

TRANSPORT NOTES

TRANSPORT ECONOMICS, POLICY AND POVERTY THEMATIC GROUP



THE WORLD BANK, WASHINGTON, DC

Transport Note No. TRN-19

January 2005

Notes on the Economic Evaluation of Transport Projects

In response to many requests for help in the application of both conventional cost benefit analysis in transport and addressing of the newer topics of interest, we have prepared a series of Economic Evaluation Notes that provide guidance on some of issues that have proven more difficult to deal with.

*The **Economic Evaluation Notes** are arranged in three groups. The first group (TRN-6 to TRN-10) provides **criteria** for selection a particular evaluation technique or approach; the second (TRN-11 to TRN-17) addresses the selection of values of various **inputs** to the evaluation, and the third (TRN-18 to TRN-26) deals with specific **problematic issues** in economic evaluation. The Notes are preceded by a **Framework** (TRN-5), that provides the context within which we use economic evaluation in the transport sector.*

The main text of most of the Notes was prepared for the Transport and Urban Development Department (TUDTR) of the World Bank by Peter Mackie, John Nellthorp and James Laird, at the Institute for Transport Studies (ITS), University of Leeds, UK (The draft text of Note 21 was prepared for ITS by I.T. Transport Ltd). TUDTR staff have made a few changes to the draft Notes as prepared by ITS. Funding was provided from the Transport and Rural Infrastructure Services Partnership (TRISP) between the Department of International Development (DFID) of the Government of the United Kingdom and the World Bank.

The Notes will be revised periodically and we welcome comments on what changes become necessary. Suggestions for additional Notes or for changes or additions to existing Notes should be sent to rcarruthers@worldbank.org

PROJECTS WITH SIGNIFICANT EXPECTED RESTRUCTURING EFFECTS

(URBAN RAIL, MAJOR BARRIER CROSSINGS)

The World Bank view of the role of private and public sectors in the provision of transport infrastructure and services is described in TRN 1 (Public and Private Roles in the Supply of Transport Infrastructure and Services). TRN1 provides guidance on the diversity of options for public private collaboration in the transport sector, not only in the funding and provision of infrastructure but also in relation to transport services and other activities that were once considered as exclusively for the public sector.

Here we focus on the economic evaluation of more conventional infrastructure investments, and specifically on two types of projects which may result in significant economic restructuring – relocation of economic activities, generation of new activities, or changes in the way that current activities are undertaken. The two examples used, new urban rail lines and major new barrier crossings (see Sections 2 and 3) serve simply as examples of a much wider issue. The issue is that whenever projects bring about a large step change in transport costs, there is a stimulus for a reorganisation of economic activity outside the transport sector. For example, a manufacturer may change the source of their raw materials or relocate their production, a retailer may centralise their operations to serve a larger market area, or a farmer may change their crops to a more marketable combination and hire labour.

These effects are as likely to be stimulated by a major new road in a resource rich region as by either of the examples above. The key point is that these projects raise issues for modelling (Section 4) and for appraisal (Section 5). This note seeks to explore these issues, but also to give firm guidance to project evaluators on the practical methods which can be used within what is a complicated and difficult area. The guidance is summarised in Section 6.

It is perhaps worth noting that these projects are – in effect – extreme cases of Induced Traffic (see TRN 11); anything which applies there applies in these cases with greater emphasis. Finally, there is also a link with the advice on Low Volume Rural Roads (see TRN 21); both that case and the cases discussed in this note involve restructuring outside the transport sector – the difference is that the low volume rural roads case is simple enough to deal with by focusing on producers in only one sector, or a small number of sectors. This note addresses projects where the economic context is more complicated.

WHAT ARE THE LINKS BETWEEN TRANSPORT INVESTMENT AND ECONOMIC RESTRUCTURING?

