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The logo consists of three overlapping curved lines: a light blue outer arc, a green middle arc, and a dark blue inner arc that forms a partial circle.

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**THE TRANSPORT INFRASTRUCTURE SECTOR
AND INNOVATION: ISSUES, CHALLENGES
AND A POSSIBLE WAY FORWARD**

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The OECD logo features a blue circle to the right of two stylized, overlapping grey shapes that resemble the letters 'O' and 'E'.

OECD

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EXECUTIVE SUMMARY

The transport sector has undergone a remarkable transformation during the past fifty years. Following World War II the sector was heavily regulated, often with stringent entry, quantity and price controls. Many of the big operators in the sector were owned by the state and were also monopolies, and thus operated on principles with limited concern for consumers. Today most of these monopolies are gone, and markets have been opened up to new operators who can freely determine the quality and quantity of services to supply. Prices are mostly set through competitive forces. Deregulation, privatisation and competition have created an environment which has been highly conducive to innovation.

Some would argue that the sector is now a victim of its own success, with the rapidly increasing demand for transport being one of the main contributors to climate change and other emissions. It is claimed that the sector is not sustainable and therefore that some of the reforms should be rolled back.

This paper argues that this is a wrong conclusion. One point being made is that the reform process is not yet completed. There is a need to also reform the current arrangements for the operations and financing of road and rail infrastructure as they do not foster innovation but promote rent-seeking forces. The explanation is to be found in that rail and road infrastructure networks are normally run by organisations owned by, or part of the public sector and to a considerable extent are financed through appropriations.

Another point is that a more effective policy making process will be required in order to be able to identify responses to the current challenges, including climate change. For policy making to be effective government must be able to focus on the major public issues at hand. The reforms that have taken place in the sector have indeed allowed governments to do this, as they have gradually been relieved of having to worry about, say, the financial performance of the previously government-owned transport operators.

But this work is only partially done. Governments still sit on two, often, conflicting chairs in the sector, serving both as the regulator and as the operator. And this applies today in particular to transport infrastructure. A continuation of this business model does not bode well for improving the effectiveness of policy making and, in particular, for dealing with the challenges posed by climate change and other negative side effects of transport.

Finding an alternative arrangement for transport infrastructure will not be straight forward, but there are, or have been, other ways of running transport infrastructure in the world that could provide some direction. These directions indicate that a new arrangement (i) must put the users in the driving seat, (ii) will involve a type of private association (a club), and (iii) will entail full cost recovery of at least the core rail and road networks.

1. Introduction

For innovation to take place, incentives must be there and the incentive structure must be the right one. A correct incentive structure implies that actions taken by individuals and organisations are compatible with the basic policies of the transport sector:

- Improving the use of resources in accordance with economic efficiency criteria.
- Attaining and facilitating the attainment of targets for emissions.
- Attaining and facilitating the attainment of targets for reductions in road traffic casualties.

For incentives to be there, it is clear that the following points must be in place:

- Individuals and organisations must be allowed to do the right thing.
- In addition, individuals and organisations must be rewarded for doing the right thing.
- Individuals and organisations must have access to information, and on equal terms.
- The rules of the game must be transparent and consistent.

This contribution will focus on the issue of incentives in the transport infrastructure sector, emphasising road and railway infrastructure, since this is viewed as one of the major issues in the transport sector. I will use Sweden as an example, but I believe that much of what is being said is of relevance to other countries as well¹.

One message that I am trying to convey is that we have a tendency to exaggerate the differences between the transport infrastructure sector and other sectors of the economy. There are certainly differences, and they warrant attention. But the questions that we need to ask and address about transport infrastructure and innovation are not all that different from those that we are confronted with in other sectors of the economy.

A second message is that the prevailing incentive structure in the transport infrastructure sector in Sweden and elsewhere is warped from the point of view of the basic policies of the sector. In particular it makes the attainment of efficiency and climate goals much more difficult and complicated. So doing something about the incentive structure is really the main challenge in order to improve the innovation climate in transport in the future.

The third message is that improving the incentive structure is doable. But for that we must start to talk about first things first.

2. The questions that we often ask about transport infrastructure and the questions that we rarely ask

That there is something wrong with the incentive structure can best be illuminated by first considering some issues that frequently arise in the debate on transport infrastructure, but also issues that are given surprisingly slight attention.

More frequently asked questions

There are two questions which more often than others figure in the debate on transport infrastructure. The first and most frequently asked question is **if investments and maintenance expenditures in infrastructure are not inadequate.**

1. This contribution is a slightly revised version of a paper commissioned by the Swedish Royal Academy of Engineering Sciences in 2009.

Let it be stated that the question, of course, is legitimate. The problem is that asking questions of this nature rarely takes us anywhere. There are two interrelated problems. The first is that questions about 'under-investment' give rise to a credibility problem. Expenditures on infrastructure often involve big contracts, and new infrastructure may have strong distributional impacts as much of the money is public. In other words, there is a risk that the question will be ignored because it is argued that the ones who pose it are promoting narrow interests, if not their own.

The second problem is that, in general, and not just in Sweden, there is no good answer to questions of this nature. Making use of a 'macro approach' for comparison purposes by referring to how much money different countries spend on infrastructure in relationship to their GDPs is not a good approach because there is no law or good 'macro' theory which explains how much should be spent. And a falling expenditure volume could indeed be an indication of that the sector is being right-sized after earlier frivolous expenditure sprees.

No, if we want to shed light on 'how much' or 'how little', 'micro' approaches (based on an analysis of needs using typical instruments of expenditure analysis) have to be used as in other sectors of the economy. It may sound implausible given the high cost of transport infrastructure investment, but the fact remains that it is in general hard to find good answers to the question of how much should be spent on investments based on a micro approach. This is disturbing because, as mentioned, public money is often involved and thus the expectation would be an abundance of information justifying how taxpayers' money is being used or will be used. Why is this so? I will argue that the **lack of transparency** is a fundamental characteristic of the sector as it functions today. More will be said about that later.

