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Financing and Managing the Maintenance and
Expansion of Road Networks

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Financing and Managing the Maintenance and Expansion of Road Networks

By Cesar Queiroz, Roads and Transport Infrastructure Consultant

Abstract

Over the last decade, many transition and developing countries have experienced diminishing funding for their road infrastructure, affecting significantly the countries’ capacity to expand, maintain and rehabilitate their road networks. The severity varies from one country to another in terms of budget cutbacks, but in many cases, total road expenditures (including construction) has amounted to less than 0.8% of GDP. This ratio compares unfavorably to the 1% to 2% of GDP generally considered necessary to adequately maintain highway networks and to carry out a modest amount of construction.

As a result of such low expenditures, networks have been fast deteriorating and vehicle operating costs increasing. In a large number of countries, more than one third of the main road network is in poor condition. In view of the scarce resources, priority has been given to the main road network. Consequently, lower class-roads (including rural and urban roads) have received even less maintenance than the national networks. The problem is further exacerbated by the rapid increase in road vehicle fleet and commensurate road usage. This serious situation requires that road administrations prepare optimized road maintenance and development programs, based on a sound knowledge of road conditions, so as to make a strong case for increased budgetary financing for roads, in view of competing priorities from other modes of transport and sectors of the economy. Furthermore, road administrations can take advantage of more private sector involvement in financing and operating highway assets.

This paper covers the most commonly used means to charge users, such as fuel and lubricant taxes, vehicle taxes, and tolls, as well as the mechanisms to allocate funds for roads (budget allocations or road funds). Special consideration is given to private financing of roads through different forms of public-private partnerships (PPP), including a review of potential applications of the World Bank Toolkit for PPP in Highways as an instrument to help decision-makers and practitioners to define the best PPP approach for a specific country.
**Introduction**

An efficient transport system is important for economic development, as transport costs are a significant part of the cost structure of the goods that a country produces or imports. If transport costs are unnecessarily high, then the country’s products will not be competitive with goods from other countries. Road transport costs include not only the cost of building and maintaining the road network, but also vehicle operating costs, which increase as roads deteriorate due to increased vehicle maintenance costs, and the costs associated with increased time in transit.

In many developing countries, a significant portion of the roads, including the main road network, is in poor condition or only in fair condition (requiring attention immediately or in the next 3-5 years). Experience has shown that timely maintenance is much less expensive than delayed maintenance. If roads can receive maintenance at the appropriate time, then the overall cost of maintaining the roads is less than if roads deteriorate to the point that requires reconstruction rather than less expensive treatments such as surface dressings or asphalt overlays. For example, reconstruction costs in the order of five times as much per kilometer as an overlay, and 25 times as much as a bituminous surface dressing.

Consequently, it is imperative for the efficient operation of the road transport system that resources be available for timely road maintenance. This is just as much in the interest of the Ministry of Finance and to road users as it is to the road administrations and the Ministry of Transport. However, many countries have experienced diminishing funding for road maintenance and rehabilitation. The severity varies from one country to another in terms of budget cutbacks, but frequently total road expenditures (including construction) amount to less than 0.8% of GDP. This ratio compares unfavorably to the 1% to 2% of GDP, generally considered necessary to adequately maintain the road networks and carry out a modest amount of construction.

This serious situation requires that road administrations prepare optimized road maintenance and development programs, based on a sound knowledge of road conditions, so as to make a strong case for increased budgetary financing for roads, in view of competing priorities from other modes of transport and sectors of the economy. Furthermore, road administrations can take advantage of more private sector involvement in financing and operating highway assets.

**Road User Charges**

It is in the interest of the road users to have well maintained roads, as their operating costs are reduced substantially more than the corresponding cost of road maintenance. Thus the first step in seeking financing for road maintenance is to look to the users of the roads to pay the cost of road maintenance. Experience in a number of countries has shown that road users are willing to pay for road maintenance if they can be assured that the fees and taxes that they pay are in fact spent on road maintenance.
The preferable road user charges are those that link the charges most closely to the use of the roads. Generally, the most appropriate are charges for the use of the road space, and charges for the disproportionate damage caused by heavy vehicles.

**Method of Charging for Roads.** The principles of taxing road users are that charges should be economically efficient, equitable, cost little to collect and are not easily evaded. They should also rise automatically with inflation (Yenny 2002).