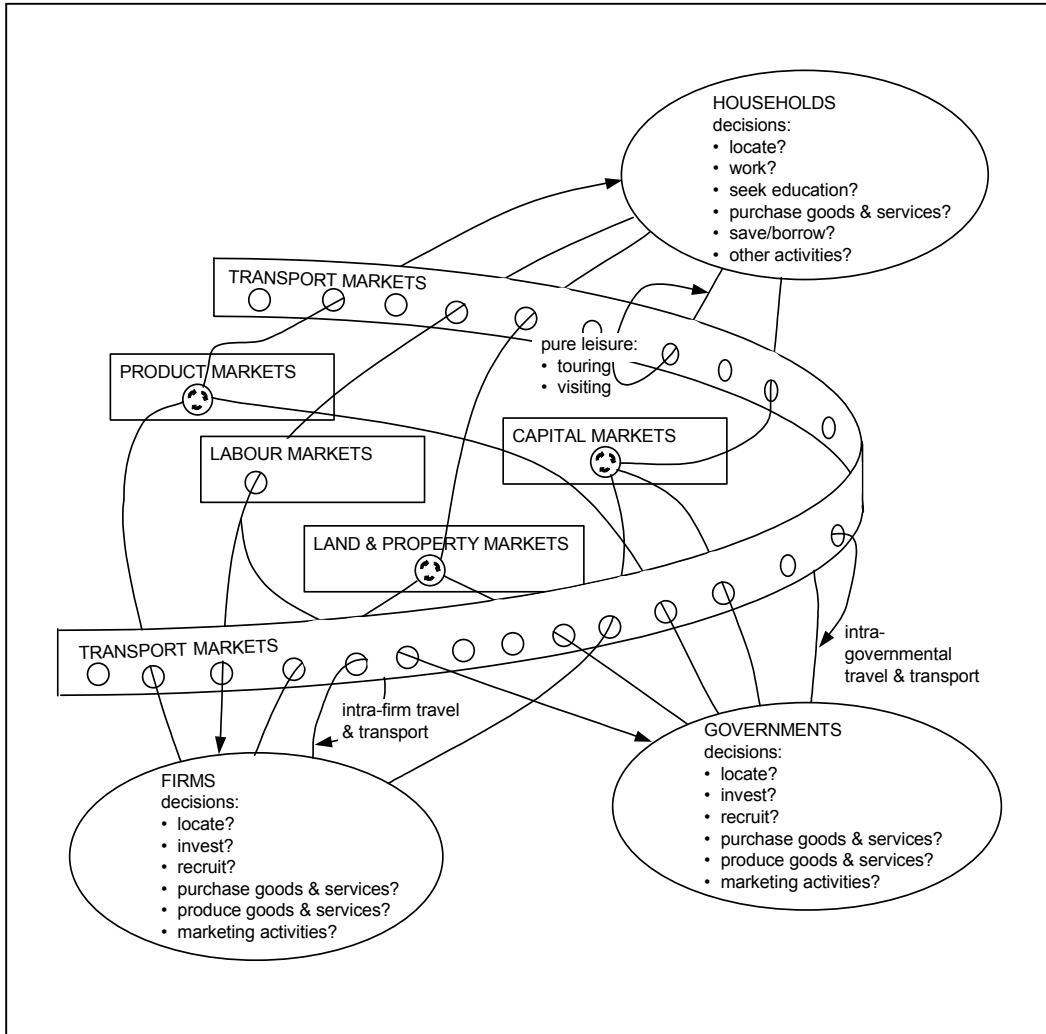
Transport networks can play a key role in the economic development of countries and regions (SACTRA, 1999). Communications were crucial to ancient civilisations throughout the world, were crucial in the industrial revolution, and remain crucial in the knowledge-driven economies today. Whilst telecommunications offer an alternative to transportation in some situations, research suggests that so far the development of telecommunications has tended to complement, rather than substitute for, the demand for transportation.

Transport plays a special role in economic development since it provides the connection (across distance) between consumers and producers in a wide range of markets:

- ❑ transport brings together employers and employees in the labour market;
- ❑ it facilitates trade by bringing together buyers and sellers, and their products;
- ❑ it has the potential to radically change the pattern of activity in the land market; and
- ❑ to some extent it facilitates other economic sectors such as the capital market, education, government, culture and tourism.

Figure 1 gives an overview of some of these connections through the transport sector, emphasising the point that transport facilitates a wide range of economic activity, and affects a wide range of economic decisions. It is not surprising that transport receives attention in economic development policies throughout the world (eg. CEC, 2002; World Bank, 2002). But what evidence is there that individual transport projects can contribute significantly to economic change?