The other most commonly asked question, in particular, as concerns the road sector, is **if the road users are not paying too much**. Quick calculations will show that the amount of revenues collected by the government (not only in Sweden but in OECD countries in general) from specific taxes on fuel and vehicles vastly exceeds expenditures on the road network, and road users are therefore, some will argue, 'more than covering their costs' (and this applies even if the taxes reflecting carbon emissions are excluded). Some road users may at the same time argue that this is not only unfair as 'too' much is collected, but also that rail users are paying far too little. The taxes or fees collected for use of rail infrastructure only generate revenues which make up a fraction of the costs for maintaining and investing in that infrastructure in Sweden today (as is likely the case in several other European countries as well).

This is again a difficult question and argument, because anyone who uses it will be told that taxes (including taxes reflecting emissions) are being set based on the principle of marginal cost and from that perspective, it is argued, the relationship between total revenues and total expenditures – even when summed over time – is of limited relevance.

Is then this question not legitimate? Yes, I would argue, again. Because if one starts to dig into the issue, one will eventually find out that whilst the principle of price equal to marginal cost may be clear in theory, it is exceptionally difficult to apply in a credible and consistent way (at least as it is being done at present). Anyone who starts diving into the issue of marginal cost will soon start asking the question: are we not opening a Pandora's Box? The answer is in my opinion yes. In other words, **there is not much genuine transparency as concerns transport infrastructure charging either**.

My observation is: Starting to ask questions about what appears to be fundamental issues can normally not be expected to lead to any clear replies. I think that this signals something.

Less frequently asked questions

Let us now turn the approach around by asking questions which seem straightforward, yet apparently are not being asked all that often. One important such question is **why is there so little innovation in the sector or, rather, why efforts to do something about this situation are so limited**. After all, the fact that innovation is low is generally recognised and has also attracted some attention in the debate on transport infrastructure in Sweden² and elsewhere.

The issue at hand has to do with how works are being carried out for the provision and maintenance of transport infrastructure, or more specifically the procurement methods used as most works nowadays get done by way of competitive tendering. The prevailing procurement methods are thus based on pre-specified construction methods and techniques (input based or 'built' contracting) rather than on functions (output or performance-based contracting). So the real question being asked is why such limited efforts are being made to introduce new procurement methods. True, some efforts have been made, particularly in the UK, and the World Bank preaches this message in a number of countries around the world where they finance transport infrastructure³. Some attempts have also been made in Sweden but, again, at least I am not impressed by the progress being made. The issue of performance-based contracting has been considered for some 25 years now in a country that should have all the required human, engineering and financial resources at hand to be able to tackle it head-on. There is a nagging feeling that there is a lack of will.

I dare to draw that conclusion because there is a related disturbing aspect of transport infrastructure expenditure in Sweden (and in most other countries as well). Transport infrastructure, at least road infrastructure, but in Sweden also rail infrastructure, is provided by monopolistic public sector organisations. They spend billions of SEK each year, yet none of these organizations, the Swedish Road Administration (i.e. the national road network manager) and the Swedish Rail Administration (i.e. the manager of most of the rail infrastructure), has been subjected to any form of (independent) audit to review performance as concerns efficiency. And, to my knowledge, parliamentary committees have never conducted any hearings on the performance of these organizations.

The question is why, because a substantial amount of research – in Sweden and in other countries – suggests that the implementation of (at least) major transport infrastructure projects too often is fraught with problems. Many such projects are associated with cost overruns, forecasts of traffic which later reveal themselves to be too optimistic and implementation periods much longer than originally planned⁴.

Of course, cost overruns make the system whereby financing is based on parliamentary appropriations troublesome, so a few years back the Swedish Ministry of Industry, Employment and Communication commissioned a study of the costing practices of the long-term transport infrastructure development plans prepared by the road and rail administrations. The findings were clear; there were not only consistent underestimates of investment costs; the costing procedures and processes were poorly developed and whatever methods were in place were not very rigorously applied. Moreover, quality control systems in place were limited and follow-up analyses few and far between⁵. There have been changes in the costing procedures since then, but still limited attention is being paid to the overall issue of performance, and not only by government and parliament, but also other stakeholders in the sector.

2. See e.g. Grennberg (1998).

3. See e.g. Zietlow (2005).

4. See e.g. Flyvbjerg et al (2002) and (2003).

5. COWI A/S (2003).

To state it more bluntly: the nagging feeling is that there is a lack of attention being paid to performance issues, and to how we can get more for our tax money in the form of transport infrastructure. It is thus not only that there is no real transparency in the transport infrastructure sector; it is worse: **there is an apparent lack of willingness to promote transparency**. Why is that so? **How is it that no one wins from increased transparency?** That is the important question to ask, in my opinion, but unfortunately it is not being posed very often.

3. The real issue

In other words, the important questions about transport infrastructure are not so much about too much or too little. If we are going to make any substantive progress as concerns the contribution of transport infrastructure to the development of the overall economy then we must ask ourselves if the current institutional and financing paradigm is the right one for the future.

Current arrangements in Sweden are essentially based on public sector operations and public financing (with some variations as detailed further below). Moreover, and importantly, **operations and financing of road and rail infrastructure are delinked**, as also reflected in the fact that operations fall under a ministry of transport and financing under a ministry of finance. Both the road and the rail infrastructure sub-sectors are huge and involve a large number of people. And, much of what these people do is of an operational nature, i.e. it involves work processes that are repeated over and over again, including planning, procurement, supervision, follow-up, etc. Such operations lend themselves to delegation, as is also demonstrated by the fact that in some countries a very large body of the work is eventually done by contracting with private sector entities.

Delegation of infrastructure management in the public sector is achieved by way of establishing an agency (or administration), using programme budgeting and performance agreements. The particular design of the instruments used, the governance regime that regulates the agency, varies from country to country but the arrangements used in Sweden are not that different from what you will find in other countries.

There are a number of conditions that must be fulfilled for such a governance regime to function at all:

- A clear objective that can be measured.
- A transparent system for measuring results.
- A mechanism for effecting accountability.
- Other checks and balances.

