PRIVATE FINANCING OF TRANSPORT INFRASTRUCTURE: SOME UK EXPERIENCE

Roger Vickerman[1]

Abstract

This paper establishes a framework for considering the use of private finance in the development of transport infrastructure and applies it to examples drawn from United Kingdom experiences. The framework highlights the key issues of risk (and especially risk transference) and transactions costs in determining the effectiveness of different private finance options. The examples used range from the totally private provision of the Channel Tunnel, through the privatisation of Railtrack to the use of DBFO schemes for major roads. The key conclusion is that the expected gains from increasing transparency in transactions costs have been difficult to achieve and that this is at least in part due to a reluctance by the private sector to accept the transfer of risk. It will require much greater confidence in identifying private sector benefits from transport projects and reducing the risk of change in government policies to make a fuller engagement of the private sector effective.

1 Introduction

The optimal organisation and means of financing infrastructure remain awkward questions in the transport sector. Traditionally the preserve of the public sector in most economies, there has been increasing questioning of the rationale for this as the cost of maintaining the existing infrastructure and of making marginal additions to the infrastructure stock have escalated. If it is the case that better transport infrastructure has a direct impact on productivity and growth, or at least boosts the productivity of private capital (Vickerman, 2000, 2001), then are there ways of shifting at least some of the responsibility for infrastructure provision to those who may benefit most?

Private infrastructure provision is not a new idea. Bridges have been privately owned for centuries[2]; the early turnpikes were privately provided and tolled; early railway development in many countries, including the UK and France, was purely private-sector driven. However, government approval or licensing, regulation and eventually, in most European countries, state

[1] Centre for European, Regional and Transport Economics, The University of Kent at Canterbury, UK. R.W.Vickerman@ukc.ac.uk
[2] Note that the original classic of infrastructure economics (Dupuit, 1844) referred to bridges.

ownership became the norm. This state involvement was sometimes for ideological reasons, sometimes for military/security reasons, but more often for purely economic reasons as the private sector failed to meet rapidly growing or changing demands.

Growing concern over state budgetary deficits, and an (often ideologically driven) concern over the inability of the public sector to manage complex infrastructure efficiently in an increasingly competitive climate, led to the reversal of this trend from the 1980s. Led by the deregulation movement in the US, enthusiastically picked up by the privatisation movement in the UK, and fuelled by the availability of a highly liquid private capital market, the past two decades have seen a major change in the way infrastructure is viewed. But this has not been without its disappointments for the supporters of private initiatives or for governments wishing to see the off-loading of some of their financial responsibilities.

In this paper we first review key elements in the economics of infrastructure provision, concentrating on the issues of risk and transaction costs, before examining options for both public and private funding. The framework is then used to evaluate the experience of the UK in various attempts to use private finance or achieve complete privatisation of transport infrastructure: the Channel Tunnel, national rail infrastructure, urban light rail and national roads.

2 Key Elements in the Economics of Infrastructure Provision

The basic underlying conflict in infrastructure is that it has all the characteristics of a public good at levels of demand below capacity, but the lack of competition in infrastructure supply leads to the problem of a natural monopoly. The natural monopoly argument has been the underlying rationale for public involvement in infrastructure provision since the nineteenth century. The public good argument depends on the recognition that infrastructure is expensive to provide, and that the lead time in construction requires a large advance funding. Once provided, however, the short-run marginal cost of usage is zero (or close to zero) leading to the basic pricing difficulty.

This problem has been recognised in the debate on “fair and efficient pricing” for infrastructure conducted by the High Level Group for the European Commission (1999).

Central to the problem of infrastructure provision is the question of opportunity cost and risk. Fixed infrastructure typically has a zero opportunity cost. Infrastructure providers, unlike transport service providers, cannot cover the risks of their investment by the residual value of the

infrastructure. This is central to the notion that infrastructure should be priced at its short-run marginal cost, since there is no transfer price of the capital asset to be taken into account. But at levels of usage below capacity the short run marginal cost is effectively zero and hence the infrastructure can make no contribution to its capital costs. Against this we have to reckon with the lumpiness and long gestation period of infrastructure which prevents perfect marginal adjustments of capacity to demand. It is this characteristic which is seen as a valid argument for public funding as well as public provision, since only the public sector will be able to take future needs into account adequately and ensure the correct level of provision at the right time, although this may imply cross-subsidy to cover the shortfall in revenues against full costs in an infrastructure priced at short-run marginal costs. At capacity the situation reverses, however, and prices based on short-run marginal cost rise rapidly, making the infrastructure cash rich, implying the need for expansion. Such an expansion, however, even if it is able to be financed over its life, will pose problems in its early years when it will require subsidy.

