

**INFRASTRUCTURE**

**POLICIES**

**FOR THE 1990s**





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**ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT**

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## Foreword

There is growing concern in both industrialised and industrialising economies about the state of infrastructure. Reports of congestion on roads and at airports are widespread; there are missing links in major high-speed rail networks and bottlenecks on key sections of track; water supplies and sewerage in some countries are considered woefully inadequate; and huge investments are required in the less prosperous regions to bring telecommunications and energy provision up to average standards. Yet, calls for more spending on infrastructure come at a time of overstretched public finances in most OECD countries, so that governments are confronted with difficult decisions on how to raise infrastructure efficiency, which new projects to select, and how to finance them.

It was in this context that the OECD organised, in 1993, a Forum for the Future conference around the theme of infrastructure policies for the 1990s. It aimed at providing an opportunity for key players in government and industry to explore some of these issues, and to reflect on the broad lines of infrastructure policy that will best prepare developed economies for the next century. The meeting consisted of four sessions. The first assessed recent trends and the current state of infrastructural investment in the major regions of the world economy; particular attention was paid to the question of the alleged shortfall in investment and the link to macroeconomic performance. The second session addressed options for raising the efficiency of infrastructure provision. The third explored problems of decision-making and planning for major infrastructure projects, including the integration of environmental considerations. The fourth session was devoted to drawing conclusions and policy recommendations from the preceding discussions.

An effort was made to restrict the thematic coverage of the conference to manageable proportions. Thus, the regions concerned were OECD countries, some of the more dynamic Asian economies, and Mexico. The focus was on core physical infrastructure: road and rail networks, waterways and ports, airports, energy and water utilities, and telecommunications. The meeting did not attempt to deal with physical infrastructures in such areas as education and health, or with intangible investments, even though these are arguably just as important. The emphasis was on major infrastructural projects which, for the most part, are sited outside urban areas. Finally, long-term considerations took precedence, *i.e.* the effects of infrastructure provision on growth capacity, international competitiveness and living standards rather than the demand-side impacts of public investment on output and employment, which tend to be short-term.

This publication brings together the papers presented at the meeting, as well as an introductory contribution by the Secretariat. The book is made available to the public under the responsibility of the Secretary-General.



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*Chapter 1*

**Infrastructure in the 1990s:  
An Overview of Trends and Policy Issues**

*by*

***Barrie Stevens and Wolfgang Michalski***

OECD Secretariat, Advisory Unit to the Secretary-General

**1. Overall trends in infrastructure: past and future**

An adequate stock of efficiently operating infrastructure is of key importance to economic performance. Over recent years, however, all advanced economies have been showing at least some signs of mounting pressure on infrastructures. For example, in the United States between 1981 and 1989, only 0.6 per cent more highway mileage was added to the existing road network, while over the same period the number of cars and trucks rose by one-quarter and total vehicle miles by over one-third. In Europe, overall road traffic (vehicle kilometres) grew 60 per cent from the mid-1970s to the end of the 1980s, yet road investment remained below 1975 levels throughout the period. In the United Kingdom during the 1980s, average daily traffic grew by over one-third on all roads, but by more than half on motorways. Traffic density on German highways has risen fourfold over the last thirty years. Swiss cross-Alpine traffic has grown by over 50 per cent in the last decade, and the volume of cross-Channel freight handled by ferries increased 143 per cent. Taiwan saw car numbers multiply fivefold in the 1980s while only 15 per cent more roads were built. Many airports throughout the world are already congested today; there are widespread reports of water supplies and sewerage in disrepair; and solid waste disposal is becoming a major problem in many countries.

This fragmentary picture of infrastructures under strain is mirrored by aggregate trends in public spending. Over the 1980s, total fixed capital formation in infrastructure as a share of GDP declined in the United States, throughout Europe and in Japan. US federal public spending on infrastructure investment has fallen from over 5 per cent of total federal outlays in the mid-1960s to its present level of around 2.5 per cent. In EC Europe, investment in transport infrastructures fell from 1.5 per cent of GDP in the 1970s to 0.9 per cent in the 1980s, and investment in both ports and inland waterways has fallen to less than half its 1975 level. In Japan, government fixed investment as a percentage of GDP has fallen from almost 11 per cent in the late 1970s to below 7 per cent at the start of the 1990s.

Explanations for this relative decline in infrastructure spending have been sought in a variety of factors: large budget deficits; the stagnation of tax revenues after the first oil crisis; the crowding-out in some countries of public investment by welfare spending; underestimation of the predicted growth in economic activity; high real interest rates on long-term loans; and uncertainties raised by events on financial markets in the 1970s and 1980s. However, much of the blame has also been attributed to the long delays experienced in the planning and implementation of major infrastructure projects as these grew in complexity, as land prices rose, and as local populations – increasingly environmentally conscious – stiffened their resistance to such projects.

A decline in infrastructure spending as a share of GDP does not in itself call for more expenditure. Indeed, it may be part of a long-wave cycle in infrastructure investment induced by the advent of major new technologies; by changes in the growth, composition and regional distribution of the population, rising incomes and shifting consumption patterns; and by major discontinuities in supply brought about by such historical events as postwar reconstruction in Europe and the cold war military build-up in the United States. Moreover, in some countries, significant amounts of new investment in infrastructure have been carried out by the private sector (*e.g.* in electricity power generation and distribution, storage facilities for air cargo, telecommunications) which are not reflected in data on public investment. In effect, there are sectors (*e.g.* energy, inland waterways and sea port facilities in certain regions of Europe) in which overcapacity rather than undercapacity is the problem.

It is difficult to conclude, therefore, that levels of infrastructure investment these last 10-15 years have on the whole been inadequate by historical standards. However, the 1990s hold out the prospect of mounting pressures on infrastructure. The combination of continuing internationalisation of economic activities, intensifying regional economic integration (especially in Europe) and the drive for improved international competitiveness will ensure that demands on transport, energy, water supplies, telecommunications, waste disposal, etc. will increase rapidly in the years ahead.

Congestion on US roads is projected to lead to traffic delays equivalent to 4 billion vehicle hours by the year 2005. Individual European countries will also experience considerably greater traffic strains, as will trans-European routes. For example, between 1990 and 2015, intra-EC road traffic is expected to grow by between 110 and 140 per cent. The volume of goods carried by international combined rail-road transport is forecast to triple by 2005; and freight flows through the Alps are likely to rise by 3-3.3 per cent *per annum* to 114 million tonnes by the end of the century.

The volume of international air transport is projected to grow at over 6 per cent *per annum* this decade, although with substantial geographical variations. High growth (8-9 per cent) is foreseen for traffic within Asia and on routes linking Asia with North America and Europe, and fairly low growth (around 4 per cent) in the more mature North American and European markets. However, airport congestion could prove to be a severe growth bottleneck. By 1997, more than 30 US airports could experience severe flight delays, compared with 21 today. By 2010, 13 of the 27 airports that are the major traffic centres of Europe will suffer from capacity problems, even with potential enhancements. In Asia, serious problems exist or are anticipated at Tokyo's Narita airport, Osaka and Hong Kong; Sydney and Bangkok also require new facilities.

Total energy demand in the OECD region is expected to grow at only a moderate rate, averaging about 1.3 per cent *per annum* over the period to 2010. Nonetheless,

important structural changes are under way which will necessitate substantial investments in energy infrastructure. For example, reducing energy intensity over the coming years will require considerable spending on the application of energy technology advances. Supplies of natural gas are expected to increase quite rapidly as the distribution networks in parts of the OECD area not yet served by gas are expanded and the role of natural gas in electricity generation becomes much more pronounced. Japan is planning nearly to double its nuclear power-generating capacity between 1990 and 2010, and Korea will have 11 additional nuclear power plants in operation or under construction by the end of the century.

The financial requirements these infrastructure investments generate are potentially huge. The US Congressional Budget Office recently estimated the nation's infrastructure needs to the end of the decade at \$800 billion. The European Round Table puts the cost of upgrading transport, communication and energy networks in Europe at around 100 to 110 billion ECUs *per annum* over the next years. The German state telephone company expects to invest DM 40 billion in the eastern parts of the country over the next five years. Bringing telecommunications in the peripheral countries of southern Europe up to average European standards will cost an estimated 50 billion ECUs. Even without the recently proposed domestic spending package, Japan's public sector investment (with a strong focus on infrastructure development and improvement) is expected to accelerate to close to 8 per cent of GDP by the turn of the century. Similarly, some of the more dynamic Asian economies face a massive infrastructure bill for the 1990s. Taiwan's national six-year plan (1991-96) foresees spending \$300 billion, while Korea's effort over the same period should amount to around \$52 billion.

The bulk of these investments will have to be borne by the public sector. However, they come at a time when public finances are in poor shape, with little prospect of significant improvement over the medium term. Government indebtedness has increased in all but two OECD countries in recent years, lifting the OECD average from 23 per cent of GDP in 1979 to 40 per cent by the end of the 1980s. Since 1989 there has been a significant deterioration of budget balances with, until 1992, net borrowing increasing by some 3 percentage points of GDP. Despite a projected reduction of budget deficits area-wide over the next few years, debt ratios are still likely to continue rising. Moreover, long-term factors, in particular relating to the pension and health care requirements of ageing populations, suggest that further fiscal consolidation is called for. Thus, governments are caught in a dilemma. On the one hand, they are under pressure to tackle long-term infrastructure deficiencies facing the economy; on the other, the unfavourable fiscal context considerably reduces their margin of manoeuvre on spending.

Three broad lines of action are open to policy-makers. First, they can reassess the composition of public sector outlays with a view to freeing up resources for infrastructure investment. The scope for shifting public spending from consumption to investment is, however, limited and far from straightforward: some expenditures falling into the consumption category, such as those on education and training, may improve human capital and boost growth prospects, while investment in under-utilised infrastructure projects generates low or negative returns. The challenge is thus to organise the review of public expenditure in a way that makes an adequate social rate of return a key criterion for undertaking spending, regardless of whether it falls into the investment or consumption category. This in turn requires a strengthening of budget management and wider and more systematic use of tools such as cost-benefit analysis, assessment of redistributive

effects, and public accounting systems that allow monitoring subsequent to the decision to proceed with a project.

Secondly, governments are increasingly inclined to consider greater private sector participation in the financing of major infrastructure projects. Private equity investment with a public guarantee has the advantage of enabling governments to sidestep expenditure limits. To date, however, private sector funding of large projects has been on a very small scale. The chief obstacle is the lack of incentives. Infrastructure has a number of very specific characteristics (*e.g.* a long and risky amortisation period; a very substantial time lag between the start of capital formation and the start of financial returns; high sunk costs) which ensure that large and costly fixed infrastructure assets will be financed privately only in exceptional cases.

In order to exploit more fully the scope for making greater use of private capital in building infrastructure, government and the private sector need to explore new and flexible ways of co-operating with each other – including the possibility of mixed financing – and establish clearer criteria for the allocation of roles between public and private resources. In particular, it will become increasingly important for governments to develop a more systematic and viable framework for facilitating the participation of private capital. This should entail, among other things, a realistic assessment of the risks and potential profitability of the projects.

One idea that has been floated is that if a project's rate of return is perceived to be sufficient to attract private sector capital, then the project should be left to the private sector to construct. This is what is happening with the Channel Tunnel. Where a project's profitability is a borderline case and/or social equity considerations are involved, then the government should offer incentives to attract private capital. The Italian Government, for example, is contributing a substantial share of the resources for its high-speed train project as a basis for securing private sector finance. Only where profitability is clearly negative but the social rate of return high should the project remain in the public domain.

The third line of action open to governments is to reduce the requirements for additional infrastructure capacity, and thereby alleviate some of the pressure on the public purse, by exploring the potential for achieving greater efficiency in the provision of infrastructure goods and services. This is the theme of the following section.

## **2. Efficient provision of infrastructure**

Ideally, efficient infrastructure should maximise the gap between the benefits to society and the costs that arise from the construction and use of that infrastructure, including the costs users impose on others and those to the environment. This is a highly complex concept, however, and is extremely difficult to implement – not least because the full range of costs are not accurately quantifiable with current state-of-the-art techniques.

Most estimates of infrastructure inefficiency thus restrict themselves to the economic costs involved. A frequently cited illustration is the annual cost of congestion on roads: guestimates range from \$9 billion in the United States and £15 billion in the United Kingdom to \$1.7 billion in Korea and Gld 1 billion in the Netherlands. Inefficiencies are both quite common and costly in other areas of infrastructure as well. The Federal Aviation Administration estimated that in the mid-1980s, air travel delays resulted in

\$1.8 billion in additional airline operating expenses and \$3.2 billion in time lost by travellers; IATA sees congestion at European airports costing \$5 billion *per annum* in the early 1990s, and that figure rising to \$10 billion by the year 2000 if no action is taken. Inadequate waterfront facilities and shipping can be a serious brake on competitiveness. Despite their long coastlines, Italy transports only 0.1 per cent of total merchandise by sea, and Australia freights 85 per cent of new cars by road. Delays in cargo-handling at Korean ports are thought to cost the economy some \$1 billion.

Even partial eradication of such inefficiencies could involve substantial new investment. However, building additional infrastructure is not always the most effective route to take. For example, cost-benefit analysis suggests that there are cases where the real rates of return on the upgrading of facilities and on maintenance work are much higher than for new construction. Furthermore, most experts would agree in any case that it is pointless to combat vehicle congestion simply by providing more or wider roads, as these frequently generate increased demand. It seems clear, therefore, that what is also required is an exploration of ways of making more efficient use of infrastructure. These can be grouped into four categories: strengthening the role of the private sector in the operation of infrastructure; deregulating wholly or partly the operations of those industries providing infrastructure goods and services; making wider use of pricing techniques; and introducing efficiency-enhancing incentives and performance targets.

The first avenue for exploring potential efficiency gains is privatisation. Industries providing infrastructure goods and services comprise essentially two types of enterprise: those which could – and in many cases, do – operate in competitive markets (*e.g.* long-distance bus companies); and those which, because of such factors as economies of scale or density, high sunk costs, etc., are generally regarded as possessing natural monopoly characteristics (*e.g.* energy and water utilities, airports, railways).

Evidence suggests that privatisation of the first category of enterprise leads on the whole to significant efficiency gains, provided that effective competitive conditions prevail on the market. It should be noted, however, that there are numerous cases of efficiency gains in publicly owned companies where these have been subjected to competitive market conditions and operate on economic criteria, free of undue political control. Privatisation of the second category of enterprise is a relatively recent phenomenon, and experience with the impacts of ownership transfer does not yet permit firm conclusions to be drawn. Tentative evidence suggests that privatisation does seem to have led to an upturn in productivity, but that the results cannot be considered sufficiently precise to enable actual efficiency increases to be separated from other factors.

Indeed, a number of conditions must be met if the potential efficiency gains from privatisation are to be realised. First and foremost is the requirement that as much competition as possible be injected into the market, be it (for example) through genuinely competitive bidding for the construction contract or franchise, or through the opening up of the market to rival operations and access to network services for third-party carriage. It is also vital to the success of privatisation that a change in management responsibility be involved, and that at least some transfer of risk (be it capital cost or operating cost risk) to the new contractors, owners or operators take place. Thirdly, and more generally, privatisation frequently needs to go hand in hand with changes in the regulatory environment which encourage competition, more open market access and rational pricing.

The changes in the regulatory framework which have accompanied privatisation of infrastructure industries in the recent past have involved moving the corporations in

question from direct regulatory control by the government to indirect regulation, under private ownership, through an independent supervisory agency and/or a governmental department.

A prime motive for privatisation in conjunction with regulatory reform was to reduce the scope for government failure, with all its attendant allocative and cost inefficiencies. Under public ownership, regulatory objectives are pursued within the administrative bureaucracy, so that regulation is less visible, less structured, and likely to be sensitive to political as well as economic pressures. Public monopolies have sometimes been cultivated specifically as practical instruments of government policy for the pursuit of economic and non-economic objectives. Pricing under such conditions tends to be highly inefficient or involve costs which may not be commensurate with the non-economic objective pursued. Also, the goals that government sets for market-dominant firms in competition with one another can be in conflict. No matter how these conflicts are resolved, pricing structures that reflect such combined national commitments provide little transparency, flexibility or accountability – and without transparency, market entry and informed investment will be greatly hampered.

Regulation under private ownership constrains enterprises to perform more effectively, at least as regards the achievement of productive efficiency. There are inherent flaws, however. Regulators may not maximise economic welfare; more often than not, information is both imperfect and unequally distributed between regulator and firm (which may lead to regulatory capture); and there may be perverse incentive effects, especially on investment. For example, depending on its specific structure, regulation may provide strong incentives for management to overcapitalise, and only weak incentives to improve cost-efficiency (rate-of-return regulation) – or, alternatively, heighten the risk of returns on cost-saving investments being clawed back by the regulator, with the possible consequence (if firms are risk-averse) of underinvestment (price-capping regulation). Thus, while private ownership of monopoly utilities removes the inefficiencies stemming from direct political intervention, it can introduce other distortions.

Hence, addressing the ownership question may be only part of the solution. While public and private ownership establish different frameworks in which regulatory policy is conducted, the broad objectives of such policies and the underlying economic issues are much the same. Privatisation changes the context of regulation and thus the nature of the trade-offs confronting policy-makers, but it does not necessarily resolve them.

A second avenue of exploration is deregulation – or rather, regulatory reform – of the provision of infrastructure products and services. Efficiency gains are harder to achieve from the deregulation of natural monopolies than from enterprises operating in competitive markets. Until recently, the natural monopoly characteristics of most infrastructure were thought to preclude competition. However, technological advances and new thinking on the subject are changing these ideas. It is becoming increasingly apparent that most of the industries commonly regarded as natural monopolies in fact bundle together activities in which competition is inevitably imperfect with activities in which competition is feasible.

The experience of recent years has shown that efficiency in these industries can be considerably enhanced by promoting competition in components of the monopoly “bundle” which are susceptible to the benefits of market-place rivalry. Examples abound: the deregulation of supply inputs in the energy sector, the separation of local networks and long-distance operations in telecommunications, the unbundling of long-distance passen-

ger coaching and coach terminals, the splitting of air transport and computer reservation systems, and of train services and track infrastructure – to name but a few.

There is substantial scope for further regulatory reform. Requiring more open access to utilities' infrastructure networks and facilities (*e.g.* third-party carriage) would pressure monopolists to compete for their previously protected markets, thus providing the ultimate incentive for efficient utility operations and pricing. For example, although in some countries (the Netherlands, Norway, Germany) third-party carriage and the right to direct third-part purchases are available for certain end-user customers (primarily industrial users), access to the European gas grid remains on the whole severely limited by explicit and implicit regulatory restrictions. Moreover, while there is already some degree of integration of national electricity grids in Europe – which saves some 3 per cent of the total electricity production costs – it is estimated that savings could rise to 5-6 per cent if available EC transmission capacities were fully utilised, and to 10 per cent if the system of interconnections were complete and did not constrain trade.

The potential efficiency impact of regulatory reform of a more general nature can also be considerable. In the United States, for example, it is estimated that the 1980 Staggers Act which deregulated railways has generated annual gains to the economy in the order of \$15 billion, while trucking deregulation – instituted the same year – has benefited shippers by some \$14 billion annually (1988 dollars) in lower freight costs and better service. Lifting restrictions of various kinds (not least those on cabotage) on European transborder road haulage would, it is thought, contribute substantially to reducing the 35-40 per cent unused capacity resulting from empty return runs.

The third avenue to more efficient use of infrastructures is a wider application of efficient pricing techniques. Strictly speaking, the market for infrastructure services (in transport, energy, water, etc.) will not function efficiently unless all the costs and benefits are properly represented and perceived by users and operators. The most transparent way to achieve this is through the price mechanism. However, efficient pricing of infrastructure provision is in fact quite rare.

To begin with, there is a wide range of infrastructures for which prices bear no relation whatsoever to consumption by individual users. Roads are the most striking example; their construction and maintenance are financed almost entirely from taxes and vehicle licence fees. With the exception of some motorways in Austria, France, Italy, Portugal, Spain and United States, certain bridges and tunnels, and a few isolated cases of urban road-pricing in the Netherlands, Norway and Sweden, road-pricing is virtually non-existent. Yet, its potential for relieving congestion, for identifying where the provision of additional infrastructure would be beneficial, and for raising the financial resources for maintenance and new investment is considerable. US studies suggest that the nationwide introduction of tolls in the order of \$1 to \$2 per round trip for typical congested commutes could reduce the average commuter's round-trip travel time by 10 to 15 minutes, raise tens of billions of dollars annually, and provide some \$5 billion a year in net benefits to society.

The situation is somewhat more favourable in the area of water supply and sewerage. In much of EC-Europe, most of Scandinavia, Japan and the United States, a mixture of fixed and volumetric charges for water use are common. However, in Australia, Canada, Norway and the United Kingdom, charges for the residential sector are related to the value of property, and metering is rare. Flat rate charging systems are easy to administer and provide a predictable flow of revenues, but they encourage wasteful use of

water. Some countries (the United States, Belgium, Canada) have in the past even used declining block tariffs, whereby very large domestic water users end up facing much lower marginal and average prices than low-volume consumers. Of all the types of user-pays charging methods, increasing block (*i.e.* progressive) tariffs are probably the most efficient. They are widely used in Japan, for example, where more than half of all water authorities apply them.

Limited forms of peak-pricing are practised in some countries in a few areas of infrastructure provision, *e.g.* on inter-city rail services, electricity distribution, telecommunications and some airports (notably London). Recently, peak-hour tariffs have been introduced experimentally on some French motorways. To recoup investment costs, infrastructure facilities such as gas and electricity utilities would need to set prices at long-run marginal cost, or introduce two-part tariffs. This is not widespread practice, but reforms are under way. In the United States and Canada, open consideration is now being given to the use of competitive incentives for utility services, including marginal cost-pricing, and in Mexico 55 per cent of total electricity sales are based on marginal cost rates. Long-run marginal pricing has been introduced in Italy for certain services and in Norway for new contracts. In Spain, a nationwide tariff is set equal to the nationwide average cost for all utilities, thus rewarding the more efficient and providing incentives to the less efficient to improve.

If efficient pricing is largely lacking in most sectors of infrastructure provision, it is because it faces a wide range of obstacles. To begin with, it is argued that efficient pricing offers simplistic solutions to complex economic problems. For example: information is usually insufficient to compute the appropriate charge; it assumes that full marginal cost-pricing is the norm throughout the economy, and that users are aware of their own marginal private cost.

Secondly, partial implementation of efficient pricing is problematic. Its introduction on individual infrastructure links is likely to be unsuccessful where parallel or substitute facilities are available free of charge. This partly explains why it is more practical to install tolls on such projects as the Channel Tunnel than on additions to the inter-urban road network. What is more, there is a risk in some sectors of externalities being pushed from users of the facility to non-users. For example, a traffic shift from tollways to secondary roads can cause new congestion and create environmental intrusion in areas quite distant from the toll highway.

Thirdly, cost-based pricing would very likely give rise to a broad range of social concerns, especially since cross-subsidies are a widespread feature of many infrastructure services that are considered in some way essential. However, the potentially regressive effect of reducing socially motivated cross-subsidies could be substantially mitigated through judicious use of the savings generated. For example, the revenues produced by road use charges could be used to lower vehicle licence fees or to reduce the effective tax load on low-income groups. It would anyway be more efficient in many instances to provide some form of direct assistance to the disadvantaged population groups or communities, than to use market-distorting cross-subsidies to achieve income redistribution objectives.

Lastly, in many cases technological problems need to be resolved if progress is to be made towards efficient pricing in major infrastructure areas. Roads are a case in point. Although pricing in closely circumscribed geographical areas such as inner cities is operating quite successfully in a few countries (Norway, Singapore), its wider application



would at the present time be hampered by the lack of a monitoring and collection technology that is acceptable to broad sections of the population. For the future, however, recent technical developments in Intelligent Vehicle-Highway Systems and in electronic road-pricing systems suggest that the costs of more sophisticated schemes are falling, and that it may prove possible to avoid the need for centralised data collection (which can impinge on personal privacy).