**Taxes on Vehicle Fuel** satisfies best the above criteria and is widely used. They are relatively inexpensive to collect, easy to administer and reasonably equitable, as they are proportionate to road use. Their main disadvantage is that they do not reflect the much higher damage done to roads by heavy vehicles. Although trucks consume more fuel per kilometer than cars and would therefore pay more fuel taxes per kilometer traveled, this is not in proportion to their higher impact on the roads. Therefore, fuel taxes need to be supplemented by additional charges on heavy vehicles.

Taxes on fuel are also used by Governments for purposes such as restraining fuel consumption or raising revenues for the budget, and this is common practice in many developing and developed countries. Nevertheless, what is needed is that a sufficient proportion of the fuel tax revenues are allocated to carry out an appropriate level of road maintenance and expansion.

**Vehicle Licenses** are common in most countries, mainly in the form of annual license fees (or for a two-year period, as in the United States). They are easy to collect and can differentiate between types of vehicle and reflect the costs that each type causes to the roads. The main drawback is that they are not use related. A truck used for only 20,000 km per year would pay the same as one traveling 100,000 km per year.

**Direct Usage Charges** could provide an alternative to the flat annual vehicle license for heavy vehicles. This system has been introduced in a number of countries, including Norway, Sweden and New Zealand. The charges are administered through sealed hub odometers or other measuring devices. The problem is that such systems require a substantial initial outlay, sophisticated administration, and are prone to evasion. Even in law-abiding New Zealand, the evasion is estimated at 10 to 20 percent.

**Tolls** are used for specific roads, bridges and tunnels. Although they charge directly for the use of particular facilities and are therefore equitable, they are a relatively expensive form of revenue raising. They have significant capital costs (construction of toll plazas and tollbooth, controlled access) and operating costs (toll collection). A rough rule of thumb is that tolls should not be considered for roads with traffic of less than 10,000 vehicles per day, to keep the administrative costs at a relatively low percentage of the toll revenues. Toll systems also reduce the economic benefits of the tolled facilities by minimizing entry and exit points, delaying traffic at tollbooths and diverting traffic to parallel roads with higher vehicle operating costs. Modern toll collection procedures (e.g., the German Toll Collect system), discussed later, can minimize such inconveniences.
Vignettes have been substituted for tolls in a number of European countries, typically to charge for the use of an entire class of roads such as motorways and, except for Austria and Switzerland, applied to trucks only. This charge does not have the costs associated with tolls described above, but does not reflect usage as vignettes are usually sold for one year (or other periods). Vignettes limited to one or a few days or one month have been used, although short periods may add considerably to the cost of administering the system. Evasion may also be a problem, as random checks are the only way to verify that vignettes are displayed on the vehicles. Vignettes for the use of motorways are in effect in the Czech and Slovak Republics and now also in Hungary as an alternative for paying tolls for a given time period. In Poland, vignettes are issued to trucks and buses involved in international transport.

Charges for non-standard and overweight vehicles are levied in many countries, the principle being that these charges should compensate for the extra damage caused to the roads by over-sized or overloaded vehicles. These charges seldom reflect the costs imposed on the roads by these vehicles and barely cover administrative costs. They are easily avoided by payment of bribes. In the case of overloading, it would be better to enforce axle load limitations by stricter control, fines and forced unloading of contravening trucks.

Charges on the purchase of new vehicles, practiced in certain countries, can be graduated for different kinds of vehicles (more for trucks). Similar to annual vehicle registration fees, they are relatively easy to collect, but are not related to subsequent vehicle use.

Sales taxes, of which part of the revenues have been assigned to roads (this is the case, for example, of the State of Virginia, in the U.S.). However, these taxes are not directly related to road use.

Most countries have found that the most appropriate road user charges are a combination of fuel taxes (usually responsible for 70 to 80 percent of the total road user charges); an annual vehicle registration fee that varies depending on the size of the vehicle; special charges for extra heavy vehicles in proportion to the damage that they do to the roads; and transit fees for foreign vehicles, to compensate for the local fees and charges that they do not otherwise pay.

