

The Eddington Transport Study

Main report:
Transport's role in sustaining
the UK's productivity
and competitiveness

Sir Rod Eddington
December 2006

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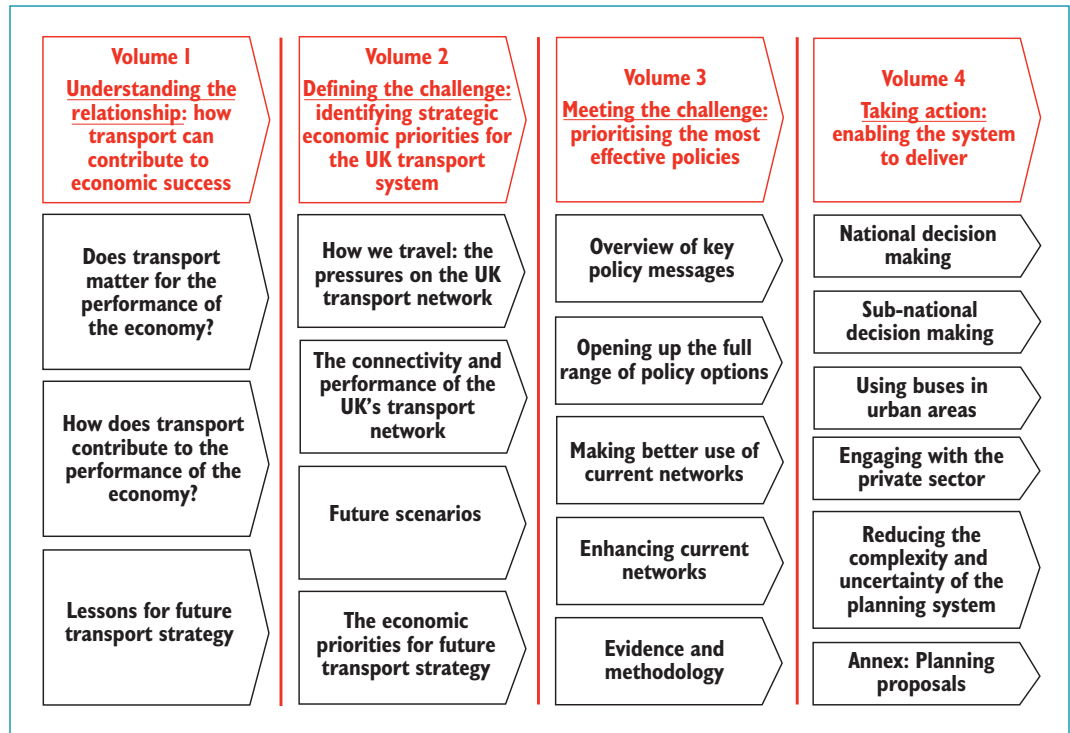
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MAIN REPORT

TRANSPORT'S ROLE IN SUSTAINING THE UK'S PRODUCTIVITY AND COMPETITIVENESS

This is the main report of the Eddington Transport Study. It is organised in four volumes, as set out in the diagram below, which present a wide range of evidence, information and recommendations on transport's long-term impact on the UK's economic growth, productivity and stability, within a sustainable development context.

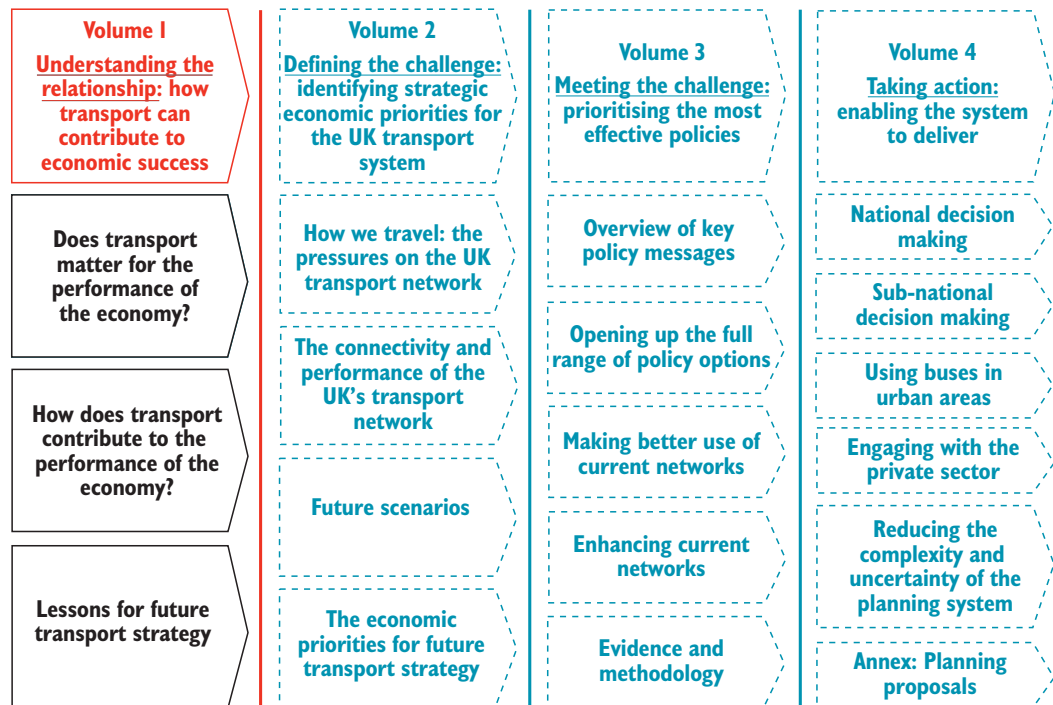


The Study's main findings and key recommendations can be found in summarised form in *The case for action: Sir Rod Eddington's advice to Government*, which accompanies this report.