Those financing infrastructure face three main types of risk which can affect provision: construction risk; revenue and maintenance risk; and planning and political risk. Construction risks arise because of the individuality of large infrastructure projects and their long gestation periods, both of which make costs difficult to estimate accurately. Large infrastructure projects frequently require detailed design to be carried out whilst construction is in progress, for example to overcome specific construction problems encountered. Sometimes inadequate specification of the project compounds the expected construction cost risk. This compounds the problem of inefficiency in the actual management of the construction contract which can make it easy for contractors to inflate costs and not appear to be responsible for these increases. Despite these tendencies for costs to increase there is a risk to the commissioning organisation that contractors may systematically underestimate the costs involved. Lower costs increase rates of return and make it more likely that projects will be undertaken; although aware of this commissioning organisations may also wish to see the costs underestimated in order to get a project accepted. Once large infrastructure projects are started it becomes very difficult to abandon them completely.

In a recent survey Flyvbjerg *et al* (2002) suggest that infrastructure costs are underestimated in 90 per cent of transport projects and that actual costs are on average 28 per cent higher than estimated. This figure rises to 34 per cent for fixed-link (major bridge and tunnel) projects and 45 per cent for rail projects, and is around 20 per cent for road projects. The data used in the study cannot determine whether private sector projects are more or less prone to such underestimation than

public sector projects, but it does suggest that transport projects are not more susceptible to this problem than other large infrastructure projects.

Once completed, infrastructure providers also face operational risks. Where usage is below that expected there may be revenue risks. These are the other side of the coin from construction cost risks, but may be associated with particular problems since the tendency to systematically underestimate costs is often seen to go together with the tendency to overestimate usage. The most difficult infrastructures, those with the highest costs, are likely to be those with the greatest risks from the combination of these two factors since they are the ones where previous experience is unlikely to be useful. Where traffic forecasts are wrong in the other direction and underestimate traffic, there can also be a problem since this may impose much higher maintenance costs on an infrastructure, both because of the need to repair structures designed for lower traffic levels and because of the loss of revenue during the repair periods, which will arise sooner and more frequently. This would be compounded by poor construction which could arise if contractors were not responsible for its consequences.

Finally, and most difficult to assess are the policy and planning risks which any infrastructure provider has to take into account. Once again the long gestation periods and the longevity of pay-back periods for major infrastructures makes them vulnerable to changes of policy. Enthusiasm for private finance has been tempered where there is a risk that a change of government may lead to re-nationalisation. Even more worrying can be the lack of consistency displayed by governments with respect to their own decisions; the lack of clarity in the handling of Railtrack by the UK government is an example of this. When this becomes an open conflict between two levels of government, as in the case of the mechanism for bring private funding into London Underground, it is difficult for the private sector to receive clear signals.

Even without changes of policy which impact directly on the way infrastructure is operated, changes of policy which affect the competitive position of the mode to which the infrastructure relates can cause problems. Again it is often uncertainty over future directions of government policy which causes difficulties. The confusion over Railtrack has caused problems for the rail operators and their commitment to co-financing infrastructure improvements. Continuing ambiguity over the attitude of governments to some form of universal road pricing poses problems for potential investors in both road and competing modes.

We need, however, to retain some perspective over the relationship between infrastructure costs and total transport costs. Infrastructure is a problem because it is costly to provide, but the unit costs of that infrastructure per passenger or tonne km are relatively small, both with respect to total transport costs. It has been estimated that infrastructure costs contribute between 18% and 23% of average road costs per vehicle km (including external costs, but excluding congestion) (see ITS, 2001 and Link *et al*, 2000). The contrast is even greater with respect to total logistics costs. One of the problems here is that the end users of infrastructure are taking a whole series of independent decisions about their logistics and transport needs for which demand for infrastructure is then a derived demand which it is expected will be available at the place and time needed.

The possible benefits of infrastructure go beyond the immediate user, however. A basic rationale for public involvement is that there are wider economic benefits from transport infrastructure which affect both the level and the spatial distribution of economic activity. The debate on the impact of infrastructure on economic growth and development, and how to capture this in project appraisal, is beyond the scope of this paper. Vickerman (2000, 2001) provides a summary of the issues and SACTRA (1999) and Mackie *et al* (2001) discuss the relevance of this for evaluation procedures. The question of the balance between the competitiveness and the cohesion impacts of infrastructure remains, however, crucial in the debate over funding since, if the primary economic impact of public infrastructure is on the productivity of private capital, then it is reasonable to expect that part of that surplus should be made available to fund the infrastructure. However, there may be occasions where that surplus would lead to infrastructure being built in the wrong place to secure the desired regional development/cohesion benefits This leads to difficulties for the public sector in managing the private sector pressure for specific investments which may not be seen to be in the wider public interest.