Developing a Road Financing Plan

When the revenues available to the road sector are significantly less than the amount required to maintain the road network in a stable long-term condition - and to undertake justified improvements (e.g., projects with an economic rate of return of more than 12%) - the main road agency should prepare an explicit long-term financing plan showing the size of the financing gap and suggesting how it might be bridged (Heggie and Vickers 1998). Among other things, the financing plan should consider the scope for getting better use out of existing resources by, for example, contracting out more design and
implementation work to the private sector (or exposing in-house work to competition from outside contractors); increasing revenue mobilization by simplifying road user taxes and charges, restructuring them and improving revenue administration to reduce avoidance, evasion and leakage, and allocating additional revenues from the government's consolidated budget. The following World Bank site provides further information on developing a road financing plan:


**Road Funds or Budgetary Allocations?**

A number of countries have attempted to earmark part of their road user revenues in order to guarantee a certain level of funding for roads. Some countries have done that through the creation of a road fund (as is the case of Poland, Romania, and several States in Brazil). Other countries (e.g., Estonia and Slovenia) have legally earmarked part of their fuel tax for roads without establishing a road fund. Despite the legislation in favor of road financing, the difficult budget situation faced by most countries is resulting in a much lower proportion of funds than legally earmarked for roads actually going to the sector. In Poland, only 30% of revenues from excise tax on fuels are presently allocated to national, local and urban roads. This is the minimum required by the parliamentary act. In Estonia, the Roads Act stipulates that 75% of revenues from fuel taxes and 100% of vehicle taxes should go directly to roads, but amendments keep postponing the implementation of these provisions, and the actual allocations have been significantly lower. Other countries (e.g., Russia, Latvia, and Lithuania) have abolished their road funds as a measure aimed at improving their management of public finances.

The pros and cons of earmarked funds such as road funds have been debated at length. See, for example, Creightney 1993, De Richecour et al. 1995, Gwilliam and Shalizi 1997, Heggie and Vickers 1998, Malmberg Calvo 1998, Bousquet and Queiroz 1996, Potter and Barry 1997. Some argue that the Government is the best judge to decide how revenues are allocated and that it is wrong to earmark specific taxes for specific purposes. It is said also that road funds may “lower the financial discipline (compared to the general state budget) instead of rising the commercially managed output and efficiency of the road sector.” Others have taken the view that, given the urgent needs of the road sector, users would benefit from paying higher taxes related to road use, provided the extra revenue is actually spent on roads. This was a decision made by Slovenia for developing its motorways.

Many governments depend on fuel and other taxes for general revenues. Fuel taxes are relatively easier to administer and collect than income taxes, and therefore it is not reasonable to argue that all taxes on road users should be spent on roads. In that respect, the U.S. is the exception rather than the rule. Fuel taxes are much lower than in other developed countries, but about three-quarters go to the highway account, a small portion is allocated to mass transit and only the residual goes to the general budget. In Europe, where fuel taxes are much higher, a substantial portion goes to the general budget. In
Germany, for example, fuel and other vehicle taxes are the third largest source of Government revenues (Metschies 2002).

The general issue of road financing and road funds is discussed in detail on the World Bank web site at:


**Innovative Road Financing Approaches**

When the needs are higher than the budgets available, government agencies tend to look for additional or alternative sources of revenues. This section reviews the case of the State of Texas, in the U.S., which held a roundtable discussion in conjunction with the annual meeting of the Transportation Research Board (TRB) in January 2003, to discuss transportation finance, particularly revenues, for its Department of Transportation (DOT). While DOT's budget in 2002 was US$5.2 billion, its highway needs were estimated at US$14.8 billion (of which US$3.1 billion was for maintenance). The objective of the roundtable was to brainstorm (using a group of invited participants) innovative ideas for increasing revenues, and to identify several methods not currently used in Texas for more detailed consideration.

The broad strategies identified by the participants included:

- Funding sources that provide the greatest revenue and that can be sustained over time should be pursued.
- Reducing costs is an effective way of increasing the impact of available funding.
- The general public should have a large say in how money should be raised and where it should be spent.
- The sources of funding should be linked to specific needs (look at the source-benefit nexus).
- The ownership of right of way can potentially be a large generator of revenue.
- One should compare local taxation with other states (or countries) in terms of issues such as sales tax, registration fees, fuel tax, weight fees, and diversion of funds.
- There are bridges that could be regarded as vulnerable. They could be tolled to raise revenue for protection and maintenance.

A discussion on new technologies indicated that a vehicle-km traveled (VKT)-based tax using global positioning satellites (GPS) technology should be considered. Trucks should be equipped first, followed by other vehicles. A GPS-based system has many security benefits, which are recognized by insurance companies. However, privacy is still a major concern for private automobile users.

The roundtable participants discussed several innovative financing methods, including:
Toll Roads. Toll new roads, as well as roads that are reconstructed with increase in capacity.