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UNDERSTANDING THE RELATIONSHIP: HOW TRANSPORT CAN CONTRIBUTE TO ECONOMIC SUCCESS



INTRODUCTION

The global economy is facing rapid change and witnessing large-scale restructuring of industry and services. For the UK this means a continued shift towards a service and high-value manufacturing based economy, with growing reliance on other countries for raw materials and basic low-value manufactured goods. Alongside this change, economic success resulting in higher incomes and a rising population are expected to generate greater demands for travel for both work and non-work/leisure purposes. This in turn can create congestion and reliability problems on the transport network: increasing costs on business and damaging quality of life. Society as a whole must respond to such challenges, and a well-functioning transport system that supports economic success will be key to securing a long-term sustainable response.

Relationship between transport and the economy

This volume sets out the evidence to inform a more comprehensive understanding of transport's role in supporting the productivity of the UK economy and its sustainable growth. It begins by looking at the big picture: examining the academic literature and reviewing the historical evidence on the overall relationship between transport and the economy. It then goes on to examine the underlying economic drivers by which transport impacts on economic performance. In doing so, it identifies the nature and types of journeys that users of the transport system want and considers how improvements to these journeys can deliver economic benefits. The volume concludes by identifying a series of principles that should guide the development of transport policies to support sustainable development of the UK economy over the next 15 to 30 years.¹

¹ The analysis presented in this Study has benefited greatly from comments received from Sir Rod Eddington's Academic Friends' Group, however the Eddington Study takes sole responsibility for the conclusions drawn.

3 As well as the evidence presented, the volume draws on new research commissioned and undertaken on behalf of the Eddington Study, and published alongside it. This comprises: *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005; *Transport and Labour Market Linkages*, Gibbons and Machin, 2006; *Agglomerations in the UK and the Role of Transport Policy*, DfT and Eddington Study, 2006; and *Step Change Transport Improvements*, Mike Mann, 2006.

4 The volume is divided into three chapters:

- **Chapter 1.1:** looks at the big picture and considers the overall relationship between transport and the performance of the economy, including exploration of some of the historical evidence;
- **Chapter 1.2:** takes a bottom-up approach and seeks to identify how transport can contribute to the performance of the economy; and
- **Chapter 1.3:** draws together the evidence from this volume and sets out a series of principles for informing a transport strategy for sustainable growth.



DOES TRANSPORT MATTER FOR THE PERFORMANCE OF THE ECONOMY?

Headlines

- Transport matters for the economic performance of countries and regions.
- Historically, step changes in transport connectivity have been pivotal in supporting periods of rapid growth of economies as they developed, and critical in driving past phases of globalisation.
- Today, in mature economies like the UK, with well-established networks and where connectivity between economic centres is already in place, the evidence suggests that there is considerably less scope for transport improvements to deliver the periods of rapid growth seen historically.
- Instead, the debate for such countries should be focused on the performance of the existing network, particularly where capacity is stretched, as demonstrated, for instance, through congestion or unreliability.
- Increasingly, studies are suggesting that the efficiency with which existing transport networks are used is just as important as the underlying investment.
- The relationship between transport and the economy in a developed economy is therefore likely to be an incremental one.
- However, economic success can itself generate higher demand for transport and where there is a lack of adequate capacity, transport can start to constrain that success.
- But a ‘one-size-fits-all’ approach to transport policy, in terms of the type of intervention, the modal solution or indeed the level of expenditure, is not appropriate. Shaped by their different social, economic, environmental and geographic characteristics, different countries and regions have different transport needs.
- Equally, in some circumstances, transport is not the answer; there are times when countries have enjoyed economic success without significant improvements to transport; and history highlights that transport does not always deliver expected economic benefits.
- The Stern Review has demonstrated powerfully that tackling climate change is the pro-environment, pro-growth strategy. Transport will need to be part of this response.

INTRODUCTION

I.1 A good transport network is important in sustaining economic success in modern economies. The transport network secures connectivity between different parts of a country, as well as to the rest of the world: linking people to jobs; delivering products to markets; underpinning supply chains and logistics; and supporting domestic and international trade. The quality of infrastructure, and how comprehensive the transport network is, will influence the role transport plays and its contribution to the functioning of a successful economy.

1.2 This chapter examines the evidence and considers the fundamental question at the heart of the Study: does transport matter for the performance of the UK economy? The chapter:

- explores the contribution of transport to the performance of the economy by examining historical examples in the UK and elsewhere;
- considers how important this relationship might be for a modern economy by looking at the academic evidence in this field; and
- considers the conditions necessary to secure the best returns on transport policies.

1.3 The next chapter goes on to explore in more detail, through a series of economic drivers, the precise mechanisms by which transport influences the performance of the economy.

1.4 Transport’s contributions to the economy can be assessed in a number of different ways. Figure 1.1 defines some of the common metrics that are used throughout this Study.

Figure 1.1: Assessing transport’s contribution to the economy

Transport can impact on the performance of the economy in a number of different ways:

1. Transport’s impact on GDP

- Transport can impact on the performance of the economy and will ultimately impact on overall output. **Gross Domestic Product (GDP)** is currently the best measure of the size of the economy as it measures the total value of goods and services produced. Transport can have an impact on economic output (GDP) through two channels:
 - (i) Firstly, transport can affect GDP through the number of inputs that are used, for example transport may increase employment either by allowing greater access to labour or stimulating the creation of new firms, which can increase the number of goods and services produced and lead to an increase in GDP.
 - (ii) Secondly, transport can improve the efficiency with which firms use inputs, in other words transport can have an impact on **productivity**. For instance, a well functioning transport network can raise productivity by reducing journey times. Transport investment can impact on the drivers of productivity by encouraging private investment through raising its profitability; facilitating labour mobility and thereby increasing the returns to investment in skills; and enabling effective competition even when economic activity is geographically dispersed. Identifying the impact of transport on productivity is important because improving productivity is a key determinant of long-term growth and living standards.
- These effects can either have a one-off effect on the level of productivity or a sustained impact on the growth rate of productivity. Transport can impact on the growth rate of productivity by stimulating innovation through its impact on agglomeration economies, trade and foreign direct investment (as Chapter 1.3 goes on to explore). In practice these dynamic impacts are very difficult to measure, but are nevertheless extremely valuable, as they determine how quickly the economy grows and therefore the **rate of growth in GDP**.