A fourth area worth exploring for potential efficiency gains is that of managerial and organisational incentives. Over recent years, wide-ranging reforms have been introduced in almost all OECD countries to give the management of the public sector a more market- and efficiency-based orientation. In general, however, public infrastructure authorities still tend to lack appropriate incentives to develop efficient operational and investment policies. The institution of performance measures, combined with more sophisticated requirements for monitoring and reporting on the conduct of their affairs, offers a partial alternative. In particular, there is scope for encouraging performance-based decisions. This might be achieved through such means as the introduction of cost/profit centres, capital budgeting, and the improvement of managerial performance by matching accountability to direct financial rewards.

### **3. Infrastructure provision, planning, and environment**

There is a widespread perception that the planning phase for major infrastructural projects is lengthening. In the United States it is estimated that large public works projects which a generation ago took only two to three years to get under way now take up to fifteen years. Other countries exhibit similar figures. In the United Kingdom, current trunk road procedures take on average thirteen years before works start on site (compared with average construction times of only two to three years). Germany is illustrative of the huge delays that can be incurred in planning and building new airport facilities. In Frankfurt, it took seventeen years to obtain approval to open a new runway in 1984; it took more than twenty years of approval procedures to obtain the go-ahead for construction of the new Munich airport, with the result that the terminal will already be operating close to capacity in less than five years' time; and in Hamburg, it took twenty-five years of planning to decide not to build a new airport.

This phenomenon of lengthening planning periods has much to do with the growing complexity of the projects. Many are of considerable technical complexity and so require a broad range of expertise, very sophisticated project management techniques, and an elaborate contracting process. With the growth of regulation in related areas such as the environment, health, safety, etc., the legal complexity of major infrastructure projects has grown apace, paralleled only by the intricacy of the financial packages needed to fund them. And in step with the ever-larger financial stakes involved, infrastructure investment has become a major arena of competing economic interests. Perhaps even more importantly, there is a growing list of agencies, regional and local government departments, and sections of the population which – largely as a consequence of the broad shift virtually throughout the OECD area towards decentralisation and more open public access to the decision-making process – now have to be consulted on the environmental, economic and other implications of important infrastructural decisions.

However, in many areas crucial to the smooth and timely planning and implementation of major projects, decision-making and administrative structures have not evolved in a way that adequately reflects the growing complexity of infrastructure itself.

Shortcomings in co-ordination are among the most important obstacles, despite the advances governments have made in recent years in mastering co-ordination techniques. These deficiencies occur in various forms. The first is related to the high degree of substitutability and complementarity among infrastructures. This is most self-evident in the transport sector and in energy, but it also exists in less obvious interconnections, such as those between transport and telecommunications. Experience has shown that without adequate co-ordination among the various modes of transport, for example, opportunities for efficiency gains go unexploited, externalities are even more difficult to control, and tax and subsidy measures become conflicting and counter-productive. Recognition of this problem has led to calls in some countries for the strategic responsibility for all modes of transport to be concentrated in one ministry or, alternatively, for a national transport co-ordination group to be established. Germany has recently moved in this direction by focusing the planning of routes for all transport on the Ministry of Transport, enabling it to exert greater influence and speed up decision-making processes. What is still lacking in a number of countries is a long-term transport strategy.

The absence of clearly defined and assigned responsibilities can have severe repercussions when numerous government departments are involved. Water policy with regard to the River Meuse in Belgium is a case in point. There is no lead agency or interdepartmental structure to facilitate co-ordinated measures, and policies for water purification are separate from the formulation of environmental protection policies. Without clear administrative jurisdiction, the powers to enforce pollution control measures are fragmented and the resources to counter the pollution problems are inadequate.

Traditional divisions of technical and administrative competence between local and regional bodies and among government departments can also severely hamper the planning process. In the United States, for example, land use planning is almost entirely a local responsibility, while in transportation planning and implementation, state and regional agencies are major actors. The result is that in many areas, residential and industrial development is frequently out of step with available and even planned transportation capacity. In the United Kingdom, the current lengthy planning procedures for the construction of trunk roads are attributed in part to lack of co-ordination between land use and transportation decisions, both at central and local government levels.

Problems of co-ordination are particularly acute in regions which constitute key international transit points. The Lemman Region straddling France and Switzerland is an illustration. Co-ordination of transport policy is bedevilled by two different sets of national laws and regulations, five regional governments, and several independent transport authorities. Cantons are in dispute over building a third railway line between Geneva and Lausanne; the French authorities consider the proposed South Lemman motorway uneconomic, and the SNCF has shown little interest in upgrading the railway along the southern shore of the lake; on the Swiss side, cantons are also split on whether to back the Geneva-Macon TGV link or a TGV spur direct to Lausanne from the projected Rhone-Rhine route linking France and Germany; and co-ordination between Geneva's international airport and its competitor Lyon-Satolas on the French side is almost non-existent.

At the broader European level, co-ordination of infrastructure projects is particularly problematic. Especially in the field of transport, there had been until very recently

practically no erosion of national sovereignty, with decisions remaining firmly in national or regional hands. It is thought, for example, that the London-Paris-Brussels, Cologne, Amsterdam high-speed rail network might have benefited considerably from being planned, developed and managed as an integrated system. Instead, responsibility for all these functions in each national segment of the network will be under the jurisdiction of the national railways. In addition, although all the infrastructure projects in SCANLINK are bound together in a single-system concept, decisions on the national portions remain national decisions rather than common Nordic decisions.

Much as a reflection of these perceived deficiencies, there have been calls for the establishment of European institutions to facilitate Europe-wide conceptual solutions and to co-ordinate national plans. Progress has been made: a trans-European network is now in place to co-ordinate major projects in the fields of high-speed rail, motorways, inland waterways and combined transport at EC level.

A second area in which institutional structures appear to be poorly adapted to the growing complexity of infrastructure provision is the process of consultation with and involvement of regional and local interests, particularly local inhabitants. As was noted earlier, it is now fairly common practice in OECD countries to consider environmental impacts in the design of major new infrastructure projects. Indeed, an Environment Impact Assessment – already established procedure in the United States – is gradually becoming a legal requirement for all major infrastructure projects in European countries. Notwithstanding the considerable progress they represent, such EIAs may open up a diverse range of environmental sensitivities among local populations. These, together with problems of land use, compensation, and potential economic spillovers, can lead to major delays.

There are no easy solutions, but there is scope for alleviating such pressures through better focusing of objectives and responsibilities, establishing and enforcing deadlines for required reviews, and using increasingly well-developed techniques for preventing and resolving disputes. For example, planning and consultation procedures should be reviewed from the point of view of their compatibility with broader national policy objectives. In many countries, procedures established in the 1960s and 1970s to protect the legitimate interests of the parties involved may not (or may no longer) fit well with the strategic choices that now have to be made at the national and international levels. Moreover, countries encountering problems with compensation schemes for compulsory acquisition of property – such as the United Kingdom – might benefit from the experience of other countries: the United States seems to be having some success with the use of flexible compensation codes for the voluntary acquisition of land; Denmark employs an independent commission to assess compensation; and a number of continental European countries regularly pay 20-25 per cent over the market value of property to facilitate and accelerate the planning and implementation of projects.

Some recent suggestions have focused on the notion of redistributing the external costs and benefits generated by major infrastructure projects among the various regions and population groups involved. To take a hypothetical example, a high-speed rail track between two cities may bestow substantial benefits on the urban populations but impose considerable environmental costs on the rural communities. The aim would be to arrive at an agreed quantification of the costs and benefits involved, and provide the rural areas with compensation financed largely by the urban centres. However, difficulties of measurement apart, there are policy-related drawbacks to such cost/benefit redistribution

schemes, not least the likelihood of rapidly soaring construction costs if redistribution were to concentrate solely on the external costs and ignore external benefits.

Streamlining of consultation procedures may even involve extending the consultation phase in order to reduce the risk of dispute and delays over the aggregate period of the project's planning and implementation. Proposals have been put forward in France, for example, not only to make the official enquiry prior to the construction of transport infrastructure more accessible to the public, but also to create a body to evaluate and monitor the course of the construction work so as to ensure continual dialogue between authorities and the public.

Finally, a third potential source of delays is the role that the government plays in the financing process. To begin with, government financial regulations can prove an important hindrance. In the United States, for example, there is a plethora of regulations restricting state and local infrastructure finance. State constitutions and statutes limit the capacity of states and local governments to finance public works; they also limit state and local spending, taxing and borrowing powers, prescribe interest rate limits and referenda requirements, and impose conditions on privatisation. In Australia, the question of changes to tax provisions has proved a stumbling block for the further development of the Very Fast Train project proposed by the private sector.

Too strict a stance on the participation of private capital can also prove an obstacle. Until recently in the United Kingdom, for instance, the so-called "Ryrie rules" decreed that private money invested in public sector projects could only be used in place of public spending and not in addition to it, and that private funding should be allowed only if it delivered a project more cheaply than public sector funding (an unlikely event given the government's access to lower rates of interest on the financial markets). The government's insistence that the Channel Tunnel Rail Link be funded entirely by the private sector has seen the project deferred indefinitely, since the returns are clearly insufficient to attract private investors. By contrast, the Italian Government's willingness to put up 40 per cent of the investment costs of the country's high-speed rail project has been an important factor in encouraging private investors to fund the remainder. Financial markets may not be able to handle the very high risks involved in many infrastructure projects, and new financial instruments and packages may need to be devised in co-operation between governments and financial institutions.

Once approved, major infrastructure projects can still run into considerable funding problems. In a number of countries, the decision-making process is hampered by a lack of integration between the annual budget decision taken by the finance ministry and the long-term planning and implementation carried out by the transport ministry, public works ministry, etc. In Italy, for example, financial resources are made available by instalments issued yearly through financial legislation. However, since most infrastructure projects need years to complete, there is continuous uncertainty as to government priorities and the availability of funding in subsequent years. Considerable uncertainty also surrounds the national financial laws themselves, so that often local authorities wait until the laws have been definitively issued before they begin to plan their budget for infrastructures, thereby incurring yet further delays. These uncertainties are compounded by inefficiencies in the disbursement of funds. In 1988, almost one-third of the total resources authorised by the Italian parliament for infrastructure investment had still not been distributed by the end of that year.

It should be noted, however, that there are encouraging signs in a number of OECD countries (*e.g.* Australia, Canada, Denmark and notably Italy) of moves towards forward-estimation and longer-term planning methods for public expenditure which should facilitate better linkage over a multi-year period between budgetary allocation and policy programmes, not least in the field of infrastructure.

#### **4. Concluding remarks**

A central theme of this introduction has been the need to explore market-based options, if the infrastructure problems of the 1990s are to be tackled successfully. Paradoxically, this may well mean a more active role for governments. It has been argued that where the solution to infrastructure bottlenecks lies in more spending, the possibility of involving private finance should be given serious consideration. In many cases, however, private sector involvement is unlikely to materialise to the extent desired unless governments take the lead by contributing part of the finance and/or by setting guarantees and incentives. Where more efficient rather than additional infrastructure is the answer, the instruments that present themselves are privatisation, regulatory reform and the strengthening of competitive mechanisms, efficient pricing techniques and public management incentives. For each of these options, government initiative is of crucial importance, indeed indispensable: for privatisation, re-regulation and public management, because these fall squarely within the government's remit; for efficient pricing, because it is inconceivable that in areas such as road tolls the concept could gain widespread recognition without governments taking a resolute lead. By the same token, responsibility for much-needed restructuring of decision-making processes rests firmly with the public authorities.

More generally, there appears to be a growing awareness in both the public and private domains of the need for long-term strategic thinking in government on matters of infrastructure. Given the crucial importance of infrastructure for the regional location of private industry and for the international competitiveness of the economy as a whole, it is thought to be increasingly necessary that governments provide orientation to actors in the business community about their longer-term thinking on such matters as transport policy, energy provision and telecommunications, so as to provide a focal point for public debate and ensure that the business community in turn has a clear but flexible framework in which to plan for the future.

Hence, the 1990s will not necessarily usher in an era of less government. Rather, they offer the prospect of different government and perhaps even enlarged scope for public action, but that action will need to be innovative and imaginative to be effective.



*Chapter 2*

**An Assessment of Trends in and Economic Impacts  
of Infrastructure Investment**

*by*

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**1. Introduction**

Over the past decade, infrastructure issues have moved to the forefront of the policy agenda in the United States and other developed countries. In the case of the United States, this movement reflected the lack of attention to both public and private investment during the 1980s, when most of the nation's output went for current consumption rather than the enhancement of future production. Experts and policy-makers concerned about continued low levels of productivity growth argued for shifting resources from consumption to investment.

The argument for increased public, as opposed to exclusively private, investment followed a series of commission reports documenting the sharp decline in public capital spending, the collapse of some bridges and roadways – involving not only damage but also loss of life – and academic work initiated by David Aschauer (1989a) showing a significant relationship between public capital and private sector output. Aschauer argued that much of the decline in US productivity during the 1970s was precipitated by declining rates of public capital investment.

The reaction in the United States has been extraordinary. Advocates of more public infrastructure seized on these research findings as support for more spending on roads, airports and water systems. The Secretary of Transportation and the Governor of New Jersey joined traditional interest groups in arguing that increases in such spending would help the economy. Prominent economists in 1991 signed a national petition for increased infrastructure spending. Several congressional committees held hearings on this topic. The US Conference of Mayors in early 1992 called for stimulative public capital investment, and in his election campaign President Clinton made infrastructure spending a major part of his economic plan.

The enthusiasm among policy-makers for increased infrastructure spending has been matched, if not surpassed, by scepticism on the part of many economists. Critics claim

that the link between public capital spending and productivity is grossly exaggerated. They charge that the methodology is flawed, that the direction of causation between public investment and output growth is unclear, and that even if the historical empirical relationships were estimated correctly, these relationships provide no clear indications for current policy. Others contend that the problems associated with the nation's infrastructure – namely, deterioration and congestion – can be traced to inefficiencies that plague the construction and use of the nation's transportation systems. Better design and pricing could alleviate many of the difficulties and greatly reduce the need for new spending.

In an effort to provide some perspective on the debate, this paper considers whether concern about the level and condition of public infrastructure is warranted, and whether greater investment in public capital is likely to produce significant payoffs. The analysis falls into three parts. The first examines the trends in infrastructure investment to see whether the decline in the United States and some other developed countries simply signals the completion of transportation and other projects initiated after the Second World War, declining school populations, and other real developments – or whether it suggests some deterioration in the quality of the stock of public capital and in the services provided by that capital. The second part evaluates the evidence regarding the potential payoffs of additional public capital investment in terms of economic growth, productivity, private investment and regional development. The third part explores the extent to which infrastructure may be undersupplied as opposed to the contention that any deficiencies could be relieved by more efficient pricing and design.

Although some data on other OECD countries have been included, most of the analysis and illustrations come from the United States, and so the conclusions that emerge stem primarily from the US experience. Scattered evidence suggests that the story may be different for other countries. With that caveat in mind, three generalisations follow from this review. First, in the United States the decline in infrastructure reflects more than the completion of highway systems and the education of the baby boomers; some real deterioration has occurred in the role for public capital in achieving national goals. Secondly, numerous investment opportunities exist with high payoffs in terms of conventionally measured cost-benefit ratios, and these ratios probably understate the benefits because traditionally they have failed to account for the increased private sector output and productivity resulting from public capital investment. Thirdly, ample room exists for improvements in the pricing and design of infrastructure, particularly in transportation, and some progress has been made in this area. Resistance from consumers, however, precludes immediate or complete adoption of congestion pricing; it would therefore be foolhardy to wait for optimal pricing before undertaking additional investment. In sum, the United States should be able to improve future standards of living by investing more of its resources in public capital.

These conclusions do not easily apply to other OECD Member countries; the idiosyncracies are overwhelming. In some countries, such as Spain, Italy and Norway, public investment relative to gross domestic product (GDP) continues to rise, sometimes producing significant payoffs to the private sector, sometimes not. Germany faces the unique burden of rebuilding the former German Democratic Republic, a task that eventually will require major infrastructure initiatives. The United Kingdom and France are completing a massive infrastructure project, financed by private funds, which will connect the two countries through a tunnel under the English Channel, but general budget pressure in the United Kingdom probably will limit publicly funded capital spending initiatives. At the same time, the unification of Europe will require EC-wide information,

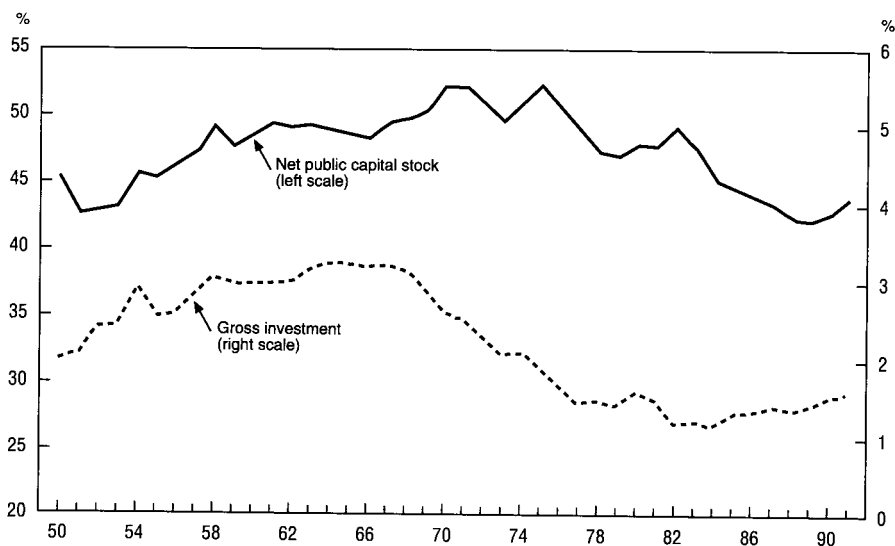


telecommunication and transportation systems; constructing such facilities will require new institutional and financial arrangements on an international scale. These disparate patterns and approaches provide opportunities to collect the data to determine whether the evidence from the United States – that public capital investments have significant private sector payoffs – is universally applicable. Fragmented evidence suggests that public capital has increased output and productivity in other OECD countries, but definitive conclusions must await more detailed investigations.

## 2. Trends in public capital investment

Investment in public capital has declined markedly in the United States since 1970, and as a result the stock of public capital has not kept pace with the growth of the economy (Figure 1). Some of this decline is a rational response to economic developments, but some represents a lack of attention to the quality of the nation’s infrastructure. To understand what is going on, it is useful to look at the provision of specific types of infrastructure.

Figure 1. Net public capital stock and gross investment in the United States, as a percentage of GDP, 1950-91



Note: The capital stock figures are calculated from historical investment figures that are revalued to current cost, then cumulated and depreciated using a perpetual inventory method.

Source: Bureau of Economic Analysis, *Economic Report of the President, 1991*.

## *The nature of the decline in public capital*

Total nonmilitary public capital in 1990 amounted to \$2.2 trillion, compared to \$5.3 trillion of private capital (Table 1). Most of this public capital (86 per cent) consists of assets owned by state and local governments. State and local public capital falls into three main groups (Table 2). The first four categories – highways and streets; sewer systems; water supply facilities; and utilities, transit systems and airports – could be viewed as core infrastructure, *i.e.* components that would be expected to contribute most directly to private sector output. The second major group is buildings, mainly schools and hospitals. Conservation and development is a small component consisting primarily of

**Table 1. Private and public non-residential net capital stock, 1990**

Capital stock	Billions of dollars	Percentage of total
Total	7 943.0	100
Total private	5 280.3	66
Non-farm business	5 110.3	64
Farm	170.0	2
Total public	2 662.7	34
Military	482.5	6
Non-military	2 180.2	27
Federal	298.0	4
State and local	1 882.2	24

*Source:* US Bureau of Economic Analysis, unpublished data.

**Table 2. State and local public capital in the United States by type, 1950-90**

Capital stock	1990 stock (\$ billions)	Percentage of GDP				
		1950	1960	1970	1980	1990
Core infrastructure	1 143.0	23.2	24.3	26.3	24.2	21.5
Highways and streets	693.6	15.6	16.9	18.2	15.6	13.0
Sewer systems	184.1	2.8	3.0	3.1	3.6	3.5
Water supply facilities	109.6	2.5	2.3	2.4	2.1	2.1
Utilities, transit systems, airports	155.7	2.4	2.1	2.7	2.9	2.9
Buildings	575.0	8.7	10.9	13.2	12.6	10.6
Educational	312.0	5.2	7.2	9.0	7.7	5.7
Hospitals	49.1	1.4	1.4	1.2	1.2	0.9
Other	213.9	2.1	2.3	3.0	3.7	3.9
Conservation and development	33.3	0.4	0.4	0.7	0.7	0.6
Equipment	131.0	0.9	1.4	1.8	1.9	2.5
Total	1 882.3	33.3	37.1	42.0	39.3	35.1

*Source:* US Bureau of Economic Analysis, unpublished data. In calculating the percentages, both GDP and public capital were expressed in constant (1987) dollars.

water resource projects aimed at flood and erosion control. All three groups have declined relative to GDP since 1970, after increasing significantly during the 1950s and 1960s.

The sanguine view of this decline holds that much can be explained by demographic and other developments and that there are no adverse implications for the economy (Tatom, 1991; Winston and Bosworth, 1992). Specifically, the pattern of investment in schools reflects the educational needs of the baby boom generation. State and local governments dramatically expanded educational facilities during the 1950s and 1960s as the boomers came of school age and then cut back as school enrolments dropped sharply after 1975. In the same manner, the pattern of hospital construction can be explained by the generous grant programme that produced significant expansion during the 1960s. These programmes actually resulted in overcapacity, eliminating any further need for new investment.

Similarly, some of the categories that comprise core infrastructure have actually increased as a share of GDP. Investment in water and sewer facilities grew in the wake of major federal grants for wastewater treatment resulting from the Clean Water Act of 1972. Spending on public utilities, transit systems and airports also has increased since 1970. Thus, the story narrows down to highways and streets, where the stock has declined from 18.2 per cent of GDP in 1970 to 13.0 per cent in 1990. Even here, a significant part of the decline mirrors the pattern of spending for the interstate highway system, which required large investments during the 1960s but was largely completed in the early 1970s. In the end, then, the decline in investment reflects little more than a fall-off in investment on secondary roads, where congestion has increased noticeably and pavement condition has deteriorated slightly.

The less sanguine view holds that the ratio of public capital to GDP does not tell the whole story; many observers question the ability of existing facilities to support current activity adequately, much less meet the demands of future growth and development (Aschauer, 1990; National Council on Public Works Improvement, 1988). For example, despite large-scale expenditure following the passage of the Clean Water Act in 1972, many streams and lakes in the United States remain incapable of supporting their designated commercial or recreational uses (US Department of the Interior, 1990). The problem rests in large part with municipal wastewater treatment facilities, which account for about one-third of the use impairment of the waters. These treatment facilities also raise the toxicity levels of lakes and rivers. The Environmental Protection Agency (EPA) says that many municipalities have yet to construct sewage treatment facilities to meet permanent requirements.

A second area where inadequate infrastructure has an adverse impact on health, aesthetics and economics is the treatment of solid waste. Household and industrial refuse is being generated at unprecedented rates, while the number of facilities to handle the waste is shrinking. Between 1978 and 1991, the number of operating landfills declined from 20 000 to fewer than 6 000, and many of those remaining will be closed by the mid-1990s due to lack of capacity and inadequate safety and environmental practices (Executive Office of the President, 1992). These trends suggest increased health risks to residents and damage to the environment.

