures have a significant positive effect on growth, most pronounced in the long run.⁴²

In summary, while the body of empirical literature in this field is rich and diverse, and the findings can vary from study to study, the majority of research increasingly concludes that there is a positive and significant relationship between public investment and economic growth.⁴³ The link to economic growth is typically judged strongest from investment in facilitating structures, such as communication, transport and R&D, as well as in productive expenditure items such as education, health and defence. However, the magnitude of the effect is generally found to be lower than that suggested in the earlier analysis. Nor does the link seem to be a simple linear one whereby a given amount of public capital spending leads to a certain increase in growth. Instead, the positive effects from investment appear to be conditional on a number of other complementary factors that help make public investment an “effective catalyst for growth”.⁴⁴ In particular, there is a broad consensus in the literature that the following are important:

- stable macroeconomic conditions conducive to harnessing benefits;
- the availability of other high quality factors of production, like skilled labour and private capital;
- the size and configuration of existing networks when considering marginal units investment;
- efficient management of the infrastructure and efforts to ensure that projects meet effective demand;
- the adherence to commercial principles (e.g. through competition, user charges);
- regular and consistent flow of sufficient resources being devoted to public capital projects to entrench planning stability.

On balance, the literature also emphasises that returns to public capital tend to be greater in the long run. It has also made the important distinction between the positive growth effects of extra investment and the adverse growth effects of

⁴² A 1 percentage point increase in productive expenditure raises the growth rate by 0.3 percentage points, rising to 0.4 in the dynamic panel setting. When allowing for lagged effects to capture the long-run impact, the authors find that investment has a bigger effect over time and one that is statistically significant.

⁴³ Nijkamp and Poot (2004), for example, employing meta-analysis – a technique to undertake a systematic quantitative review of literature that distils a great number of studies into statistical values – assess a sample of 93 studies published between 1983 and 1998. They confirm the long-run importance of education and public infrastructure on growth and, moreover, they find that the longer the sample period in any particular study the higher the probability that public capital positively affects long-run economic growth.

⁴⁴ Op. cit., Kessides, C. (1993), “The Contributions of Infrastructure to Economic Development: A Review of Experience and Policy Implications”, The World Bank, Discussion Paper, p. 9.

distortionary taxation. Part of this strand of literature also points to the existence of constant returns to scale to public investment up until a "saturation point" is reached and marginal returns begin to decline.

REFERENCES

- Ahn, S. and P. Hemmings (2000), "Policy Influences on Economic Growth in OECD Countries: An Evaluation of the Evidence", OECD, Working Paper, No. 246.
- Alesina, A. and R. Perotti (1994), "The Political Economy of Budget Deficits", NBER, Working Paper, No. 4637.
- Aschauer, D.A. (1989), "Does Public Capital Crowd Out Private Capital?", *Journal of Monetary Economics*, Vol. 24.
- (1989), "Is Public Expenditure Productive?", *Journal of Monetary Economics*, Vol. 23.
- (1990), "Why is Infrastructure Important?", in A.H. Munnell (ed.), *Is there a Shortfall in Public Capital Investment?*, Federal Reserve Bank of Boston.
- Baffes, J. and A. Shah (1993), "Productivity of Public Spending, Sectoral Allocation Choices and Economic Growth", The World Bank, Policy Research, Working Paper, No. 1178 (September).
- Balassone, F. and D. Franco (2000), "Public Investment, the Stability Pact and the 'Golden Rule'", *Fiscal Studies*, Vol. 21.
- Balls, E. and G. O'Donnell (eds.) (2001), *Reforming Britain's Economic and Financial Policy*, Palgrave.
- Barro, R. (1990), "Government Spending in a Simple Model of Endogenous Growth", *Journal of Political Economy*, No. 98, pp. s103-s117.
- (1991), "Economic Growth in a Cross Section of Countries", *Quarterly Journal of Economics*, Vol. 106, No. 2, May.
- Batina, R. (1999), "On the Long Run Effects of Public Capital and Disaggregated Public Capital on Aggregate Output", *International Tax and Public Finance*, Vol. 5, No. 3.
- Blanchard, O. and G. Giavazzi (2003), "Improving the SGP through a Proper Accounting of Public Investment", *European Economic Perspectives Newsletter*, CEPR.
- Bleaney, M., N. Gemmell and R. Kneller (2001), "Testing the Endogenous Growth Model: Public Expenditure, Taxation, and Growth over the Long-run", *Canadian Journal of Economics*, Vol. 34, No. 1, February.
- Bougheas, S., P. Demetriades and T. Mamuneas (2000), "Infrastructure, Specialization and Economic Growth", *Canadian Journal of Economics*, Vol. 33, No. 2, May.