2. Transport’s role in supporting structural change in the economy

- An effective transport system can help an economy better **respond to structural changes**, helping to minimise the impact on the economy; for example, allowing people to access work in growing industries by supporting commuter travel.

However, conventional measures of output and productivity gains fail to capture the full contribution of transport to quality of life or environmental sustainability.

3. Transport's role in supporting quality of life

- Transport improvements can increase the variety of products available and create new leisure opportunities (e.g. low cost airlines to new destinations) and lifestyle choices (e.g. living in the suburbs). These benefits to consumers are known as **productivity of consumption**.
- Critically though, GDP measures alone fail to capture the impacts of transport on the environment or its contribution to the wider well-being of society. Transport's impact on the environment, for example through carbon and other emissions, can increasingly lead to unsustainable growth, as well as impacting on people's quality of life. Transport improvements that free up wasted travel time allow people to spend more time with friends and family, and enjoy more leisure activities. An economic welfare measurement would seek to measure such broader impacts of transport on society and the environment rather than just a pure GDP measure. These benefits to general well-being are known as **economic welfare, or welfare**.

This Study seeks to understand transport's contribution to both GDP and welfare.

TRANSPORT'S RELATIONSHIP WITH ECONOMIC PERFORMANCE: SOME HISTORICAL EXAMPLES

1.5 History provides some valuable insights into understanding the role of transport in supporting the performance of the economy. Step changes in transport connectivity, often associated with new transport, and facilitated by technological advancements, have been critical in enabling past phases of globalisation and pivotal in supporting significant changes in the economic performance of economies, and their regions, as they have developed.

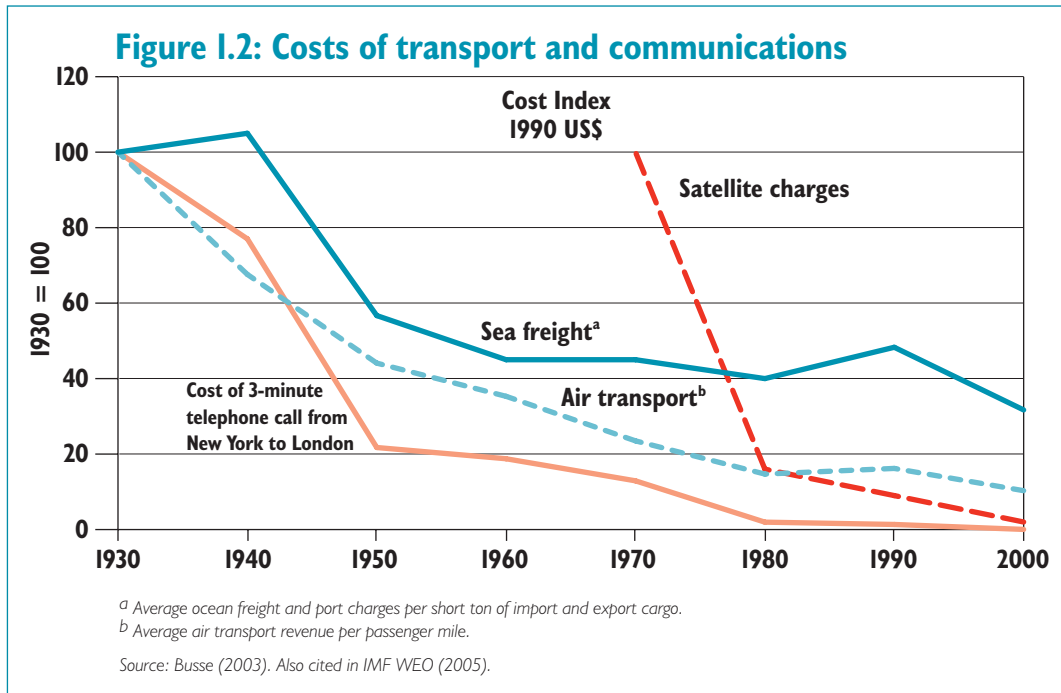
Transport pivotal in past phases of globalisation

Transport supporting globalisation

1.6 Large step changes in transport infrastructure have been pivotal in driving forward past phases of globalisation in the world economy. Trading patterns between countries and continents were transformed in the nineteenth century by the use of steam power for ocean-going ships. This supported a greater international division of labour and increased global specialisation, with countries focusing their production on the areas where they had most expertise and could operate most cost-effectively. The benefits of these advances were increasingly realised in the twentieth century, as rapidly falling transport costs, together with more significant falls in communications costs, meant goods and services could be traded with growing ease. Figure 1.2 illustrates the downward trend in international transportation and communication costs since 1930.

1.7 Transport not only played a fundamental role in facilitating globalisation, it also allowed countries' domestic economies to respond to these new economic forces. In 19th century Britain, for instance, rail transport in particular supported internal migration, which was necessary to transfer workers from declining industries to new industries and create labour market flexibility, helping Britain to take advantage of new global opportunities.¹

¹ See *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.



Transport supports the economic performance of countries and regions

1.8 Step changes in transport connectivity have also helped shape the geography and economic performance of countries and of the regions and urban areas within them.

Canals and the industrial revolution

1.9 The expansion of the UK's canal network in the eighteenth and early nineteenth centuries played a key role in the industrial revolution, providing much-needed connectivity between sites of industrial activity, urban areas and ports.

Railways supporting export growth

1.10 The expansion of the railways in the second half of the nineteenth century also delivered significant gains for developed economies. See figure 1.3. The head-start that railways (and their associated technology) gave to the performance of the UK economy should not be underestimated. The welfare benefits to society from railways in 1865 have been estimated to be equivalent to some 4.1 per cent and 2.8 per cent of Gross National Product (GNP) for freight and passenger transportation respectively.² Interestingly, the returns on creating a railway network have been estimated to be even higher in developing countries, such as Brazil, which had poor alternative transport links, than in more developed ones, such as the UK, where a well developed canal network and extensive coastal shipping remained in operation.