In the area of transportation, inadequate public transportation poses a serious barrier to employment for those without cars. Disabled citizens cite their lack of transportation as the primary obstacle to obtaining jobs and being fully productive members of society. Similarly, job opportunities in many suburbs remain unfilled because of the lack of

transportation from the urban core. Moreover, average levels of capital investment do not always yield an accurate picture. Mass transit is overcapitalised in many smaller cities and inadequate in larger cities; maintenance has been erratic, especially in larger cities.

Increased congestion in the ground and air transportation networks impairs people's leisure and raises business costs. The Federal Highway Administration forecasts a 436 per cent increase in urban freeway congestion by the year 2005 unless the interstate system is improved (US Department of Transportation, 1987). Similarly, the Federal Aviation Administration forecasts a significant increase during the next decade in the number of airports suffering serious delays. The air traffic control system needs substantial upgrading to maintain safety. In short, transportation is another area where inadequate infrastructure is beginning to serve as a drag on economic performance.

The problem actually extends beyond deterioration and congestion in secondary roads. For the past two decades, policy-makers have given scant thought to how government investment in public capital might enhance private sector activity. That is the overriding issue. Government must maintain roads and repair bridges, but policy-makers also should consider the advantages of new modes of transportation such as high-speed rail, or investigate how government might help develop an extensive system of telecommunications that reduces the need to travel. The solution thus rests not simply with speeding up the rate at which roads are repaved, but also with searching for the 21st-century counterparts of the Erie Canal, the transcontinental railway, the interstate highway system and the great dams and water systems of the West.

### ***Reasons for the decline in public capital investment***

What prompted the neglect of infrastructure in the United States during the 1970s and 1980s? The answer lies mainly in the budget pressures felt at all levels of government. While states and localities undertake almost all spending on nonmilitary public capital investment, the federal government provides matching contributions for transportation and, more recently, environmental projects. Most of the federal money is paid from the Highway Trust Fund, created by Congress in 1956 to finance the ambitious interstate highway system. It is funded by numerous excise taxes derived from transportation activity, but most of the money comes from a fuel tax. For projects that qualify for funds under the highway programme, the federal government has traditionally provided between 75 and 90 per cent of the total cost.

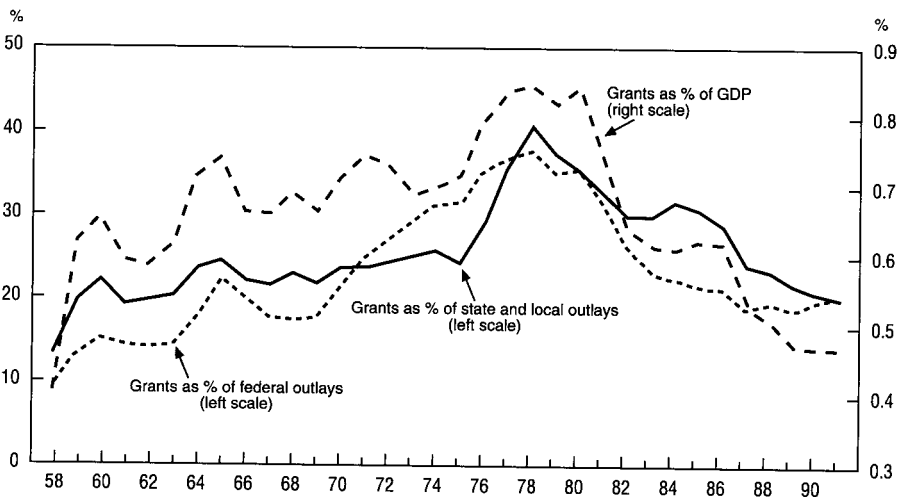
Funding for aviation capital expenditures is channelled through the Airport and Airways Trust Fund, established in 1970 and financed by excise taxes on passenger ticket sales, freight charges and aircraft fuel. The matching percentages for airport capital construction range from 75 per cent for the largest airports to 90 per cent for the rest, and vary by type of project.

The major grants for wastewater treatment began with the Clean Water Act of 1972, when the federal government first assumed responsibility for controlling water pollution. The Act required the EPA to establish minimum standards for municipal and industrial wastewater treatment, and significantly increased federal funding. The grants went to states based on population and EPA standards of need; the states then allocated funds to local communities for building or improving publicly owned treatment facilities. The programme, never intended as permanent, was phased out in 1991.

Since 1970, federal grants to state and local governments for physical capital investment have remained relatively stable in constant dollars. This means that the federal contribution has declined markedly when measured as a share of state and local outlays, as a share of federal outlays, or as a share of GDP (Figure 2). Two factors have contributed to this pattern. First, the major source of financing is taxes on fuels, and these taxes, levied on a cents-per-gallon basis, have failed to keep pace with inflation over the years. Secondly, the 1970s brought slow economic growth, which placed great pressure on the federal budget; by the time growth resumed in the 1980s, Congress had dramatically cut taxes, leaving no room for expanding grant programmes. Federal grants, which accounted for 40 per cent of state and local outlays at their peak in 1978, now account for only 20 per cent.

Beyond the drop in federal support, states and localities have had their own budget problems. The states have limited their outlays for public capital investment because much of their spending is also financed by taxes on petrol, and the effective tax rate has fallen even more at the state level than at the federal level. Local governments, which traditionally have built schools, hospitals, police stations, sidewalks and local streets, also have been under great pressure. Property tax revenues, historically an ample supply of funds for local government initiatives, are no longer guaranteed. Taxpayer resistance to repeated property tax increases have culminated in state initiatives that place caps on local taxes. By 1985, local jurisdictions in 33 states faced limits on the taxes they could levy on local property-owners; California's Proposition 13 and Massachusetts' Proposition 2½ are the best known.

**Figure 2. Federal capital grants as a percentage of state and local capital outlays, federal capital outlays, and GDP in the United States, 1958-91**



Source: *Governmental Finances*, various issues; *Budget of the United States Government: Fiscal Year 1993*, Supplement.

Thus, a shortfall in revenues at all levels of government has contributed to the neglect of infrastructure in the United States. Capital investments are always easily postponed under the pressure for current services. Hence, if public capital investment is to be given higher priority, the government will have to assign a revenue source that is responsive to inflation and economic growth.

### *The experience of other OECD countries*

Although the level of public capital investment is consistently higher in other OECD countries than in the United States, the pattern over time for most countries looks somewhat similar (Figure 3). Public gross investment as a percentage of GDP tends to peak around 1975 and decline thereafter. This pattern could reflect an effort by all the countries to rebuild in the wake of the Great Depression of the 1930s and the diversion of resources and destruction caused by the Second World War; by the 1970s, much of the required reconstruction had been completed. Similarly, all countries were affected by the oil shock in 1974 and the ensuing inflation and slower growth, which sharply reduced tax revenues. These worldwide events could be responsible for producing a consistent pattern of public capital investment.

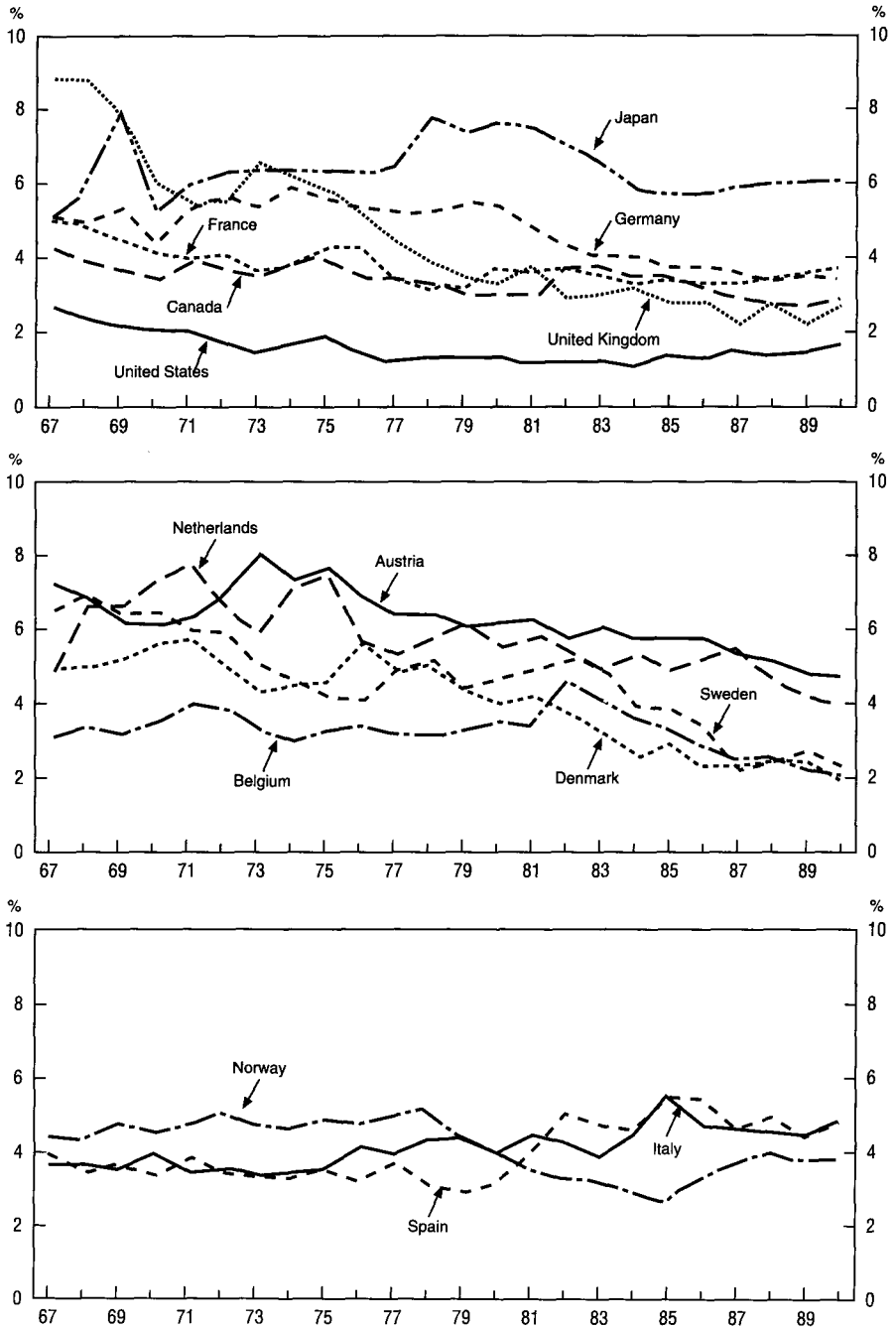
The exceptions to the general pattern of declining public investment in the 1980s are Spain, Italy, and Norway. In Spain, the poor state of infrastructure and the inadequacies of public services were recognised as a major impediment to reducing production costs. In order to become competitive within the EC, Spain undertook an extensive programme of upgrading its stock of public capital. Preparation for the Olympics in Barcelona and the Seville International Exposition also required a major public investment programme. This extensive public investment was accompanied by rapid economic growth; although Spain's economy has now slowed, experts expect high levels of public sector investment to continue (OECD, 1991).

In Italy, the state has always played a larger role in investment than in other major European countries, and public sector investment relative to GDP continues to rise. The bulk of capital spending by the state goes to public services run as commercial enterprises, such as transportation and communications. This significant investment should improve the efficiency of the Italian economy, but comparative data suggest that the quality of services lags behind that of other European countries, putting Italian enterprises at a relative competitive disadvantage<sup>1</sup>.

In Norway, the pattern of public capital investment appears to be related to oil; rapidly rising government revenues from oil activities have contributed to an expanded role for government in the economy. Until the early 1990s, Norway used its oil income to provide extensive regional subsidies, target subsidies to maintain international competitiveness of ailing industries, and support agriculture at record levels. The higher spending on public capital fits this general pattern. Although significant tax cuts will reduce government revenues in 1992, public capital investment is expected to continue at its current pace.

Spain, Italy and Norway clearly are exceptions to the general pattern of declining public investment relative to GDP. The key question for most of the OECD countries, one which cannot be answered from aggregate investment data, is whether the level of infrastructure investment is appropriate, or whether these nations, like the United States, would benefit from a more aggressive policy of assessing infrastructure needs.

Figure 3. Public investment as a percentage of GDP, 1967-90



Source: OECD, *Historical Statistics, 1960 to 1980, 1960 to 1990.*

### 3. What are the benefits from infrastructure investment?

The direct and immediate impact of infrastructure spending is to stimulate demand for construction workers, engineers and other types of labour and factor inputs required for the actual building of a road or facility. The increased demand for such resources has a prompt and positive effect on output and growth. Public works projects were used aggressively in the United States during the Great Depression to provide employment and stimulate income growth. Infrastructure projects also figure prominently in a fiscal stimulus package under consideration in the United States by the new administration; the US Conference of Mayors (1992) has compiled a list of approved projects that could be undertaken as soon as funding becomes available. Similarly, the EC appears to be considering a co-ordinated economic growth package to head off prolonged economic stagnation, consisting of investment in transportation, telecommunications and other infrastructure projects (*Financial Times*, 25 November 1992). Stimulating demand, however, offers only one channel, and rather a short-lived one, through which public capital affects private economic activity; the more important and longer-lasting effects occur on the supply side.

Everyone agrees that public capital investment can expand the productive capacity of a region by increasing resources and enhancing the productivity of existing resources. A well-constructed highway allows a truck driver to avoid circuitous back roads and to transport goods to market in less time. The reduction in required time means that the producer pays the driver lower wages and the truck experiences less wear and tear. Hence, public investment in a highway enables private companies to produce their products at lower total cost. The condition of the highway, of course, also matters. Similar stories can be told for mass transit, water and sewer systems, and other types of infrastructure.

Beginning with Aschauer's work, a number of studies have estimated regressions where the dependent variable is output within some area, and the independent variables are private capital, labour, public capital and a constant for the level of technology (see Appendix A). In such regressions, the levels of public capital are generally significant, and the consensus is that Aschauer made a significant contribution by drawing attention to the importance of public infrastructure and by adding public capital to the conventional production function. The controversy arises over the method of estimating this expanded function and the interpretation of the results.

Aschauer's original aggregate time series estimates (1989a), the present author's re-estimates (1990a), and earlier work by Holz-Eakin (1988) suggest that the impact of aggregate public capital on private sector output and productivity is very large. The present author's equations indicate that a 1 per cent increase in the stock of public capital would increase output by 0.34 per cent. Given the size of the public capital stock and output, these figures imply a marginal productivity of public capital of roughly 60 per cent – that is, a \$1 increase in the public capital stock would raise output by sixty cents. The marginal productivity of private capital estimated from these equations is about 30 per cent. Looking at similar numbers, Aschauer concludes that “increases in GNP resulting from increased public infrastructure spending are estimated to exceed those from private investment by a factor of between two and five” (1990, p. 16).

In the present author's view, the implied impact of public infrastructure investment on private sector output emerging from the aggregate time series studies is too large to be



fully credible. It does not make sense for public capital investment to have a substantially greater impact on private sector output than private capital investment, particularly considering that so much public investment goes to improving the environment and other goals that are not captured in national output measures.

To obtain more evidence, it is useful to examine the relationship between public capital and measures of economic activity at the state level (Munnell, 1990*b*). Since no data on state-level public or private capital stocks were available, the first step was to construct stock estimates; these estimates were then used in three separate exercises. The first, parallel to the national work, estimated production functions for states and found that public capital had a significant positive impact on output, although the output elasticity was roughly half the size of the national estimate.

The second analysis examined the relationship between public and private investment, which is characterised by two opposing forces. On the one hand, public capital enhances the productivity of private capital, raising its rate of return and encouraging more investment. On the other hand, from the investor's perspective, public capital acts as a substitute for private capital and "crowds out" private investment. The estimated equations confirmed both forces but suggested that, on balance, public capital investment stimulates private investment.

The third exercise used a business location model to explore the relationship between public capital and employment growth. Here, the average annual change in employment was estimated as a function of variables reflecting input costs (labour, energy, land), market size, tax burden, and public capital stock. The results showed that after accounting for all the other factors that affect employment, public capital had a positive, statistically significant effect on employment growth.

Taken together, these three analyses indicate that public capital has a positive impact on several measures of state-level economic activity: output, investment and employment growth. The magnitudes of these effects are considerably smaller than those found at the national level; for instance, the elasticity of public capital with respect to output was 0.15, roughly half the estimate at the national level. These estimates are consistent with those of other researchers working at the state level (Mera, 1973; Costa, Ellson and Martin, 1987; Garcia-Mila and McGuire, 1992).

### *Enter the critics*

Critics have levelled three major charges at the results emerging from estimated production functions. First, they contend that common trends in the output and public infrastructure data have led to a spurious correlation. Second, they argue that the wide range of estimates emerging from the various studies renders the coefficients suspect. Finally, they suggest that causation runs not from public capital to output, but rather in the other direction.

The most vociferous critics, concerned about the seeming clarion call for dramatically increased public investment, focus mainly on the aggregate time series; they argue essentially that the equations should be estimated in the form of first differences (Aaron, 1990; Hulten and Schwab, 1991; Jorgenson, 1991; Tatom, 1991). Specifically, they contend that the data are not stationary but tend to drift over time, and that it is necessary to remove this trend to eliminate spurious correlations and determine the true relationship between the two variables. This means specifying the relationship in terms of first

differences, which often yields results showing that public capital's effect is quite small, sometimes negative, and generally not statistically significant.

The first-differencing specification has its problems, however. After all, no one would expect growth in capital stock, whether private or public, in one year to be correlated with the growth in output in that same year. In fact, equations estimated in this form often yield implausible coefficients for labour and private capital as well as for public capital (Evans and Karras, 1991; Hulten and Schwab, 1991; Tatom, 1991). None of the critics conclude from these misspecified equations, however, that private capital and labour lack a significant effect on private sector output.

In addition, first-differencing destroys any long-term relationship in the data, which is exactly what one is trying to estimate. Instead of just first-differencing, the variables should be tested for co-integration, adjusted, and estimated accordingly. In other words, researchers should examine not simply whether the variables grow over time, *i.e.* the extent to which they are non-stationary, but also whether they grow together over time and converge to their long-run relationship – *i.e.* the extent to which they are “co-integrated”.

The second broad criticism is that the wide range of estimates of public capital's impact on output makes the empirical linkages fragile at best. In the present author's view, the critics are seriously misreading the evidence. In almost all cases, the impact of public capital on private sector output and productivity has been positive and statistically significant. This finding is amazing, given that much public capital spending is designed to alleviate environmental problems or enhance the quality of life, and therefore contributes little to national output as conventionally measured.

Furthermore, the coefficients at each level of government tend to be very similar across studies, as shown in Table 3. The variations between estimates occur as the unit of observation moves from the nation to states to cities. As the geographic focus narrows, the estimated impact of public capital becomes smaller. The most obvious explanation is that because of leakages, it is impossible to capture all of the payoff to an infrastructure investment by looking at a small geographic area.

The third major criticism holds that the direction of causation may run from high levels of output to greater public capital investment, rather than the reverse. The criticism is legitimate. Capital investment, private as well as public, goes hand in hand with economic activity. However, this mutual influence can exist without necessarily tainting the coefficient on public capital or, for that matter, private capital in estimated production functions.

Eberts and Fogarty (1987) examined the question of causality by looking at public and private investment data from 1904 to 1978 for 40 metropolitan areas. They found causation running in both directions. Their analysis indicated that public investment led private investment in cities that experienced most of their growth before the 1950s, while the reverse was true for southern cities and cities that have grown faster since 1950.

To examine the simultaneity issue, the present author re-estimated some equations using state data, but included only the value of public capital at the beginning of the period, which foreclosed the possibility of any feedback effect of output growth on public capital investment. Nonetheless, public capital continued to exhibit a large, positive, statistically significant effect on output. This small exercise does not put the question to rest, but does suggest that the coefficient of public capital is not seriously tainted by the simultaneity problem.

**Table 3. Production function estimates of the output elasticity of public capital by level of geographic aggregation**

Author	Level of aggregation	Specification	Output elasticity of public capital
Aschauer (1989 <i>a</i> )	National	Cobb-Douglas; log levels	.39
Holz-Eakin (1989)	National	Cobb-Douglas; log levels	.39
Munnell (1990 <i>a</i> )	National	Cobb-Douglas; log levels	.34
Costa, Ellson and Martin (1987)	States	Translog; levels	.20
Eisner (1991)	States	Cobb-Douglas; log levels	.17
Mera (1973)	Japanese regions	Cobb-Douglas; log levels	.20
Munnell (1990 <i>b</i> )	States	Cobb-Douglas; log levels	.15
Duffy-Deno and Eberts (1989) <sup>1</sup>	Metropolitan areas	Log levels	.08
Eberts (1986)	Metropolitan areas	Translog; levels	.03

1. The authors do not estimate a production function; instead, they use personal income as the dependent variable.

Other critics have suggested that the production function framework is inadequate, because it omits input prices (which affect factor utilisation and bias the estimated coefficients), and also because it places too many restrictions on firms' technology and behaviour (Friedlaender, 1990; Morrison and Schwartz, 1992). They believe that researchers should instead estimate cost functions, which allow one to disentangle the effects of infrastructure, scale economies, and fixed effects on costs and the cost-output relationship. Dalenberg and Eberts (1992), Morrison and Schwartz (1992), and Nadiri and Mamuneas (1992) all adopt the cost-function approach and find that public capital significantly reduces the costs of private production.

In sum, the critics correctly note that the numbers emerging from the aggregate time series studies are not fully credible, and that more evidence is needed on the causation issue. However, the tendency to throw the baby out with the bath-water should be resisted. At this point, an even-handed reading of the evidence – including the growing body of cross-sectional results – suggests that public infrastructure is a productive input which may have large payoffs.

### *Some new evidence*

In the United States, the public and private capital data and the national income statistics have been significantly revised since the present author's earlier study relating private sector output to the stock of public capital, private capital and labour at the state level (Munnell, 1990*b*). Preparing this overview provided an opportunity to incorporate the revised data and expand on the earlier analysis. The nature of the data revisions and the estimated equations are presented in Appendix A; a brief summary of the results follows.

It is always heartening to have statistical relationships survive substantial data revisions (Appendix Figure 1), so it is good to report that the equations presented in Appendix Table 1 confirm that states with higher levels of public capital, all else equal, tend to have higher levels of private sector output<sup>2</sup>. As before, disaggregating by type of public capital – highways and streets, water and sewer systems, and buildings and equipment – has almost no impact on the private capital and labour coefficients, yet yields estimates in line with expectations. Specifically, the major impact on output from public capital comes from highways and water and sewer systems, while other public capital, which consists primarily of buildings such as schools and hospitals, has virtually no measurable impact on private production.

Separate equations were re-estimated for the different regions of the country to see how stable the relationship was across the nation (Appendix Table 2). Although the connection between inputs and outputs appears to vary significantly from one region to another, public capital continues to have a strong positive effect on output everywhere, with the sole exception of the mountain states. When the states are grouped into urban and rural categories, based on population per square mile, the equation for each group shows a statistically significant effect of public capital on private output (Appendix Table 3). The effect is larger in urban states than in rural ones, and the effects of various types of infrastructure differ for urban and rural states. Public buildings, not important in the aggregate, appear to have a large positive effect on output in urban states, but not in rural states. Highways and streets appear to matter in rural states, but not in urban ones. Water and sewer systems are consistently important.

Finally, estimating the equations by type of industry yields plausible and consistent results (Appendix Table 4). Public capital plays a strong role in both the agricultural and manufacturing sectors. While the results for nonmanufacturing as a whole suggest no role for public capital, disaggregating the nonmanufacturing sector reveals that the lack of effect stems from a perverse relationship in the mining industry. Once mining is separated out, the impact of public capital on private sector output ranges from modest and not quite statistically significant in the finance, service, and trade industries to very large and statistically significant in construction, with results for the transportation, communications and public utility industries falling somewhere in between.