An examination of the situation in Sweden for the rail and road infrastructure administrations will show that all these elements are there. But the system is weak, indeed it is very weak. Firstly, the objective is unclear as there normally is more than one objective, and these objectives are moreover often formulated in such a way that they are difficult to measure (not to mention making it impossible to aggregate to an overall index). Transparency has improved over the years in that much more information is today available through reports that can easily be obtained than was the case some years ago; but if objectives still remain unclear, what help is that? Accountability regimes are weak, since there is no real public scrutiny of performance, as has already been suggested, and there are limited further checks and balances. The governance regime is in place but in reality it is more formal than real. That is the case in Sweden, but can be expected to apply in other countries as well, where the infrastructure is run in a way similar to Sweden. If the reader is in doubt, I encourage him/her to take a close look, and then compare it to the governance regime in the private sector, in particular for listed companies.

Most importantly, the road or rail user is not there to serve as a check on performance as in the market economy, where the consumer provides the final verdict. Indeed the current regime of decoupling operations from financing has a particularly debilitating effect on the road users as they reap no benefit by engaging themselves as an external evaluator. Most benefits of private initiative accrue to the central fund of the government. On the other hand, lobbying for a decrease in taxes on road users will yield direct benefits to users (albeit on a smaller scale), whilst lobbying hard for the big projects could result in bingo, but then to a limited group of private (and other) interests⁶.

So, as I see it, the truth is that in our market economy the consumer is king, whilst the user of road and rail infrastructure, on account of the current institutional and financing paradigm, is playing the role of the fool.

What has to be acknowledged is that the current institutional and financial arrangements for, in particular, road and rail infrastructure are not all that different from how the economy was run in those centrally planned economies in Eastern and Central Europe which have now gone under. Ultimately, all the power in those countries was vested in the party, whilst in Sweden it is vested in parliament. For a major political issue this is a fundamental difference, but when one looks at tasks that are essentially operational in nature then the differences diminish dramatically. Since the management of infrastructure is so complex, power must be delegated, and as the governance regime is weak that means that power will tend to become usurped by the bureaucracy. It is sometimes argued that the Swedish way of running infrastructure is appropriate, because the important decisions can now be made by those who have been democratically elected. That is the theory; in reality politicians have limited actual influence on the sector, including everything related to the day to day use of resources and to how to address issues related to R&D. But they have retained the power to decide on the big projects. And certainly the politicians are also in a position to act if something would go terribly wrong. Fortunately for Sweden corruption is not endemic.

It should also be acknowledged that there are further major differences between the current paradigm for road and rail infrastructure in Sweden and that of the centrally planned economies, e.g. that almost all the works carried out by the roads and rail administrations are contracted subject to competitive tendering. That requirement brings with it a certain measure of discipline and also increases transparency. But it does not change the basic condition of weak governance.

Given the current governance regime and the absence of strong checks and balances, the resources made available to infrastructure could probably yield considerably more output than at present. That there is not more debate (except over appropriations and taxes) reflects that, overall the present system functions because the power that has, in effect, been usurped has filtered way down in the administrations, the politicians can have their pet projects and the private sector is rewarded as it is engaged to do very much of the operational job.

Infrastructure users are also reasonably satisfied because infrastructure in Sweden is certainly not bad, and road congestion is on the whole rather limited. And, finally, indications are that academics and consultants, albeit at times expressing their frustrations about, in particular, the lack of an open climate in the sector, have plenty of work to do on feasibility studies, calculating marginal costs and twisting the parameters of the cost-benefit analytical method that is used to assist (albeit unevenly) in the planning process.

6. A good example is provided by the appropriations made by parliament in 1992 for investments in and support to operations on the Interior Railway in Sweden (Bruzelius (1995)). Another story that should be told is the one behind the City Tunnel in Malmö, but is there any interest?

So why rock the boat? Because the current arrangements are not good, as they do not promote critical assessment and innovation. Innovation poses a challenge to the current hidden power structures in the road and rail administrations, and no one in these administrations will be rewarded for trying to do things differently. And, as mentioned, the fact that everything is financed by appropriations implies also that outsiders reap no or very limited benefits for making exceptional effort.

So the key to improving the preconditions for creating an innovative-friendly environment is to embark on a process of reforming the institutional and financing arrangements for road and rail infrastructure. But, before elaborating on that, there is a need to look further at the transport infrastructure sector, as well as the specific issues that have to be addressed when formulating proposals for policies for the sector.

4. The current arrangements for management and operations of road and rail transport infrastructure

The road sub-sector

The model found in Sweden is the most common in the world, i.e. management is handled by an agency of the state under a ministry of transport, whilst financing is by way of appropriations. The nature of the agency varies in that in some countries it is only a sort of independent 'directorate' in the ministry, whilst in others the agency reports to parliament, but is under the supervision of the transport ministry (as is the case in New Zealand). Sweden's model based on authorities, is in between as it is rooted in the notion that an authority is a part of the government. In this model the agency prepares and implements everything, subject to directions from and supervision by the ministry of transport, whilst parliament makes the appropriations based on the submitted plans. Planning is made with the help of cost-benefit analysis (CBA), but this method of prioritisation is not officially prescribed, and projects which are not necessarily viable from an economic point of view may receive funding. The values and parameters of the CBA have, as noted, been fixed by way of consultation with experts/academics.

Works are nowadays executed through contracting and, to a large extent, by way of build contracts for works (including periodic maintenance), whilst various forms of hybrid contracts (elements of functions in a build contract) are used for routine and recurrent maintenance. The agency typically manages the 'national' road network, whilst local governments take care of the local/regional networks.

In the typical model road users pay taxes on fuel and vehicles, which are set by parliament and accrue revenues for the central fund of the government. Advice from experts/academics is considered when fixing the level of the taxes, including carbon taxes⁷.

The following deviations from this 'standard' model are noted:

- a. Major arteries in some countries are financed by tolls and run by public, mixed or fully private companies, normally subject to a concession agreement. There is a host of different models, from Japan which has a unified approach with one state-owned company involved to, at the other end, Chile where the core network has been parcelled out to a number of different private concessionaires. These toll roads are often risky business (more on this later) and the frequency of restructuring of the companies running them or renegotiating the concession agreements has been quite high.