Transport influencing economic geography

1.11 The creation of the transport network influenced the UK's economic geography, i.e. the location of its economic activity. Canals were a primary factor in determining the location of industry. Although railways, which followed, had little impact on the location of industry, they revolutionised passenger movement and were critical in the creation and growth of many urban areas. The subsequent development of the strategic road network played a key role in the relocation of new, light industries, attracted by market access and new clusters. This was especially the case in the South East and is evident in the new industrial districts created around outer London, for example, those close to the A406 (North Circular).³

² *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

³ The South East region attracted 48 per cent of all new manufacturing plants in 1932 to 1982. *New manufacturing plant formation, clustering and locational externalities in 1930s Britain*, Scott and Walsh, *Business History* 47, 2005, as cited in Crafts and Leunig 2005.

Figure 1.3: Railways delivering for growth in the nineteenth century^a

- Railways played a pivotal role in the economic success of the UK economy in the mid-nineteenth century. The UK was the first country in the world to establish a railway network. By 1870, the UK had about 15,000 miles of track, had invested on average about 1.5 per cent of GDP in railways over the previous 40 years and the railway capital stock equalled 30 per cent of GDP.
- The UK became a leading developer and beneficiary of railway technology. During this period, for instance, the UK became the world's largest producer of pig iron, which was essential for the building and maintenance of railways. The UK also became the largest producer of cotton goods, and the Lancashire cotton mill cluster was a key beneficiary of railway technology; see figure 1.4.
- Despite this, it was a long time before productivity benefits from the railways were realised. It was only when they were extended to passenger, as well as freight traffic, that the sector's profitability and its large-scale productivity benefits began to emerge.
- Railways revolutionised passenger travel. Expanding the scope of the railway network from freight traffic to passenger travel enabled the rapid movement of large numbers of people for the first time, allowing many families to access parts of the country, such as the UK's coastline and beaches, that could not previously be reached. Railways were also pivotal in the establishment of national daily newspapers and a national football league.
- The welfare benefits to society have been estimated to be equivalent to some 4.1 per cent and 2.8 per cent of GNP^b in the UK in 1865, for freight and passenger transportation respectively.^c The freight benefits, in particular, depended heavily on the alternative forms of transport that were available. The UK had an extensive canal network and cheap coastal shipping, with the latter accounting for 60 per cent of tonne miles. The welfare benefits for Brazil, in comparison, which was a developing economy with poor alternative transport networks, have been estimated at 18.1 per cent and 2.1 per cent of GNP in 1913, for freight and passenger transportation, respectively.

^a Evidence taken from *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

^b The Gross National Product (GNP) is the value of all the goods and services produced in an economy, plus the value of the goods and services imported, less the goods and services exported.

^c *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005, estimates that the social rate of return on railway investments between 1840 and 1870 was about 15 per cent compared with the private rate of return of 5 per cent, suggesting the prime beneficiaries of railways were consumers rather than the private business investors.

Development of urban areas

1.12 New transport technologies were also fundamental to the development and the success of the major global cities in existence today. The role of transport in the success of the New York city cluster is summarised by Paul Krugman, who notes "...there has been no important commercial traffic on the Erie Canal since 1850, yet the head start that the canal gave to New York city has allowed New York to remain the largest US city to this day."⁴

1.13 Canals in the mid nineteenth century were also critical in developing London's comparative advantage in maritime services. The widespread use of passenger rail and the creation of the Underground system in the late nineteenth and early twentieth centuries reinforced the emerging economic and geographic trends still observed in London today; see figure 1.4.

⁴ *Increasing Returns and Economic Geography*, Krugman 1991a, *Journal of Political Economy*.

Figure 1.4: Transport facilitating the growth of clusters in the UK

Supporting the competitiveness of the Lancashire cotton industry^a

- Transport played a pivotal role in the development and longevity of the Lancashire cotton mill cluster in the mid nineteenth century. The productivity advantages were such that the sector was able to prosper with wage levels six times those of its major competitors. By the late nineteenth century the UK was the lowest cost producer of most cotton goods, representing some 80 per cent of the global market for exports.
- The Lancashire cotton mill cluster consisted of a number of textile towns, each specialising in a particular stage of the production process, with no single town offering an advantage over the tight cluster of specialised individual towns. This suggests that the benefits of the cluster occurred at a regional level.
- The industry benefited from innovations in spinning technology and the exploitation of world markets through transport. International shipping provided the regular import of raw cotton and the export of manufactured cotton goods; the rail links within Lancashire supported the movement of intermediate goods from one specialised district to another, and to and from the port.

Supporting the emergence of the London cluster

- Transport was also critical to the development of London. Canals and shipping in the eighteenth and early nineteenth centuries allowed the city of London to establish itself inland, whilst also developing expertise in maritime services.
- This led ultimately to the development of other industries. London continued to expand, as complementary services developed in insurance, trading and finance. The geography of the city was very much established by the early nineteenth century.
- The introduction of railways in the mid nineteenth century, originally for freight transportation, supported the movement of labour, with London’s suburbs developing around Underground and electric and diesel-powered railway lines into the city.

^a See *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005, for further details.

1.14 In the past few centuries developed economies around the world have experienced step changes in connectivity through new transport technologies: through widespread use of canals in the eighteenth and early nineteenth century; to steam ships and railways in the nineteenth century; to the development of affordable car travel and the completion of the strategic (motorway and trunk) road network in the twentieth century. The evidence is clear that in a developing economy context, establishing basic connectivity is a very significant economic contributor to rapid economic growth.

Is aviation today’s step change?