These results highlight the importance of not limiting an evaluation of the evidence on the relationship between public capital and private sector output to the time series studies. The cross-sectional evidence is much more persuasive. However, the issue of causality remains a legitimate criticism. More work is needed to sort out the extent to which more public capital causes economic growth, or growth leads to more public capital.

### *Evidence for other OECD countries*

Economists have begun to explore the relationship between infrastructure investment and economic activity in other Member countries. Although the results are not wholly consistent, they tend to support the contention that public sector infrastructure spending and private sector productivity growth are related.

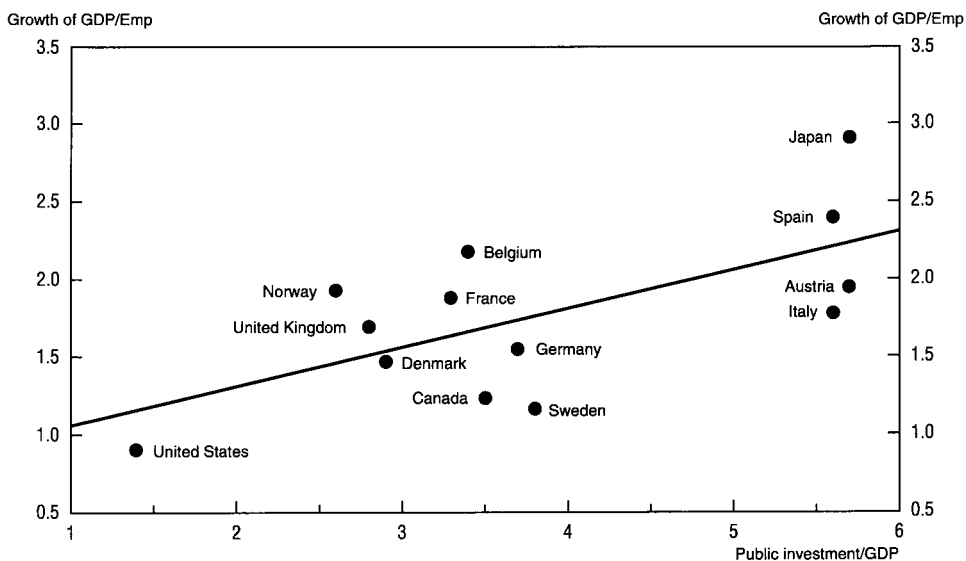
Ford and Poret (1991) applied Aschauer's time series aggregate production function analysis separately to the United States and to eleven other OECD countries. Since the split between publicly and privately provided capital varies from country to country, the authors constructed two measures of public infrastructure. The narrow definition consists of the capital stock of producers of government services, while the broad measure, which they argue is probably a more consistent concept internationally, also includes equipment and structures in electricity, gas and water, and structures in transportation and communication. Ford and Poret confirmed a large estimated return from infrastructure in the United States, but were able to produce similar results for only four other OECD countries (Germany, Canada, Belgium and Sweden). The lack of consistent effects across countries, and the implication that production functions differ widely from country to country, led the authors to conclude that the estimates were not robust enough to support a recommendation to increase public sector investment sharply.

As discussed earlier, even for the United States the time series evidence is not the most persuasive component of the case that infrastructure spending significantly increases private sector output. Earlier studies for the United States show extraordinarily high returns to public capital, significantly exceeding the returns to private capital investment. Moreover, Ford and Poret estimate the equations for each of the countries in the form of first differences, a procedure that rarely produces sensible results for either public or private inputs. Indeed, the Ford-Poret equation for the United States, which showed a strong positive relationship between public capital and productivity growth, implies almost no impact on output from private capital and labour at the margin.

A more fruitful exercise for the United States has been exploring differential effects of public capital across regions, states, or urban areas; the counterpart for OECD countries would be cross-country analyses. Figure 4 suggests that countries with higher levels of gross public investment tend to have higher rates of growth in productivity as measured by GDP per worker; of course, this simple scatter diagram fails to control for the role of private sector inputs. In an effort to approach the question more rigorously, Ford and Poret estimated an equation, across countries, relating average annual rates of growth of productivity to the rate of growth of public capital and to private sector inputs. They found that public capital had a statistically significant effect when it was defined broadly to include utilities. In a similar exercise, Aschauer (1989c) had examined the relationship between productivity and public investment for the Group of Seven<sup>3</sup>. He found that the ratio of public capital investment to GDP had a significant positive effect on the rate of growth of output per worker, even controlling for the ratio of private investment to GDP. Thus, the cross-country comparisons do suggest an important role for public capital investment.

Some researchers in the United States and Europe have abandoned production functions in favour of cost functions. They argue that econometric estimation of production functions suffers from an important problem of misspecification. Specifically, input prices affect factor utilisation and thus the point where firms are operating on their transformation function; omitting prices in an econometric analysis of technology could

Figure 4. **Public investment as a percentage of GDP, 1985 vs. annualised GDP growth per employed person, 1980-90**



Source: Bureau of Labor Statistics, unpublished data; OECD, *Historical Statistics*, 1960 to 1990.

lead to substantial biases in the estimated coefficients. Adopting the cost-function approach to analyse Swedish data over the period 1960-88, Berndt and Hansson (1992) found that for a given level of private sector inputs, public capital substantially reduces private sector costs<sup>4</sup>. In other words, public capital improves the productivity of the private sector by reducing the cost of producing private sector goods.

While scattered evidence from the OECD countries tends to support the contention that public infrastructure enhances private sector growth and productivity, most of the studies have been based on time series analysis. Time series estimates, however, are always subject to the criticism that the results tend to be very sensitive to the period selected and the specific variables included. The more promising area for investigation is cross-sectional studies. While this is relatively easy in the United States, which is a large, federated country consisting of numerous states, it is considerably more difficult in smaller countries where public capital per worker varies little by jurisdiction. The alternative is to look across countries, a potentially useful but difficult exercise given the differences in institutional arrangements and cultures. Nevertheless, increasing data collection in the area of public capital may well prove fruitful.

#### 4. Should public capital investment be increased?

Given that investment in public infrastructure has declined relative to GDP in most countries and that it appears to have substantial payoffs, does this imply that public

capital is undersupplied and higher levels of investment are warranted? To argue that infrastructure is underprovided is to argue that the rate of return to public capital exceeds the return to other investments, whether in private capital or in human capital, and that additional infrastructure spending should be undertaken until the rates of return are roughly equal.

The very nature of public investment makes the questions of relative rates of return and undersupply difficult to answer. After all, the reason that some forms of investment are provided publicly is the inability to exclude those unwilling to pay from enjoying the services of the capital project. This means that the services generally are provided free of charge, making meaningful rate-of-return estimates difficult to obtain. Instead of comparing rates of return, the case for more capital spending must rest on several limited but suggestive pieces of evidence; these include so-called “needs” studies, occasional cost-benefit analyses, and outcomes of capital spending referenda. At the same time, critics urge caution when considering increased spending; they argue that the existing stock could be used much more effectively, thereby eliminating the need for greater investment.

### *The case for greater public capital investment*

Production function estimates provide one piece of evidence in support of more public capital investment. Results from state-level studies suggest that the marginal productivity with respect to private sector output may be roughly equal for public capital and private capital. Given that public capital also frequently produces significant non-market benefits, greater investment in public capital would do much to enhance national welfare. Three other pieces of evidence also suggest that more infrastructure investment is warranted.

#### *“Needs” studies*

The issue of undersupply of capital investment was initially raised by a series of surveys in the early 1980s that documented large, unmet infrastructure requirements, and argued for increased public capital spending (Associated General Contractors of America, 1983; Congressional Budget Office, 1983; US Congress, 1984). Unfortunately, these studies typically focused only on the demand side, without comparing the payoff from more investment in public capital to alternative investments.

Needed investments were estimated in one of two ways. One approach involved calculating a backlog of investment based on some historical ratio of infrastructure spending to GNP; the reference points chosen for these calculations were usually somewhere around the historical spending peak, resulting in very expensive estimates. Alternatively, needs were estimated as the cost of bringing all existing facilities up to some ideal engineering standard, regardless of the actual performance requirements of the facility, and without considering alternative technologies. For example, bridge replacement and rehabilitation estimates assumed that every bridge would be restored or replaced, even though many could be downgraded to handle lighter traffic or closed altogether.

The most recent study in this area, *Fragile Foundations* (National Council on Public Works Improvement, 1988), attempted to compensate for the limitations of mechanical needs studies by augmenting information about the required stock of infrastructure with consideration of the amount of the services provided, the quality of those services, and a measure of the cost-effectiveness of providing those services. Applying these four criteria

to eight categories of public investment (highways, aviation, mass transit, wastewater, water supply, water resources, solid waste and hazardous waste) revealed that American infrastructure, while not in ruins, was probably inadequate to sustain future growth. The imbalance between the growing demand and the declining supply was already affecting the quality of services provided and would continue to do so. Some of the growth in service demands could be met by better management and more effective use of current facilities, but the report concluded that the level of capital investment should be roughly doubled.

Several federal agencies conduct ongoing needs assessments for their areas of responsibility. In its most recent publication, the Federal Highway Administration (US House of Representatives, 1991) estimates the investment needed over the next twenty years to meet specific engineering requirements regarding pavement condition and congestion for highways and functional or structural deficiencies for bridges. Estimates are provided for achieving two alternative goals: maintaining 1989 conditions and performance, or the more ambitious goal of repairing all pavement in poor condition (roughly 10 per cent of the current system) and sharply reducing the portion of the system classified as congested; both estimates assume 2.5 per cent annual growth in vehicle-miles of travel. Dividing the total projected costs by twenty years yields an annual figure of \$46 billion for the more modest goal and \$75 billion for the more ambitious effort<sup>5</sup>. These figures, once adjusted for land acquisition costs, suggest that current funding levels are roughly adequate to achieve the low option, but that a near-doubling would be required to attain the higher option.

Needs studies should be considered only a starting point in assessing capital investment options. They highlight the costs of restoring the existing capital stock to some ideal standard, but do not identify the most cost-effective technologies, the most beneficial capital projects, or the trade-offs between projects. Although needs studies established and continue to reinforce the public perception that the country suffers from serious underinvestment, these studies cannot be used to determine whether public capital is undersupplied.

### *Referenda on public capital spending*

Another piece of evidence comes from the work of George Peterson of the Urban Institute (1990 and 1991). Peterson has explored voters' preferences for public capital investment as expressed in bond elections and other referenda. If public officials were trying to satisfy the median voter, as theory suggests, they would submit frequent bond proposals for consideration to assess voters' preferences. As a result, bond elections should be closely contested, with bond approval rates and margins close to 50 per cent<sup>6</sup>.

Peterson's results show that between 1984 and 1989, 80 per cent of the dollar value of infrastructure proposals was approved by the public. Over the same period, the approval margin of infrastructure proposals was the highest of any type of referendum, with the average bond proposal approved by 66 per cent of the vote. Since the proportion of voters approving a referendum represents the portion wanting *at least* the proposed amount of spending, high approval rates indicate undersupply<sup>7</sup>.

Peterson speculates that this undersupply stems from a "fear of rejection" on the part of public officials. Instead of designing proposals to satisfy the median voter, they try to garner as large a majority as possible to minimise voter repudiation. The result is that proposals simply are not brought to the attention of the public, and so public investment



languishes. Peterson's work thus suggests that infrastructure may be undersupplied relative to people's preferences. Even this information, however, provides little guidance for actual investment spending. In the end, investment decisions will have to be based on comprehensive cost-benefit studies.

*Cost-benefit studies*

Cost-benefit studies of individual projects traditionally have been used to justify capital expenditures. This method remains the best way to establish priorities among competing projects and could eventually be structured to guide choices among broad categories of investments. Another advantage is that these studies generally incorporate estimates of non-market as well as market costs and benefits, and thus reflect a project's impact on aggregate welfare and not just on national output or income. Cost-benefit studies can also provide some information on the issue of undersupply. The existence of a significant number of projects with very high rates of return would suggest the need for greater investment in public capital.

One drawback is that cost-benefit studies usually focus on individual projects and cannot provide general guidelines as to which areas are most in need of investment. They can show that a given city ought to invest in a water treatment plant before building an airport, but they cannot assess whether, at a national level, funds should be channelled towards water treatment or aviation. Moreover, studies often are not comparable because they use different discount rates. Furthermore, it is often difficult to value non-market costs and benefits.

In spite of these difficulties, some recent studies show that many very profitable public investment opportunities do exist. To take just one example, cost-benefit studies reported by the Congressional Budget Office (CBO) (1988) indicate that the return for projects designed to maintain the average condition on the federal highway system could be as high as 30 to 40 per cent (Table 4). Even new construction in urban areas exhibits returns on the order of 10 to 20 per cent. In another recent survey (1991), the CBO

**Table 4. Returns to highway investment in the United States**

Investment strategy	Expected real rates of return on investment (national averages)
4R Projects to maintain current highway conditions (average present serviceability rating of 3.1) <sup>1</sup>	30-40%
New construction, urban areas	10-20%
4R Projects to upgrade sections not meeting minimum service or safety standards	3-7%
New construction, rural areas	Low <sup>2</sup>
4R Projects to fix all deficiencies above minimum service and safety standards	Negative

*Note:* 4R Projects are those involving restoration, resurfacing, rehabilitation or reconstruction.

1. Present serviceability ratings rank highway conditions on a scale from 0 (very bad) to 5 (excellent). A rating of 3.1 puts the Federal Aid System in good to very good condition.

2. Economic returns may be higher for replacement of substandard bridges on the national truck network.

*Source:* Congressional Budget Office (1988, Table 5).

suggests the likelihood of substantial benefits from increased outlays for both air traffic control and expansions in airport capacity. These studies also represent a breakthrough, because they estimate the national benefits of broad categories of investment spending as opposed to individual projects.

Cost-benefit studies remain the best tool for guiding actual investment spending. Unfortunately, cost-benefit estimates generally are not available for broad categories of infrastructure, with the exception of the studies noted above. They are feasible, however, and would help provide information on areas with the greatest deficiencies. The 1988 CBO study points out that several federal agencies already collect the data necessary to make these estimates in areas such as mass transit and water resources.

### *The case for caution*

Despite the opportunities for productive public capital investments revealed by cost-benefit studies and the fact that public capital has a positive impact on private economic activity, several voices urge caution when considering increased spending for public infrastructure. Clifford Winston of the Brookings Institution and his colleagues (Winston, 1990 and 1991; Small, Winston, and Evans, 1989; Winston and Bosworth, 1992) contend that the condition of the nation's highways and airports could be improved, and congestion reduced, with the same or less investment by remedying three particular problems.

First, roads in the United States are paved too thinly, causing unnecessarily high maintenance and replacement costs. Building roads thicker than prevailing engineering standards would produce great savings.

Secondly, the types of taxes currently imposed on trucks encourage vehicles that do the most damage to roads. Specifically, damage rises exponentially with the weight per axle, but both the fuel tax and highway tolls now encourage truckers to load as much as possible on each axle. In the case of the fuel tax, the effect is indirect: the tax encourages transporting a given load with the smallest possible engine since smaller engines are more fuel-efficient, but smaller engines can pull fewer axles. In the case of tolls, the effect is direct: toll roads often charge by the number of axles, increasing the incentive to use fewer axles. Shifting from taxes on the number of axles to one on weight per axle would greatly encourage efficient use of highways and minimise damage.

The third problem involves congestion. Even though congestion pricing has been advocated by economists for decades, this tool has not been used effectively. Consumers strongly resist the imposition of tolls during peak commuting time, and their sentiments have in fact produced more commuter discounts than peak-load surcharges. At airports, the major cost of landing a plane is the delay of other traffic, but landing fees generally correspond to the weight of the aircraft, a characteristic with little bearing on the amount of delay caused. Introducing congestion pricing on roads would significantly reduce overcrowding and lead to more efficient use; shifting from landing fees based on weight to ones based on delays caused would noticeably reduce congestion at airports. Such improvements could markedly reduce the need for new construction of both highways and airports.

Other critics point to inefficiencies in the US federal grant programmes (Gramlich, 1990 and 1991), where matching rates probably are much higher than can be justified on the basis of interjurisdictional spillovers. As a result, many states face artificially low prices for infrastructure investment.

Those worried about the incentives to spend, the efficiency of design, and the appropriateness of the prices charged want all efforts focused on eliminating current distortions and inefficiencies. They believe that once the perversities in the existing system are removed, the present stock of infrastructure may meet most of the nation's needs. Additional investment at this time, they argue, will divert attention and alleviate the pressure to make needed reforms.

It would seem that substantial room exists for improving the efficiency with which services are provided from the current stock of infrastructure. Some progress is already under way; airport congestion pricing increasingly is being implemented, and a shift in truck taxation from number of axles to weight per axle has been introduced in Oregon. Electronic tollbooth technology has been developed so that congestion charges can be introduced without interrupting the flow of traffic. The difficulty is that the area of biggest payoff – rush hour charges for commuters – is the one facing the strongest political resistance. Business, labour, and civic groups traditionally have been hostile and quite vocal about such proposals, and very effective in fighting their implementation. Thus, while the payoff from more efficient design and pricing may be large, the Small-Winston-Evans estimate of \$25 billion per year probably cannot be achieved.

Improved design and pricing should be viewed not as an alternative to additional infrastructure investment, but rather as a policy to be pursued in concert with a major public capital investment initiative. After all, the more efficiently the bread and butter items such as roads, bridges, and airports are built and used, the more money will be available for developing sophisticated systems of telecommunications and other such networks for the 21st century.

There is almost no information on whether infrastructure is oversupplied or undersupplied in other OECD countries. Three nations – Italy, Spain and Norway – are resisting the decline in public capital investment and maintaining high levels of government-provided capital relative to GDP. Whether or not these expenditures produce projects with significant payoffs rests so far on anecdotes. The discussion regarding Italy suggests that investment may not be productive, and therefore may not increase the output or reduce the costs of the private sector. In Spain, much of the government money appears to have been well spent, raising the level of potential output. The exception appears to be Spain's flirtation with high-speed rail. The Ave, which runs from Madrid to Seville, is not covering its operating costs, and currently uses only 6 of the 24 railway cars purchased from France. Norway may well be supporting ailing industries that should be allowed to fail.

The major effort to construct a tunnel under the English Channel is nearing completion. A careful study of early cost-benefit estimates compared with the *ex post* realisations should provide insights into the role of large infrastructure projects. It may also offer some information on the advantages and disadvantages of private sector financing.

Looking forward, econometric studies are not required to conclude that Germany will require massive amounts of infrastructure investment to bring eastern Germany up to the standards of the rest of the country. It also appears that investment in communication and transportation will be required to fully integrate the EC. As these investments are undertaken, they will offer opportunities to supplement the current skeletal theory with some rich detail.

## 5. Conclusions

Four different sources of information bear on the question of whether public infrastructure is underprovided – so-called “needs” studies, production function estimates, referenda voting, and cost-benefit analysis. Each piece has its limitations, but all merit consideration in trying to determine whether or not more infrastructure investment is warranted.

The issue of an undersupply of capital investment initially arose from so-called “needs” studies. These surveys typically concluded that massive amounts of public investment were required to bring the US stock of public infrastructure up to certain standards or to return annual public capital investment to historic levels. The problem with these studies is that they did not present any systematic comparison of the payoff of infrastructure investment versus other uses of government funds, and the target standards, whether articulated in terms of engineering criteria or spending levels, were necessarily arbitrary. Nevertheless, the surveys did suggest that a problem of underspending might exist in the area of public infrastructure.

The sense that infrastructure might be undersupplied was reinforced by early results from estimates of production functions, which showed an enormous payoff in private sector output from greater investment in public capital. However, the magnitude of the payoff was simply not credible, since it suggested that the return to public capital may be two to five times greater than the return to private capital investment. On the other hand, a growing body of evidence appears to confirm a statistically significant positive relationship between public capital and output. Public capital investment appears as productive as private capital in terms of increasing private sector output; adding to these returns the non-market benefits usually provided by public infrastructure makes a strong case for increasing public capital investment.

Voters seem to want more public capital spending, suggesting that they perceive a high payoff to this form of government spending. Evidence from voter preferences as revealed in referenda on public capital spending shows that in recent years, large percentages of these proposals have passed, and with high margins. It appears that people are willing to support greater amounts of public capital investment than officials have proposed.

Cost-benefit studies confirm that projects yielding substantial payoffs do exist. These kinds of studies can, and should, be used more broadly than assessing individual projects, in order to determine the benefits of different classes and kinds of projects.

While none of the evidence examined here leads, on its own, to an unequivocal answer regarding the question of undersupply of public capital, the conclusion of this paper is that the United States does need more public investment to repair roads and bridges, expand existing airports and build some new ones, treat wastewater, dispose of trash, and improve the quality of the nation’s lakes and rivers. It does not automatically follow, however, that funds for public capital investment should be blindly doubled. Rather, investment in carefully selected projects will produce significant returns, both in the quality of life and in private sector production.

## Appendix A

### **New evidence on the relationship between public capital and private sector output**

Treating public capital as an input whose services enhance the productivity of both capital and labour yields the equation  $Q = (MFP)e^{\lambda t} f(K, L, G)$ , where  $Q$  is output,  $MFP$  is the level of technology,  $K$  is the private capital stock,  $L$  is labour, and  $G$  is the stock of public capital. Assuming a generalised Cobb-Douglas form of technology yields a more specific relationship between inputs and outputs:  $Q = MFPe^{\lambda t} K^a L^b G^c$ . Translating this equation into logarithms produces a linear function that can be estimated:

$$\ln q = \ln MFP + \lambda t + a \ln K + b \ln L + c \ln G$$

The coefficients  $a$ ,  $b$  and  $c$  are the output elasticities of factor inputs. In other words, the coefficients indicate the percentage change in output for a given percentage change in factor input.

Appendix Table 1. **Regression results: output as a function of private capital (K), labour (L), and public capital (G), and disaggregated public capital (H, WS, O), 48 states, 1970-86 and 1970-90 (revised data)**

Equation for output (lnQ)							R <sup>2</sup>	SE	DW		
	lnMFP +	$\lambda t$ +	alnK +	blnL +	clnG +	dU%					
1970-86	5.70 (39.3)	.002 (2.7)	.30 (28.9)	.59 (42.6)	.17 (9.4)	-.008 (5.4)	.9926	.088	1.9		
1970-90	6.98 (53.0)	.004 (7.8)	.21 (19.4)	.70 (56.8)	.14 (9.0)	-.011 (7.9)	.9926	.089	1.8		
	lnMFP +	$\lambda t$ +	alnK +	blnL +	clnH +	dlnWS +	elnO +	fU%			
1970-86	5.71 (41.7)	.001 (1.5)	.31 (26.4)	.55 (35.3)	.07 (4.1)	.12 (9.3)	.011 (0.8)	-.01 (5.4)	.9930	.085	1.9
1970-90	6.95 (55.8)	.003 (5.8)	.22 (18.7)	.66 (47.7)	.04 (3.0)	.11 (10.2)	.004 (0.3)	-.01 (7.8)	.9930	.087	1.8

*Note:* Q = gross state product; MFP = the level of technology; t = time; K = private capital stock; L = employment on non-agricultural payrolls; H = stock of highways; G = stock of state and local public capital; WS = stock of water and sewer systems; O = other state and local public capital, primarily buildings; U% = state unemployment rate; t-statistics in parentheses.