Toll Bridges. Toll bridges that could be regarded as vulnerable. They could be tolled to raise revenue for protection and maintenance.

Alternative Fuel Tax. Repeal tax exemptions on alternative fuels and charge equivalent taxes to alternative fuels as that now in place for petroleum based fuels. Alternative fuels include methanol, ethanol, liquid petroleum gases, natural gas and electricity.

Vehicle Kilometers Traveled Tax. VKT tax is based on the distance (km) a vehicle travels. Higher rates could be charged to heavy vehicles and buses because they cause more wear and damage to the roadway.

Weight-Distance Tax. Tax assessed to vehicles weighing over a certain tonnage. The tax is based on both vehicle weight and distance traveled. A simpler method of collection would be to charge for the truck’s maximum potential weight.

Freight Tax. A flat rate tax charged to trucks each time they enter the state to help offset the costs of the damage they cause to the roadways while traveling through. The tax could be based on truck weight, number of axles, or type of freight.

Congestion Pricing (facility or area). Motorists have to pay a fee for traveling within a certain area (usually a central business district) during specific times of the day. If the fee is not paid, a large fine is given to the motorist.

Conventional Tolls of the Entire Freeway System. Freeway users enjoy a higher level of service than do their counterparts using other road systems. These users could be assessed a user fee for the higher level of service.

Electronic Road Pricing. Vehicles are equipped with Automatic Vehicle Identification (AVI) so that the customer does not have to stop at tollbooth. The AVI sends out a low-level radio signal that is decoded and the toll is charged to that vehicle’s account. Offenders’ license plates are photographed and fined.

Increased Enforcement and Overweight Fines. Increase commercial vehicle overweight fines statewide and provide higher enforcement to ensure compliance of this law. Portable weigh stations or new technologies that measure vehicle weight while moving could be used.

Premium Lanes. Tolls along the roadway vary throughout the day based on the level of congestion. Higher prices would be charged during heavy congestion and peak hour times.
Windscreen License. A form of congestion pricing where road users must display a daily or monthly license to enter a certain “Restricted Zone”. The licenses must be purchased in advance. The windscreen licenses are enforced using visual inspection.

Lease Air, Right-of-Way, and Underground Rights. Highway agency may lease to a private developer the right to develop space above the grade line within its right-of-way; lease right-of-way for items such as fiber optic cables and cell phone towers; lease rights for underground infrastructure.

Road Branding. Roadway segments would be named after businesses or individuals willing to pay a fee. Revenue for road branding would be placed in the general transportation fund and used for projects.

Cost Reduction by Competitive Bid of Maintenance Contracts. Experiences across the world has shown that a shift to 100% contract maintenance and assuming good competition and well qualified contractors would save between 30% and 40% of routine maintenance. Furthermore, additional cost reduction and increased efficiency can be achieved through adoption of performance-based contracts (PBC) for road maintenance (Stankevich, Qureshi and Queiroz 2005)

Private Financing of Road Infrastructure

Many governments do not have all the financial resources required to expand, maintain, and operate their country’s highway networks and other transport infrastructure. The overall resources needed are enormous. In the United States, for example, it is estimated that $55 billion will be required annually over the next 20 years simply to maintain the highway and bridges in their current condition.

In many countries, the private sector has been involved in financing infrastructure through concessions under a public-private partnership (PPP) program. Broadly defined, a concession is a legal arrangement in which a firm obtains from the government the right to provide a particular service (Kerf 1998). PPP schemes, however, are somewhat underutilized in developing economies, where the potential financing gaps are significant and growing, and there seems to be an enormous potential for more private sector involvement in the financing and operation of highway assets in these countries.

With many countries increasingly interested in attracting private capital to infrastructure projects, institutions such as the World Bank can contribute through greater use of their guarantee power, in addition to supporting, when required, the public sector contribution to the construction cost of a PPP project through loans. Partial risk guarantees are particularly relevant in the context of seeking more private involvement in the financing of road infrastructure.

Successful PPP cases in roads in developing countries include the M5 motorway in Hungary and a number of highway concessions in Argentina, Brazil and Chile. In Chile,
total funds for roads have been increasing thanks to significant private investments in the sector, while public funding has shrunk in the last several years (Figure 1).