1.15 Today, it is interesting to consider the rapid expansion in international passenger and freight connectivity in light of historical evidence. The most recent phase of globalisation appears to be driven by rapid expansion in global connectivity provided by a combination of two distinct changes witnessed in recent decades. Firstly, the widespread use of shipping and aviation and its falling costs (as illustrated in figure 1.2), and secondly, the telecoms and IT revolution. Together these two factors may be seen as transforming the connectivity of both the manufacturing and service sectors globally. It is expected that such changes will have the potential to impact on the growth of domestic and world economies, and policy makers need to be alive to this, as well to the fundamental environmental and social challenges this may create.

UNDERSTANDING THE NATURE OF THE RELATIONSHIP BETWEEN TRANSPORT AND THE ECONOMY

There is a relationship between transport investment and economic performance

I.16 Whilst history demonstrates the importance of transport to productivity growth in the economy, the exact nature and scale of the relationship is much debated. Figure 1.5 sets out some of the recent literature in this area.

I.17 David Aschauer sparked the debate on the relationship between investment in public sector infrastructure and the performance of the economy in 1989. He found that for the United States economy a 1 per cent increase in the stock of public sector capital could boost GDP by 0.38 to 0.56 per cent annually.⁵ Subsequent studies suggest a much weaker link between infrastructure and growth. Although there is considerable variance in the empirical evidence, the studies are broadly consistent with the conclusion that a 1 per cent increase in public capital stock could result in a one-off, sustained increase in GDP of 0.2 per cent for a developed economy.⁶ The varying returns offered from these studies indicate the importance of targeting investment in the right places.

Direction of causality debated

I.18 Although many of these studies are informative and shed some light on the relationship between transport and the performance of the economy, it would be misleading for transport policy to be developed on the basis of these expected returns to GDP.

I.19 In particular, there remains some ambiguity over the direction of causality in the relationship between transport investment and the performance of the economy. What comes first? Do countries choose to spend more on transport as they grow richer? Or does an increase in GDP come after transport investment, i.e. transport investment generates economic success?⁷ Our analysis of the literature and engagement with expert academics in the field suggests that, in practice, it is likely to be a combination of the two.

I.20 Such studies also omit the wider economic, social and environmental impacts not accounted for by the narrow definition of GDP. On balance, therefore, the above analyses may be understating the true magnitude of the relationship between transport investment and the performance of the economy. The Study's view is that the link between transport and productivity is clear and is best demonstrated through the micro economic approach which the next chapter goes on to explore.

⁵ *Is Public Expenditure Productive?*, Aschauer, Journal of Monetary Economics, Vol. 23, 1989.

⁶ The average across OECD countries for the period 1960 to 2001 is estimated to have been 0.2. *New Estimates of government net capital stocks for 22 OECD countries, 1960-2001*, Kamps, IMF working paper, 2004, cited in Crafts and Leunig, 2005.

⁷ This would suggest that transport impacts on productivity.

Figure 1.5: A review of evidence on transport's contribution to GDP

- A number of empirical studies have looked at the relationship between all public infrastructure investment and GDP growth. On average these studies seem to indicate a positive elasticity of output to public capital of around 0.20. Put another way, a 10 per cent increase in public capital stock increases GDP by around 2 per cent.
- However, there are limitations to these empirical studies and the results should be viewed with caution. OECD (2003) argues that early empirical work on the link between infrastructure investment and economic performance overstated the magnitude of the impact on GDP and productivity growth.^a In particular, studies that focus on public investment in capital and infrastructure in the broad sense, rather than on transport specifically, do not really distinguish between types of investment in terms of new build, upgrade, maintenance, etc., although some do make specific conclusions about the value of transport infrastructure investment, see below.
- Later studies using more complex modelling suggest a positive, albeit weaker, relationship between infrastructure and GDP. These include: Kocherlakota and Yi (1997), Demetriades and Mamuneas (2000), O'Fallon (2003), and Nijkamp and Poot (2004).^b
- Others assert that transport investment in particular has a positive impact on growth, these include: Barro (1991), Canning and Fay (1993), Easterly and Rebelo (1993), Kneller, Bleaney and Gemmell (1999), Victoria Transport Policy Institute (2003). Studies looking specifically at transport have offered more precise evidence: Nadiri and Mamuneas (1998) looking at interstate highways in the US found that the output elasticity averaged 0.08 from 1950 to 1991, suggesting that a 1 per cent increase in infrastructure stock increases GDP by 0.08 per cent. Crafts and Leunig (2005) illustrate that highways accounted for a third of all productivity growth in the 1950s and 1960s in the US (although this figure was only 4 per cent in the 1980s).^c
- However, such studies are often subject to the caveat on causality. The SACTRA Report to the then Department for the Environment, Transport and the Regions (1999) highlights the problem of understanding what is likely to be a two-way causal relationship, suggesting that although the theoretical links are strong, evidence is weak and by no means undisputed.^d OECD (2003) also suggests that, although the benefits of transport infrastructure to economic growth are generally recognised, a direct causal link is difficult to establish.^e

^a *The sources of economic growth in OECD countries*, OECD, 2003.

^b See: *Is there endogenous long-run growth? Evidence from the United States and the United Kingdom*, Kocherlakota and Yi, 1997; *Intertemporal output employment effects of public infrastructure capital: Evidence from 12 OECD economies*, Demetriades and Mamuneas, 2000; *Linkages between infrastructure and economic growth*, O'Fallon, 2003 and *Meta-analysis of the impact of fiscal policies on long-run growth*, Nijkamp and Poot, 2004.

^c See: *Economic growth in a cross section of countries*, Barro, 1991; *The effects of transportation networks on economic growth*, Canning and Fay, 1993; *Fiscal policy and economic growth*, Easterly and Rebelo, 1993; *Public policy and the government budget constraint: Evidence from the OECD countries*, Kneller, Bleaney and Gemmell, 1999; *Transport Cost and Benefit Analysis – Evaluating Transportation Benefits*, Victoria Transport Policy Institute, 2003; Nadiri and Mamuneas, 1998; and *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

^d *Transport investment, transport intensity and economic growth*, Standing Advisory Committee on Trunk Road Assessment (SACTRA), 1999.

^e *The sources of economic growth in OECD countries*, OECD, 2003.