**Appendix Table 2. Regression results: output as a function of private capital (K), labour (L), and public capital (G), by region, 1970-86 and 1970-90 (revised data)**

Equation for output (lnQ)							R <sup>2</sup>	SE	DW
	lnMFP	+ λt	+ alnK	+ blnL	+ clnG	+ dU%			
<b>Northeast</b>									
1970-86	8.8 (24.4)	.006 (5.2)	.05 (1.4)	.89 (23.9)	.12 (3.9)	-.01 (4.0)	.9978	.062	1.6
1970-90	8.5 (20.9)	.009 (7.6)	.09 (2.6)	.86 (20.1)	.11 (3.1)	-.02 (5.1)	.9968	.076	1.6
<b>North Central</b>									
1970-86	5.7 (15.6)	.00005 (.06)	.34 (14.6)	.62 (22.0)	.12 (4.5)	-.005 (2.3)	.9977	.046	2.0
1970-90	6.4 (17.7)	.0015 (2.6)	.29 (12.3)	.69 (24.7)	.11 (4.2)	-.008 (4.5)	.9973	.051	2.2
<b>South</b>									
1970-86	2.9 (9.4)	.005 (3.9)	.38 (23.5)	.33 (10.9)	.38 (11.6)	-.02 (7.9)	.9886	.080	1.8
1970-90	4.7 (16.3)	.005 (6.5)	.24 (14.2)	.49 (17.9)	.35 (11.8)	-.02 (8.7)	.9891	.079	1.8
<b>West<sup>1</sup></b>									
1970-86	4.6 (24.0)	-.003 (3.0)	.54 (26.5)	.55 (28.7)	.04 (1.3)	-.02 (6.6)	.9971	.055	2.0
1970-90	5.8 (34.8)	-.004 (5.7)	.47 (25.8)	.65 (42.8)	-.004 (.2)	-.02 (7.5)	.9975	.054	2.1
<i>Note:</i> Q = gross state product; MFP = the level of technology; t = time; K = private capital stock; L = employment on non-agricultural payrolls; G = stock of state and local public capital; U% = state unemployment rate; t-statistics in parentheses.									
1. The 1990 statistically insignificant coefficient on public capital in the west is the result of a statistically significant positive relationship between public capital and output in the pacific states and a statistically negative relationship in the mountain states. Further work is needed to sort out the reasons for the difference.									
	lnMFP	+ λt	+ alnK	+ blnL	+ clnG	+ dU%			
<b>Pacific</b>	4.7 (9.3)	-.005 (4.8)	.51 (5.6)	.55 (12.7)	.07 (3.6)	-.02 (7.4)	.9995	.024	1.4
<b>Mountain</b>	6.3 (25.1)	-.003 (3.7)	.50 (18.8)	.70 (33.5)	-.09 (2.6)	-.02 (.66)	.9901	.058	1.9

Appendix table 3. **Regression results: output as a function of private capital (K), Labour (L), and public capital (G), for urban and rural states, 1970-90**

Equation for output (lnQ)							R <sup>2</sup>	SE	DW
	lnMFP +	$\lambda t$ +	a lnK +	b lnL +	c lnG +	dU%			
Urban	8.7 (32.2)	.004 (4.4)	.19 (7.0)	.86 (30.3)		-.01 (5.4)	.9949	.0764	1.3
Urban	7.7 (26.1)	.006 (6.9)	.11 (4.2)	.75 (24.6)	.18 (6.6)	-.02 (7.0)	.9956	.0709	1.2
Rural	7.1 (66.0)	.002 (4.6)	.33 (32.5)	.70 (75.4)		-.01 (6.8)	.9902	.0837	2.0
Rural	6.7 (47.1)	.003 (5.5)	.30 (24.0)	.66 (51.6)	.08 (4.3)	-.01 (7.1)	.9904	.0827	2.0
	lnMFP +	$\lambda t$ +	a lnK +	b lnL +	c lnH +	d lnWS +	e lnO +	fU%	
Urban	7.6 (25.9)	.003 (2.4)	.19 (4.8)	.70 (20.7)	-.04 (0.9)	.09 (4.2)	.09 (4.8)	-.02 (7.3)	.9957 .0701 1.3
Rural	6.6 (51.8)	.002 (4.6)	.30 (24.2)	.62 (45.0)	.03 (1.8)	.13 (11.3)	-.05 (3.9)	-.009 (6.7)	.9916 .0771 1.8

*Note:* Q = gross state product; MFP = the level of technology; t = time; K = private capital stock; L = employment on non-agricultural payrolls; G = stock of state and local public capital; U% = state unemployment rate; t-statistics in parentheses.



Appendix Table 4. Regression results: output as a function of private capital (K), labour (L), and public capital (G), by type of industry, 1970-89

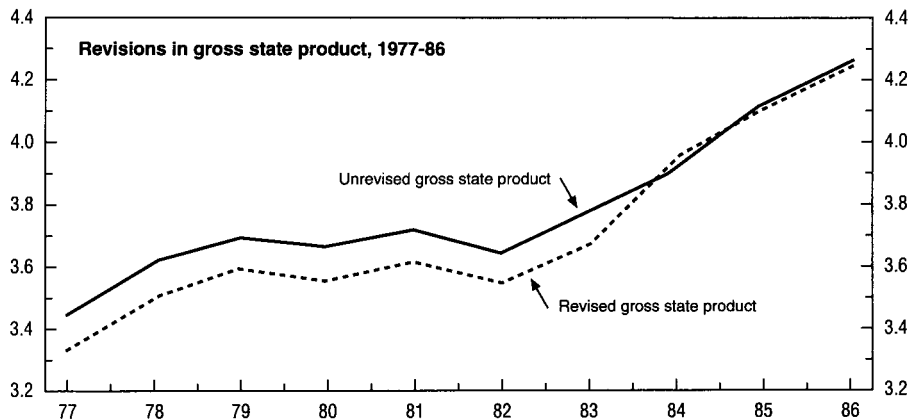
Equation for output (lnQ)							R <sup>2</sup>	SE	DW
	lnMFP +	$\lambda t$ +	a lnK +	b lnL +	c lnG +	d U%			
Farm	3.51 (11.6)	.021 (11.3)	.47 (22.2)	.46 (18.1)	.10 (6.5)	-.03 (7.2)	.9300	.3068	1.9
Manufacturing	6.44 (43.1)	.02 (22.3)	.27 (19.1)	.71 (51.9)	.10 (9.9)	-.02 (8.1)	.9904	.1318	1.9
Non-manufacturing	7.42 (39.1)	-.004 (6.2)	.28 (24.1)	.77 (43.5)	.01 (0.6)	-.003 (2.1)	.9891	.1076	1.9
Mining <sup>1</sup>	7.58 (24.6)	-.006 (2.6)	.40 (23.7)	.73 (30.5)	.07 (4.2)	-.01 (1.9)	.9392	.3804	2.2
Non-manufacturing less mining	8.20 (50.4)	-.002 (3.9)	.15 (11.3)	.84 (56.3)	.07 (3.8)	-.002 (1.4)	.9920	.0936	2.1
Construction	7.07 (19.5)	-.02 (13.0)	.19 (5.6)	.70 (21.0)	.16 (5.8)	-.009 (2.6)	.9482	.2219	2.3
Transportation, communication, public utilities	8.74 (33.9)	.02 (25.1)	.10 (6.8)	.86 (42.8)	.07 (3.9)	.002 (1.0)	.9896	.1060	1.8
Finance, insurance, real estate, services, retail and wholesale trade	2.46 (38.4)	-.003 (5.0)	.13 (11.0)	.91 (63.9)	.03 (1.5)	-.0 (0.0)	.9924	.0933	2.0

Note: Q = gross state product; MFP = the level of technology; t = time; K = private capital stock; L = employment on non-agricultural payrolls; G = stock of state and local public capital; U% = state unemployment rate; t-statistics in parentheses.

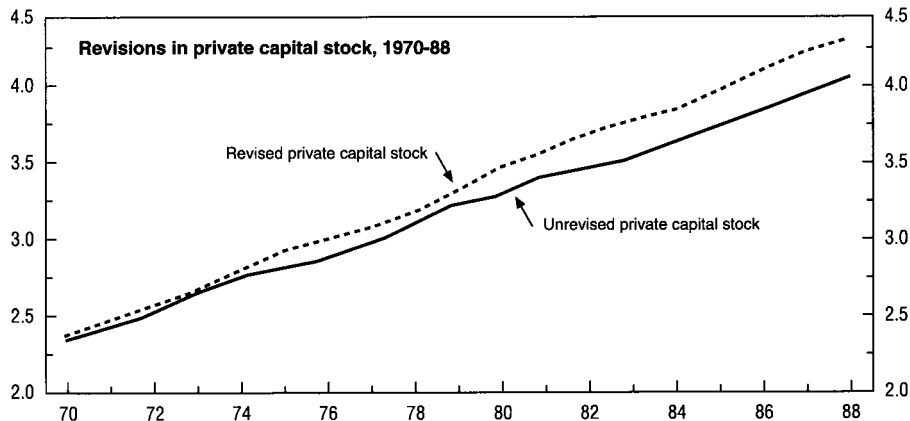
1. Does not include Delaware, Maine, New Hampshire or Rhode Island due to insignificant mining employment data.

Appendix Figure 1

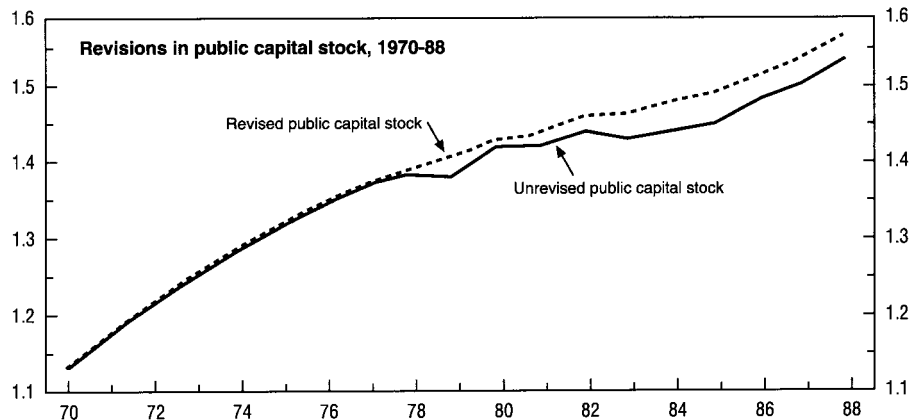
Trillions of 1987 \$



Trillions of 1987 \$

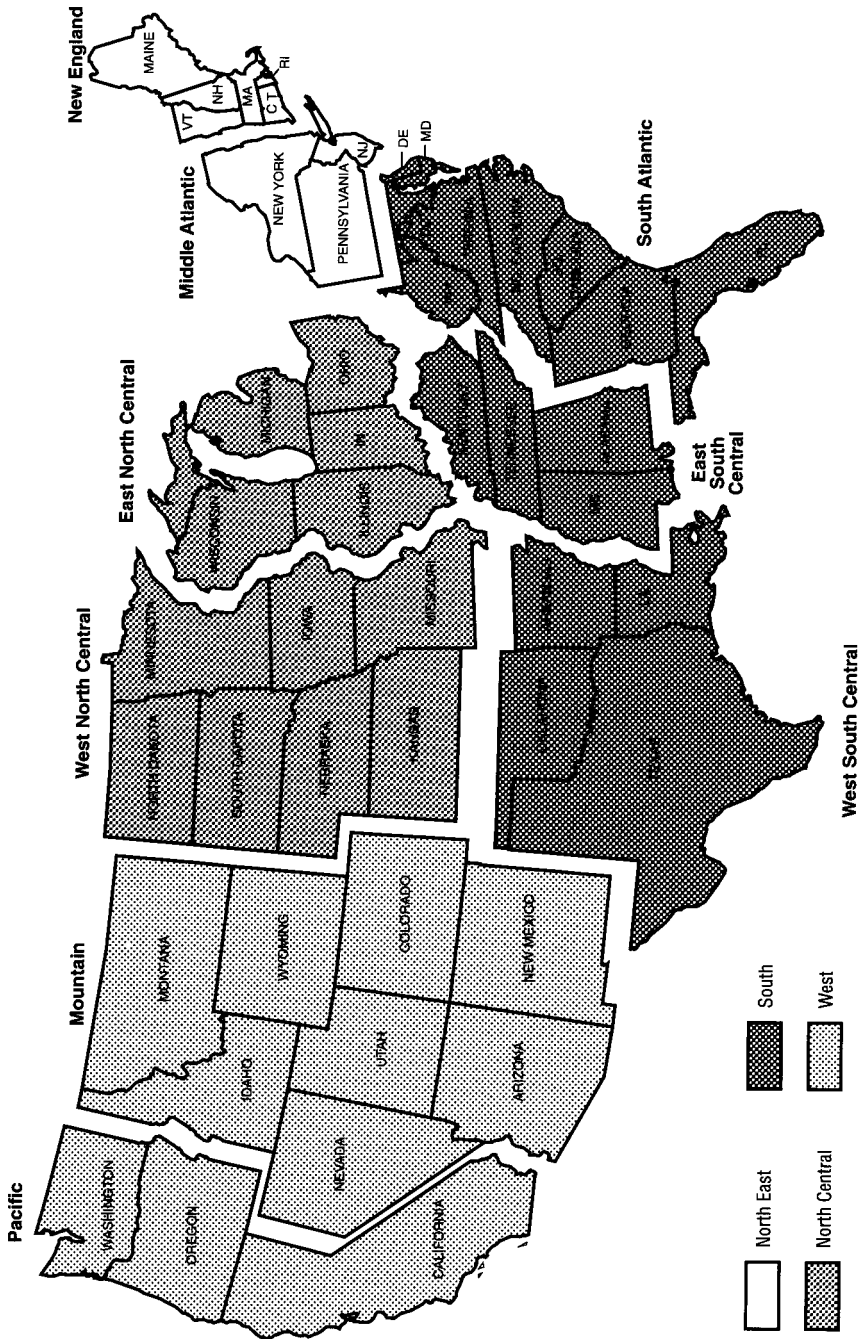


Trillions of 1987 \$



Source: Bureau of Economic Analysis.

Appendix Figure 2. Regional map of the United States



## Notes

1. It takes three and one-half days to send a letter from one town to another in Italy, compared to two days in other major European countries. The telecommunications system is overstaffed and inefficiently equipped, resulting in a cost to users much higher than that in Italy's main competitor countries. The Italian railroad employs as many people as the French railways despite the fact that the network is only half as long. Local public transportation suffers from antiquated vehicles and inefficient labour, which – together with artificially low fares – make profitability the lowest of any country in Europe.
2. Although these equations use pooled state output, capital, and labour for the period 1970-90, most of the effect comes from the cross-sectional nature of the data (Eisner, 1991).
3. The Group of Seven (G-7) industrialised countries includes Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.
4. Their analytical approach also allowed them to assess whether the stock of public capital is insufficient or excessive. Interestingly, they concluded that the stock of public capital in Sweden exceeds that justifiable on the basis of private sector cost-saving, but that the "excess" has been declining over time. In addition to cost-saving to producers, of course, public capital provides cost- and time-savings to the final consumers, and these benefits are not included in the analysis.
5. Some suggest that dividing by twenty overstates the current cost of the two alternatives (Winston and Bosworth, 1992). They contend that it is more reasonable to calculate the percentage of GDP required to meet the goal at the end of twenty years and apply that percentage to today's GDP. Such an exercise yields figures of \$35 billion and \$58 billion, respectively.
6. Approval rates are an imperfect measure of preferences for a couple of reasons. Only one-third of public infrastructure projects are approved directly by voters, either through direct balloting on general obligation bonds or by referenda on revenue bonds. Furthermore, voters do not directly vote for a particular level of capital spending or value of capital stock; rather, they approve or veto specific proposals for certain facilities or types of projects. However, these data provide the best available evidence on revealed preferences.
7. Aaron (1991) offers a note of caution concerning Peterson's results. Specifically, he points out that elected officials control the supply of proposals and it is very difficult to make any determinations about voters' demands for infrastructure without analysing changes in supply. Aaron concludes that while he would not be surprised if Peterson's claims are entirely correct, he does not feel that the case has been proven.

## Bibliography

- AARON, Henry J. (1990), "Discussion of 'Why is Infrastructure Important?'" in Alicia H. Munnell (ed.), *Is There a Shortfall in Public Capital Investment?*, Conference Series No. 34, Federal Reserve Bank of Boston, June, pp. 51-63.
- AARON, Henry J. (1991), "Discussion of 'Historical Perspectives in Infrastructure Investment: How Did We Get Where We Are?'" , paper presented by George E. Peterson at the American Enterprise Institute Conference on "Infrastructure Needs and Policy Options for the 1990s", 4 February, Washington, D.C.
- ASCHAUER, David Alan (1989a), "Is Public Expenditure Productive?", *Journal of Monetary Economics*, Vol. 23, March, pp. 177-200.
- ASCHAUER, David Alan (1989b), "Does Public Capital Crowd Out Private Capital?", *Journal of Monetary Economics*, Vol. 24, September, pp. 171-88.
- ASCHAUER, David Alan (1989c), "Public Investment and Productivity Growth in the Group of Seven", *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. 13, No. 5, September/October.
- ASCHAUER, David Alan (1990), *Public Investment and Private Sector Growth*, Economic Policy Institute, Washington, D.C.
- ASSOCIATED GENERAL CONTRACTORS OF AMERICA (1983), *America's Infrastructure: A Plan to Rebuild*.
- BERNDT, Ernst R. and Bengt HANSSON (1992), "Measuring the Contribution of Public Infrastructure Capital in Sweden", *The Scandinavian Journal of Economics*, Vol. 94, Supplement, pp. 151-68.
- CONGRESSIONAL BUDGET OFFICE (1983), *Public Works Infrastructure: Policy Consideration for the 1980s*, Government Printing Office, Washington, D.C.
- CONGRESSIONAL BUDGET OFFICE (1988), *New Directions for the Nation's Public Works*, Government Printing Office, Washington, D.C., September.
- CONGRESSIONAL BUDGET OFFICE (1991), *How Federal Spending for Infrastructure and Other Public Investments Affects the Economy*, Government Printing Office, Washington, D.C., July.
- COSTA, Jose da Silva, Richard W. ELLSON and Randolph C. MARTIN (1987), "Public Capital, Regional Output, and Development: Some Empirical Evidence", *Journal of Regional Science*, Vol. 27, August, pp. 419-37.
- DALENBERG, Douglas R. and Randall W. EBERTS (1992), "Estimates of the Manufacturing Sector's Desired Level of Public Capital: A Cost Function Approach", paper presented at the Annual Meeting of the Western Economic Association, 10-13 July, San Francisco.
- DUFFY-DENO, Kevin T. and Randall W. EBERTS (1989), "Public Infrastructure and Regional Economic Development: A Simultaneous Equations Approach", Working Paper No. 8909, Federal Reserve Bank of Cleveland, August.

- EBERTS, Randall W. (1986), "Estimating the Contribution of Urban Public Infrastructure to Regional Economic Growth", Working Paper No. 8610, Federal Reserve Bank of Cleveland, December.
- EBERTS, Randall W. (1990), "Public Infrastructure and Regional Economic Development", *Economic Review*, Federal Reserve Bank of Cleveland, Quarter 1, Vol. 26, pp. 15-27.
- EBERTS, Randall W. and Michael S. FOGARTY (1987), "Estimating the Relationship between Local Public and Private Investment", Working Paper No. 8703, Federal Reserve Bank of Cleveland, May.
- EISNER, Robert (1991), "Infrastructure and Regional Economic Performance", *New England Economic Review*, Federal Reserve Bank of Boston, September/October, pp. 47-58.
- EVANS, Paul and Georgios KARRAS (1991), "Are Government Activities Productive? Evidence from a Panel of US States", unpublished.
- EXECUTIVE OFFICE OF THE PRESIDENT (1992), *Environmental Quality*, Council on Environmental Quality, Government Printing Office, Washington, D.C.
- FORD, Robert and Pierre PORET (1991), "Infrastructure and Private-Sector Productivity," *Economic Studies*, No. 17, autumn.
- FRIEDLAENDER, Ann F. (1990) "Discussion of 'How Does Public Infrastructure Affect Regional Economic Performance?'" in Alicia H. Munnell (ed.), *Is There a Shortfall in Public Capital Investment?*, Conference Series No. 34, Federal Reserve Bank of Boston, pp. 108-12.
- GARCIA-MILA, Theresa and Therese J. McGUIRE (1992), "The Contribution of Publicly Provided Inputs to States' Economies", *Regional Science and Urban Economics*, Vol. 22, pp. 229-41.
- GRAMLICH, Edward M. (1990), "How Should Public Infrastructure Be Financed?" in Alicia H. Munnell (ed.), *Is There a Shortfall in Public Capital Investment?* Conference Series No. 34, Federal Reserve Bank of Boston, June, pp. 223-37.
- GRAMLICH, Edward M. (1991), "US Infrastructure Needs: Let's Get the Prices Right", paper presented at the American Enterprise Institute Conference on "Infrastructure Needs and Policy Options for the 1990s", Washington, D.C., 4 February.
- HOLZ-EAKIN, Douglas (1988), "Private Output, Government Capital, and the Infrastructure 'Crisis'", Discussion Paper Series No. 394, Columbia University, New York, May.
- HULTEN, Charles R. and Robert M. SCHWAB (1991), "Is There Too Little Public Capital? Infrastructure and Economic Growth", paper presented at the American Enterprise Institute Conference on "Infrastructure Needs and Policy Options for the 1990s", Washington, D.C., 4 February.
- JORGENSON, Dale W. (1991), "Fragile Statistical Foundations: The Macroeconomics of Public Infrastructure Investment", paper presented at the American Enterprise Institute Conference on "Infrastructure Needs and Policy Options for the 1990s", Washington, D.C., 4 February.
- MERA, Koichi (1973), "Regional Production Functions and Social Overhead Capital: An Analysis of the Japanese Case", *Regional and Urban Economics*, Vol. 3, May, pp. 157-85.
- MORRISON, Catherine J. and Amy E. SCHWARTZ (1992), "State Infrastructure and Productive Performance", Working Paper No. 3981, National Bureau of Economic Research, January.
- MUNNELL, Alicia H. (1990a), "Why Has Productivity Declined? Productivity and Public Investment", *New England Economic Review*, Federal Reserve Bank of Boston, January/February, pp. 3-22.
- MUNNELL, Alicia H. with the assistance of Leah M. COOK (1990b), "How Does Public Infrastructure Affect Regional Economic Performance?", *New England Economic Review*, Federal Reserve Bank of Boston, September/October, pp. 11-32.