Perhaps the most difficult issue with respect to the balance between the market and planning approaches to infrastructure development is the question of network planning. One of the characteristics of private sector financed infrastructure is that it typically has to be broken into manageable sized projects in order to be financeable. But transport infrastructure only works as a network, thus investors have to be assured that each relevant part of the network will be constructed and means have to be found of ensuring that appropriate external spillovers can be identified and compensated.[3] This problem is compounded by the recognition of the need to provide

[3] As an example see the question of the completion of the high-speed rail network associated with the Channel Tunnel; different attitudes to the network were taken in France and the UK. In France announcement of the construction of the TGV-Nord was made just ahead of the public flotation of Eurotunnel; in the UK concern over public opposition to construction of a high-speed line and

interoperability, now enshrined in successive EU transport policy documents. This limits the scope of individual infrastructure providers to minimise costs by providing for access only for users imposing the least costs; for example the need for road operators to meet minimum axle weight and safety standards, new rail infrastructure to meet common loading gauge and signalling requirements.

We have set out in this section a range of the basic issues which arise in considering the provision of infrastructure. In the following two section we examine how far the public and private sectors are able to meet these requirements.

3 Funding Options

3.1 Public infrastructure and public funding

The principal rationale for public sector provision of infrastructure is through its public good characteristics. This would imply that infrastructure should be financed directly out of general tax revenues. However, infrastructure rarely meets all the criteria for a public good. In particular, mode specific transport infrastructure is excludable and at levels of use approaching capacity becomes rival. This shifts the argument towards the externality effects of infrastructure, and in particular the wider economic effects. Too frequently these wider effects have been used as an assumption rather than as the outcome of a rigorous assessment (SACTRA, 1999).

Concern over the validity of the traditional arguments, coupled with the need to reduce public sector budgets, led to a retreat from routine acceptance of public funding. The debate initiated by the Aschauer (1989) and Biehl (1986, 1991) studies in the late 1980s showed that there were identifiable wider economic impacts which could justify public funding, but that these were not universal and needed to be justified on a case by case basis (Gramlich, 1994; SACTRA, 1999).

If there is a case for arguing that there are identifiable external/spillover benefits rather than just a general public good contribution this may raise questions as to why most public sector funding comes out of general funding. Since users of infrastructure create external costs of congestion and environmental damage there is a case for raising charges for the use of infrastructure to reflect this

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recognition of the problems of separation of the marginal returns to high-speed line and tunnel (which had been instrumental in the abandonment of the previous scheme in the 1970s) led to a delay in even considering construction of CTRL which will only be completed some 13 years after the Channel Tunnel was opened (see Vickerman, 1995).

use of resources. The revenues from such charges should be regarded as the payment for a resource and not as general tax revenue and hence there is a case for these to be hypothecated to the transport sector, not on a mode by mode basis, but treating the transport sector as a whole. A case can hence be made for a self-financing, user-pays transport infrastructure network as by Peirson and Vickerman (1993) (see also the evidence for the UK in Peirson et al (1995) and Peirson and Vickerman (1998).

The difficulty remains that many of the wider benefits of transport may accrue to individual firms and people, whose potential surplus could be expropriated to pay for the infrastructure, but disentangling private and social benefits is not easy.

We have referred above to the problems caused by the long gestation and construction periods of infrastructure. These frequently do not coincide with the planning horizons of public finance. Experience with railway investment in the UK has shown clearly the impact which public expenditure constraints and short-term horizons have led to levels of investment below that which would have been optimal for the system as a whole. Two related points are relevant here; infrastructure does not have an immediate impact on voting behaviour and thus is easier to defer than social welfare expenditure, likewise the perceived benefits are long-term and diffuse and thus difficult to capitalise into voting behaviour.

3.2 Private funding options

The identification of a range of private benefits forms the basis of the case for the private financing of infrastructure. The principle argument for private finance arises for two main reasons, concern about the ability and efficiency of the public sector in the management of large scale projects and the availability of finance capital seeking projects which could advance the scheduling of a project. These two factors taken together would be expected to reduce the total cost of projects.

The main counter-argument to this expected cost advantage is that the cost of finance to the private sector would typically be higher than to the public sector given the higher degree of risk to the former. This problem can be partially overcome if the public sector provides guarantees to ensure that any benefits are not lost through inability of the private sector to complete a project.

The problem for the private sector is that of identifying the beneficiaries from a project such that they can be appropriately charged. Since infrastructure operators will typically only be able to

charge the direct users of the infrastructure this requires that the total benefits are sufficiently captured by user surplus. Such projects are likely to be those which are discrete, clearly bounded and largely self-contained with no close competitor. For this reason the most common privately financed schemes have been bridges and tunnels, but it could also apply to parallel roads or express or truck lanes on highways. Thus private sector funding of infrastructure is likely to be associated with a degree of monopoly power.

This may lead the public sector to consider exercising some regulatory control. Most toll bridges and motorways do face price controls, but Eurotunnel, the operator of the Channel Tunnel, was not subjected to such regulation given its competitive situation with the ferries, which are (largely) private sector operated, although it does face a degree of quantity regulation in having to provide certain minimum levels of service. The issue for the public sector is the balance to be struck between seeking the expected benefits of private sector finance and maintaining a degree of control for public benefit reasons, including the key issue of maintaining appropriate safety standards.