7. In part the system is ruled by EU legislation.

- b. The use of Design-Build-Finance-and-Operate (DBFO) contracts instead of build contracts for major works, is an approach pioneered in the UK⁸ but also applied in a number of ways in other countries, using different catch words to describe the contracting method. The main implication of this form of contract, which is based on a performance-based approach, is that many of the (mainly project-related) risks are transferred from the public to the private financier, who mobilizes the financing up front for an investment. At the end of the day, payment is by way of appropriations.
- c. The management of local community road networks can occur by non-profit private companies. This model was not uncommon in the early days of motorisation, but has largely vanished. The road association management structure, however, still remains a prominent feature in Sweden and Finland. It represents an example of what can be termed the 'club model' for infrastructure management, a notion to which I will return later⁹.
- d. On the financing side there are several developments, in addition to tolling, that should be mentioned. They all involve an element of linking financing with supply. The most notable development is the re-emergence of earmarking (which was a common feature, say, 50 years ago). Earmarking involves transferring the revenues of some of the taxes on road users into a 'ring-fenced' fund, to be used primarily for financing of maintenance works. Usually the fund is managed by a separate administration, and its brief is, in principle, not only to ensure adequacy of financing for maintenance, but also to (i) enable an increase in the level of levies paid, particularly by large/heavy vehicles, by promising that the money will be ploughed back into roads, (ii) facilitate private sector involvement in maintenance by reducing risk and bureaucracy related to payment for work done (the comfort factor), and (iii) to ensure value for money. Road funds are mushrooming, yet have a mixed record to date as they are very often political animals, with limited independent power.
- e. Another development, similar in nature, is the imposition in some EU countries of separate charges on heavy vehicles¹⁰. These charges are only collected on the motorways (or main roads), and have the unique feature, as applied in some countries (e.g. Germany and Austria), in that they are based on actual distance travelled on the designated roads. Elaborate systems have been introduced in order to be able to measure the distance travelled by the heavy vehicles. These charges may hence be seen as an example of a weight-distance charge. The revenues are rechanneled for use on the motorway network. Proposals have been made in a few countries (e.g. in the UK and Holland) to take this system further by having all vehicles pay distance-based charges and on all roads.
- f. Finally, mention should be made of New Zealand and Namibia, which have attempted to establish more independent self-financing arrangements. Both countries have comprehensive road-user charging regimes involving sur-charges on fuel, annual access fees and separate weight-distance charges on heavy vehicles. Both countries also have legislation to promote independent management of the sector with heavy involvement of road users. But the original intentions have been compromised, and in both countries policy makers now play a heavier role than originally envisaged, either directly through the process of nominating board members or by modifying the legislation to limit the powers of the board.

8. See e.g. Highways Agency (1997).

9. For and economic analysis of clubs, see McGuire (1987).

10. In terms of Directive 2006/38/EC amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures.

The rail sub-sector

Railways were originally mainly (albeit not always) privately operated and financed, and have traditionally also been operated by a vertically integrated organisation, that is, the same entity has managed both operations and infrastructure. With the advent of the car, the railway market, in particular for passengers, started to decline and eventually collapsed. In countries where it was possible for the railways to withdraw from the passenger market, particularly the medium-to-long-distance one, the railway companies could be restructured by focusing on freight and by rationalizing the operations. That development is primarily associated with North America.

In other parts of the world, the loss in the railways' fortunes led to governments taking over, including providing an increasing amount of subsidies to ensure continued operations. That meant the creation of huge parastatal companies, which eventually, because of politicization and lack of pressure for performance, earned them a reputation for waste and inefficiency, giving rise to considerable dissatisfaction not only with customers but also with the owners, the governments concerned.

Restructuring has therefore come to characterize more recent railway history. One trend is associated with what is called the Swedish railway model, as the first step was taken there in 1988/89. That first step in this second round of reforms involved the separation of infrastructure from operations, by transferring the former to a separate provider. In Sweden this was done by creating a separate administration to manage infrastructure, and from the very beginning this was seen as being a first step in the establishment of the road model for the management and financing of rail infrastructure. The thinking was that since society was responsible for roads, the same should apply to the rail network. Whether or not by design, the financing of infrastructure by appropriations in effect also meant that it would be more difficult to determine the amount of public money – subsidies – that would go to the railway sector. Another dimension of the new model was that entry onto the railway network would be opened up to more than one user.

A fundamental issue as concerns infrastructure is 'capacity' and in particular who should have the power over allocation of capacity to operators as well as the day to day management of capacity when it is limited. For railways, this is much more of a burning issue than for other types of infrastructure for two inter-related reasons:

- Infrastructure can be characterized by degrees of independence between the entities using it. In the air there are three degrees of freedom as an aircraft can pass another without much restriction provided that mandated distances are adhered to for safety reasons. On a road, there are two degrees of freedom, as a vehicle can pass another vehicle relatively freely. In railways, there is normally only one degree (except in exceptional cases) as a train cannot freely overtake another. Runways at airports are also characterized by this limitation, making them the critical factor in air transport operations.
- On railways which carry mixed traffic, trains move at very different speeds.

Capacity allocation becomes even more of a central issue if one wants to allow for more than one operator on the railway network, as envisaged by the notion of 'the road model', and the initial set of reforms has therefore later been followed by additional reforms. An independent regulator has had to be established to regulate access and to define and allocate capacity. Moreover, that regulator or a similar separate organization has had to take over the day-to-day function of managing the capacity. In the old railway structure, train management was part of the vertically integrated company.

What has been called the Swedish model later became the EU model and the regulatory framework for railways is today based on EU directives. The reform has been implemented, in general, by EU member states, often with hesitation due to a lack of conviction of the appropriateness of the new model, but also as old structures – bureaucracies – have come under threat. The railways have been opened up to, in particular, new freight operators, with the new ones generally serving niche markets.

As in Sweden, the rail infrastructure in other EU countries has in general been entrusted to some form of agency, whilst the old operator, if not so before, has become an ordinary company in terms of a company's act. There are important variants, and the one country to mention here is the UK, which started implementing its reform already in the early 1990s resulting in the demise of the former giant parastatal, British Rail.

In brief, the British model is based on concessions for all passenger operations on specific lines, implying that two different companies normally do not serve one and the same line. Freight operators can serve the entire network. The infrastructure was initially privatized as Railtrack Plc, which was listed on the London Stock Exchange, but following its collapse it was converted into a not-for-profit company Network Rail ('with limited guarantee'). The 'owners' (or, formally, members) are the train operators, i.e. the primary users. Network Rail is hence another example of the application of the club model for the management of transport infrastructure.