- **Dodgson (1997) points out that empirical evidence to back up theoretical links is extremely hard to obtain and to interpret, because of the difficulty of determining cause and effect when GDP is influenced by so many other factors.^f Eberts (1999) concludes that there is no definitive estimate of the effect of infrastructure in general, or of transport infrastructure more specifically, on GDP.^g**

^f *A framework for assessing studies of the impact of transport infrastructure projects on economic activity*, Dodgson, 1997.

^g *How levels of investment in transportation affect economic health*, Eberts, 1999.

Overstretched transport can constrain economic success

1.21 Although the evidence presented suggests that transport can impact on the performance of the economy, additional transport expenditure is not always beneficial. Many countries and regions around the world have demonstrated that economies can grow without significant step changes to their transport network. However, such economic success can itself generate a higher demand for transport, and where there is a lack of adequate capacity, transport can start to constrain that success. Hence some countries, which at first glance are perceived to be surging ahead with minimal transport investment, may find their transport network stretched if growth of GDP continues significantly to outpace that of infrastructure.

China: infrastructure leads growth 1.22 It can be argued that two of the world's fastest growing economies, China and India, have taken very different approaches to transport policy and growth. China over the last two decades has followed an infrastructure-heavy approach to growth, with considerable investment going into roads, railways, ports and airports, on the expectation that this will support and fuel additional economic growth. The pace of investment in recent decades is such that the total length of roads in the country is now second only to the United States.

India: infrastructure lags growth 1.23 Infrastructure investment in India, on the other hand, has lagged the rapid growth of its economy, which in recent years has been driven through investment in human capital (i.e. skills) and information technology, with transport investment given much lower priority within the Government's spending portfolio. Since the early 1990s, India's growing economy has witnessed a rise in demand for transport infrastructure and services of around 10 per cent a year. However, transport provision has not kept pace with rising demand, to the extent that it is now impacting on future growth and competitiveness. The World Bank notes that major improvements in the transport sector are required to support the country's continued economic growth, a challenge that India is now responding to.⁸

1.24 Turning to an example from among the advanced economies, Ireland's economy, like India's, has surged ahead with limited transport investment. The economy has grown rapidly in recent decades, primarily on the strength of its investment in skills, and fiscal incentives for foreign direct investment. By 2000, foreign-owned firms accounted for 48 per cent of total employment in manufacturing.⁹ Only now, as greatly increased demand has started to outstrip supply, has transport become a factor in limiting growth. In particular, during this period, transport investment, with the exception of infrastructure to support international trade, considerably lagged behind growth of the economy. As a consequence, Ireland is now facing serious traffic congestion around its growing urban areas, such as Dublin. It is also becoming apparent that surface access routes to Dublin's port and airport are inadequate.¹⁰

⁸ www.worldbank.org.

⁹ *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

¹⁰ *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

Cost of not responding to transport pressures can be substantial

1.25 Recent experiences from India and Ireland illustrate that there are times when countries can grow without significant improvements to transport. However, economic success can itself generate increasing transport demand, which can then become a constraint on growth in GDP. Potential productivity benefits from growing London in the early twentieth century were lost, due to the absence of adequate passenger transport infrastructure hindering realisation of even the most cautious forecast population growth of the city.¹¹ This suggests that there would be significant benefits from government reacting quickly to address transport demand when growth is identified.¹² As an illustration of the potential costs to the UK economy, it is estimated by DfT's National Transport Model that eliminating existing congestion on the road network (relative to free flow conditions) would be worth some £7-8 billion of GDP per annum.¹⁵ Although it is not realistic or cost-effective to eliminate congestion completely, this figure does illustrate that the cost of not responding to transport pressures can be substantial.¹⁴

1.26 Growing congestion on the network is a clear indication of increasing transport demand outpacing transport supply. This may suggest that either the pricing structures on different parts of the network are not working effectively and/or there is a case for investment, provided that the costs of relieving such congestion are reasonable. This will have an impact on both GDP and quality of life. Volume 2 explores further the cost to UK GDP and welfare if transport policy is not responsive to the needs of the economy, and Volume 3 provides evidence on the case for different pricing structures and investments.

Little consensus on what constitutes an 'adequate' transport system

Transport requirements differ by country

1.27 Although it is evident from the academic literature that the transport system can impact on the performance of the economy, it is equally evident that this impact will be of different magnitude at different times and in different places. There is little consensus about how much, at an aggregate level, should be invested in transport, or what an 'adequate' national transport system looks like. What is clear, however, is that a 'one-size-fits-all' approach to transport policy – in terms of types of intervention, modal solution or indeed level expenditure – is not appropriate. Shaped by their different social, economic, environmental and geographic characteristics, different countries and regions have different transport needs.

1.28 The contribution that transport investments make to the rate of economic growth depends on a number of factors. These include:

- the maturity of the economy and the quality of the existing transport network;
- the degree to which the transport network is managed efficiently; and
- the presence of other external factors material to productivity and growth.

¹¹ Report of the Royal Commission appointed to inquire into and report upon the means of locomotion and transport in London, Royal Commission, 1905, cited in Crafts and Leunig, 2005.

¹² Vickerman notes the importance of identifying bottlenecks in the infrastructure acting as constraints, see *Transport Infrastructure in the European Community: new developments, regional implications and evaluations*, 1992.

¹³ These figures are calculated on the basis of journey time savings to business and freight traffic using 2005 prices and DfT's appraisal guidance. These figures exclude potential reliability and agglomeration benefits that the next chapter goes on to explore.

¹⁴ It would not be sensible to aim for a complete reduction in congestion because the costs in building new infrastructure or in deterring people from driving would outweigh the time savings benefits to travellers; see Volume 2 for more on travel demand.