Figure 1. Road Expenditures in Chile

![Figure 1](image.png)

Source: Ministerio de Obras Publicas, Chile

**Toolkit for Public Private Partnership in Highways.** The Toolkit for PPP in Highways, developed by the World Bank, is a multimedia product aiming at assisting policy makers and transport officials in low and middle income countries in identifying different contracting, regulatory, and funding options for engaging the private sector in road development, maintenance, operation and financing. The Toolkit addresses all types of road projects, regardless of their complexity and scope of work, with or without private financing involved and irrespective of the term used to qualify them (e.g., performance-based contract, concession, franchise, BOT—build, own, transfer).

The Toolkit provides guidance to clarify public sector objectives and to set up project characteristics accordingly, in particular as regards:

(i) the tasks (scope of work) entrusted to each party;

(ii) the level of autonomy left to the private actors and the way their performance is assessed;

(iii) the possibility and implications of including several road links in a single contractual package;

(iv) the risk allocation principles and mechanisms;
(v) the cost recovery system (general, specific taxes or direct road user charges);

(vi) the financial scheme based on a Government budget, private financing or a combination of both.

A CD-rom is available from the World Bank with the Toolkit, which can also be downloaded from:

www.ppiaf.org/toolkits/ppphighways/index.htm

**Partial Risk Guarantees**

Guarantees may be used to help attract private financing for roads. The World Bank partial risk guarantee covers specified risks arising from nonperformance of sovereign contractual obligations or certain political force majeure events. Partial risk guarantees are particularly relevant in the context of private financing of infrastructure. Such guarantees cover specific government obligations spelled out in a support agreement (e.g., concession agreement, implementation agreement, BOT contract) with the project entity. They are appropriate for enhancing a project’s limited recourse project financing, the most common method of financing concessions for transport infrastructure. A schematic representation of a partial risk guarantee is presented in Figure 2, while Figure 3 provides an illustration of how this general structure can apply to a highway concession contract.

Partial risk guarantees ensure payment in the case of debt service default resulting from the nonperformance of sovereign contractual obligations undertaken by Governments or their agencies in private sector projects. Sovereign contractual obligations vary depending on project, sector, and country circumstances, and would be embodied in a support agreement negotiated between the Government and the project sponsors. Typical government contractual obligations include:

(i) maintaining the agreed regulatory framework, including toll rates;

(ii) construction assistance, such as permitting and rights-of-way, land, ancillary services;

(iii) operations assistance, such as maintaining access roads to a toll road;

(iv) financial assistance, such as minimum revenue guarantee, if any;

(v) assistance with currency issues, such as foreign currency convertibility and availability, and banking permits; and

(vi) payment of damages in the event of breach of the support agreement by the Government or its agencies.
A partial risk guarantee is triggered by debt service default resulting from Government noncompliance with one or more of its obligations as stipulated in the support agreement with the project company.

Figure 2. World Bank Partial Risk Guarantee Structure
Canceled Toll Road Projects. Some cancellations of private infrastructure projects should be expected, as the "freedom to fail" provides incentives for the private sector to be efficient (Harris et al. 2003). The projects canceled thus far represent only a small share of the projects that have encountered problems. Most problems are solved by adjusting key terms, by renegotiating contracts, or through other means short of cancellation. Even where substantial macroeconomic shocks occurred, most private infrastructure projects successfully withstood the impacts.

According to a survey by Harris et al. (2003), 327 toll road projects reached financial closure between 1990 and 2001, representing a committed investment of US$76 billion. In the same period, only 19 (or 5.8%) of these projects were canceled (one in Hungary, one in Thailand, two in Indonesia, and 15 in Mexico), representing a total amount of investment canceled of US$12.2 billion, or 16% of the total commitment.

The small number of canceled projects, the attempts by governments to reprivatize some of them, and new private projects in countries that have seen cancellations all suggest that many governments still view the private sector as an efficient means of providing road infrastructure.
Electronic Toll Collection

Electronic Toll Collection (ETC) is a fairly mature technology that allows for electronic payment of highway tolls. ETC systems take advantage of vehicle-to-roadside communication technologies (traditionally via microwave or infrared communication, more recently via GPS technology) to perform an electronic monetary transaction between a vehicle passing through a toll station and the toll agency. ETC systems require Onboard Units (OBU), vehicle detection and classification as well as enforcement technologies.