Figure 1. Complex of Linkages within the Transport-Economy System



Sources: Mackie et al (2001); David Simmonds Consultancy / ME&P (1998).

A common theme in the literature on transport and the economy, is that the presence of adequate transport is a necessary condition for economic development, but is not sufficient to guarantee it. Other key local conditions include available human capital/skills in the workforce; availability of suitable land and property; and a stable political and legal context. It is also very much easier to make the case for 'restructuring effects' where there is a well worked-out economic strategy for the country or local area concerned. One of the roles of the analyst in economic appraisal is to investigate and report on this wider context, because it can be highly relevant in the process of decision.

When the conditions are right, transport projects have the potential to contribute to significant local, regional or even national economic restructuring. In this note we consider two examples (Sections 2,3), and consider the implications for modelling (Section 4) and appraisal (Section 5).

URBAN RAIL PROJECTS

Urban rail projects, whether metros, trams or heavy rail, have the potential to alter the structure of the urban economy. Whether the impact is significant or not will depend upon the scope of the network, and the quality and price of the service offered.

Among the key effects identified by monitoring studies are:

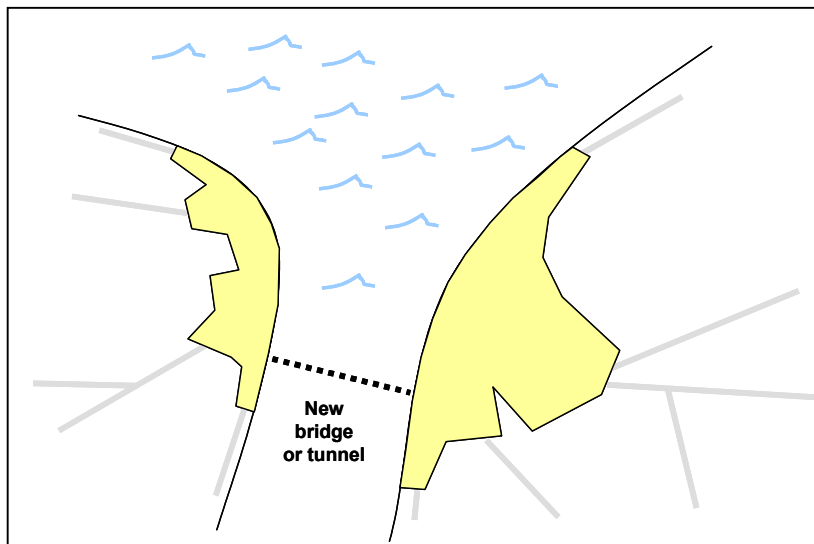
- ❑ expansion of labour supply at the centre, and to a lesser extent throughout the network,

- ❑ bringing workers from peripheral districts dominated by agriculture into the manufacturing and services sectors in the city;
- ❑ opening up access to education;
- ❑ intensification of land use around rail stations, especially in the urban centre, with corresponding changes in property prices;
- ❑ relocation of business towards rail served corridors and expansion of existing businesses.

MAJOR BARRIER CROSSINGS

These often take the form of bridges (eg. Jamuna bridge; Tagus river crossing) or tunnels (Japan) across bodies of water, although there are other possibilities (eg. a causeway across a flood plain, mountain crossings). In some cases a barrier can be political, eg. a recently opened national border, rather than physical.

Figure 2. Estuary or River Crossing - Sketch



In transport network terms, these projects serve to provide a link between disjoint networks. In other words, they link up the networks on either side of the barrier, creating a wider range of destination and route options for people and goods.

In economic geography terms, these projects create new opportunities for spatial competition and economies of scale. Suppose these are significant. Firms located on each side of the barrier gain the opportunity to compete in each other's markets, which may initiate a process of consolidation and concentration. Residents located on each side of the barrier gain the opportunity to relocate, taking advantage of property market inequalities across the barrier. Labour becomes mobile across the former barrier, expanding the pool of workers and skills available on both sides. Taking advantage of the improved accessibility of the areas on both sides of the crossing, firms and households are attracted to the region.