- Maturity of economy and transport network**
- I.29** The quality of existing transport does matter. The existing size, type and condition of transport infrastructure in a country are all key factors influencing the economic benefits of further transport infrastructure investment.
- I.30** Returns from transport investment are likely to be greatest where no alternatives exist, infrastructure is scarce and basic networks are not complete, as may be the case for some developing economies. As was noted above, for instance, railways had a greater impact on productivity in Brazil than in the UK, where a well-developed canal network already linked major industrial locations.
- I.31** While transport infrastructure accumulation is crucial for developing economies, for mature economies with well-established networks, where connectivity between economic centres is already in place, the evidence suggests that there is considerably less scope for transport improvements to deliver the periods of rapid growth seen historically.
- I.32** For developed economies, the debate should be focused on the capacity and performance of the existing network: productivity benefits from transport may be more closely related to the efficiency of infrastructure use, rather than simply the absolute amount of investment, particularly where capacity is stretched, as demonstrated, for instance, through congestion or unreliability. The relationship between transport and growth in a mature economy is therefore likely to be an incremental one.
- Efficient management of existing network**
- I.33** Increasingly, studies are suggesting that the efficiency with which existing transport networks are used is just as important as the underlying investment. Hence, even if additional infrastructure on its own may not always boost trend growth, transport investment to support performance of the network in developed economies can be economically beneficial and is necessary to maintain a high quality transport infrastructure – a key requirement for continued growth.
- I.34** Efficient management of the infrastructure includes adherence to commercial principles such as competition, efficient pricing across different modes, including roads, user charges to allocate scarce infrastructure, and sufficient resources being devoted to the maintenance and repair of the network. There is some evidence, see figure 1.6, that improving the performance and efficiency of an existing network can be just as, if not substantially more, beneficial than investment in new network capacity. Evidence on efficient management measures is provided in Volume 3.

Figure 1.6: Economic benefits from efficient use of existing transport network

- Erenburg (1994) finds that policy measures that make more efficient use of existing transport infrastructure through pricing mechanisms or other traffic management solutions can have a significant impact on growth.^a
- Hulten and Schwab (1996) estimates that a 1 per cent increase in infrastructure effectiveness would have an impact on growth seven times larger than a 1 per cent increase in the rate of public infrastructure investment.^b
- OECD / ECMT (2001) paper on the benefits of transport concludes that ‘...wider economic benefits may be achieved more efficiently by introducing prices which correspond more closely to costs, or by reallocating existing infrastructure more efficiently between users, or by adopting other transport policies.’^c
- Victoria Transport Policy Institute (2003) argues that investment in alternative modes of transport and in management strategies to encourage more efficient use of existing road capacity (e.g. pricing congestion/parking) tends to provide greater economic benefit than expanding existing highways to reduce congestion. The study also argues that the benefits of transport improvements are heavily dependent on local circumstances, in that they will only increase economic development where inadequate transport is a significant constraint on economic activity.^d

^a *Linking public capital to economic performance*, Erenburg, 1994.

^b *The public capital hypothesis: The case of Germany*, Hulten and Schwab, 1996.

^c *Assessing the benefits of transport*, European Conference of Ministers of Transport, OECD, 2001.

^d *Transportation cost and benefit analysis – evaluating transportation benefits*, Victoria Transport Policy Institute, 2003.

Regulatory reform can deliver for growth **1.35** Delivering productivity benefits from transport does not always mean more investment. There is some evidence to suggest that regulatory reform within the transport-using sector could be an important element in better management of existing networks. For example, trucking deregulation contributed more to reductions in costs for the transport-using sector than public capital spending in both France and the United States after the mid-1980s.¹⁵ Similarly for the UK, recent increases in the maximum weight of trucks from 38 to 41 and then to 44 tonnes in 2001, supported by necessary infrastructure improvements, have been estimated to cut road haulage costs by 19 per cent for weight-constrained loads.¹⁶

Conditions necessary to deliver growth benefits **1.36** Equally, more often than not, transport is unlikely to be the answer to regenerating an area or region. Whilst transport can play an important role in facilitating productivity growth, transport infrastructure alone does not create economic potential. In particular, it is widely accepted that the positive effects of transport investment, and its magnitude, are conditional on certain external pre-conditions complementing any transport provision, namely: stable macroeconomic conditions; the availability of skilled labour; and a favourable environment for business investment to drive output growth. See Figure 1.7.

¹⁵ *The Historical Significance of Transport for Economic Growth and Productivity*, Crafts and Leunig, 2005.

¹⁶ *The economic and environmental benefits of increasing maximum truck weight: the British experience*, A. McKinnon, Transportation research part D 10 (2005) Elsevier. See Chapter 1.2 for more on the impacts of increasing maximum truck weight.

Figure I.7: Evidence of conditions necessary for transport to impact on the performance of the economy

- Canning and Fay (1993) assert that infrastructure should not be seen as a factor of production but as a condition for high growth. Kessides (1993) notes that infrastructure does not create economic potential; it only develops such potential where appropriate conditions exist, i.e. other inputs such as labour and capital are available to drive output growth.
- Indeed, Lynde and Richmond (1993), Trinder (2002) and O’Fallon (2003) assert that public and private capital are complements: that physical infrastructure requires the existence of available productive private capital (human or physical) in order to realise economic growth potential, and that infrastructure investment can boost the productivity of such private capital.^a Infrastructure investment may also indirectly feed through to increased labour productivity.
- Canning and Pedroni (1999), Banister and Berechman (2000), Trinder (2002) and O’Fallon (2003) highlight other important underlying conditions that will influence the impact of transport investment on the economy.^b In summary:
 - economic conditions: a stable macroeconomic policy climate, local market circumstances, agglomeration, and labour market conditions;
 - investment conditions: availability of funds, timing and structure of investment, type of infrastructure investment, location of investment in terms of network structure; and
 - political and institutional conditions: decision making, planning, sources and methods of finance, level of investment (local, regional or national), supporting legal and organisational/institutional policies and processes, and method and governance of infrastructure delivery and provision.

^a See: *Public capital and long-run costs in the UK*, Lynde and Richmond, 1993; *Economic growth and transport infrastructure appraisal*, Trinder, 2002; and *Linkages between infrastructure and economic growth*, O’Fallon, 2003.