A number of options are open as summarised in Table 1. The most important distinctions are between the full scale private provision of infrastructure and those which involve some form of contract between public and private sector. These involve schemes such as the Private Finance Initiative (PFI) and Public Private Partnerships (PPP) in the UK. PFI involves a long-term contractual partnership in which the private sector takes on the risks of a venture in return for payments dependent on agreed standards of performance. PPP is a rather more general arrangement between public and private sectors (often with legal force) for expected mutual benefit in the provision of services. The distinction between the two is rather blurred with PFI being a specific subset of PPP.

Generally the conclusion from UK experience is that full privatisation raises considerable difficulties. The one pure private sector developed scheme, the Channel Tunnel, suggests that the expected cost savings in managing construction may not be as great as believed and that a PPP scheme such as the Channel Tunnel Rail Link and PFI road schemes may have offered better results. CTRL is currently on schedule and to budget and the Highways Agency estimates cost savings of about 15% on PFI road schemes. The difficulties faced by Railtrack in managing and developing the rail network in the private sector without increasing public sector support also cast some doubt on pure private sector provision.

The argument against this view usually takes the form that such private sector schemes have not worked because of the residual regulation preventing full competition. There are two responses to this. First, it can be argued that the competition does take place in the form of the competitive bidding for the rights. This is argued to be the most potent factor in reducing costs in PFI schemes. Secondly, it has to be questioned whether a framework allowing for full competition, rather than competitive bidding, could ever be introduced for major infrastructure.

Table 1. Schematic outline of private finance options

Type of scheme	Example scheme	Advantages to private sector	Disadvantages to private sector	Advantages to public sector	Disadvantages to public sector
Full private provision	Channel Tunnel	Full control of project; limited regulation	Full risk exposure; possible need to transfer project at end of agreed concession period	Transfer of all risk; retain some rights to asset at end of concession period	Residual risk of failure; Lack of control over prices etc unless regulatory structure.
PFI-scheme	DBFO Road schemes; Urban rapid transit (tram) systems	Greater control over project management; some risk retained by public sector	Value of project depends on correct forecasting of costs and revenue streams; need to return asset to public sector at agreed end of franchise	Transfer of (some) risk; lower overall cost of project; typically receive asset at end of agreed payback period	Retention of some risk; Need to fix payment for services to be delivered over long life of project
PPP-scheme	Channel Tunnel Rail Link; London Underground Modernisation	Agreed framework for payment received	Little or no ownership rights	Retention of ownership and control; all rights to asset revert at end of agreed payback period	Cost of payments; retention of risk elements

PFI/PPP schemes, as well as allowing for lower costs of delivery, have typically delivered on time at a lower overall costs and thus meet the basic public sector test of value for money. The questions which are raised against such schemes is whether they sufficiently transfer risk to the private sector, given the agreement for the public sector to make certain contractual payments against a defined performance regime and the extent to which projects achieve cost savings, not through greater efficiency but through schemes which are inherently less safe. In the UK all PFI projects have to be set against a relevant Public Sector Comparator (PSC), the reference cost of a project in the public sector which define the value for money of the private sector option. Defining the PSC then becomes the critical issue.

A battle has raged over the PPP scheme for London Underground which sees the transfer of the management and responsibility for upgrading of the infrastructure (but not the ownership) to private sector consortia, whilst control remains firmly in the public sector through Transport for London (TfL). TfL and the London Mayor have argued strongly in favour of a public sector managed scheme financed by bonds. There seems to be little to choose in the relative costs of alternative means of finance, PPP projects do give savings over the agreed PSC, although bond finance appears to be more uncertain (Ernst and Young, 2002), but there is a major political battle over the real degree of residual control retained in a PPP scheme.

The key questions remain those of the distribution of risk and the level of transaction costs in privately financed schemes. Although the principle of PFI-type projects is that there is a shift from the procurement of the assets involved in infrastructure to the purchase of the services provided by those assets, with the responsibility for provision and management of the assets remaining in the private sector, there is still a residual risk left with the public sector. As has been seen both with the early development of CTRL and the later problems with Railtrack, the public sector remains as the ultimate guarantor of a scheme.

This raises the question of the appropriate length of the franchise/concession period. The usual basis sees the contract fixing a maximum period at the end of which the asset reverts to the public sector free of any encumbrances, but reversion will usually occur at the time that the asset is fully amortised. In this way the public sector tries to shift the downside risk onto the private sector whilst retaining the upside "risk". The adjustment of the concession period can be a bargaining issue, as for example in the case of the Channel Tunnel where the original concession of 55 years (including construction) was extended to 99 years to enhance the project's overall value at a time of crisis in the financing. Later projects have seen the transfer of a revenue earning asset to a concessionaire to help provide a cash flow during the construction period as a means of easing the potential revenue risk in the early years.