- NADIRI, M. Ishaq and Theofanis P. MAMUNEAS (1992), "The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of US Manufacturing Industries", New York University, mimeo, February.
- NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT (1988), *Fragile Foundations: A Report on America's Public Works*, Government Printing Office, Washington, D.C., February.
- OECD (1979), *National Accounts of OECD Countries, 1960-1977. Vol. II: Detailed Tables*, Paris.
- OECD (1982), *Historical Statistics: 1960-1980*, Paris.
- OECD (1983), *National Accounts of OECD Countries, 1964-1981. Vol. II: Detailed Tables*, Paris.
- OECD (1988), *OECD Economic Surveys: Norway*, Paris.
- OECD (1989), *OECD Economic Surveys: Italy*, Paris.
- OECD (1991), *National Accounts of OECD Countries, 1977-1989. Vol. II: Detailed Tables*, Paris.
- OECD (1992a), *Historical Statistics: 1960-1990*, Paris.
- OECD (1992b), *OECD Economic Surveys: Norway*, Paris.
- OECD (1992c), *OECD Economic Surveys: Spain*, Paris.
- PETERSON, George E. (1990), "Is Public Infrastructure Undersupplied?" in Alicia H. Munnell (ed.), *Is There a Shortfall in Public Capital Investment?*, Conference Series No. 34, Federal Reserve Bank of Boston, June, pp. 113-35.
- PETERSON, George E. (1991), "Historical Perspectives on Infrastructure Investment: How Did We Get Where We Are?", paper presented at the American Enterprise Institute Conference on "Infrastructure Needs and Policy Options for the 1990s", Washington, D.C., 4 February.
- ROHATYN, Felix (1992), "What the Government Should Do", *New York Review of Books*, 25 June.
- SMALL, Kenneth A., Clifford WINSTON and Carol A. EVANS (1989), *Road Work: A New Highway Pricing and Investment Policy*, The Brookings Institution, Washington, D.C.
- TATOM, John A. (1991), "Public Capital and Private Sector Performance", *Review*, Federal Reserve Bank of St. Louis, Vol. 73, May/June, pp. 3-15.
- US CONFERENCE OF MAYORS (1992), *Ready to Go: A Survey of USA Public Works Projects to Fight the Recession Now*, US Conference of Mayors, Washington, D.C.
- US CONGRESS (1984), *Hard Choices*, Joint Economic Committee, Government Printing Office, Washington, D.C.
- US CONGRESS (1990), *Rebuilding the Foundations: State and Local Public Works Financing and Management*, Office of Technology Assessment, Government Printing Office, Washington, D.C., March.
- US DEPARTMENT OF COMMERCE (1991), *Government Finances: 1988-89*, Bureau of the Census, Government Printing Office, Washington, D.C., February.
- US DEPARTMENT OF THE INTERIOR (1990), *National Water Quality Inventory 1988*, Environmental Protection Agency, Government Printing Office, Washington, D.C.
- US DEPARTMENT OF TRANSPORTATION (1987), *The Future National Highway Program: 1991 and Beyond*, Federal Highway Administration, Government Printing Office, Washington, D.C.
- US DEPARTMENT OF TRANSPORTATION (1990), *Moving America: New Directions, New Opportunities*, Government Printing Office, Washington, D.C., February.
- US HOUSE OF REPRESENTATIVES (1991a), "Hearings on Investments in America's Hometowns: Community Development, Issues in Urban Areas and Other Places", Committee on the Budget, Task Force on Community Development and Natural Resources, Government Printing Office, Washington, D.C., 26 September.

- US HOUSE OF REPRESENTATIVES (1991b), "Hearings on Our Nation's Transportation and Core Infrastructure", Committee on Public Works and Transportation, Government Printing Office, Washington, D.C., 20 February.
- US HOUSE OF REPRESENTATIVES (1991c), "The Status of the Nation's Highways and Bridges: Conditions and Performance", Committee on Public Works and Transportation, Government Printing Office, Washington, D.C., September.
- US SENATE (1991), "Hearings on Infrastructure, Productivity, and Economic Growth", Committee on Environment and Public Works, Subcommittee on Water Resources, Transportation, and Infrastructure, Government Printing Office, Washington, D.C., 5 February.
- WINSTON, Clifford M. (1990), "How Efficient Is Current Infrastructure Spending and Pricing?" in Alicia H. Munnell (ed.), *Is There a Shortfall in Public Capital Investment?*, Conference Series No. 34, Federal Reserve Bank of Boston, June, pp. 183-205.
- WINSTON, Clifford M. (1991), "Efficient Transportation Infrastructure Policy", *Journal of Economic Perspectives*, Vol. 5, winter, pp. 113-27.
- WINSTON, Clifford M. and Barry P. BOSWORTH (1992), "Public Infrastructure" in Henry J. Aaron and Charles L. Schultze (eds.), *Setting Domestic Priorities: What Can Government Do?*, The Brookings Institution, Washington, D.C.



*Chapter 3*

**Efficiency and Private Capital in the Provision  
of Infrastructure**

*by*

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**1. Introduction**

Infrastructure is easier to recognise than to define. This paper considers activities which have several of the following characteristics:

- They are networks, they involve delivery systems and there are substantial interactions in the provision of services to individual customers.
- They form a small but indispensable part of the total cost of the wide range of products in which they are used. Thus, the losses which result from service failure are often very large relative to the basic cost of service provision.
- They have substantial elements of natural monopoly. Competitive provision of the infrastructure itself is costly, often prohibitively so. This need not exclude competition in the use of infrastructure.
- Capital costs of infrastructure are generally large relative to the running costs.
- The sunk costs of establishing an infrastructure are substantial: a high proportion of the total cost of a service has already been irrevocably incurred before that service is offered.

The examples of infrastructure activities which spring immediately to mind – the distribution networks of public utilities and the development of road and rail systems – generally meet all five of these conditions. Activities which meet several but not all are sometimes categorised as infrastructure. For example, postal services and payment systems in the financial services industry have several features in common with utility distribution facilities: they involve networks, have significant sunk costs and satisfy what might be thought of as the test of “strategic importance”, *i.e.* they are widely used, are indispensable, and have a relatively low cost. However, they are not capital-intensive (although they are becoming increasingly so), and it is not clear whether or not they are natural monopolies.

As these examples illustrate, the five characteristics described above are logically independent of each other, although the last three – sunk costs, capital intensity and natural monopoly – are bound closely together and often confused. Together, they have traditionally been seen as casting doubt on the efficiency of private-sector, competitive provision. Two of them, natural monopoly and predominance of sunk costs, simply mean that competitive supply is unlikely to emerge. The network characteristic raises the possibility that efficient supply will not be achieved without mechanisms of central co-ordination. Finally, the strategic importance of the product means that governments have been unwilling to rely on the competitive private sector in circumstances where a single dominant supplier is likely to emerge, where unco-ordinated outcomes will probably be unsatisfactory, or where the large capital investments needed may not be provided in time.

In most countries, the outcome is that the majority of infrastructure activities are publicly owned, managed and financed. In transport, the government owns and operates the road system everywhere and the rail network almost everywhere; it often owns airlines, usually owns airports and always takes responsibility for air traffic control. In the energy industries, state-owned enterprises are still monopoly providers of electricity in most OECD countries, and are often also the sole suppliers of gas. The government everywhere retains the monopoly of postal services – which originated in the desire of medieval monarchs to inspect the correspondence of their citizens – and in most cases dominates telecommunications also. Curiously, competition in telecommunications seems to be facilitated where the language of communication is English – thus competitive public telecommunications networks have been licensed in the United States, the United Kingdom, Australia and New Zealand but in few other jurisdictions.

These state monopolies in infrastructure activities are under increasing scrutiny and mounting pressure. This pressure has several origins. The 1980s saw a movement worldwide towards privatisation and deregulation. This was the result of an intellectual revival of faith in free markets whose implications extended widely. There was also growing dissatisfaction, particularly in Anglo-Saxon countries and LDCs, with the performance of state-owned enterprises. In addition, the 1980s saw government budgets under pressure as a political and economic reaction to the expansion of the 1960s and early 1970s. With that came an anxiety to remove or reduce the impact of infrastructure spending on government budgets. This was seen both as a means of minimising government borrowing and as a way of protecting economically necessary but politically dispensable infrastructure expenditure from general budgetary pressures. These were the considerations that led to the first major utility privatisation – the sale of a 51 per cent stake in British Telecom to the public in 1984 – and the example has been followed both in other utilities and in other countries.

Pressure on traditional patterns of state control and financing of infrastructure activities has come from two other sources. With public ownership has gone the national organisation of infrastructure activities. While national boundaries often corresponded to national transport links and resource locations, evolving history and changing technology have made these divisions increasingly irrelevant. The management of infrastructure activities on national lines has therefore become a barrier to trade. While several countries have national high-transmission networks in electricity, the capacity of these networks to interact with each other is quite limited. Sometimes barriers to trade in infrastructure activities prevent production being organised on an efficient basis which would ignore frontiers, as with air traffic control. Europe's fragmented structure compares

unfavourably with the efficient systems in place in the United States, where the concept of Kentucky's airspace is not contemplated, let alone protected. Sometimes, as in telecommunications, national organisation acts as an obstacle to the development of competition which would favour the more efficient operators over the less. The European Commission in particular has been concerned by these issues and has taken or proposed actions in transport, energy and communications that would increase access to national infrastructure for service providers from other member states.

At the same time, technological changes have been challenging traditional methods of supply. In telecommunications, microwave links have made it economical to provide long-distance connections at relatively low volumes, and so have eroded the natural monopoly previously enjoyed by PTTs. In the airline industry, technological change has fostered industry concentration, with the lower running costs of large modern planes favouring hub-and-spoke patterns of operation and the development of computerised reservation systems giving, unexpectedly, a range of benefits to bigger airlines. The consequence, however, is the same; the organisation of production by primary reference to national producers makes much less sense than it did.

Although the trends of the last decade have moved unambiguously in one direction, they have encountered stiff resistance. Established utilities have, almost without exception, emphasized the advantages of co-ordination and vertical integration; it is only in a small number of countries with a strong ideological commitment to microeconomic reform, and a larger, poorer group in which such reform has been a condition of structural assistance, that substantial changes have occurred. The self-interested origins of the counter-arguments do not, of course, mean that they are without merit. Moreover, it is important to recognise, as the more enthusiastic advocates of privatisation often fail to do, that state provision and management of infrastructure activities is not the product of sheer perversity. There are well-founded reasons, described above, for doubting the feasibility and effectiveness of competitive market provision of these services, and it is certainly not the case that the role of government ceases, or necessarily becomes less complex and wide-ranging, when private ownership, management or capital is introduced.

If the private sector is to take a greater role in the provision of infrastructure services, it can provide capital, management, or both. If it provides either, then the existing structure of relationships within the framework of state management and control will have to be changed to a more explicit system of regulation of private sector bodies by public agencies. This paper examines the issue of private capital in infrastructure activities, beginning with an illustration of some of the ways in which such capital has been deployed. It goes on to consider the relative costs of private and public capital. The conclusion of the analysis is that there are significant differences only if the introduction of capital is associated with a change in the allocation of risks, and such a change is likely to be achieved only if there is also a change in the structure of management responsibility.

Discussion of the evidence on the effects of introducing private management to activities previously undertaken in the public sector leads to a precisely complementary conclusion: this will promote efficiency only if it exposes the private contractor to significant risk, either (and preferably) through competition or through incentive-based regulation. Thus, the value of introducing private capital is directly related to its combined effectiveness in transferring risk and responsibility. The paper closes with an assessment of several financing vehicles in terms of these criteria.

## **2. Private financing of infrastructure investment**

This section provides brief details of some specific infrastructure projects in which private financing has been utilised, in order to indicate the range of issues and possibilities. Private financing has most often been used in transport projects, and most examples here relate to transport, but the section also draws on cases from a number of other industries.

### ***Eurotunnel***

Eurotunnel is probably the largest infrastructure activity ever undertaken wholly on the basis of private financing. On completion, probably in early 1994, the company will offer a twin rail tunnel service between Folkestone in England and Sangatte in France, accommodating private vehicles in specially designed trains, as well as offering direct rail services between London and Paris and Brussels. The UK legislation facilitating the project precludes any public finance or subsidy towards it.

The Eurotunnel proposal was selected from a number of competing bids after the French and British Governments agreed in principle to support a fixed link between the two countries. These bids included alternative fixed-link concepts, such as a road tunnel and a mixed bridge/tunnel approach. Bids were funded by consortia which mainly consisted of companies likely to be awarded supply or construction contracts if the bid was successful. Once Eurotunnel was awarded the franchise, a second round of equity financing was provided by investing institutions. This allowed the preparation of detailed plans, and on this basis the major part of the finance was obtained on fixed-interest terms from a group of banks. Additional equity was raised through a public offering of shares, and the company is quoted on the London and Paris stock exchanges. It enjoys unregulated rights to tunnel revenues for fifty years, after which ownership reverts to the two governments. It also has a first option on any other fixed-link proposal during the first half of its franchise.

The project has been subject to major cost overruns, and appears to have been in technical breach of its banking covenants on several occasions; however, it now seems likely that the tunnel will be completed without requiring a wholesale financial reconstruction of the Eurotunnel operating company.

### ***Spanish motorways***

Several European countries have developed their motorway system through concessions funded by user tolls. In most cases, however, the concessionaires are wholly or substantially publicly owned. Spain has emphasized private finance by awarding concessions to consortia based on groups of banking institutions and construction companies. The Spanish Government has been anxious to secure external financing of these projects and has therefore offered guarantees against default to foreign purchasers of bonds as well as exchange rate risk guarantees to the concessionaires. Tolls are regulated and the length of concessions is designed to enable franchisees to recoup their construction costs. Spain is well suited to tolled motorways, with relatively large distances between major population centres and limited numbers of good quality "free" roads in competition with the motorways. Nevertheless, a number of concessionaires have encountered financial

difficulties, and the government has taken over ownership through its own holding company.

### *German transport communities*

The Hamburger Verkehrsverbund (HVV), founded in 1965, has proved a model for transport communities in other parts of Germany. The HVV is an umbrella organisation which provides transport services in and around Hamburg with a common identity, co-ordinated timetables, and integrated ticketing. All services are provided by HVV shareholders under contract to the HVV itself. The largest equity stakes are held by the Hamburg city municipal transport service and the Deutsche Bundesbahn, both of which are publicly owned and loss-making. Other members of the consortium operate as private profit-making businesses and, although none of the members of the HVV is wholly privately owned, such companies do participate in transport communities in other parts of Germany.

### *Australian electricity*

Loy Yang B is a brown coal-burning power station currently under construction in the Australian state of Victoria. As in other parts of Australia, electricity generation in Victoria is under the control of a state-owned corporation, the State Electricity Corporation of Victoria (SECV).

Due to the large cost, and the budgetary difficulties encountered by Victoria, the government sought private finance for this project. It reached agreement with a consortium of banks and a Canadian company, Mission Energy, which will complete financing. Mission Energy will be responsible for operating management, and the output of the station will be sold under a long-term contract to SECV at a price designed to recoup its capital costs. It is expected that Mission Energy will be able to operate Loy Yang B with manning levels significantly lower than those in plants operated directly by SECV.

### *UK water*

Until 1989, most water supply and all sewerage services in England and Wales were provided by autonomous government-owned water authorities. Shares in the authorities were sold in a public flotation and are now quoted on the London Stock Exchange.

These companies are now free to borrow as they wish on the private capital market (or indeed to raise fresh equity, although they have not done so on any scale). Their charges are regulated so as to allow them to recover the costs of new investment programmes, and a provision for interim determinations allows the regulator to adjust prices up or down to reflect variations between anticipated and out-turn capital expenditure. Savings or overruns in operating costs initially accrue to the company, but a provision for regulatory review after five years enables the charging level to be rebased at that time.

### *French water*

Water provision in France is the responsibility of municipalities. Increasingly it is contracted out, and there are now more than 10 000 franchises. Two companies – CGE and Lyonnaise – are dominant in the provision of franchises, accounting for two-thirds of the total.

The most common form of franchise is the leasehold contract, with a period of ten years, in which the operator is responsible for service, operation, maintenance and billing. The contract requires investment in short-life assets, but the municipality funds and retains ownership of the principal infrastructure assets. In some municipalities there are shorter management contracts; in others, the term of the franchise is longer – twenty-five or thirty years – but the franchisee is responsible for infrastructure investment and the cost can be recovered over the life of the franchise. Although there is often fierce competition for the initial right to a franchise, it is very rare for an incumbent franchisee to be displaced.

### *UK refuse services*

British local authorities are now required to submit the business of refuse collection to competitive tender at regular intervals. The successful contractor will manage the assets of the authority for the period of his franchise, and will generally take over the personnel of the authority (or of the previous contractor), although he may change the senior management or reduce the number of employees. His ability to do this may be restricted by the provisions of a European Community directive on transfer of undertakings.

Initially, most contracted-out services were performed by private firms. As contracting out has proceeded, however, the majority of tenders have been won by the local authority's own staff, reformed as an autonomous management unit for the purpose. This reflects the waning of excessive optimism on the part of early contractors, as well as the greater efficiency achieved by the public sector organisations themselves.

### *Competitive telecommunications*

In most countries, telecommunications have traditionally been the province of an integrated monopoly. A number of countries have now permitted the development of alternative public networks, and the resale of capacity leased from the dominant provider. These new public telecommunications operators may be in competition with an established, privately owned but regulated incumbent (the United States), a newly privatised state concern (the United Kingdom), or a firm which remains in public ownership (Australia).

The viable provision of alternative facilities requires that the incumbent give the entrant access to its network, and the terms of such access have been a critical issue in all cases.

## Summary

Tables 1 and 2 attempt to classify these very different ways of introducing private finance into infrastructure projects by three key criteria: who bears the risks associated with the project, who is responsible for management, and whether there is a government guarantee underpinning the loans or bonds which fund the project. The risks are of two principal kinds, or phases. One group is associated with capital expenditure and the management of the capital project. Other risks are attributable to demand uncertainty or operating cost variation.

In some cases, the existence or absence of government guarantee to lenders has yet to be tested; often, although the government has given no formal undertakings, it seems in practice inconceivable that the borrower would be allowed to default. It is difficult to imagine that ownership of London's water and sewerage facilities could be allowed to pass into the hands of a receiver or liquidator, and the regulator has a statutory obligation to ensure that the company which provides the services concerned can, by obtaining a reasonable return on capital, secure the proper financing of its functions. The Loy Yang B arrangements are structured so as essentially to rule out the likelihood of default. It is unlikely (although not impossible) that Eurotunnel plc would fail, but the possibility of a financial reconstruction in which bonds lost part of their value is one that has to be entertained, and it is claimed that Eurotunnel debt has been traded at a significant discount to its face value. In all cases, there seems to be a possibility of loss to private equity holders, although these mostly represent a small proportion of the total finance provided.

There are several criteria which should be applied in an evaluation of Tables 1 and 2. If there is no difference in the allocation of either risk or management responsibility between the two tables, then the introduction of private finance is purely cosmetic. The more often the word "company" appears, the more extensive is the involvement of private financing, and efficiency dictates that management and risk-bearing should as far as possible be associated with each other. The paper will return to these issues.

**Table 1. Risk allocation with public financing**

	Capital cost risk?	Capital cost management?	Operating cost risk?	Operating cost management?
Eurotunnel	Customer	Government	Customer	Government
Spanish motorways	Taxpayer	Government	Customer	Government
Australian electricity	Customer	Government	Customer	Government
UK water	Customer	Government	Customer	Government
Refuse	Taxpayer	Government	Taxpayer	Government
French water	Customer	Government	Customer	Government
Competitive telecoms	Customer	Government	Customer	Government
German transport	Taxpayer	Government	Customer	Government

Table 2. **Risk allocation with private financing**

	Capital cost risk?	Capital cost management?	Operating cost risk?	Operating cost management?	Government guarantee?
Eurotunnel	Company	Company	Company	Company	No
Spanish motorways	Taxpayer	Company	Customer	Company	Yes
Australian electricity	Customer	Government/ Company	Customer/ Company	Company	De facto
UK water	Customer	Company	Customer/ Company	Company	De facto
Refuse	Taxpayer	Government	Company/ Taxpayer	Company	Yes
French water	Customer	Customer	Customer	Company	Yes
Competitive telecoms	Company	Company	Company	Company	No
German transport	Taxpayer	Taxpayer	Company	Company	Yes

### 3. The cost of capital

The introduction of private capital into infrastructure investment is likely to affect the cost of capital for such activities. There are several points of departure for evaluation here. The cost of capital is lower to almost any Western government than it is to almost any private sector firm. Government debt has the twin attributes (rarely otherwise obtainable) of offering a high degree of security and being available in very large quantities. The combination of safety and marketability is uniquely attractive to investors, and debt which is guaranteed by the governments of major states has persistently attracted the highest ratings of credit agencies.

A quite different perspective is suggested by the Modigliani-Miller theorem, which emphasizes that the cost of capital to a project or activity is determined by the risk characteristics of the underlying stream of returns and is unaffected by the mixture of debt and equity involved in its financing, or by other characteristics of its capital structure. (This is explained in most corporate finance texts, *e.g.* Brealey and Myers, 1991.) In this world, the repackaging of securities involved in the introduction of private (including equity) investors into public projects is irrelevant to the correctly measured cost of financing such projects.

These views give an incomplete picture of the issues, but both contain substantial elements of truth. The Modigliani-Miller view emphasizes that the cost of financing a project depends essentially on its risk profile. Unless alternative methods of financing change that risk profile – by affecting the nature of the risks or the way in which their ultimate burden is assigned between shareholders, taxpayers and other shareholder groups, or by improving the information agents have about the nature of the risks they assume – they will not influence the cost of capital.



The view that “private sector capital costs more” is naive, because the cost of debt both to governments and to private firms is influenced predominantly by the perceived risk of default rather than by an assessment of the quality of returns from the specific investment. We would lend to the government even if we thought it would burn the money or fire it off into space, and we do lend to it for both these purposes. It is not relevant to project evaluation that capital is apparently cheap to the public sector because the government is a good credit risk, and this credit risk is unrelated to the project risk.

Where the introduction of private capital does not change either the allocation of risks associated with public projects or the firm or the incentive of their management, it will be likely to increase the costs of these projects. In particular, where that private capital represents pure off-balance-sheet financing – *i.e.* financing which has no effect on the ultimate distribution of the costs and benefits of public projects – it can only have the effect of substituting state obligations that are not transparent and poorly marketable for debt that is wholly transparent and wholly marketable. This substitution must increase financing costs overall. The argument that creative accounting lowers the cost of capital to a firm by successfully deceiving investors as to the nature of the risks they assume may have some validity; applied to governments, it is much less persuasive.

This section began by considering how the cost of capital is measured in practice in both public and private sectors. The discussion will show that measurement procedures differ for reasons that relate only loosely to real differences in the costs of public and private finance. The issue of what these real differences in costs actually are will be addressed later.

The most commonly accepted method of measuring the cost of capital for privately funded activities is the capital asset pricing model (CAPM) (see, for example, Brealey and Myers, 1991). The CAPM builds up the cost of capital from two components: the risk-free rate, generally measured by the real yield available on government securities, and a risk premium. That premium is the product of a general equity premium and the  $\beta$  coefficient, a measure of the correlation between firm, project or activity risk and general market movements. Thus, the CAPM assesses the cost of capital by referring to the relationship between the anticipated costs and revenues of the project under evaluation and activity in the economy at large. Specific risk – for example, the failure of a project for reasons unconnected with broader economic conditions – is discounted by the CAPM, as such risks are assumed to be wholly diversifiable.

The approaches most generally adopted for the assessment of the cost of capital for public projects are rather different (see, *e.g.*, Arrow, 1966 and Kay, 1972). The point of departure here is conventionally the social time preference rate – the market rate at which consumers or taxpayers trade off future for current consumption – which is similar to the risk-free bond rate which underpins the CAPM. Generally, however, this rate is increased by reference to the social opportunity cost of capital, an estimate of the returns which would be earned by the same funds invested in the private sector. A common reference point for such an estimate is the hurdle rate used in investment appraisal by large private firms.

Although these two approaches should not give substantially different answers, there are several reasons why, in practice, results differ. First, the CAPM yields answers that are often surprisingly high. The equity premium that is used for an earnings stream with a  $\beta$  coefficient of 1 is generally around 8 per cent after tax, a figure derived from a range of long-term analyses of stock price movements in the United Kingdom and the United

States. This generally implies an after-tax cost of equity capital in excess of 10 per cent in real terms. This figure is higher than the *average* rate of return on equity in most economies and, given typical equity yields of 5 per cent or less, the assumed cost of equity implies an indefinite rate of dividend growth well in excess of the real growth rates of OECD economies. In other words, if investors' expectations are truly in line with the CAPM, it is very difficult to see how the corporate sector as presently structured can fulfil them.

Secondly, the treatment of tax is a complicated issue. This applies both to its incorporation in estimates of the cost of capital and in the way in which it is levied on infrastructure activities that are wholly or partly privately financed. In general, however, tax bears more heavily on private than on public financing. A third factor is that hurdle rates of return, in either the public or private sector, tend to be substantially in excess of realised rates of return. An important aspect of this is that hurdle rates include a necessary premium for appraisal optimism. Taken together, these considerations have the normal consequence that the rate of return applied by governments in the assessment of public sector investment activities is lower than the cost of capital applied to similar projects by providers of private sector finance. It should be emphasized that this cannot be interpreted as meaning that public sector financing is, in either a commercial or economical sense, cheaper.