- Bougheas, S., P. Demetriades and E. Morgenroth (2003), "International Aspects of Public Infrastructure Investment", *Canadian Journal of Economics*, Vol. 36, No. 4, November.
- Brooks, A.M. (2003), "Recent and Prospective Trends in Real Long-term Interest Rates: Fiscal Policy and Other Drivers", OECD, Economics Department, Working Paper, No. 367.
- Brundtland, G.H. (1987), *United Nations Commission on Environment and Development: Our Common Future*.
- Buiter, W. (2001), "Notes on a Code for Fiscal Stability", *Oxford Economic Papers*, Vol. 53.
- Buiter, W. and C. Grafe (2002), "Patching Up the Pact: Some Suggestions for Enhancing Fiscal Sustainability and Macroeconomic Stability in an Enlarged European Union", CEPR, Discussion Paper, No. 3496.
- Calderón, C., W. Easterly and L. Servén (2002), "How Did Latin America's Infrastructure Fare in the Era of Macroeconomic Crisis?", Central Bank of Chile, Working Paper, No. 185.
- Canning, D. and E. Bennathan (2000), "The Social Rate of Return on Infrastructure Investment", The World Bank, Research Paper, No. 1145, part of The World Bank Research Project on Infrastructure and Growth.
- Canning, D. and M. Fay (1993), "The Effect of Transportation Networks on Economic Growth", mimeo, Columbia University.
- Canning, D. and P. Pedroni (1999), "Infrastructure and Long-run Economic Growth", Consulting Assistance on Economic Reform II (CAER), CAER, Discussion Paper, No. 57, December.
- Cashin, P. (1994), "Government Spending, Taxes and Economic Growth", IMF, Working Paper, No. 92.
- Clarida, R.H. (1993), "International Capital Mobility, Public Investment and Economic Growth", NBER, Working Paper, No. 4506.
- Clark, T., M. Elsby and S. Love (2002), "Trends in British Public Investment", *Fiscal Studies*, Vol. 23.
- Conrad, K. and H. Seitz (1992), "The Public Capital Hypothesis: The Case of Germany", *Recherches Economiques de Louvain*, Vol. 58.
- (1994), "The Economic Benefits of Public Infrastructure", *Applied Economics*, Vol. 26.
- Conway, P. and A. Orr (2002), "The GIRM: A Global Interest Rate Model", Westpac Institutional Bank, Occasional Paper.
- Creel, J. (2003), "Ranking Fiscal Policy Rules: The Golden Rule and the Stability and Growth Pact", OFCE, Working Paper, No. 4.

- Dalamagas, B. (1995), "A Reconsideration of the Public Sector's Contribution to Growth", *Empirical Economics*, Vol. 20.
- de Haan, J., J.E. Sturm and B.J. Sikken (1996), "Government Capital Formation: Explaining the Decline", *Weltwirtschaftliches Archiv*, No. 132, pp. 55-74.
- De la Fuente, A. (2000), "Infrastructures and Productivity: A Survey", Instituto de Análisis Económico, CSIC, Working Paper, Barcelona.
- DeLong, B. (1997), "What Do We Really Know About Economic Growth", in M. Boskin (ed.), *Economic Growth*, Stanford.
- Demetriades, P. and T. Mamuneas (2000), "Intertemporal Output Employment Effects of Public Infrastructure Capital: Evidence from 12 OECD Economies", *Economic Journal*, No. 110, July.
- Devarajan, S., V. Swaroop and H.F. Zou (1993), "What Do Governments Buy?" The World Bank, Policy Research and External Affairs, Working Paper, No. 1082, February.
- (1996), "The Composition of Public Expenditure and Economic Growth", *Journal of Monetary Economics*, Vol. 37.
- Devarajan, S., D. Xie and H.F. Zou (1998), "Should Public Capital Be Subsidized Or Provided?", *Journal of Monetary Economics*, Vol. 41, No. 2.
- Easterly, W. (1999), "When is Fiscal Adjustment an Illusion?", *Economic Policy*, No. 28, April.
- Easterly, W. and S. Rebelo (1993), "Fiscal Policy and Economic Growth", *Journal of Monetary Economics*, Vol. 32.
- Eisner, R. (1994), "Real Government Saving and the Future", *Journal of Economic Behavior & Organization*, Vol. 23, No. 2.
- Fernald, J. (1993), "How Productive is Infrastructure? Distinguishing Reality and Illusion", *Federal Reserve Board Discussion Paper*, August.
- Flores de Frutos, R., M. Gracia-Diez and T. Perez-Amaral (1998), "Public Capital Stock and Economic Growth: An Analysis of the Spanish Economy", *Applied Economics*, Vol. 30, No. 8.
- Galí, J. and R. Perotti (2003), "Fiscal Policy and Monetary Integration in Europe", NBER, Working Paper, No. 9773.
- Gramlich, E. (1994), "Infrastructure Investment: A Review Essay", *Journal of Economic Literature*, Vol. 32, September.
- Grossman, S.J. and O.D. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, No. 94.