The vertical separation of infrastructure and service provision inherent in the private finance of infrastructure implies that transaction costs become more transparent and therefore open to competitive pressure leading to greater efficiency. However, protecting each organisation against risk of default implies contractual obligations which may raise effective transaction costs. This is

compounded by the asymmetry of information in such contracts which leads to their being incomplete and therefore more costly.

In the following section we turn to consider a number of examples of private provision in the UK and assess these against the framework developed above.

4 Some UK Examples of Private Finance

4.1 The Channel Tunnel

The Channel Tunnel is a unique case and in many respects not typical of private project finance. The project itself consists of a double rail tunnel, plus a smaller service tunnel, each running for 50 km under the sea between France and England. Although a rail tunnel it takes both rail traffic (freight and passenger) and road traffic (on specially constructed shuttle wagons). The project was, at the insistence of the British government, entirely privately financed. The method used was basically the conventional French-style concession as used for French Autoroutes, but modified to meet certain British requirements, principally that there should be neither government subsidy nor guarantees. The concessionaire was composed of a range of British and French construction companies and banks which were reconstituted as a single operator (Eurotunnel).[4] This effectively placed the operator at arms' length from the construction companies which wanted to build the tunnel and the banks who wanted to finance it. The concession was let in 1986, construction started in 1987 and the tunnel was opened for service in 1994.

The complexity of the project, coupled with its bi-national nature led to a complex contractual structure. As well as the individual concessions to the British and French concessionaires, Eurotunnel let a design and build contract to the original construction companies operating as a joint venture, and signed a complex finance deal with the original banks acting as lead banks for a worldwide consortium. In addition, Eurotunnel signed a usage contract with the national rail operators guaranteeing them a share of the available capacity in return for a fixed minimum annual payment.

The original estimated total cost was of the order of €7.5 billion in 1987 prices, of which an estimated €4.3 billion was for direct construction costs and the remainder for overheads and

[4] Legally there are two concessionaires, one British and one French, but Eurotunnel is run as a single integrated company.

financing costs. The original plan was for almost half of this sum to be provided by equity capital and the rest by loans. The total cost increased progressively during construction to over €16 billion, due to problems in construction, the necessary re-design of certain aspects to meet changing government safety requirements and a delay of about a year in the start of operation. Most of the additional cost was covered by additional loans, although some dilution of the equity has taken place through rights issues and some debt for equity swaps as the company struggled to meet its debt charges. The governments agreed to successive increases in the length of the concession, from an initial 55 years to an eventual 99 years. This might be taken to imply that the governments were not totally standing back from the project as originally intended, and there is indeed further evidence that the UK government did intervene in the financing through the activities of the Bank of England.

As well the increase in costs, revenues have not met original expectations. Although traffic levels had been fairly well predicted (in fact under-predicted as far as truck traffic is concerned), the first three years of operation were characterised by excessive price competition from the existing ferry operators such that revenue yields were much worse than had been forecast. Following the abolition of duty-free entitlements on cross Channel Traffic in 1999 (which had served to subsidised low fares) both fares and yields have risen steadily, but the poor early years' performance had serious consequences for Eurotunnel's overall indebtedness. Through rail services have never reached the traffic levels forecast, neither passenger nor more particularly freight, and although Eurotunnel has been protected to some extent from the full effect of this by the railway usage agreement, this remains an area of concern.

A number of lessons can be drawn from the experience of Eurotunnel:

- First, the high degree of uncertainty which surrounds all aspects of a project of this scale, construction costs, traffic forecasts etc. was a major problem. To a large extent, the finished project was not the one which had been originally proposed.
- Secondly, the project highlighted the need for a strong concessionaire from the beginning. Eurotunnel, with no record of project promotion or management, experienced major problems in negotiating contracts and then managing them. It found itself in a position where it had been forced to accept construction contracts which favoured the construction companies, and financial contracts which favoured the banks, in a concession agreement which left it with relatively little room for manoeuvre.