The Swedish or EU-model has seen some followers elsewhere, but only in part, e.g. in Australia and New Zealand. But the Swedish inspired and EU-led reform is really a European project reflecting that railways serve three markets in this part of the world that do not fit well together on the same track, i.e. commuter rail, long-distance rail passenger traffic and freight traffic. There is a political will to ensure the survival of rail transport in a market increasingly based on road traffic and transport.

Railway planning in Sweden is assisted by cost-benefit analysis, but, again it is not a prescribed method. The present planning culture must be viewed as not being transparent. The level of charges to be paid by operators for use of the track is so low that the revenues do not provide for recovery even of annual maintenance cost, not to mention replacement costs. The pricing structure is justified with reference to the marginal cost principle, but as already suggested it is doubtful if the present charges really reflect marginal cost. Whilst the payment by the operators in Sweden for use of the infrastructure is referred to as charges, they are set by the infrastructure operator and are essentially to be viewed as taxes as they are not earmarked.

5. What is special about transport infrastructure?

Seen from the perspective of traditional economic theory, there are a number of dimensions that set transport infrastructure apart from other productive sectors of the economy, and which therefore have to be considered in a policy formulation process. The following should be mentioned in particular:

- Joint production and therefore monopoly and distributional effects.
- Lumpiness, and therefore scale and scope effects, and congestion.
- Riskiness.
- Important external effects (emissions, noise and the creation of risk for third parties).

Joint production

The most important characteristic of transport infrastructure is that it produces services, and that those services are not sufficient in order to generate the product that is required in the end, i.e. a movement of a person or a good from one point to another. A vehicle is required as well, but that is not all. In addition to the infrastructure and the vehicle, the transported person or good also consumes resources as reflected in the time values that are sometimes used to price these resources. If the infrastructure is changed there are hence external effects on other economic entities as well, and this is a pervasive phenomenon. The users of the infrastructure can thus not be seen in isolation from the provision of infrastructure; the users are not only consumers, as they also contribute to the production. Given that, it is ironic that they play such a small role today in the management and financing of transport infrastructure.

The close interaction between users and transport infrastructure is magnified by another characteristic, viz. that infrastructure is location-specific. It generates one output in one location and another output in another location. In a world of limited resources, more infrastructure in one area means better products for the operators and passengers in that area compared with those in another location. Ultimately, the location-specific aspect gives rise to the network effect of infrastructure. A network is an efficient way (in the economic sense) of linking different locations. At the nodes there may have to be a special terminal depending on the nature of the vehicle used to transport the passengers and the goods.

A network hangs together and for it to be efficiently structured coordination is necessary, which means there must thus be a manager of that network. A network manager is a monopoly provider for the users of his network. Does that imply that the manager must act as a central planner (i.e. use cost-benefit analysis) or can planning be done subject to the rules of the marketplace (i.e. by using a financial criterion)? I would argue that this is a question that should be determined considering whether or not the network manager, if operating in a commercial world, could exert market power.

That is probably not always the case as it is often possible to choose different networks for different modes and also at different geographical levels. But this is not the place to argue further about the competitive conditions with respect to alternative networks. I note only that for the core road and rail networks (also on account of lumpiness; see below), the managers will normally be expected to be able to exert market power, if given the power to collect user charges.

That is one important implication of the joint production aspect. The other is that networks typically include many nodes, and therefore terminals. For many transport operations, the terminals, when seen in isolation and in a longer term perspective, are not in a very strong market position. Furthermore terminals may offer important differences in the quality of service provided, and they should therefore in general lend themselves to be operated on market principles.

A third important implication of the joint production aspect is that decisions on transport infrastructure often have significant distributional consequences. There are two dimensions to this aspect, viz. accessibility and financing of, in particular, investments. Accessibility is a high profile issue, and current policy typically contains several features to address it, including the provision of public service obligations and delegation of power on some aspects of infrastructure management and financing to local levels.

The other aspect to which less attention is paid, is that, because no charges are being collected for the services provided, some investments in road and rail infrastructure result in windfall gains for private interests. That is particularly so for interventions in the rail system and more so in urban areas than elsewhere. There is today no information shedding light on the issue, another example of the lack of transparency in transport infrastructure management and financing.

Lumpiness

A second major characteristic of transport infrastructure is its lumpiness, which gives it a character similar to that of a public good. That implies several things. Firstly, different users can make use of the infrastructure at the same time without interfering with each other, given a low level of usage. Secondly, the marginal cost of infrastructure could be low, indeed very low suggesting that there may be economies of scale, if demand is low. And thirdly, the lumpiness may also allow for different types of operations to use the infrastructure, such as passenger rail services and freight trains. In the event of lower overall costs by mixing transport operations on rail, there may be economies of scope. The same applies to roads and terminal operations.

The lumpiness in combination with the location-specific characteristic implies that there is very often only space for one piece of infrastructure. It is not cost-effective to provide two roads in parallel.

The lumpiness explains why it is difficult to achieve financial cost recovery for smaller-scale transport infrastructure, such as smaller ports and airports. Large terminals thus have lower unit costs. The situation is basically the same for railways when the costs of the infrastructure and operations are combined; once the railway is more intensively used the scale effects tend to diminish quickly in importance and prices based on average costs will not only yield cost recovery with respect to both operations and infrastructure but will also become equal to the marginal cost.

The exhaustion of the scale effects may also have further consequences in that, at high levels of demand, there may be a need for separation of infrastructure for different types of traffic. There are many examples: In airports general aviation uses separate, small, airports, high-speed rail passenger traffic uses its own track, and commuter traffic tends to rely on its own separate rail network.

The major 'economic' issue created by lumpiness is that when demand starts to increase there will be congestion, and when it becomes more pronounced it signals that there is a need for rationing of the infrastructure capacity as it has become scarce. How to do this is a core issue of the management and regulation of transport infrastructure. Economists advocate pricing but this approach has its limitation. In roads it has never been done (except some experimental attempts).