There is thus a contrast between public sector financing, which characteristically has a lower required rate of return but for which the funds available are typically rationed, and private sector financing, which demands a higher hurdle rate but for which capital is likely to be available for any project that meets the rate-of-return criteria. That contrast is the result of institutional factors rather than the nature of the financing systems themselves. It is, however, an important element in the increasing inclination of governments to push high-return public sector projects towards the private sector.

One effect of this use of different discount rates is to bias the choice of technique. There is a tendency for the public sector to favour long-life, capital-intensive approaches (but often not to embark on them at all), while the private sector favours shorter-life, lower-capital cost options. Eurotunnel well illustrates the issue. There was protracted analysis of a variety of ambitious, publicly promoted options, but the privately financed option that is actually being built (the rail-only tunnel) is the cheapest fixed link feasible, and offers a relatively low quality of service. Electricity privatisation in the United Kingdom led to the abandonment of nuclear power and large-scale capital-intensive generation, in favour of gas-fired plant with short construction periods and low capital costs.

Still, the central Modigliani-Miller result remains valid. The introduction of private capital will affect the costs of the project to the extent that, and only to the extent that, it alters the underlying risk structure associated with the project. It can do so in one of three ways: by changing the risk allocation, changing the process of risk-monitoring, or altering responsibility for risk management.

As far as the first factor – risk allocation – is concerned, the basic analysis is that of Arrow and Lind (1970). If there is a complete set of markets in risk-bearing, then there will be no difference in the costs of managing a given risk between the public and private sector, since directly or indirectly markets will secure the same effective allocation. If that set of markets is incomplete, the costs of risk depend on the degree to which the risk is spread across a relatively large number of potential holders. Mostly, though not

invariably, this favours the public sector. In the main, it cannot be expected that there will be large differences in costs, but the introduction of private financing is more likely to raise than to lower them.

This conclusion assumes, however, that the underlying structure of risks is unaffected by the financing mechanism. The introduction of private capital may change the nature of these risks, either because different people manage the risks or because, even with the same people managing them, they are subject to different or more extensive monitoring.

Exposure of projects to external scrutiny is often suggested as an efficiency benefit of private financing. Such scrutiny is real only if financial market returns relate to the performance of the project rather than the performance of the issuer. As was emphasized above, the probability that debt will be repaid often reflects the credit rating of the borrower rather than the nature of the activity for which the borrowing is incurred. Table 3 explores more precisely how finance is provided for the range of activities described in Section 2.

For many infrastructure activities, finance is project-specific. Project finance structures were developed most extensively for North Sea oil exploration, and have since been used in many other sectors. The problem they are designed to overcome is that publicly traded equity is poorly suited to the financing of individual risky projects, because of the difficulties in conveying information about the nature of the risks, and progress in controlling them, to a range of equity shareholders. Generally, therefore, there is a high ratio of debt to equity in the financing structures and little, if any, equity of a traditional kind.

**Table 3. How capital financing is obtained**

	Main source of capital finance	Returns depend on:		
		Performance of project	Performance of all contractors' activities	Government guarantee
Eurotunnel	Project-specific loans and project-specific equity	Yes	Yes	No
Spanish motorways	Project-specific loans	Yes	No	Yes
Australian electricity	Project-specific loans	No	No	Yes
UK water	Firm specifications and firm-specific equity	No	Yes	?
Refuse	Local authority debt	No	No	Yes
French water	Local authority debt, some firm-specific equity	No	Slightly	Yes
Competitive telecoms	Firm- or project-specific loans and equity	Yes	Yes	No
German transport	Local authority- or government agency-dependent	No	No	Yes

Again, Eurotunnel illustrates this issue clearly. Of the probable £8 billion construction cost, around £7 billion will be provided as fixed-interest finance – a gearing ratio that would be high for any company, and especially so for one engaged in a single speculative project. The consortium providing the bank finance is supplied with regular and detailed project progress reports; the shareholders, the ostensible owners of the tunnel, obtain relatively limited information. This pattern of high gearing combined with detailed supervision by a banking consortium is common to most private financing of infrastructure projects.

The other way in which the introduction of private sector financing may change the risk assignment associated with the project is by changing the nature of the risks themselves, through company project management, so that cost overruns are less likely and operating cost uncertainties reduced. This brings up the broader question of the relative efficiencies of private and public sector management in infrastructure activities, to which the paper now turns.

#### **4. Private capital, efficiency and competition**

The relative efficiency of public and private enterprises has been the subject of extensive research. Two substantial surveys of the evidence a decade ago reached conflicting conclusions. Borchering *et al.* (1982), for example, conclude that the empirical findings are “consistent with the notion that public firms have higher unit cost structures”, while Millward (1982) finds “no broad support for private enterprise superiority”.

The absence of decisive results partly reflects the difficulties involved in making meaningful comparisons. There are problems in finding a suitable “test bed” – that is, sectors in which both public and private enterprises operate; when any are found, they are almost inevitably unrepresentative. For example, they are more likely to be competitive industries, in which many public enterprises face distorted input prices (such as access to government finance on preferential terms or obligations to purchase the output of national producers) and are required to fulfil various non-commercial functions. When outputs are not sold in competitive markets, an appropriate measure of output may need to be devised.

Since 1982, evidence has accumulated from a variety of sources. The efficiency effects of the most extensive privatisation programme – that of the United Kingdom – are shown in Table 4. There are three principal findings. First, there have been substantial gains in efficiency right across the group of firms that were publicly owned in 1979. Secondly, there is a clear break in the trend of performance that occurs around 1983, the date at which the privatisation programme gathered momentum. Thirdly, however, the improvement in performance appears to be independent of whether or not the particular industry concerned has been privatised. Indeed, the most striking success stories of UK privatisation are British Steel and British Airways; both were transformed from overmanned and inefficient state enterprises into the most efficient European firms in their sectors – yet in both cases the most substantial performance improvement occurred within the public sector. The causation runs from improved efficiency to privatisation, rather than the other way.

Table 4. **Total factor productivity in the UK public sector, 1979-90**

Rate of change, percentage *per annum*

	1979-90	1979-84	1983-90
British Airports Authority	1.0	-1.6	2.6
British Coal	2.6	-0.8	4.6
British Gas	1.0	-1.0	2.2
British Rail	1.2	-2.9	3.7
British Steel	6.4	4.6	7.5
British Telecom	3.5	3.0	3.7
Electricity supply	1.5	-0.3	2.6
Post Office	2.3	1.7	2.7
Average	2.4	0.3	3.7

*Source:* Bishop and Kay, 1988.

Thus, the evidence requires careful interpretation, central to which are the varying interactions between ownership and competition and the effects of regulation in markets where competition is absent. This leads away from simple assertions about the supremacy of one kind of ownership over another, and towards a number of broader conclusions.

In particular, most analysis is consistent with the belief that all enterprises (public or private) perform more effectively where product markets are competitive than where competition is absent. Almost all evidence concerning deregulation – the ending of statutory monopoly – supports this view (see, for example, developments in US aviation and road haulage, as well as the recent introduction of competition into sectors such as express coach services, telecommunications equipment and domestic air services in the United Kingdom).

Some studies also suggest that where product markets are competitive, the efficiency of some public enterprises may match that of private firms (Borcherding, 1982; Millward, 1982; Pryke, 1982). In Canada, the publicly owned Canadian National Railroad faced competition both from the privately owned Canadian Pacific and from alternative transport modes. Investigation of their performance has shown no difference in efficiency between the two railroad companies.

In the United Kingdom, the recent introduction of competitive tendering for such services as refuse collection and hospital cleaning has resulted in significant efficiency improvements. However, the public sector suppliers have been able to win contracts by matching the efficiency of private sector competitors. The important influence on performance is competition (or contestability) rather than ownership.

This is also reflected in the performance of parastatal marketing agencies in less developed countries. Uma Lele (1976), for example, found that “the marketing margins incurred by the government and parastatal agencies are almost invariably higher than those incurred by traditional (private) traders...Government agencies usually also have a poor record in timeliness of services in purchasing from the producer and selling to the consumer”.

A more ambiguous picture emerges in cases where product market competition is absent. Studies of sectors as diverse as electric utilities in North America and insurance services in western Germany show no general support for the view that the private firms are more efficient than public firms in these circumstances. In fact, there is some indication that the regulation of private firms has distorted incentives in ways which caused performance to fall short of that of corresponding public enterprises [see for example Pescatrice and Trapani (1980) on US electric utilities, and Finsinger and Pauly (1985) on German insurance companies].

The extent to which continued regulatory supervision is necessary when private capital is introduced is, therefore, critical to an assessment of the latter's likely efficiency effects. The introduction of effective product market competition in most infrastructure activities is impossible. The paper therefore considers how competitive forces may be utilised in these cases, and then turns to an assessment of the forms which regulation has taken.

### ***Competition through franchising***

In areas where competition is apparently impossible, franchising or "contracting out" is an attempt to introduce at least an element of it through setting up competition *for* the market rather than competition *in* the market. Potential monopoly power in the market is held in check by the competitively determined terms of the franchise contract. The government seeks to avoid the problem of taking decisions based on inadequate information through the use of competition between informed potential franchisees: competition acts as a discovery mechanism.

Table 5 shows how contractors were selected for the variety of projects described in Table 1. Some cases involve open public competition; in others, the franchise is awarded to a preferred contractor or an incumbent. Where there is competition, it may reflect the entire variety of services provided (Eurotunnel), or may be based principally on price (UK refuse collection). Where the franchise is auctioned to the highest bidder, the mechanism transfers the benefits of any monopoly power the successful bidder may enjoy to the government, but does not protect the consumers from the costs of its exploitation.

**Table 5. How contractors were chosen**

Eurotunnel	Open public competition, primarily based on likely viability of proposed scheme
Spanish motorways	Government selection with some competitive element
Australian electricity	Government selection with some competitive element
UK water	Appointment automatically awarded to publicly owned incumbent
Refuse	Open public competition
French water	Local government selection by initial open competition
Competitive telecoms	Government selection, with limited competition
German transport	Incumbents automatically appointed

Where the franchise is awarded to the bidder who proposes to charge the lowest prices, or to offer the best services (the Chadwick-Demsetz auction), if there is sufficient competition for the franchise, customers will obtain the franchised services at something close to the cost of provision.

Although franchising appears to offer a combination of competition and efficiency with minimal regulation, the franchise mechanism is not without its difficulties (Bishop and Kay, 1989). Unfortunately, the industries in which government control problems are greatest (such as energy, telecommunications and water) are especially prone to such difficulties.

These include the following:

- Bidding for the franchise may fail to be competitive because there may be very few competitors due to scarcity of requisite skills, collusion between bidders, or, most importantly, strategic advantages possessed by the incumbent franchisee that deter challenges. These could arise from experience effects, or superior information over potential bidders.
- Problems associated with asset hand-over in the event of an incumbent franchisee being displaced may distort incentives to invest (and indeed the nature of competition for the franchise). The valuation of sunk assets is both difficult and costly. If the incumbent expects that their value in the event of a hand-over would be set too low (high), and if there is a chance of his being displaced, then his incentive to invest will be correspondingly too low (high). The problem is diminished if the sunk assets are under independent ownership and the franchise is simply an operating one, but this raises questions of how the franchiser determines the level of facilities to be provided: as usual, the choice is between information problems or incentive problems.
- If there is technological or market uncertainty in relation to the product or service in question, then the specification of the franchise contract will be a complex task, and the need to monitor and administer the contract during its lifetime is certain to arise. In the privatised utility industries, for example, it would be impossible to cater for every eventuality that might occur in the life of even a short-term contract. That leaves incompletely specified contracts, but they require continuing contract administration.

When is franchising or contracting out appropriate? Two principal questions must be asked. Is the activity sufficiently similar to an existing private sector operation for privatisation to generate effective competition in the provision of management skills? Is it possible to define the services to be provided in a sufficiently clear-cut way, to allow performance to be monitored objectively? Street-cleaning, for example, evidently meets both of these criteria. Private firms already do very similar things, and it is easy to tell whether the streets are indeed clean. The administration of justice or the collection of tax are examples of public activities that fall at the opposite end of the spectrum. Although private courts and private tax collectors exist, they do not generally meet with much approval. The fundamental difficulty lies in specifying the contract for the service to be provided. The most economical methods of making judicial decisions or obtaining revenue are not acceptable, and the business of defining in sufficient detail the codes by which either is to be done would be tantamount to managing the activity concerned.

The attractiveness of franchising thus varies with circumstances. It works best where there are numerous potential competitors with the requisite skills, where sunk costs are

not high, and where technological and market uncertainty is not great. Secondly, franchising involves an implicit regulatory arrangement for all but the simplest products and services. It should be seen not as an alternative to regulation, but as a form of it that seeks to use some of the desirable incentive properties of competition.

### ***Price regulation***

In most cases where private management or capital is introduced into infrastructure activities, some element of price regulation is necessary. As noted above, franchise competition may reduce this need – that will be true if there is adequate competition and the franchiser either prepares to accept a transfer of monopoly profit from customers to the franchisee, or uses price and service quality as primary criteria in selecting the preferred incumbent. Even where there is such competition, however, price regulation of a formal or informal kind is usual, and bids are constructed with this expectation in mind. Table 6 shows the institutional mechanisms of price regulation adopted in the cases described in Table 1.

The two principal mechanisms of price regulation employed where product market competition is inadequate are 1) those based on costs and rates of return, and 2) those related directly to price caps. The central difficulty is to reconcile the objective of restraining monopoly power (which requires that prices be related to costs) with that of securing maximum operating efficiency (which requires that contractors obtain at least some benefit from their own success in cost reduction). Rate-of-return regulation scores well on the first criterion, but poorly on the second. Price cap regulation appears to offer greater incentives to efficient operators, since the operator retains the benefit of lower-than-anticipated costs. However, that depends on the regulator’s ability to derive some measure of what costs should be, which is at least partly independent of the actual costs incurred. In the industry in which the price cap approach has been most explicitly adopted – UK water – the regulatory regime appears in practice to be converging quite rapidly on rate-of-return regulation.

The most promising attempt to overcome this difficulty has involved devising a measure of what costs ought to be through yardstick competition – *i.e.* regulating each operator by reference to the performance of others. This is most often possible where

**Table 6. How prices charged are regulated**

Eurotunnel	No regulation, some competition from ferries
Spanish motorways	Government supervision
Australian electricity	Output sold to public agency at contractually determined price
UK water	Price cap imposed by independent regulator
Refuse	Competitive bidding for contract
French water	Cost pass-through mediated by local authority
Competitive telecoms	Prices limited by competition with regulated incumbent
German transport	Communities are dominated by public agencies



there are different regional providers of comparable services, and the benchmarking techniques that are increasingly used in private industry provide a technical basis for this approach. However, there is a considerable difference between the degree of comparability needed for a qualitative comparison of performance, and that needed for an objective basis for regulation which will stand up to scrutiny and (ultimately) legal challenge. For this reason, yardstick competition remains more a theoretical concept than a practical tool.

## 5. Conclusions

This paper has illustrated the variety of ways in which private financing has been, and can be, introduced into infrastructure projects. Such schemes can add value only where they substantially alter the risk allocation and management responsibility associated with these activities. Some proposals are purely cosmetic – the public sector analogue of the private sector’s off-balance-sheet financing.

A change in risk allocation is only meaningful, and normally only possible, when it is combined with a change in management responsibility; equally, a change of management responsibility is likely to be effective only when combined with a change in risk allocation, as a result of either the introduction of competitive forces or a meaningful structure of incentive-based regulation. This can occur either when a banking consortium not only provides finance for the project but also relies for repayment on the performance of the project itself (and not on the general creditworthiness of the borrower), or when responsibility for project construction or operating management (or both) is transferred to an equity shareholding group who are directly exposed to risk of capital loss or inadequate current revenues. Some methods of introducing private capital substantially meet these criteria, and Table 7 offers an assessment of the various infrastructure projects described here based on the extent to which the transfer is achieved. As will become apparent, the ratings are measures of the incentives to efficiency, rather than the extent to which efficiency is achieved: few would rank Eurotunnel, which gets a high rating on this basis, among the best managed of infrastructure projects. The best that can be said is that the losses that result will mostly be borne by the private capital market.

**Table 7. Degree to which risk and management responsibility have been transferred to the private sector**

Eurotunnel	* * * * *
Spanish motorways	* * *
Australian electricity	* * *
UK water	* *
Refuse	* * * *
French water	*
Competitive telecommunications	* * * *
German transport	*

## Bibliography

- ARROW, K.J. (1966), "Discounting and Public Investment" in A.V. Kneese and S.C. Smith (eds.), *Water Research*, Johns Hopkins University Press, Baltimore.
- ARROW, K.J. and R.C. LIND (1970), "Uncertainty and the Evaluation of Public Investment Decisions", *American Economic Review* 60, pp. 364-78.
- BAILEY, E.E. (1986), "Price and Productivity Change Following Deregulation: The US Experience", *Economic Journal* 96.
- BAUMOL, W.J. (1968), "On the Social Rate of Discount", *American Economic Review* 58, pp. 802-988.
- BISHOP, M.R. and J.A. KAY (1988), "The Impact of Privatisation on the Performance of the UK Public Sector", presented at the 15th Annual Conference of EARIE, Rotterdam.
- BISHOP, M.R. and J.A. KAY (1989), "Privatization in the United Kingdom: Lessons from Experience", *World Development*, Vol. 17, No. 5, pp. 643-57.
- BORCHERDING, T.E. et al. (1982), "Comparing the Efficiency of Private and Public Production: The Evidence from Five Countries", *Zeitschrift für Nationalökonomie, Supplementum* 2.
- BREALEY, R.A. and S.C. MYERS (1991), *Principles of Corporate Finance*, 4th edition, McGraw-Hill.
- CAVES, D.W. and L.R. CHRISTENSEN (1978), "The Relative Efficiency of Public and Private Firms in a Competitive Environment: The Case of Canadian Railroads", Social Systems Research Institute, Workshop Series.
- DEMSETZ, H. (1968), "Why Regulate Utilities?", *Journal of Law and Economics* II, pp. 55-65.
- DIAMOND, P.A. (1968), "Opportunity Costs of Public Investment: Comment", *Quarterly Journal of Economics* 82, pp. 682-88.
- DOMBERGER, S., S.A. MEADOWCROFT and D.J. THOMPSON (1986), "Competitive Tendering and Efficiency: The Case of Refuse Collection", *Fiscal Studies*, Vol. 7, No. 4, pp. 69-87.
- DOMBERGER, S., S.A. MEADOWCROFT and D.J. THOMPSON (1987), "The Impact of Competitive Tendering on the Costs of Hospital Domestic Services", *Fiscal Studies*, Vol. 8, No. 4, pp. 39-54.
- FINSINGER, J. and M.V. PAULY, eds. (1985), *The Economics of Insurance Regulation: A Cross National Study*, Macmillan.
- KAY, J.A. (1972), "Social Discount Rates", *Journal of Public Economics* 1, pp. 359-78.
- KILLICK, T. (1986), "Twenty-five Years in Development: The Rise & Impending Decline of Market Solutions", *Development Policy Review* 4.
- LELE, U. (1976), "Considerations Related to Optimum Pricing and Marketing Strategies in Rural Development", 16th Proceedings of the International Conference of Agricultural Economics.
- MARGLIN, S.A. (1963a), "The Social Rate of Discount and the Optimal Rate of Investment", *Quarterly Journal of Economics* 77, pp. 95-112.

- MARGLIN, S.A. (1963*b*), "The Opportunity Cost of Public Investment", *Quarterly Journal of Economics* 77, pp. 274-89.
- MILLWARD, R. (1982), "The Comparative Performance of Public and Private Enterprise" in Lord Roll (ed.), *The Mixed Economy*, Macmillan, London.
- PESCATRICE, D.R. and J.M. TRAPANI (1980), "The Performance and Objectives of Public and Private Utilities Operating in the United States", *Journal of Public Economics*, Vol. 13, No. 2.
- PRYKE, R. (1982), "The Comparative Performance of Public and Private Enterprise", *Fiscal Studies*, Vol. 3, No. 2, pp. 68-81.
- SANDMO, A. (1972), "Discount Rates for Public Investment under Uncertainty", *International Economic Review* 13, pp. 187-302.
- WILLIAMSON, O.E. (1976), "Franchising Bidding for Natural Monopolies – In General and with Respect to CATV", *Bell Journal of Economics* 7, pp. 73-104.



*Chapter 4*

**Decision-making for Infrastructure:  
Environmental and Planning Issues**

*by*

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**1. Introduction**

Since the 1970s, infrastructure projects have encountered both long delays and increased obstacles of various kinds in most of the OECD area. In many Member countries there has been a decline in the relative share of infrastructure spending compared to total GDP or to total investments, or even in absolute terms.

Many factors have contributed to this phenomenon, some acting singly, others in combination and mutually reinforcing one another:

- economic slow-down or slower economic growth;
- strained fiscal resources;
- shortages of space and of other natural resources;
- erroneous forecasts that underestimated demand, for transportation in particular;
- greater awareness and more systematic scrutiny of the environmental (and other secondary) effects of infrastructure projects, as well as increased environmental pressures (partly due to the fact that the beneficiaries are not carrying the environmental costs);
- lack of appropriate compensation/taxing schemes;
- higher interest rates and increased financing costs (partly due to the increase in alternative candidates for public funds);
- lack of imaginative public/private construction and financing solutions;
- incorrect pricing;
- a failure to distinguish between private and social benefits (positive and negative externalities);
- the short-term elasticity of most infrastructure installations (most systems can become overburdened in the short run).

Changing political priorities and slower decision-making structures should also be mentioned as important factors in shifting public spending away from infrastructure

projects and in lengthening planning phases. Their effect has been aggravated by a shortening of the time horizon of economic policy-making in the 1970s and 1980s in many countries – it was only recently that infrastructure was “rediscovered” as a major public policy issue. Today the danger is one of cumulative delays and shortages that are unmanageable in the short run; resolving them at all, *i.e.* even in the long run, will require new, more determined types of action and co-operation.

It is widely felt that the current and future requirements of infrastructure are over-taxing the resources even of the richest highly developed countries. The problem is amplified by the growing real or apparent opposition between the need to develop infrastructure on the one hand and the need to protect and preserve the environment on the other.

Infrastructure thus represents one of the principal economic challenges for the OECD area in the 1990s. Indeed, many Member countries sense an impending crisis; the current state of infrastructure is perceived as an obstacle to both economic growth and the improvement of the quality of life. Conversely, a boost to major infrastructure projects could have positive growth and employment impacts in Europe (the multiplier effect), and strengthen the feeling of political solidarity and integration.

The structures of political decision-making are evolving – not only in Europe, but throughout the OECD countries. Infrastructure is a major area of change in this respect, and there is both need and room for improvement of the decision-making process at the national and international levels.

The objective of this paper is to highlight some of the main issues that are likely to play an increasingly important role in the years to come.

## **2. The growing complexity of decision-making in the field of infrastructure**

### ***The global and local character of infrastructure***

Providing adequate infrastructure involves several interdependent tasks: maintaining existing structures, expanding existing capacity and creating new facilities. There is also a growing need for an integration of different types of infrastructure, such as transportation and telecommunications. The possibilities of integration at the planning stage and in the running of various projects, resulting from technological progress, can increase the efficiency of both new and existing infrastructure facilities.

The interconnection between national and international infrastructure tasks and problems has also increased. Thus, it is becoming increasingly difficult to consider in isolation “local” and “global” issues in the OECD countries. At the same time, the weight of local concerns has been increasing as a result of the growing scarcity of space and other resources.

Infrastructure issues are often lost in the general political debate. In many countries the power of those who are not concerned (even indirectly) to delay or even veto projects has increased in recent years.

One of the main advantages of open democratic and pluralistic political systems is their ability to change – both in response to the explicit wishes of the political community and in response to the transformation of “objective” factors shaping modern society.