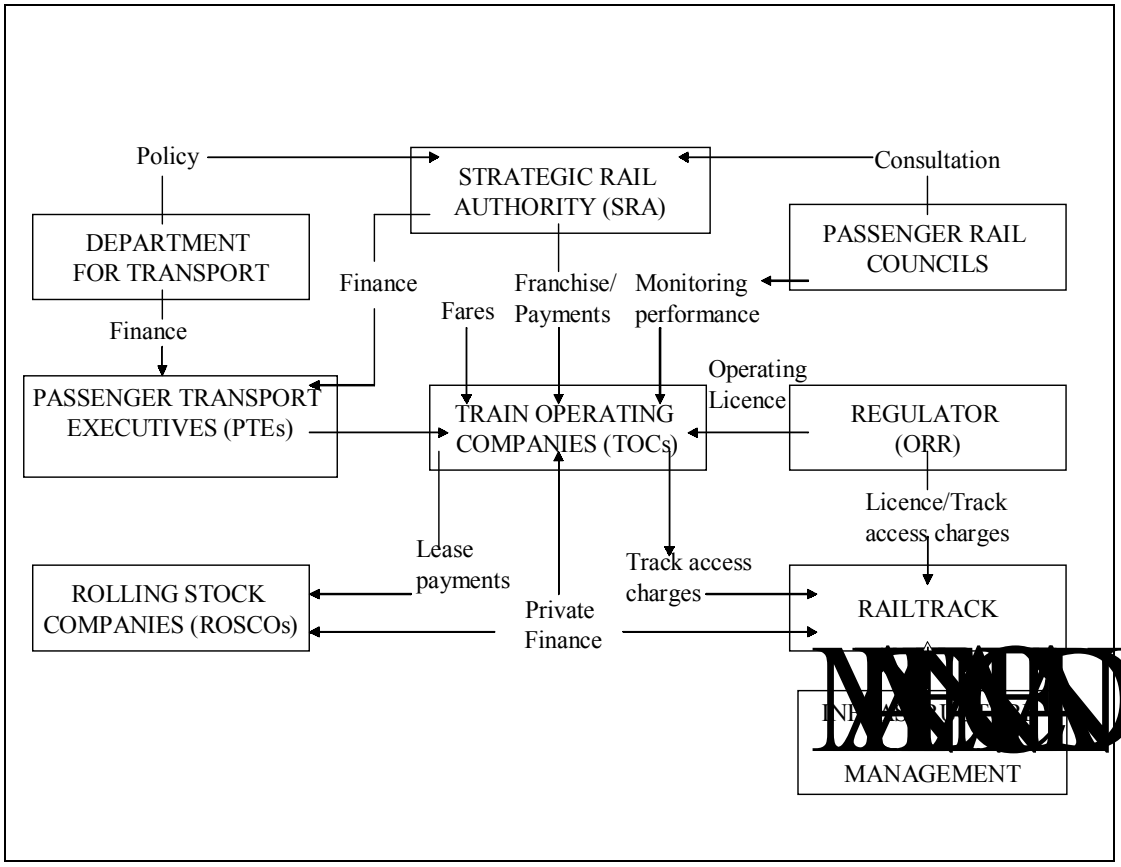
- Finally, the exceptional character of the financing necessary for a project of this size and complexity posed immense difficulties: construction required 7 years, during which time there was no revenue but a mounting debt, rendering the project unsuitable for the typical 15-20 years financing package for projects; a very long franchise additionally poses problems of assessing the true value of such a project in 40-50 years.

4.2 Railtrack

The UK has, since 1996, attempted to effect a wholesale privatisation of its rail system, following through the privatisation of most public utilities, whilst implementing European Commission directive 91/440 on the separation of rail infrastructure and operations. The method chosen was a direct privatisation of the track network as a public limited company, Railtrack; franchising passenger rail services in originally 25 separate franchises covering variously the main inter-city routes and regional services; and selling freight services to private sector companies. The privatisation of Railtrack was similar to that previously used in the privatisation of British Telecom and energy utilities with shares offered to the public at a price which discounted the true value of the assets. Railtrack's revenue was derived from track access charges, regulated by the Rail Regulator, paid by the operators, but derived in part from subsidies provided to the franchised operators by the government. Thus an enormously complex contractual structure for the rail industry was created as shown in Figure 1.

The problem which faced Railtrack derived principally from the long-term under-investment in Britain's railway infrastructure over many years. The need was to establish an investment programme to modernise the network. This was to be financed out of Railtrack revenues, borrowing, and joint ventures with the public sector where it could be shown that there were wider social benefits. As well as a substantial maintenance programme and some major investment projects, such as the West Coast Route Modernisation of the route from London to Birmingham, Manchester and Glasgow, one of the principal rail arteries, Railtrack had also to provide for the upgrading necessary to introduce new rolling stock. Under investment in the trains themselves led to a major investment need, but new trains using new technology placed major demands on infrastructure.

Figure 1 Organisational Structure of British Railways, 2001



Whilst Railtrack may appear to have had a relatively guaranteed income stream, based on known track charges guaranteed by government subsidy, there was a risk problem in that any failure to deliver a slot on the network led to a penalty claim by the operator against the company. Thus if the signalling failed the operators of all affected trains were entitled to recompense, if the train of one operator derailed due to problems with the track or failed due to rolling stock problems, then a complex set of contractual claims ensued. Given the state of the network this began to arise regularly causing Railtrack income problems. There were also delays in finalising the investment programme and the flagship WCRM project began to escalate in costs, but the major problem arose due a series of serious accidents each of which identified problems with the sate of the infrastructure, or the management of maintenance. This increased Railtrack's costs and reduced its revenues leading to increased demands for government assistance. Finally Railtrack effectively failed and was placed in administration by the government indicating its bankruptcy,[5] eventually

[5] This was itself controversial with claims that the government acted too hastily and despite the government's initial view that there should be no compensation for equity holders, the final deal setting up Network Rail providing an effective buy-out of shareholders at a price similar to that obtaining at the time Railtrack was placed into administration, but implying a substantial capital loss on the original privatisation price of shares.

being replaced by a new not-for-profit company, Network Rail, which took over Railtrack's rail assets in 2002.