As proposed by the 'new economic geography', clusters of skills (human capital) and knowledge may develop, leading to endogenous economic growth (Fujita, Krugman and Venables, 1999).

MODELLING ISSUES

The modelling issues associated with economic restructuring can be onerous, if – as is usually the case – the only pre-existing forecasting model is a conventional transportation model.

Essentially, the analyst faces two important choices:

To Model Production or Not

Freight demand, and the demand for business travel, are driven by firms and other production sector organisations. The key decisions are: what to produce, in what locations, using what inputs? The outcomes of these decisions directly affect the loads on the transport network.

- ⊕ The key advantages of attempting a spatial production model are that the modelling process can yield insights into the linkages between transport and the local economy; and can help to focus the policy process on users' needs.
- ⊖ On the other hand, such models are data hungry - detailed spatial Input-Output matrices are required; they are more suited to policies or whole networks than to individual projects; and the methodology is still subject to research questions.

To Model Residential Location Choice or Not

Land-use and transport interaction (LUTI) models offer the chance to forecast changes in land use in response to changes in the transport network, and the feedback effects into transport demand. In particular, these models have an advantage in predicting shifts in patterns of residential location (Mackie et al, 2001).

For urban public transport projects, and for inter-urban projects which open up new commuting possibilities, the residential location response can be an important source of demand. These models are also very demanding in terms of data requirements.

If it is decided NOT to attempt a production sector model or a LUTI model, then a great deal of importance is placed on certain key parameters at the trip generation stage and trip distribution stage in the transportation model. These are:

- ❑ the planning assumptions: concerning **population** and **employment** in each zone in the base year, and population and employment in each zone in future years both **with the project** and **without**;
- ❑ the procedures for deriving **trip rates** between different zones (eg. the gravity model or other aggregate demand modelling techniques);
- ❑ **freight demand matrices** (are these realistic in the do-something scenario?);
- ❑ **elasticities of demand** for travel in response to reductions in generalised cost.

In constructing defensible models, it is advisable always to seek out evidence from comparable situations elsewhere. Peer review of the demand forecasts by appropriately experienced individuals will add further to their credibility. Of the above, the base planning assumptions, and the impact of the project upon them are probably the most critical for the appraisal.

ECONOMIC APPRAISAL ISSUES

The economic appraisal issues are closely related to the modelling issues raised in the last section.

What Is the Measure of Economic Benefits?

In transport cost-benefit analysis, user benefits are usually measured in the transport market itself. This means that the change in consumer surplus is calculated from the flows and costs on the transport network using the "rule-of-a-half" (see *TRN 11*. In terms of Figure 1, the measurement is made as the demand passes through the horseshoe-shape).

When there are significant restructuring effects, it is **possible** - although not necessarily true - that benefits might arise in other markets (especially land, labour, product markets) which are not fully reflected by the Transport CBA result (see [SACTRA, 1999](#); [Mackie et al, 2001](#)). The main causes of these additional benefits (or disbenefits) are: monopoly power; non-constant returns to scale; and externalities in the wider set of markets affected by the restructuring. The example given in Section 3 of economies of scale in production leading to endogenous economic growth is one example of this.

The problem we face currently is that there is lack of experience in using the alternative model forms (Annex A) for transport project appraisal, and the initial results from research versions of models are not yet validated.

For the moment, therefore, the advice is to make the best possible use of transportation models. This means that particular attention should be paid to the realism of the key parameters listed in Section 4:

- ❑ spatial population and employment assumptions;
- ❑ trip generation and distribution functions; and
- ❑ elasticities of demand¹.

Considering and Reporting the Wider Economic Impacts

One core recommendation is to undertake a good quality transport cost-benefit analysis. Where transport schemes are incremental in nature and the network is already well-developed the assumption should be that there are no additional wider economic impacts. But in the cases considered in this note, the transport benefits will not capture the sum total of the benefits to the economic system as a whole. Nor will it allow properly for the final incidence of benefits as they percolate through the economy into changes in prices, wages and land rents.