- Gwartney, J., R. Holcombe and R. Lawson (2004), "Economic Freedom, Institutional Quality, and Cross-country Differences in Income and Growth", *The Cato Journal*, Vol. 24, No. 3.
- Hemming, R. and T. Ter-Minassian (2004), "Making Room for Public Investment", *Finance and Development*.
- Hicks, N. (1991), "Expenditure Reduction in Developing Countries Revisited", *Journal of International Development*, Vol. 3.
- HM Treasury (2003), *PFI – Meeting the Investment Challenge*.
- (2003), *The Green Book, Appraisal and Evaluation in Government*.
- (2004), *Long-Term Public Finances Report*.
- Holtz-Eakin, D. (1992), "Public Sector Capital and the Productivity Puzzle", NBER, Working Paper, No. 4122. Also in *Review of Economics and Statistics*, Vol. 76.
- Holtz-Eakin, D. (1988), "Private Output, Government Capital, and the Infrastructure 'Crisis'", Columbia University (N.Y.), Department of Economics, Discussion Paper, No. 394, May.
- Höppner, F. and C. Kastrop (2004), "Fiscal Institutions and Sustainability of Public Debt in Germany", in Banca d'Italia (ed.), *Public Debt*.
- Hulten, C. (1996), "Infrastructure Capital and Economic Growth: How Well You Use May Be More Important Than How Much You Have", NBER, Working Paper, No. 5847, December.
- Hulten, C. and R. Schwab (1991), "Is There Too Little Public Capital?", Conference Paper, American Enterprise Institute.
- (1991), "Public Capital Formation and the Growth of Regional Manufacturing Industries", *National Tax Journal*, Vol. 44.
- (1994), "Infrastructure and the Economy", in J.M. Pogodzinski (ed.) *Readings in Public Policy*, Cambridge, Blackwell Publishers.
- Jones, C. and J. Williams (1997), "Measuring the Social Return to R&D", US Federal Reserve System, Finance and Economics, Discussion Paper, No. 12.
- Kamps, C. (2004), "The Dynamic Effects of Public Capital: VAR Evidence for 22 OECD Countries", Kiel Institute for World Economics, Working Paper, No. 1224.
- Kessides, C. (1993a), "Institutional Options for the Provision of Infrastructure", The World Bank, Discussion Paper, No. 215.
- (1993b), "The Contributions of Infrastructure to Economic Development", The World Bank, Discussion Paper, No. 213.