Essentially, ETC equipment substitutes for having a person (or coin machine) to manually collect tolls at toll booths. In addition, it allows such transactions to be performed while vehicles travel at highway cruising speed. ETC benefits include (http://www.calccit.org/itsdecision/serv_and_tech/Electronic_toll_collection/electronic_toll_collection_summary.html):

- Increase in toll lane capacity
- Reduction in motorist waiting time
- Convenience for toll payers
- Fuel savings and a decrease in mobile emissions by reducing or eliminating waiting times
- Reduction in toll collection costs and enhancement of audit control by centralizing user accounts
- Possibility to implement congestion pricing by breaking technical barriers: non-intrusive toll collection requires much less infrastructure, automatic vehicle counting and classification and automated accounting systems
- Identification of toll violators through digital license plate recognition devices

ETC is a part of Intelligent Transportation Systems (ITS), which are systems that use electronics, communications and information processing to improve the efficiency and safety of surface transportation.

The following sections will discuss application of innovative ETC systems in raising revenues for road agencies and implementing congestion pricing.

Urban Congestion Charges. On February 17, 2003, London introduced a US$8-a day congestion charge for those driving in the city center (the rate has now been increased to £8.00-a day, or about US$13-a day). The scheme relies on 700 video cameras which scan the rear license-plates of cars which enter the area between 7 am and 6:30 pm during working days. This information is matched each night against a database of drivers who have paid the charge either by phone, via the internet or at shops and garages. Except for those with exemptions, anyone who fails to pay by midnight is fined about US$130. More information on the London congestion charge is available at:

http://www.cclondon.com
While some road pricing schemes had to be aborted because of political opposition (e.g., Austria, Hong Kong), others are working well. Singapore has led the way in restraining traffic by price since 1975. In the 1990s, three Norwegian cities—Oslo, Bergen and Trondheim—set up charging schemes (see more details below). Rome has introduced an electronic system to control entry into its historic center. San Diego, California, has adopted dynamic road pricing, using microwave transponders to assess congestion levels and deduct fees accordingly.

**Toll Rings in Norway.** After a long political debate, toll cordons have been introduced in Norway as a source of funding for urban road improvements with the main objectives of easing congestion and improving road safety and the environment. In 1986, the Bergen toll ring was opened in Norway (this was the second such ring in the world, the first being in Singapore, as mentioned above); the Oslo toll ring was opened in 1990, and the Trondheim toll ring was opened in 1991. In Oslo, alternatives to toll collection that were debated (and rejected) included (a) an extra fuel tax earmarked for local road improvements, and (b) an extra car ownership tax earmarked for local road investments. A reason for rejection was a general negative attitude to earmarking of taxes in Norway. Establishing toll cordon in Oslo, with 19 toll plazas, was facilitated by the city's topography, with the fiord to the south and large greenbelt areas to the north and to the east. With a few exceptions such as handicapped drivers, public transport, and ambulances, everybody has to pay toll when passing in the direction of the center of Oslo. Outbound traffic is not tolled. In 2001, toll revenues amounted to 880 million NOK (about US$126 million) and the operating costs were 95 million NOK (about US$13.5 million). Toll rates are 15 NOK for cars and 30 NOK for trucks (or about $2 and $4, respectively). The heaviest trafficked toll plaza, Plaza No. 11, with about 50,000 vpd, has 8 paying lanes -- 4 for tag users, with automatic vehicle identification and no speed limitation, 3 that are coin operated (equipped with high capacity French model machines), and 1 lane for manual services only. Operation is done by two private companies—a toll collection company, and a toll plaza operating company—both under contract with the Norwegian Public Roads Administration. The link below provides more details:

[www.vegvesen.no](http://www.vegvesen.no)

**Heavy Goods Vehicle Charging in the UK.** Several countries have introduced or are planning to introduce schemes for charging heavy goods vehicles (HGV). Such a scheme being developed in the UK, the Lorry (or Truck) Road User Charge (LRUC) will:

- Apply to all lorry operators, regardless of their nationality
- Apply on all UK roads
- Vary according to the characteristics of the lorry - for example, weight and axle structure and vehicle emissions standard
- Vary according to the type of road - for example, charging less for motorways
- Have the potential to vary according to the time of day - for example, to have the potential to charge lorries less for using motorways during the night
The LRUC initial feasibility studies have been completed. Regular consultations with industry representatives and stakeholders, including the main trade associations involved with road haulage, have been carried out. It is anticipated that the required equipment will be installed in vehicles and revenue collection will begin in 2007/08. More information on the LRUC is available at:

http://www.cfit.gov.uk/congestioncharging/factsheets/lorry/index.htm

While many of the issues in road charging are institutional and political, it is essential that the technical systems work well. As reported by TRL (http://www.trl.co.uk), the European research program on electronic charging – INITIATIVE, has developed several designs of charging equipment incorporating microwave short-range communications, cellular radio technology, satellite positioning, and a smart card reader. Such equipment is capable of identifying when the vehicle enters a charging zone, applying the appropriate charge, and transmitting charging data to a billing center. A requirement for road user charging in the UK is that travelers should need only one set of on-board equipment for use with any local charging scheme.