In railways the approach to rationing was originally to operate it in the form of a vertically integrated organisation which meant that capacity could be parcelled out by way of dictates by management subject to commercial considerations. But, since separation in Sweden and elsewhere, rationing is to be done by way of regulation, and that implies that those who have rights to capacity (i.e. train paths) from the start will be able to retain them more or less indefinitely. The same applies to scarce runway capacity at airports where the principle is referred to as grandfather rights. There is no easy solution, so it is not surprising that the recommended way out is normally to build more infrastructure.

Riskiness

A third characteristic is that the provision of transport infrastructure is associated with high risks. There are three dimensions that should be mentioned. Firstly, once the infrastructure has been built the costs are largely sunk. Because of its nature, infrastructure has no (or limited) alternative uses, so once the works have been concluded there is no turning back. Secondly, every investment is more or less a unique project, which means that the project risks are high. And thirdly, the market risks are high as they reflect the overall development of the economy. As a rule of thumb demand for transport tends to grow at twice the speed of the overall economy, and likewise in the case of a recession. In the case of major terminals (airports and seaports) which link into international networks, the market risk is amplified by that demand and reflects changes in a globalised economy.

The costs of the risks are no doubt high, but they are at present extensively ignored. And the reason is of course that the costs are largely borne by the taxpayers. It is sometimes claimed that this arrangement is appropriate because, by using tax collection, risks are spread in an efficient way. There are a number of other considerations however, viz. (i) that risk spreading can be achieved without having to resort to taxpayers, and (ii) if taxpayers are involved there is no reward for doing something about managing risks. Then, of course, it may be asked why taxpayers and not the users should be bearing the burden of the risks that they give rise to. The lack of attention paid to risk contributes to the lack of dynamics in the transport infrastructure sector.

External effects

Fourthly, the external effects of transport are considerable. These are not caused directly by the infrastructure but through its usage by motorists and operators. The external effects include congestion, increased risks of accidents, noise and the impact of emissions. These effects are not unique to infrastructure but they are pervasive. The current paradigm for how to manage these external effects is primarily based on adjustments of the cost of transport by way of the imposition of additional taxes on fuel, taxes on vehicles, taxes on insurance premiums, plus a system of direct regulatory activities related to roads/railways, traffic and vehicles. As is well known, in some places separate congestion taxes have to be paid as well.

The main feature of the current approach is that it is not market-based. It is a structure shaped by politicians and bureaucrats. There is one exception, viz. the third party insurance system, which, whilst obligatory, allows for market determined prices. On the other hand, that component of the overall cost related to risk of accidents is rather small.

6. Some guidelines for a future policy

Basic principles

In this final section I will provide some first guidelines for what I believe would be an appropriate future policy for the transport infrastructure sector in the sense that it will not only improve decision-making, but also stimulate innovation. It has to be acknowledged that, to get things right concerning road and rail infrastructure, considerable further efforts will be required to formulate credible directions. Indeed, the devil is in the details for some of the envisaged reforms. Yet difficult challenges are no reason for inaction and for not considering options carefully and not initiating more comprehensive feasibility studies into alternatives to the current governance models. And, introducing user charging alone will not be adequate to achieve better governance.

Let us start with what I believe are some basic cornerstones for a new policy. The first is that **the consumer must be recognised** in a way similar to what is seen in other sectors of the economy. There is nothing fundamentally different with infrastructure; it is not even an end product, but only a means to achieve something else. If these other ends can be provided based on choices made by consumers (as they normally are), then what should prevent transport infrastructure from being subjected to similar forces?

There are two issues, viz. (i) that transport infrastructure at times is used to promote overall good accessibility for all, and (ii) that there are two natural monopolies, one which is a genuine natural monopoly, the core road network, and another which has been created by politicians, the core rail network.

Regarding distributional consequences, it should first be noted that there is already an established principle for the provision of transport services when a financial criterion is deemed to be inappropriate. This is the provision of a 'public service obligation'. That principle is in general applied by having local governments provide subsidies for specific services which are essentially of a local nature, and the national government providing subsidised services at the national level.

I think that this policy should be extended to apply to transport infrastructure as well, and the way to do so is by differentiating between core networks and other networks (as is already recognised in planning in Sweden)¹¹.

A further cornerstone of a new policy is that of **self-financing based on the user-pay principle**, i.e. that at least the **core** transport infrastructure should bear its own costs both in a short and long-term perspective by charging the users. Cost recovery has been a basic principle of the management of state operational entities in Sweden since the 17th century, but it got lost once the belief in central planning became a dominant force in government during the 20th century.

Self-financing is necessary for several reasons as part of a future policy, including:

- To put a break on the currently ruling rent-seeking forces in transport infrastructure, and refocus efforts on rent creation instead;
- To limit windfall gains to landowners who have done nothing of a value added nature to earn those windfall gains;
- To limit the cost of risk associated with major infrastructure development to non-users, and create an environment in which those risks are being identified and managed in a much tighter way than is the case today; and
- To allow government to focus on genuine public issues, such as climate change, and reduce conflict of interest by having the government also directly involved in the rail and road infrastructure.

Ultimately then, user charging is necessary in order to change the current warped incentive structure and to begin to put the incentives right. To apply the principle is not an insurmountable obstacle as it is there already in part.

11. Cf. Sveriges Kommuner och Landsting (2008).

Application on the road and rail networks

The networks pose the real challenge. Going back to the original railway model – with a vertically integrated operator – is not a solution. Similarly, there are few models to rely on in developing alternatives for the road network¹².

I believe that the main guideline for a new policy should be based on a recognition that in former days the response to the issue of how to manage networks and other ‘monopolistic type’ infrastructure was to have them run in the form of a ‘club’, i.e. by the users themselves. As has been noted, even today this is the approach used for part of the local road networks in Sweden. The club principle can be viewed as the market’s solution to what the economists call a market failure.

In the railway sector, there are already solutions of this nature. As mentioned, the approach applied in the UK to rail infrastructure operations has entailed the creation of a special type of non-profit company that is managed by the operators. In Sweden, the approach to the running of the Interior Railway also reflects a club approach to management, in this case for a part of the non-core network. I believe that the UK model should be studied in further detail to determine its appropriateness, and if so, how it should be adapted.