Europe is currently witnessing a rapid process of innovation in the field of political procedures and structures; pragmatic innovation is also required in the field of decision-making about infrastructure.

### ***Infrastructure and the economic environment***

As noted in the Introduction, the problems related to infrastructure planning have multiple sources and manifestations. By definition, infrastructure belongs in the category of “long-term” decisions: time-consuming planning and realisation, long-lasting impact. Infrastructure can be neglected in the short term, but the impact of lasting neglect cannot be corrected through short-term action.

In the 1970s and early 1980s the demand for infrastructure services was underestimated. It was believed that transport demand in particular would grow less rapidly than total demand, due to increased costs. In many countries the growth of supply of infrastructure slowed down dramatically, and in some areas there was even a reversal of the availability of infrastructure services.

This occurred against the background of a general slow-down in economic growth and a shift from public goods to private spending. There has been a vicious circle: inadequate infrastructure is an obstacle to economic growth, and the slow-down in economic growth has been one of the major reasons for the relative (and often absolute) decline in spending on infrastructure.

The expansion of public spending and the rise in its share of total GDP led to considerable pressure in virtually all OECD Member countries:

- a) to cut back public spending (and especially public investments); and
- b) to try to shift the financing of infrastructure from the public to the private sector.

The dramatic rise in nominal and “real” (inflation-corrected) interest rates since the 1970s has added to the difficulties of (especially public) financing of infrastructure projects.

Today, the lack of available financing is recognised as a major reason for the delay or failure of many projects. In the past, however, the relative importance of this factor may have been even greater, as there were fewer obstacles of other kinds.

It also may be argued that the underpricing of infrastructure services in most countries is one of the principal reasons for the excess demand for and insufficient supply of these services. Infrastructure is – or at least some of its services are – a public good; however, it is never a free good. From an economic and social point of view, it is not necessary that all infrastructure costs be incorporated in the price of the services, since a social utility that is both private and broader may be involved. It is important, however, that the pricing of services does not lead to wasteful use (excess demand) and/or to an inability to finance maintenance and renewal.

The political attractiveness of infrastructure has declined: initiating large projects used to be a symbol of forward-looking political leadership. These days, there is considerable political disaffection with such projects in many countries.

Moreover, one factor may even facilitate inaction. Because of the apparent short-term elasticity of infrastructure projects, shortages are not immediately noticeable; the

result can be considerable political temptation to postpone spending, both on new projects and on the maintenance of existing ones.

Disaffection and hesitation notwithstanding, infrastructure projects and spending generally have a positive short-term impact on employment and economic activity. But the main favourable economic impact of an adequate supply of infrastructure is a long-term one: modern infrastructure (telecommunications, transportation, energy systems, water and waste management, etc.) is indispensable for both quantitative and qualitative growth. Shortages or poor quality are major obstacles to long-term growth.

However, not all infrastructure project impacts are positive. In addition to the general danger of overspending, planning errors or oversized projects may lead to excessive costs and even represent a major long-term burden for the national economy.

Thus, project identification and selection are a complex process: in most areas (and especially in energy and transport), competing technologies have to be considered as well as different repayment and amortization periods. Moreover, economic considerations are not solely financial: environmental and energy considerations have been playing an increasingly important role in the last twenty years, and their weight is likely to grow considerably in the future. It should be noted that these latter impacts place some long-term projects in a more favourable light than projects with a shorter repayment period.

### *Different structures of government and decision-making*

An important feature of the (democratic) “good society” (to use Walter Lippmann’s term) is the efficient and even harmonious interaction between the different levels and categories of decision-making: between the political and administrative sides, between the private and public sectors, and between the local, regional or state, national and even international levels. Signals and directives have to be able to go in either direction, depending on the topic and the interests: there is no free and efficiently working political system that does not have a combination of “top-down” and “bottom-up” as well as “lateral” decision-making structures.

It is often argued that the democratic process, with its regular election cycles, tends to place excessive emphasis on short-term vision and short-term actions. On the whole, this is an oversimplification; history shows that many democracies have been able to master the long-term vision required for creating and maintaining first-rate infrastructure. It is true, however, that effective political leadership is needed to provide vision and create consensus, both of which are indispensable for effective infrastructure policies.

All OECD countries are democracies, but with differing internal political structures. There are, in particular, important variations with respect to the degree of centralisation and decentralisation and the respective weights of the executive, the legislative bodies, and the judiciary (especially that of the indirect “legislative” role of the judiciary).

Some countries have strong federalist structures and traditions; others adhere to a more centralised model. So-called “direct democracy” (decisions by popular vote) plays a very important role in Switzerland; in most of the other European countries the instrument of referendum is only used occasionally in the political decision-making process.



These variations among the European countries with regard to centralisation extend to decisions concerning infrastructure. There is no single model that could be declared as being the most efficient, regardless of the national context.

In most European countries, major infrastructure planning and decision-making used to be, and to some extent still are, a “top-down” process. This has been due to the national or general interest in major infrastructure projects, and to their financing from central budgets. Even in the United States – where, because of size and the federalist structure, the state and municipal levels have always played key roles – the federal government has in recent decades assumed a decisive role in major infrastructure projects.

There has been little or no international delegation of sovereignty in the area of infrastructure within the framework of European integration or that of the increased international co-operation generally which has developed gradually since the 1940s. In fact, in most countries the “territorial principle” seems to have been strengthened – even at the local and regional levels – rather than weakened in recent years as a result of both increased scarcities of land and other resources, and environmental preoccupations.

### ***Multiple levels of government and decision-making***

One important characteristic of major infrastructure projects is that they produce different levels of impact in economic, geographic, financial and environmental terms. In most cases, the main environmental impact is of a local or regional nature and the financial burden is spread at the national or regional level, whereas the main positive economic impact is likely to be felt at not only the national level but also the international or European levels.

Recognition of this phenomenon in recent years has been one of several factors leading to a more complicated political decision-making and accounting structure, as additional levels or stages are taken into consideration. The decision-making process may not be a clear sequence in time, and the relative importance of the various stages may vary from country to country and according to the type of project. Also, the function attached to each stage (environmental, financial, etc.) tends to differ. On the whole, however, the number of stages and their relative importance have greatly increased since the 1950s/1960s.

Improvements are needed at virtually all levels of the process. It is necessary to clarify the legitimate interests and competence of each, as well as to improve co-ordination and co-operation between the various levels. Infrastructure planning has to be more firmly embedded into what is called in French *l'aménagement du territoire* (regional planning). The following is a brief description of developments by geographical breakdown:

- *The local (municipal) level.* In the past few years, what has probably increased the most in importance in infrastructure projects is the local or municipal level. This is mainly due to the greater weight of environmental considerations and the fact that negative impacts are usually felt at that level. Here, the power to accelerate infrastructure projects has not increased as much as the power to delay or modify them.
- *The regional level.* This level may include powerful political subdivisions, such as the Länder in Germany and Austria or the Cantons in Switzerland, or relatively

loosely knitted or even ad hoc associations linking different regions, e.g. in the Alpine countries. On the whole, their importance has increased significantly in recent years. The regional political and administrative entities are as a rule less involved in general politics or macroeconomic policies. However, the mandate at the regional level usually covers both the promotion of long-term economic development and the protection of the environment, two areas that are directly connected with infrastructure.

- *The national level.* Traditionally, this level has played the most important role in Europe, and has also assumed a growing importance in countries with federalist structures such as the United States, Germany or Switzerland.
- *International/bilateral.* The tunnel under the English Channel is the most spectacular example of a bilateral international project in many years.
- *European/international.* Infrastructure (including transport infrastructure) is one of the areas where until now little national power has been delegated to the European Community, in particular to the EC Commission. Lately, however, there has been lively debate over how much power should be concentrated at the European level in the field of infrastructure; there have also been recurring suggestions for the creation of a European Infrastructure Agency. There is a great need for increased co-operation and co-ordination in the planning of major infrastructure systems at this level. The right balance between national and international influence varies between the different areas of infrastructure and has to be established almost on a case-by-case basis. Excessive centralisation and bureaucratisation would hurt legitimate national and regional interests, and could ultimately slow down infrastructure development.

### ***Growing complexity***

Today it is widely acknowledged that the complexity of infrastructure planning and realisation is growing, and on many levels: technical, legal, political, social and financial.

The technical complexity of infrastructure planning and decision-making has been increasing as a result of several factors, including: *a)* technological developments, and the real or apparent complementarity and substitutability of various technologies; *b)* the growing scarcity of resources; *c)* the impact on and need to protect the environment; *d)* the growing costs of labour and capital; *e)* the scale of many new infrastructure projects.

In terms of legal complexity, today there are more complex regulations (local, regional and national in most countries) that have to be satisfied, as well as more extensive means of recourse against projects that hurt real or apparent particular interests. In the past fifteen years, legal complexity has indeed been one of the primary reasons for the delay or outright cancellation of major infrastructure projects.

Political complexity has also greatly increased in recent years, and one of the factors responsible is the relatively large number of actors or categories of decision-makers participating in the process at virtually all levels: *a)* the executive branch, both elected politicians and their respective administrations or bureaucracies (there is often lack of harmonization and even strong opposition between the various departments concerned); *b)* legislative bodies; *c)* the judiciary, which plays an increasingly important role arbitrat-

ing final decisions about infrastructure projects; and *d*) outside experts, citizens groups, private interests, etc.

The increased political complexity of decision-making is also due to what may be called social complexity: genuine differences in the preferences of various political groups and real or apparent conflicts of interest. The latter may have to do with the core idea of a given project, or with its localisation, its financing or the technologies to be used. Yet, because of the growing size and increased technical and financial complexity of major projects, an ever-broader political consensus is required for successful planning and implementation.

Finally, on the subject of financial complexity, the following factors should be mentioned: *a*) the rising cost of capital, which is having a particularly large impact on the financing of infrastructure projects that usually have a very long life and repayment period; *b*) the pressure on public finances, which leads to increasing calls for partial or total private financing; *c*) the difficulty of finding the appropriate mixed-financing formula and the sharing of rights and duties between public and private sectors; *d*) the difficulty of ascertaining the elasticity of demand, and the frequent political unwillingness to charge the full price of infrastructure services to the users (the fact that infrastructure is a public service is often fallaciously equated with the view that it is a “free good”).

The need for the right kind of mix of public and private financing should be emphasized. In deciding between the two types, the following rules of thumb should be observed:

1. “Profitable” projects – those with a market rate of return and limited risk – should be financed by private capital.
2. Projects that are not fully profitable – with an element of risk but also a positive social return – should be financed by private and public capital.
3. Projects with limited or no market return but with positive social return should be financed by public capital.

### ***The environmental dimension***

Environmental concerns and opposition by environmentalist groups are often cited as a cause for delay in the planning and realisation of major infrastructure projects. Experience has shown that the adversarial approach both to the protection of the environment and to infrastructure planning is often self-defeating. Project realisation requires a combination of clear and determined leadership, broad consensus, and the ability to reconcile apparently conflicting positions and interests.

Environmental and energy economics play an increasingly important role in infrastructure decisions. Preoccupation with preserving and restoring the quality of the environment began in the early 1970s, with increasing awareness of its extensive use (and often abuse) in the course of economic activity and growth. That activity resulted in the deterioration of the quality of the environment in the industrialised countries on the one hand, and the availability of new goods and services on the other. Newly developed technologies made it possible to reduce the negative environmental impact of economic activities. From the beginning, however, the “pricing” of the environment – in relation to those goods and services – contained imperfections and distortions.

The availability or lack of infrastructure influences microeconomic decisions: choice of residence, localisation of production facilities, transportation patterns, etc. This also holds for the costs of infrastructure services (transportation, energy, etc.) Mobility, communications and energy are important elements of economic activity and of the quality of life: the pricing of infrastructure that provides these services must be such that it does not lead to excess demand and shortages.

The environmentalist movement and the increased environmental concerns of a growing proportion of the general population are to a large extent the result of a change in relative scarcities. However, these scarcities – of land, of financial resources, etc. – have not fully found their way into either macro- or microeconomic calculations.

The number of those who are sensitive to environmental concerns at the individual level – in their immediate living and working areas – is probably underestimated, and much larger than the number of those supporting the green movements, or environmentalist parties. It is thus relatively easier for local groups to mobilise than the large, more diffuse environmentalist causes.

The result is a significant contradiction: local environmental opposition to specific projects is stronger than the weight of environmental movements at the general policy levels.

Despite the considerable progress achieved during the past twenty years – some countries have attempted to apply the causality principle to environmental costs – environmental analysis is far from being fully integrated into economic analysis at the macroeconomic, microeconomic or enterprise levels. The lack of sufficient quantification applies to both costs of and benefits from environmental quality. Further complicating the issue is the fact that both the environment and infrastructure are connected with the issue of positive and negative external economies: the benefits are not enjoyed by those who are paying the costs, and those who enjoy the benefits are not paying their full (or indeed any) share of the costs.

### **3. Examples of major projects**

The examples listed in this section were chosen to illustrate the complexity of modern major infrastructure projects.

#### ***Success and failure in infrastructure planning***

These projects feature both success and failure elements. It is difficult to apply absolute judgements in the field of infrastructure: not all projects that were delayed or abandoned belong to the category of failures, and not all projects that have been realised can be considered to be successes.

The following appear to be some of the main conditions for “success” in the infrastructure area:

- a) vision and implementation that are long-term, covering both the maintenance of existing infrastructure and the development of new projects and new capacity;
- b) a balanced approach between opposing interests and considerations;
- c) an overall view of infrastructure (“intermodal” or system approach);

- d) the correct pricing of infrastructure services;
- e) clear and credible presentation of options and of costs and benefits;
- f) the ability to act decisively.

Among the various causes of failures or crisis situations, the following should be mentioned:

- a) political and (consequently) economic neglect of the importance of infrastructure;
- b) a “conflict” approach between opposing interests (including environmental considerations);
- c) failure to hear out opponents and give careful consideration to their arguments;
- d) inaccurate or biased presentation of project costs and benefits by proponents and opponents;
- e) incorrect pricing that leads to excess demand and shortage of supply;
- f) lack of intermodal planning.

### ***Planned new transalpine rail tunnels between Switzerland and Italy***

Acceptance of the construction of new transalpine rail tunnels, the outcome of a referendum in Switzerland, represented a clear victory for the transport and European policies of the Swiss Government. The main purpose of the tunnels is to provide additional rail transport capacity through Switzerland and thus divert a significant portion of future traffic growth from the roads to rail. Plans also include the development of an extensive infrastructure for combined traffic (primarily for trucks, but also for passenger cars), in both Switzerland and its neighbouring countries.

An important aspect of the project is the impact on the economic development of the immediate regions, which would be connected to a new rail network. Thus there are major regional interests involved in both Switzerland and Italy.

The EC had originally put considerable pressure on Switzerland to raise the weight limitation on trucks in the country, from 28 tons to the 44-ton limit prevailing in the European Community. The Swiss rightly feared, however, that the heavier weight would have significantly increased the traffic through Switzerland, causing much greater negative environmental consequences than those that would result from the construction and operation of the tunnels. The promise to build the tunnels, allowing to expand rail traffic and in particular combined freight traffic, was a major argument used by the Swiss Government in its negotiations with the European Community.

The success of having the project approved depended very largely on developing and maintaining a consensus about environmental, political and economic considerations at the local, cantonal, national and European levels.

However, the transit and tunnel debate was not without its political fallout. The final outcome – the transit agreement with the EC and the successful tunnel referendum – may be considered as positive from the point of view of Switzerland and its environmental concerns. Meanwhile, the high-pressure tactics used on Switzerland in the transit negotiations by the EC Commission and by some of the Community member countries (including Germany, which had been an open or tacit ally of Switzerland on issues related to European integration) left a residue of resentment against the EC bureaucracy and EC

power politics. This was especially the case in the German and Italian speaking parts of Switzerland, a fact which may have contributed in part to the subsequent rejection of the Treaty on the European Economic Space by the Swiss Germans and the citizens of the canton of Ticino.

### ***Eurotunnel***

Eurotunnel is rightly considered to be one of the most impressive international infrastructure projects in Europe in years, one which was clearly the result of high-level political initiative.

The absence of a European Infrastructure Agency was no problem in the crucial initial stages. In effect, negotiations for Eurotunnel were facilitated by the fact that on the main issues only two governments (both with a tradition of centralised decision-making about infrastructure) were involved, and that the tunnel was located outside the territory of either country. At the same time, the availability of private financing and private interests in managing the project was indispensable for the project's realisation. Private interests could be mobilised with relative ease because of the favourable long-term traffic and revenue forecasts and the long-term high political visibility of the project for both France and the United Kingdom: the project was considered simply "too big to fail".

Among the major obstacles that had to be overcome – apart from psychological resistance – were the administrative and legal differences and the complexity of selecting a mutually acceptable technical solution (rail/road, tunnel or bridge).

The Eurotunnel project is a successful example of the application of the system approach at the planning and selection stage, as well as in the realisation phase. However, the project has also demonstrated the need for preparing formulae for public/private projects in advance, since not all the large international projects are likely to have the same potential rate of return or command the same visibility (and implicit guaranty).

It is also necessary to make progress on the concept and operation of combined traffic. In fact, combined traffic could be important in the future not only on relatively short distances, but also for long-distance international freight traffic. However, this potential dimension does not seem to have been taken into account in the planning of the Eurotunnel project.

The need for a new high-speed rail connection between the tunnel and London is an important element of the whole concept from an economic and financial point of view. This aspect, however, did not receive sufficient attention from the British Government. One problem was the decision for public or public/private financing of the investments required. Another was the local opposition to a new high-speed rail line on environmental grounds. The government showed great reluctance to invoke the national interest and override the local opposition.

### ***Air traffic management***

Air traffic is an important infrastructure area, with domestic, local and international dimensions. Europe's major routes already suffer from considerable congestion that threatens to increase in the future.

One way to deal with congestion is to build new airports and expand the capacity of existing ones. More efficient air traffic management also has an important role to play. System improvement would provide a significant positive environmental impact by shortening aeroplanes' waiting time before landing.

This is an area that requires considerable technical and political co-operation among the European countries and, ultimately, a common system. In the past, that concept encountered considerable national opposition, since in most countries there were important economic, financial and technological synergies between civilian and military air traffic management.

Today, opposition to European co-operation seems to have eased significantly. It is true that European air traffic management cannot be a completely centralised system, for reasons of both safety and political acceptability; nonetheless, it is a field where the common interest must prevail, without any country or combination of countries dominating the system.

### ***The new Munich airport***

The case of the new Munich airport is a clear illustration of the need for a flexible approach to planning and for efficient co-ordination and consensus-building among the various levels of political decision-making.

There had long been convincing economic and financial arguments for a new airport in the Munich area. In addition, from a general environmental point of view, a valid case could be made in favour of locating a new airport well beyond the city area.

Nevertheless, the construction of the new airport was held up for over a decade essentially by local environmental opposition. The long stalemate was presented by proponents of the airport as a typical case of the "tyranny of a small minority over the majority and the public interest". The opponents, whose quality of life was threatened by the construction of the new airport, argued that they were defending not only their own but also the general interest. The fight was a typical example of what may be called the "conflict approach" to both infrastructure-building and environmental protection.

Ultimately, the conflict approach failed for both sides. From the point of view of the hard-core opponents, the fact that the airport was eventually built was at least a partial defeat. Proponents of the airport and the general public also experienced failure – not only in terms of the direct and lost opportunity costs resulting from the long delay in construction, but also because the airport finally built may correspond to an outdated concept from both the environmental and traffic points of view. Thus, it may be argued that the new Munich airport represents an example of both: *a*) an unsuccessful planning and political decision-making process, and *b*) the realisation of a by-now outdated airport concept, the single "mega-airport" beyond the immediate metropolitan area.

## **4. Elements of a new approach**

The development and maintenance of a modern and efficient infrastructure are an essential condition for the prosperity and international competitiveness of a modern economy, as well as for improving the quality of life.

The need to protect the environment must be taken into account in the choice, planning and realisation of infrastructure projects, and in selecting among alternative technologies. More imaginative (and sometimes more costly) solutions are called for; however, protection of the environment should not be used as an absolute obstacle to infrastructure development.

The European and international dimensions of major infrastructure projects are both a result of the progress of economic integration and a factor which can further economic and political integration.

Technological progress and increasing technological complexity also call for greater international co-ordination and co-operation in infrastructure planning and decisions in Europe – both for new infrastructure projects (and for the choice of compatible systems and solutions) and for more efficient management of existing infrastructure.

It is generally expected that in the future the link between different categories of infrastructure will become even stronger than it is today – a development that calls for the adoption of common or compatible standards in the relevant areas, and for improved co-ordination at the national and European levels.

Better maintenance and more efficient use of existing infrastructure are tasks that should receive closer attention at the political and administrative levels.

Because of the long-term nature of infrastructure projects (long lead time and long useful life), there is an increased need for co-ordination and co-operation from an early stage in order to avoid undue delays, waste, duplication of effort and bottlenecks.

The examples of several major countries where, for various reasons, infrastructure has been neglected during an extended period ought to serve as a warning for all OECD Member countries. The task is one of both continuing maintenance and expanding existing systems, and creating timely new complex systems that correspond to future requirements.

There is an urgent need for a more global, systemic view of infrastructure tasks and issues in Europe. At the same time, an attempt at excessive centralisation and globalisation would be counter-productive and lead to additional loss of efficiency and further delays in the decision-making process.

One of the future growth areas for infrastructure development is the former Comecon bloc. It is also in the interest of the OECD Member countries to help stimulate rapid development there and to participate in the financing, realisation and operation of some of the new projects.

### ***The need for political and administrative innovation***

The conclusion of this paper is that there is a need both for more effective use of existing structures and methods and for innovation in dealing with the infrastructure issues of the coming decades. The following points should be emphasized:

1. There is a need to increase awareness of the threat of growing bottlenecks, and for a long-term strategic vision with regard to infrastructure.
2. Political leadership is needed, and there has to be greater political involvement.
3. There is a need for administrative streamlining at most levels. This also requires political leadership, since administrative and expert involvement is not enough.



4. There has to be a greater effort at improving cost-benefit analysis and at integrating infrastructural needs and environmental costs and preoccupations.
5. Trade-offs have to be defined in economic and intermodal terms (economic and environmental aspects have to be considered simultaneously). There is need both for more efficient compensation and for the distribution of costs among those who benefit directly and indirectly from infrastructure projects.
6. The long-term pricing of infrastructure has to reflect both environmental and other economic costs.
7. There is a need for generating ideas for new projects and alternative solutions.
8. Innovation is required to reduce the functional distance between projects and decision-makers.
9. There is a need for more effective ways to promote consensus among various interests.
10. The active participation of the private sector has to be stimulated, and not only at the financing stage.
11. New solutions for mixed financing and mixed risk-sharing between the private and public sectors have to be explored.
12. In general, the increased efficiency of existing and new infrastructure has to be promoted.
13. The resources available for infrastructure, including research on the technical, economic, environmental and political aspects, have to be increased.
14. The OECD Member countries (at both the private and official levels) should take a much more active interest in the rapid upgrading of infrastructure in the former communist countries. Integration of the systems of Central and Eastern Europe with those of Western Europe could contribute to the economic prosperity of the OECD countries as well.

## **Bibliography**

LESGUILLONS, Henry and Marcel SARMET, eds. (1991), *Financement Privé d'Ouvrages Publics à l'Horizon 1993*, FEDUCI, Forum Européen de la Communication, Paris.

ROUNDTABLE OF EUROPEAN INDUSTRIALISTS (1989), *Need for Renewing Transport Infrastructure in Europe: Proposals for Improving the Decision-making Process*, Brussels.

*Annex*

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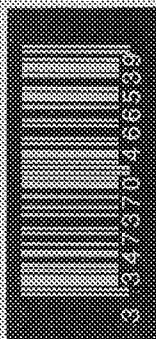


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