**Heavy Goods Vehicle Charging in Germany.** Since 1 January 2005, all lorries exceeding 12 tons gross weight will have to pay between €0.09 and €0.14 for each kilometer of road traveled on Germany's 12,000 km motorway (Autobahn) network. The tax is calculated on the vehicle's environmental status (engine emission levels) and the number of axles. This tax replaces the Euro vignette system for traveling through Germany. Lorries (trucks) using the German Autobahn network have to be fitted with an On Board Unit (OBU) to enable payments to be calculated via the satellite tracking system. Figure 4 shows a GPS-based OBU mounted on a truck.

The scheme is raising around €3 billion a year, much of which to be spent on road and rail infrastructure. “Toll Collect” runs the scheme, which is the first of its kind in the world, for the German government.

Figure 4. GPS-based on board unit mounted on a truck (Source: http://www.tollroadsnews.com/cgi-bin/a.cgi/rwXBNl0REdmcEIJ61nsxIA)

Payments can be made at up to 3500 payment points, such as petrol stations, service areas and retail outlets, or by telephone or on the internet via:
Key features of the German toll system include:

- It recognizes a fixed toll road network (about 12,000 kilometers of motorways) and only charge tolls there. This road network may be expanded at any time.
- It is able to set environmental policy through taking the pollution class into account as well as the number of axles in calculating fees.
- It offers the technical prerequisites to introduce other fee classes, such as the time and place of the trip.
- It operates on a free flow system, which charges toll without causing stops and traffic jams.
- A dual system with automatic and manual booking alternatives to ensure that all truck drivers can use the toll road system without discrimination.
- Be able to handle the full tonnage booked with the manual system if the automatic system goes down.

Updated information on the “Toll Collect” system is available at:

http://www.toll-collect.de/pdf/benutzerinformation/web_einfuhrungstex_gb.pdf and

http://www.toll-collect.de/frontend/HomepageVP.do;jsessionid=D99B2A0AB884D72D690B4EB25D608E99

Minimum Toll Rate to Attract Private Investment for a Motorway Project

Using the Financial Simulation Tool (Graph format) included in the World Bank/PPIAF Toolkit for PPP in Highways and several assumptions as indicated in Table 1, it is possible to assess the minimum required toll rate to attract private investors for motorway projects. The results of this analysis are given in Figure 5. For example, if the initial traffic volume is expected to be 20,000 vpd and the construction cost US$4 million/km, the minimum toll rate to attract private sponsors would be US$0.09/km (if the basic assumptions in Table 1 are applicable).
### Table 1. Basic Assumptions Used to Estimate the Minimum Required Toll Rates

<table>
<thead>
<tr>
<th><strong>Independent Variables</strong></th>
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<tbody>
<tr>
<td>Concession term = 20 years</td>
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<tr>
<td>Construction cost = $1 million per km to 5 million per km</td>
<td></td>
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<tr>
<td>Operation costs= $500,000 per km per year</td>
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<td>Equity=14%</td>
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<td>Subsidies=0</td>
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<td>Interest rate=5% per year</td>
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<td>Grace period=4 years</td>
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<tr>
<td>Repayment period=14 years</td>
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<td>Initial traffic=5,000 vehicles per day to 20,000 vehicles per day</td>
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<td>Traffic growth=3%</td>
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<td>Inflation=6%</td>
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<tr>
<td>Tax=18%</td>
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<tr>
<th><strong>Constraints</strong></th>
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<tbody>
<tr>
<td>Financial internal rate of return of the project (IRR) ≥12%</td>
<td></td>
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<tr>
<td>Return on equity (ROE) ≥16%</td>
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<tr>
<td>Loan life coverage ratio (LLCR) &gt;1.0</td>
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<tr>
<td>Debt service coverage ratio (DSCR) &gt;1.0</td>
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Figure 5. Minimum Toll Rate to Attract Private Investment for a Motorway Project
Some Lessons Learned from Successes and Failures