I expect the club for the core rail network to have a governance structure similar to that of a company, but only the member operators would nominate board directors. The member operators would comprise the railway companies making use of the core network, and running long-distance passenger trains, commuter trains and freight trains. The board should be guided by an overall objective to strive for an economically efficient and safe network.

I would further expect that the operators, subject to general guidelines, will themselves reach consensus on what type of charges to collect and how to set them. The main requirement should be that each operator should **at least pay his own incremental cost** (i.e. short-run marginal cost) and that total revenues should be adequate to finance all the costs of the infrastructure system seen in a longer-term perspective. The club would further form separate entities to run traffic management and to handle the allocation of train paths, where required. However, ownership of the railway itself could remain with the state (to ensure that it is not being used as collateral).

There would have to be a separate authority to serve as the regulator for safety and security, and perhaps a further entity to ensure adherence to EU directives (however, see also below). To provide for checks and balances, the club would have to have an extensive reporting framework setting out principles of operations, to ensure financial soundness, and targets on performance. There should preferably be an independent performance auditor.

Non-core parts of the rail network would likewise be run by ‘clubs’. In this case the members are envisaged to comprise local and regional governments, operators and major shippers. But it would also be possible to have only one member, e.g. when the railway is mainly used by one shipper. The clubs would collect user charges as for the core network, which the different clubs could themselves decide on, subject to an overall regulatory framework.

It is unclear whether the same principles could be applied to the management of the core and non-core road networks. The reason is that, since there are so many users, there is a risk that users might not be able to agree even subject to set rules for how to set charges and principles for how to decide on maintenance and investment programmes. There could thus be significant differences between what users from different parts of the country may wish to attain as well as

12. One model is presented in Bruzelius (2005).

between commercial transport operators and car owners. It may therefore be necessary to settle for a 'pseudo club', with boards nominated by the government. The road club would, however, have to be run explicitly in the interests of the users and subject to well-developed consultation mechanisms. Again, the objective of the manager should be to achieve an economically efficient and safe road network.

A new system of road management would have to be accompanied by a full-scale direct user charging system, so that every movement of every vehicle on public roads would be paid for. It should be possible to have a universal charging system in place within a period of less than 5 years since similar systems, as mentioned, already exist and comprehensive charging systems have also been considered in earnest by other countries. The level of the charges would be set to achieve cost recovery on the core network so that at least incremental costs should be paid for by each vehicle. Revenues generated from vehicles making use of non-core networks would accrue to the operators of the clubs/municipalities/regions managing those networks. This principle would ensure genuine delegation of the non-core networks to the local level as the revenues would likely be substantial (albeit not necessarily adequate for cost recovery)¹³.

Consideration may have to be given to depositing revenues for the core network in a separate fund (the road fund), which would play the role of the regulator to ensure that money may only be spent according to agreed rules. This additional check on the system, which can also be used to undertake technical and performance auditing, has been a key of road sector reforms in some countries (notably New Zealand and Namibia). It is another aspect that will have to be evaluated further as part of the development of a new deal for the users of the road networks.

7. Possible impacts

Contracting

One likely consequence of a new approach to road and rail management, including self-financing, is that it will greatly facilitate the introduction of new procurement methods for works in road and rail. One of the shortcomings of the appropriation system used today to finance infrastructure is that it is short-sighted. Having an entity that is similar to a company, which has assured financing by way of user charges for the future, will make it much easier – and indeed natural – to enter into longer-term contracts for the maintenance and provision of infrastructure, a requirement of effective contracting based on functions.

Moreover, by using a private framework, more flexible procurement methods may be introduced than the current ones, including procuring based on reputation. The current procurement systems used by infrastructure providers are cumbersome as they must satisfy the requirements of the public sector given that they are publicly financed and/or are part of the public sector.

User charging and financing

But by using a company-type of framework an endless number of other opportunities will be opened up. Firstly, financing will not only have to depend on charges. Much of the benefits of transport are reflected in increased land values. The current taxation and financing systems make it very difficult to capture those benefits, giving rise, at times, to windfall gains to private interests. With a private entity running road and rail, the opportunities for negotiating contributions with land owners will be opened up much more than is the case at present. Moreover, it will be possible to also negotiate for financing contributions from local governments, when they see improved infrastructure as a means to improve the business climate or simply because they are owners of land in urban areas, as is the case in Sweden.

13. Cf Sveriges Landsting och Kommuner (2008).

Another expected development is a much more dynamic process to identify new types of infrastructure solutions in road and rail, including in combined road and rail transport. With the new framework, a type of CBA will still have to be employed. But it will be different in nature as the parameters and values of the CBA will be determined by 'the club' and not by 'the planners'. They will therefore better represent the actual willingness to pay than is the case with the current form of CBA. And if the CBA actually shows that a solution should be beneficial, then the likelihood that it will be implemented is much greater, *cet. par.* Indeed such solutions may even entail having the road club financing investments in rail infrastructure, and vice versa.

A generally beneficial result of the new approach is that infrastructure developments that are required will be financed and implemented at a time when they are needed. A well-known drawback of the current system is that the state of public finances may well lead to a significant delay in the implementation of important projects to improve the capacity and quality of transport infrastructure.

However, opportunities are not limited to infrastructure as such. New opportunities could also be opened up for reducing the impact of congestion, emissions and also road traffic management. The opportunities here are made possible by the need to implement a comprehensive charging system. For roads, it will most likely not involve levies on fuel as today, but will entail km-charges, which may vary on account of the type of vehicle and which part of the infrastructure is being used. It may be supplemented with time-based fees that may also vary with the type of vehicle. Vehicle owners will likely be billed once a month, and the charging system will thus start to look like the ones used by public utilities. The changes for rail users will be less dramatic as an embryonic user-charging system already exists. As mentioned, the details of the charging system will have to be decided on by the clubs (or the road fund) subject to the requirements that (i) the total revenues (over time) shall match total expenditures, and (ii) that they should promote efficiency in the use of resources.