- King, R. and S. Rebelo (1990), "Public Policy and Economic Growth: Developing Neoclassical Implications", NBER, Working Paper, No. 3338.
- Kneller, R. (2000), "The Implications of the Comprehensive Spending Review for the Long-run Growth Rate: A View from the Literature", *National Institute Economic Review*, No. 171, January.
- Kneller, R., M. Bleaney and N. Gemmell (1999), "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, No. 74.
- (1999), "Public Policy and the Government".
- Kocherlakota, N. and K.M. Yi (1997), "Is There Endogenous Long-Run Growth? Evidence from the United States and the United Kingdom", *Journal of Money, Credit, and Banking*, Vol. 29, No. 2.
- Lane, P. (2003), "The Cyclical Behaviour of Fiscal Policy: Evidence from the OECD", *Journal of Public Economics*, Vol. 87.
- Lau, S.H.P. and C.Y. Sin (1997), "Public Infrastructure and Economic Growth: Time-series Properties and Evidence", *Economic Record*, Vol. 73, No. 221, June.
- Levine, R. and D. Renelt (1992), "A Sensitivity Analysis of Cross-Country Growth Regressions", *American Economic Review*, Vol. 82, No. 4.
- (1992), "A Sensitivity Analysis of Cross-Country Growth".
- Lynde, C. and J. Richmond (1993), "Public Capital and Long-Run Costs in the UK Manufacturing", *Economic Journal*, Vol. 103.
- Mendoza, E. (1997), "On the Ineffectiveness of Tax Policy in Altering Long-Run Growth: Harberger's Superneutrality Conjecture", *Journal of Public Economics*, Vol. 66, No. 1.
- Mittnik, S., and T. Neumann (2001), "Dynamic Effects of Public Investment: Vector Autoregressive Evidence From Six Industrialized Countries", *Empirical Economics*, Vol. 26.
- Munnell, A.H. (1992), "Policy Watch: Infrastructure Investment and Economic Growth", *Journal of Economic Perspectives*, Vol. 6.
- (1990), "Why Has Productivity Growth Declined? Productivity and Public Investment", *New England Economic Review*, January/February.
- Nadiri, M.I. and T.P. Mamuneas (1994), "Infrastructure and Public R&D Investments, and the Growth of Factor Productivity in US Manufacturing Industries", NBER, Working Paper, No. 4845.
- (1994), "The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of US Manufacturing Industry", *Review of Economics and Statistics*, Vol. 76.

- Nijkamp, P. and J. Poot (2004), "Meta-analysis of the Impact of Fiscal Policies on Long-run Growth", *European Journal of Political Economy*, Vol. 20, Issue 1.
- O'Fallon, C. (2003), "Linkages Between Infrastructure and Economic Growth", Pinnacle Research prepared for the Ministry of Economic Development of New Zealand, December.
- OECD (2003), "The Sources of Economic Growth in OECD Countries", OECD Paris.
- (2004), "Understanding Economic Growth", OECD Paris.
- Pereira, A. (2000), "Is All Public Capital Created Equal?", *Review of Economics and Statistics*, Vol. 82, No. 3.
- Pereira, A. and O. Roca-Sagales (2001), "Infrastructures and Private Sector Performance in Spain", *Journal of Policy Modeling*, Vol. 23, No. 4.
- Roubini, N. and J. Sachs (1989), "Government Spending and Budget Deficits in the Industrial Countries", *European Economic Review* Vol. 33
- Seitz, H. (1994), "Public Capital and the Demand for Private Inputs", *Journal of Public Economics*, Vol. 54.
- Stephan, A. (1997), "The Impact of Road Infrastructure on Productivity and Growth: Some Preliminary Results for the German Manufacturing Sector", *Discussion Paper FS IV 97-47*, Wissenschaftszentrum Berlin.
- Sturm, J.E. and J. de Haan (1995), "Is Public Expenditure Really Productive? New Evidence For the US and the Netherlands", *Economic Modelling*, Vol. 12.
- Sturm, J.E., G. Kuper and J. Haan (1996), "Modelling Government Investment and Economic Growth on a Macro Level: A Review", CCSO Series, No. 29 (September).
- Sturm, J.E., A.M. Jacobs and P. Groote (1995), "Productivity Impacts of Infrastructure Investment in the Netherlands 1853-1913", SOM Research, Report No. 95D30, Groningen.
- Tatom, J. (1991), "Public Capital and Private Sector Performance", *Federal Reserve Bank of St. Louis*, May.
- (1993), "Paved with Good Intentions: The Mythical National Infrastructure Crisis", CATO Institute, Policy Analysis, Working Paper, No. 196.
- Woods, R. (2004), "The Role of Public Debt in the UK Fiscal Rules", in Banca d'Italia (ed.), *Public Debt*, Rome.
- The World Bank (1988) "World Development Report 1988", Washington (D.C.).
- (1994) "World Development Report 1994, Infrastructure for Development", Washington (D.C.).