The largest rail investment programme, West Coast Route Modernisation (WCRM), is difficult to disentangle, not least due to the confusion surrounding the project since Railtrack was put into administration, but is an interesting case study of private sector infrastructure problems. Originally Railtrack made an agreement with OPRAF (the Office of Rail Passenger Franchising, now part of the SRA) for a €2.1bn core investment programme to restore the infrastructure to "modern standards", to which were added upgrades, essentially to allow 200km/h operation (€230mn) and a further enhancement to 225km/h (€930mn). The latter involved an agreement with Virgin as the main train operator. The allocation of financing between a (then) privately owned Railtrack which, however, depended on government funding, through regulated track access charges and direct grants for investment, and the privately owned rail operator (responsible for making the investment in rolling stock) is impossible to sort out. Railtrack's requirement for additional government support, not least for this project which was spiralling out of control, was one of the principal reasons for Railtrack's subsequent collapse. It also emerged that the original concept was flawed, as well as the initial management of the project, and the project subsequently had to be reformulated into two Phases. This makes it difficult to identify where the costs went out of control, but the total cost of the project has risen to at least €9.75bn of which around €6.7bn is the cost of the core investment programme over the two phases. There remains some doubts over the achievement of some of the potential benefits of the 225km/h operation for which Virgin has spent around €1.55bn on new tilting trains and the current plan is only for a delayed introduction of 200km/h operation.

More successful has been a scheme which has been largely outside the influence of Railtrack, the Channel Tunnel Rail Link. CTRL is a PPP scheme to construct a 120km high speed rail line in two stages between London and the Channel Tunnel. The government is providing €2.8bn of direct support (to secure the regional benefits), but is also supporting a further €5.8bn through guarantees to reduce the cost of the €9bn project to the private sector, a deal which the National Audit Office has deemed to be poor value for money. Actual private finance is thus very limited. Interestingly this project appears to be both on time and on budget as the first stage comes to completion for operation in 2003.

It is difficult to identify a clear set of implications from the Railtrack experience, but it seems to reflect a number of separate factors which, by luck, came together. The initial state of the network

was clearly a problem, coupled with some inadequacies in management. The temptation for an apparently cash-rich company to appease shareholders with increasing dividends as share prices rose rapidly in a stock market boom meant that the investment programme was insufficiently developed. Above all the company came under increasing pressure as reliability fell and the fatal accidents led to claims of profitability being placed ahead of safety. It seems unlikely that the principle itself was flawed, the separation of infrastructure and services in rail has been required under European Commission directive 91/440 of 1991, and although many have argued that the resulting vertical separation is inefficient, Banverket in Sweden has not had the same problems. However, the practice in the UK clearly had serious weaknesses, at least in the early stages before the creation of a Strategic Rail Authority to provide some overall direction to the rail system as a whole. This has highlighted both the transactions costs problem of complex structures and the risks involved in taking on responsibilities within such a structure.

4.3 Urban public transit

The construction of new infrastructure for urban light rail transit has also seen the use of private finance in various forms. The UK has tried to use various forms of public-private partnership (PPP) for this type of investment. In most cases this involves a joint venture company of construction firms, finance providers and transport operators to provide the private investment whilst the public sector contributes some combination of initial grants, guarantees on loans and ongoing subsidies. Not surprisingly the first of these to be completed (see Table 2) have occurred in the major urban areas (London x 2, Birmingham and Manchester). There is a long list of such projects in the pipeline now with further extensions to each of these four schemes approved and projects under construction or at the advanced planning stage in various other cities such as Nottingham, Bristol, Leeds, Portsmouth. These projects have all required direct government finance in the construction phase and/or continuing subsidies in operation.

Table 2 Examples of Urban Metro Projects

Project	Length	Total investment	Private sector investment	Public sector involvement
Midland Metro:	20.4km	£145mn	£11.4mn	Govt and EU grants
Manchester Metrolink Salford Quays/Eccles extension		£160mn		Govt grants
DLR Lewisham extension	4.2km	£202mn	£202mn	Govt approved loan TfL subsidy
Croydon Tramlink	28km	£205mn	£75mn	Govt grants

PFI projects have also been used for developments on the London Underground, initially for the provision of new rolling stock (e.g. a €635mn project for new trains for the Northern Line), but now controversially for maintenance and investment in the infrastructure.