An analysis of the experience with motorway development in the past ten to fifteen years in several developing countries showed that any PPP scheme, in order to be successful, requires strong Government support and long lasting political will and engagement. This analysis highlights the following key pre-requisites for successful PPP schemes (World Bank 2004):

- A strong political will, an appropriate and stable regulatory and legal framework, and a stable macro-economic environment
- The willingness of the public sector to provide the (substantial) public sector contribution (up to 40-60 percent of total project cost in some cases). Public sector support may also include the provision of existing assets as an in kind contribution, sovereign guarantees, and subsidies
- Sufficient traffic volumes to make it viable to the private sector - A new road is unlikely to be financially viable without a flow exceeding 10,000 vehicles per day, unless the government offers an additional substantial subsidy to the concessionaire. By contrast, the rehabilitation of a road, particularly where there are no competing corridors, can be viable where the flow is just some 6,000 vehicles per day
- A robust economic and financial appraisal of the project that asks, and endeavors to answer, three questions: is the project beneficial for society, is it commercially viable for the potential concessionaire, and is the required public sector contribution justified in terms of the additional benefits engendered by that contribution?

Risks associated with PPP programs should be adequately managed. The main risks of PPP highway projects, in addition to changes in design during construction, which can lead to significant costs increase, are those that affect gross revenue. These revenue related risks usually reflect uncertainty in both the predictability of future traffic volumes and the willingness of road users to pay tolls, together with the possibility that expected land-use patterns do not materialize. A study of 67 toll road cases by Standard & Poor’s (2002) found that actual traffic, on average, was 70 percent of the forecast volume, with a spread of 18 percent to 146 percent. For countries without previous tolling experience, the average actual traffic was only 56 percent of the forecast, compared with 87 percent for those with previous experience.

The World Bank has, together with the Public-Private Infrastructure Advisory Facility (PPIAF), developed the Toolkit for Public-Private Partnership in Highways (World Bank/PPIAF 2003). This resource (discussed earlier), when used appropriately, provides a reliable way of screening potential transport projects for private sector participation, prior to further detailed investigation.

Helpful PPP resource guidance, based on lessons learned, can be found in: (i) “Public and Private Sector Roles in the Supply of Transport Infrastructure and Services: Operational
Guidance for World Bank Staff” (Amos 2004); (ii) “Launching Public Private Partnerships for Highways in Transition Economies” (Queiroz 2005); and (iii) “Guidelines for the Development of Successful Public-Private Partnerships” (European Commission 2003).

The European Commission (EC), recognizing that countries can potentially benefit from the PPP approach to reform and upgrade infrastructure and services, has published, in addition to the “Guidelines,” a Resource Book with a number of PPP case studies across countries and sectors (EC 2004). Further related information can be found on the EC website at:

http://europa.eu.int/comm/regional_policy/sources/docgener/guides/pppguide.htm

PPPs should only be considered if it can be demonstrated that they will achieve additional value compared with other approaches, if there is an effective implementation structure, and if the objectives of all parties can be met within the partnership. Regarding additional value, as an example, the UK Government (HM Treasury 2004) has developed a value for money (VfM) framework, the application of which (including a “Quantitative Evaluation” tool) is mandatory for all PPP projects proposed in the UK. Further information regarding the UK “value for money” assessment is available on the HM Treasury website at:

http://www.hm-treasury.gov.uk/documents/public_private_partnerships/key_documents/ppp_keydocs_vfm.cfm

Summary and Conclusion

A discussion was presented of the most commonly used means to charge users, such as fuel and lubricant taxes, vehicle taxes, and tolls, as well as the mechanisms to allocate funds for roads (budget allocations or road funds). Some innovative methods to raise revenues for road agencies or charging congestion, recently adopted or being planned for adoption by several countries, were presented. These included the German “Toll Collect” system, the London congestion charging scheme, and the “toll rings” in Norway.

Consideration was also given to private financing of roads through different forms of public-private partnerships, including reference to the relevant Toolkit recently developed by the World Bank. Using the Financial Simulation model included in the Toolkit, as well as several assumptions regarding the micro- and macroeconomic environment, a demonstration was made to assess the minimum required toll rate to attract private investors for motorway projects. For example, based on the assumption made, if the initial traffic volume is expected to be 20,000 vpd and the construction cost US$4 million/km, the minimum toll rate to attract private sponsors would be US$0.09/km.
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Selected References