One immediate consequence of the creation of this new type of charging system is that it can be imposed also on roads and railways that are not operated by the club, but are managed by regional and local organisations. It thus strengthens the opportunities for these organisations to address local and regional access. Another consequence is the possibility of introducing congestion-related charges, reflecting that the simultaneous use of infrastructure capacity will create external costs. This will result in better overall use of the network, and will also give better signals (in comparison with today) as to where there is a need for capacity improvement. I would not be surprised if the congestion based charging will ultimately result in relatively higher charges for heavy vehicles on roads than for lighter vehicles than is the case today. Of course, the new charging system could also be used by the local and regional organisations to implement a charging system on their road and rail networks reflecting congestion.

Environmental impact

The present approach to reducing carbon dioxide emissions in transport is based on taxes on fuel and vehicles. An alternative would be to introduce the EU Emissions Trading Scheme (EU ETS), as has indeed already been considered by the European Commission. The introduction of a system based on trade in emission allowances will be introduced for air transport operators starting from 2012.

The drawbacks with the current approach to emission reductions in transport, which is based on taxes, are that they:

- Have poor overall public support as the taxes are seen as arbitrary, being determined by a political process (and not by the market). The degree of arbitrariness is amplified by subsidies being provided for certain types of fuels and vehicles.
- May be supported by data and analysis that are not transparent to the average person.
- Primarily affect the behaviour of the operators and therefore ultimately those who provide the inputs to the operators (vehicles and fuel). There is thus limited impact on the infrastructure providers.

Emission trading has the advantage in that the overall objective (in principle) is clear and transparent (specific caps and thus reductions in the number of tones emitted) and that the prices on the allowance to emit are determined by a market and therefore are also transparent. A main challenge is to establish specific targets for levels and reductions in carbon dioxide over a longer period and which are comprehensive enough to give clear long term signals to the market actors.

The European Commission has focused on two options for the extension of the ETS to road transport, the inclusion of car manufacturers and individual motorists. A third proposal has also been made separately, viz. for fuel sales¹⁴.

My view is that a possible ETS for the transport sector should target the vehicles (and therefore the owners of vehicles), and in the case of rail transport the owners of locomotives using fossil fuels. If the system of charging as envisaged for use of infrastructure is implemented, then this system could be extended to also cover the operational and financial implications of the ETS for road users (and rail users). Indeed the road club (or the road fund) could be used as the agent for this purpose, which would hold the allowances (likely to have to be purchased by way of auctions), and would then pass on the cost to the users.

There are a number of opportunities that could be created by this arrangement (over and above what is made possible by the taxation approach):

- It could provide an incentive to the 'club' to identify infrastructure actions that will result in reductions in emissions, since there would be a cash flow associated therewith. The CBA of a proposed investment would not include estimates of the values of reductions in emissions any longer. It would include the additional money to be made by being able to sell emission allowances in the market.
- It would enable the rail infrastructure club to enter into negotiations for long-term contracts with transport operators for them to shift traffic from road to rail. The improvements in the services to be provided by the rail infrastructure club would then in part be paid for by these operators transferring some of their allowances to the rail infrastructure club. There would thus be an additional source of income for the rail club.
- It could pave the way for the introduction of an additional trading scheme covering those emissions that are not being taxed at all, at least not in Sweden, i.e. criteria air contaminants (CACs), and in particular nitrous oxides. Unlike carbon dioxide, CACs have more localised effects. It should thus be possible to introduce a new separate trading

14. Department for Transport (2008?).

scheme for nitrous oxide, with the road club (or the road fund) again serving as the agent to work out the quantities involved and then managing the trading scheme on behalf of the road users.

Day to day regulation of road and rail traffic

As indicated, the establishment of clubs will not obviate the need for having regulators. But within the current arrangements there could be a scope for considering an increased level of self-regulation by way of the clubs, including for minor traffic offences, vehicle certification, overload control, etc. Indeed the club could have its own quality assurance system, which the regulator would only have to audit. And fines for minor traffic offences and overloading could be channelled back to the road club (or fund). Again the opportunities for innovation in road traffic control and management would grow.

8. Concluding words

The transport sector has during the past fifty years undergone a remarkable transformation. Following World War II the sector was heavily regulated with often stringent, entry, quantity and price controls. Many of the big operators in the sector were owned by the state and were also monopolies, and thus operated on principles with limited concern for consumers. Today most of these monopolies are gone, and markets have been opened up to new operators who can freely determine the quality and quantity of services to supply. Prices are mostly set through competitive forces. And this does not only apply to operations in the sector (road, rail, air and maritime transport), but also to terminal services (port and airports), although the work for these components of the sector is still to be completed. Deregulation, privatisation and competition have created an environment which has been highly conducive to innovation. It is not only a question of new, better and cheaper services being available to the shipper and traveller. This new environment has also made it possible to develop versatile information systems that have led to remarkable cost savings in the production of transport services.

The deregulation of the sector has been accompanied by another significant development, i.e. the vesting of remaining regulatory functions, primarily related to external effects, such as safety, security and environmental concerns, but also the promotion of competition in new institutions, like semi-independent regulatory agencies.

Some would argue that the sector is now a victim of its own success, with the rapidly increasing demand for transport being one of the main contributors to climate change and other emissions. It is claimed that the sector is not sustainable and therefore that some of the reforms should be rolled back.

I think this is a wrong conclusion. No doubt the impact on the environment by transport is one of the largest challenges facing society today. But to do something about this situation there is a need for:

- Effective policy making
- An environment fostering and conducive to innovation.

For policy making to be effective government must be allowed to focus on the major public issues. The reforms that have taken place in the sector so far have indeed allowed governments to do this, as they have gradually been relieved of having to worry about, say, the financial performance of the previously government-owned transport operators.

But this work is only partially done. Governments still sit on two, oftentimes conflicting chairs in the sector, serving both as the regulator and as the operator. This applies in particular to transport infrastructure, and as argued above to road and rail infrastructure. A continuation of this business model does not bode well for improving the effectiveness of policy making. A new approach is required which will not only allow the government to focus on first things first but will also make it possible to introduce much more innovation in this part of the transport sector.

The overall impact of the suggested new business model and governance arrangement for transport infrastructure cannot be identified. The proposals made here reflect a new paradigm, and a significant break with current practice. Before talking about the overall impact there is a need for substantial additional work on the design of the new model and arrangement. And even to get started on that will be a major challenge. But there is no real alternative in order to infuse new blood in to the sector. Continuing as at present is, in my view, not acceptable.

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