^b See: *Infrastructure and long-run economic growth*, Canning and Pedroni, 1999; *Transport investment and economic development*, Banister and Berechman, 2000; and *Linkages between infrastructure and economic growth*, O’Fallon, 2003.

I.37 The Jubilee Line Extension is often cited as a case study of how transport can support regeneration of an area, in this case the Docklands area of East London. However, in this particular example, it is also clear that other factors contributed, and were essential, to the area’s success. For example, the area benefited from favourable business rates that attracted business investment and it met the existing demand for a convenient alternative office centre to the City, as well as access to London’s skilled labour pool. Transport was the final piece in the jigsaw, releasing a constraint and supporting London’s growth.

I.38 Hence, although in very limited circumstances, transport investment may be able to unlock under-utilised resources, such as skilled labour and land in the area, or relieve pressure in neighbouring labour market catchments, a blanket “build it and they will come” approach to transport projects is extremely speculative. It is unclear whether a general policy of significantly improving the connections between a peripheral urban area and a core urban area through transport generates productivity benefits for both areas. A link between the two areas can result in a displacement of economic activity, with the core benefiting at the expense of the periphery, and with little or no impact on national productivity.¹⁷

¹⁷ *Transport investment, transport intensity and economic growth*, Standing Advisory Committee on Trunk Road Assessment (SACTRA), 1999 and *Economic linkages across space, report for ODPM*, Coombes, Duranton, Overman and Venables, 2005.



I.39 This suggests that a transport link is unlikely to improve an unproductive urban area unless there is underlying demand for this connection, and that productivity returns are likely to be greatest where there is demand for transport, as manifest, for example, through congestion. The evidence suggests that governments need to think carefully about the role of transport in supporting the growth or regeneration of an area or region. This is not to say that transport cannot contribute, where the right complementary conditions are present, but that policies such as skills or fiscal incentives may be more appropriate in driving economic performance.

Transport and climate change

I.40 This chapter has explored the relationship between transport and the economy. It is also necessary to recognise transport's critical interaction with climate change and the potential for damaging the environment. The Stern Review 2006 has provided compelling evidence of the impact that climate change will have on economic growth unless there is urgent, global action. Figure 1.8 outlines further what this means for the transport sector. This Study has sought to take account of these conclusions of the Stern Review throughout its analysis.

Figure 1.8: Transport and climate change – findings from the Stern Review 2006

- A deterioration in environmental quality can lead to a reduction in economic growth. Climate change provides perhaps the starkest example of this.
- The Stern Review on the economics of climate change shows that all countries will be affected by climate change, and that the impacts and risks will intensify as temperatures rise. It finds that if emissions of greenhouse gases continue along a ‘business-as-usual’ path, temperatures could rise by 5 degrees centigrade or more over the following decades. This is the same as the temperature difference between now and the last Ice Age, and would have serious, transformational consequences for the physical and human geography of the world.
- Modelling estimates by the Review show that climate change could generate economic costs equivalent to an average reduction of at least 5 per cent of global consumption each year, now and forever. If a wider range of risks and impacts are taken into account, the estimates of damage could rise to 20 per cent of consumption. In contrast, taking early action to reduce greenhouse gas emissions to stabilise emission concentration levels at 550ppm carbon dioxide equivalent (CO₂e) or below would cost around 1 per cent of global GDP (Gross Domestic Product) by 2050, if well-designed global policies are implemented soon. The Review finds that the benefits of action to reduce emissions far outweigh the costs.
- To stabilise concentration levels at 550ppm CO₂e by 2050, the Review argues that total emissions would need to be 25 per cent lower than current levels. Transport will have a role to play in contributing to these emission reductions. However, transport is among the fastest growing carbon-emitting sectors and also has among the highest abatement costs. So, the Review argues, in moving to a low carbon economy the transport sector could be among the last sectors to experience absolute levels of emission cuts because it would be more efficient to focus first on those sectors that can abate more cheaply.^a The Review highlights, for instance, that it is likely that a 60 per cent reduction in the carbon intensity of electricity production will be necessary. Transport is therefore likely to remain largely oil-based until 2050.
- The Review argues that tackling greenhouse gas emissions from transport and other emission intensive activities will require policy action on broadly three fronts. Firstly, polluters should be faced with a carbon price; this could be via taxation, inclusion in a trading scheme or implicitly by regulation. (From an economics perspective, carbon pricing and road pricing are very similar as they both involve presenting the user with the external costs of their activities.) Secondly, innovation policy is necessary to bring forward new clean technologies. Thirdly, barriers to behavioural change should be removed using, for example, information policy.
- In the transport sector, carbon savings in the period to 2050 are likely to come from improvements in vehicle efficiency, biofuels, and behavioural change. Beyond this date, low carbon technologies such as hydrogen or electric powered vehicles could play more of a role.
- **Source: Stern Review 2006.^b**

^a Abatement costs in transport are high relative to other sectors for two reasons. Firstly, the low carbon technologies in transport (electric and hydrogen powered vehicles) are currently relatively expensive. Secondly, the welfare costs associated with reducing demand for travel or switching to more fuel-efficient vehicles are fairly high.

^b *The Stern Review: The Economics of Climate Change*, HM Treasury, 2006.

CONCLUSIONS

1.41 This chapter has set out the historical evidence and academic literature on the relationship between transport and the economy at the macro level. The evidence presented shows that transport, under the right conditions, can deliver GDP and productivity benefits, although the scale of this contribution is difficult to assess. This analysis provides useful indicators on the economic case for transport in supporting the economy at the broader strategic level. It illustrates how lack of transport infrastructure can also constrain growth but that transport alone will not transform economic performance.

1.42 The macro approach offers limited help in identifying where individual investments might yield large benefits. Chapter 1.2 sets out a framework for examining the precise mechanisms by which transport can contribute and drive economic growth at the micro level. It is only this kind of understanding that will properly equip policy makers to focus their actions where they will help productivity growth.