A more controversial proposal is to hand over the infrastructure of the London Underground network to three separate PPP ventures. This follows the successful use of PPP to support the provision of new rolling stock, but has been criticised on the basis of the problems with Railtrack on the national rail network. Given these problems it is not just opponents of the use of private finance who have been critical, but also the private sector itself has recognised the size of the downside risk in these projects, most particularly from government action itself.

4.4 Privately financed road projects

Whereas the French system of Autoroute concessions uses direct tolls, the UK has used a system of shadow tolls. This involves contracting out the provision and maintenance of sections of road to private contractors in return for a payment based on traffic flow and a notional toll. The Highways Agency, an agency of the Department for Transport charged with planning and managing the national road network lets Design, Build, Finance, Operate (DBFO) contracts to private contractors. In some cases this has involved transferring the responsibility for a complete route in return for new constriction (or upgrading) of one section. Clearly the incentive to the operator is to balance the higher cost of quality in construction against lower potential maintenance costs (and loss of traffic volume and hence revenue) in the future. Thus far 8 projects totalling nearly 600 km of route and involving new investment of more than €900 million have been completed (see Table 3) and a further two projects are in the contract stage.

This supplements the concession system also used for some of the principal estuary crossings. Two of the more recent ones, the construction of new bridges at Dartford on the M25 London Orbital Motorway and across the Severn on the M4 London – South Wales Motorway, involved transferring existing tolled crossings to the new concessionaire, thus providing a source of revenue during construction, in contrast to the problem identified above with Eurotunnel. Instead of a fixed length concession, the concessions run until the capital cost of the new infrastructure is amortised up to a maximum life (typically 20 years), when it has to be returned to the State in fully maintained working order. Thus the concessionaire accepts the downside risk, but benefits from a better than forecast traffic flow by being released from the concession early.

Table 3 UK DBFO Road Schemes

Project	Length	Total investment	Region
A69: Carlisle-Newcastle	84km	£9.4mn	N
A417/419: Swindon-Gloucester	52km	£49mn	SW
A1(M) Alconbury-Peterborough:	21km	£128mn	E
M1-A1 Lofthouse-Bramham	30km	£214mn	YH
A50: Stoke-Derby link	57km	£20.6mn	EM/WM
A30/35: Exeter-Bere Regis	102km	£75.7mn	SW
M40 Denham-Warwick	122km	£65mn	SE/WM
A19/A168: Dishforth-Tyne Tunnel	118km	£29.4mn	N
A249 Sheerness Link Road*	17km	£75mn	SE
A1(M) Darrington-Dishforth*	22km	£240mn	YH

The UK is experimenting with a purely private road, the Birmingham Northern Relief Road, to provide an alternative to a particularly congested section of the M6 Motorway. The idea is that this should be a section for which users would be prepared to pay for a better, less congested, route than the parallel free road. There have been long delays in approving this road and signing the necessary contracts, but construction is now under way. Interestingly, as with the Second Severn Crossing, the route is being configured so as to direct though traffic towards the tolled link.

There are similarities between this scheme and the concept of tolled express lanes on some highways in the US. This idea is being carried forward in Germany with truck lanes paralleling existing Autobahn routes for which extra charges would be levied in the proposed "A-modell" . Germany has also had the "F-modell"[6] in operation since 1994 which relates principally to key links in the network, mainly bridges and tunnels, and currently involves 10 projects totalling 70.7km with a total construction cost of €2.9bn. These are designed as tolled links, aided where necessary with up to a 20% federal subsidy. (Ewers and Tegner, 2000).

5 Conclusions

In this paper we have highlighted how the basic characteristics of infrastructure lead to a number of major difficulties in the introduction of private finance. This has been illustrated with examples

[6] Fernstraßenbauprivatfinanzierungsgesetz

from British experience in a number of contrasting projects. The difficulties arise principally from the various dimensions of risk which are present in such projects: construction, operational and planning risks. However, the sheer complexity of major transport infrastructures and how they relate to the operation of services leads to problems. The idea that increased efficiency can be gained from the greater transparency of transactions costs when infrastructure is separated from operation and provided privately has been shown to be misplaced.

The UK examples range from the purely privately financed Channel Tunnel project to a variety of public-private partnerships in the provision of new urban public transit projects. Risk, and the ability of the private sector to shift risk back onto the public sector, has clearly caused problems in each of the cases examined. The complexity of organisation has caused difficulties, not least in the saga of Railtrack.

The conclusion to be drawn from this analysis is that, although private finance may have a role to play in the provision of infrastructure, especially where clear private sector benefits can be identified, this is only likely to be successful in a public-private partnership where a clear allocation of responsibilities between the two sector can be identified and maintained. Thus estuarial bridge schemes or urban public transit projects have been successful, major fixed link or network infrastructures much less so. This confirms the view that private sector involvement requires projects to be discrete and clearly defined.

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