In such cases, we recommend the use of a qualitative approach. A commentary should be provided, focusing on the following issues:

- ❑ the *linkages* between transport and the regional economy, focusing on the specific linkages impacted by this project (which markets are expected to be affected – housing? labour? goods and services? - through improvements in which types of transport – commuter transport? inter-city business travel? freight and logistics? - is there any relevant evidence about the direction and magnitude of these effects?);
- ❑ the *competitive advantage* of the regions connected by the improved transport link, in traded sectors (for example, competitive advantage may flow from natural resources and their role in agriculture, fishing, tourism or manufacturing, or it may flow from a regional pool of skilled labour with specific skills) – this will influence the changing pattern of employment and output as a result of the project.

Market research methods including interviews, surveys and focus groups can be used to gain an insight into these effects. The research would be conducted primarily among employers (and potential employers) in the regions concerned, aiming to understand how the project will impact on their decisions about production, employment, location, and transport. Similar work could be conducted with property market professionals if commuting patterns and residential location are vulnerable to change. For further information on these techniques, see [Barrett \(1999\)](#). This work would provide qualitative evidence in support of the core transport cost-benefit analysis.

SUMMARY OF RECOMMENDATIONS

The overall message of this Note is as follows. Where the transport system is reasonably well developed and economic rigidities are not too strong:

- ❑ the first priority should be to get a realistic model and assessment of the transport benefits and costs;

¹ It is these parameters which influence the size of the 'additional' benefits compared with a situation where demand could not respond to the project.

- ❑ except where there is clear empirical evidence to the contrary, wider economic impacts should not be adduced as a source of additional benefits which help to justify schemes which fail in transport terms;
- ❑ the appraiser should bear in mind that many transport benefits are in fact converted through the economic process into final impacts on prices, wages, rents, etc. Thus the final distributive impact of transport projects may be very difficult to measure.
- ❑ a good qualitative assessment of the wider economic impacts, recognising the dangers of double counting with the transport impacts, is useful and practical.

FURTHER READING

- [1] The World Bank (2004), *Transport Note 1, Public and Private Roles in the Supply of Transport Infrastructure and Services*, Washington D.C: The World Bank
http://siteresources.worldbank.org/INTTRANSPORT/214578-1099319223335/20273720/tp-1_pp-roles.pdf
- [2] Aschauer DA (1989), 'Is Public Expenditure Productive?', *Journal of Monetary Economics*, 23.
- [3] Barrett G (1999), *Review of the Methodology for Assessing the Economic Development Impacts of New Highway Infrastructure*. Report to SACTRA. London: DETR. Available online at:
<http://www.roads.dft.gov.uk/roadnetwork/sactra/support99/review/pdf/review.pdf>
- [4] Commission of the European Communities (2002), *Framework for Funding of Investments in the Field of Transport Infrastructure with ISPA*. Brussels: CEC.
http://europa.eu.int/comm/regional_policy/funds/download/trans_en.pdf
- [5] David Simmonds Consultancy (in collaboration with Marcial Echenique and Partners Ltd) (1999), *Review of Land-Use/Transport Interaction Models*. Report to SACTRA. London: DETR. Available online at:
<http://www.roads.dft.gov.uk/roadnetwork/sactra/support99/landuse/pdf/landuse1.pdf>
- [6] Mackie PJ, Nellthorp J, Kiel J, Schade W and Nokkala M (2001), *IASON Project Assessment Baseline*. Deliverable 1. IASON Project (Integrated Appraisal of Spatial economic and Network effects of transport investments and policies). Delft: TNO Inro. Available online at:
<http://www.wt.tno.nl/iason/>
- [7] SACTRA (The Standing Advisory Committee on Trunk Road Assessment) (1999), *Transport and the Economy*. London: The Stationery Office. Available online at:
<http://www.roads.dft.gov.uk/roadnetwork/sactra/report99/index.htm>
- [8] Fujita M, Krugman P, Venables AJ (1999), *The spatial economy : cities, regions and international trade*. Cambridge, MA: MIT Press, 1999
- [9] The World Bank (1996), *Sustainable Transport: Priorities for Policy Reform*. Washington, DC: The World Bank.
- [10] The World Bank (2002), *Cities on the move : a World Bank urban transport strategy review*. Washington, DC: The World Bank.
<http://www.worldbank.org/transport/urbtrans/utsr.htm>