



Global Development Network 1999 - 2009

GDN Working Paper Series

On The Efficient Provision of Roads

Eduardo Engel, Ronald Fischer and Alexander Galetovic

Working Paper No. 12

September 2009

About GDN

The **Global Development Network (GDN)** is a leading International Organization of developing and transition country researchers and policy and research institutes promoting the generation, sharing, and application to policy of multidisciplinary knowledge for the purpose of development. Founded in 1999, GDN is now headquartered in New Delhi, with offices in Cairo and Washington DC.

This Working Paper has been prepared within the GDN's Global Research Project *Varieties of Governance: Effective Public Service Delivery*. The project is currently supported by the International Development Research Centre (IDRC), Canada; and The World Bank, United States of America. The views expressed in this publication are those of the author(s) alone.

© GDN, 2009

On The Efficient Provision of Roads

Eduardo Engel¹, Ronald Fischer² and Alexander Galetovic³

Abstract

The main problem with road provision in developing countries is lack of maintenance, which leads to increased transportation costs. Other important problems are the inefficient choice of projects and excessive costs of construction. To a large extent, these problems are due to a poor institutional design of the public works authority that exacerbates a host of agency problems. We explore alternatives to improve road provision policies both under the traditional model and when using public-private partnerships. We discuss in detail the principles that should underlie the institutions in charge of the road sector in both cases, and analyze the extent to which institutions that exist in different countries come close to this ideal.

¹ Professor, Department of Economics, Yale University, USA; NBER, USA

² Profesor Titular, Departamento de Ingeniería Industrial, Universidad de Chile, Chile

³ Profesor, Universidad de los Andes, Chile

ON THE EFFICIENT PROVISION OF ROADS

Eduardo Engel
Yale and NBER

Ronald Fischer
U. de Chile

Alexander Galetovic
U. de los Andes

Contents

1	Introduction	3
2	The traditional model: shortcomings and proposals	5
2.1	Overview	5
2.2	Road maintenance	8
2.2.1	Road maintenance	9
2.2.2	Road maintenance in poor countries	12
2.2.3	Decentralization and local roads	13
2.3	Institutional design: principles and suggested solutions	14
2.3.1	Production and human resources	16
2.3.2	Contracting and procurement	17
2.3.3	Separation of functions and management	17
2.3.4	Governance	19
2.3.5	Financing	19
2.3.6	Decentralization	21
3	The potential of public-private partnerships	21
3.1	Basics of PPPs	23
3.2	PPP and bundling	26
3.3	PPP as a second best	27
3.4	PPP from a public finance perspective	29

¹Engel: Department of Economics, Yale University, 28 Hillhouse Ave., New Haven, CT 06511. Fischer: Center for Applied Economics (CEA), Department of Industrial Engineering, University of Chile, Av. República 701, Santiago, Chile. Galetovic: Facultad de Ciencias Económicas y Empresariales, Universidad de Los Andes, Av. San Carlos de Apoquindo 2200, Santiago, Chile. E-mails: eduardo.engel@yale.edu, rfischer@dii.uchile.cl, alexander@galetovic.cl. We thank Guillermo Perry, Eduardo Bitrán, Mario Waissbluth and Ramona Angelescu for many useful comments and suggestions. This paper was prepared for the Project Development Workshop on *Varieties of Governance: Effective Public Service Delivery*, to be held in Kuwait on February 1–2, 2009. A. Galetovic and R. Fischer acknowledge the support of the Instituto Milenio de Sistemas Complejos en Ingeniería.

3.5	Major pitfalls: renegotiations and guarantees	30
3.5.1	PPPs, accounting rules and soft budget constraints	31
3.5.2	Inefficiencies caused by guarantees and renegotiations	32
3.5.3	PPPs vs. conventional provision	32
3.5.4	Evidence on renegotiations and the anticipation of spending	33
4	Governance and contract design of PPPs	34
4.1	Two basic contractual principles	34
4.2	The governance of PPPs	35
4.3	Legal environment	36
4.4	Risk allocation and PPPs	36
4.5	The optimal PPP contract	39
4.5.1	No tolls	39
4.5.2	Tolls and high demand roads	40
4.5.3	Tolls and intermediate/low demand roads	44
4.5.4	Availability contracts	46
4.6	Budgetary accounting	46
5	Empirical strategies	47
5.1	Cross country study of road maintenance efficiency	48
5.2	Country studies	49
A	Appendix: Country studies of concession programs	50
A.1	Argentina	50
A.2	Chile	56
B	On the International Roughness Index (IRI)	63

1 Introduction

Traditionally, roads and highways have been provided and maintained by governments and financed out of general revenues. While tolls are not uncommon, usually they have been viewed as a substitute for taxes, not as a prices that should ration scarce capacity or guide investment decisions.² Thus, road networks result from decisions made by planners and governments, and not by profit-driven firms.

Government provision of roads and highways is necessary because efficient road networks require planning. For their part, the arguments for financing roads out of general revenues are that until recently, toll collection technologies were primitive, but also because many socially desirable roads would be unable to pay their way if efficiently tolled. Nevertheless, the traditional model has shortcomings, specially in developing countries. Chief among them are: excessive congestion in urban highways; cost overruns; pork barrel projects; rigid standards that slow innovation; a bias towards building new roads instead of maintaining existing ones; and defective timing of maintenance, often there is too little and too late.

A recent proposal is that highway privatization would be a significant improvement over the traditional model. This does not invalidate the arguments for public planning, and public provision will continue to be the main driver for road investment. Moreover, the experience with “partial” privatization around the world via so-called public-private partnerships (PPPs), has been mixed and many institutional challenges remain to be addressed before PPPs work as advertised. In addition, most developing countries seem to lack the institutions that make privatization a viable alternative.

Granted that full privatization is neither viable nor desirable, in this paper we explore alternatives to improve road provision policies, both under the traditional model and when using PPPs. The proposals for improving the traditional model are the only option applicable to countries with weak property rights and poorly developed financial markets, since PPPs are infeasible in this case. More developed countries, have the option of improving road provision through both traditional and PPP models. We argue informally, that in some dimensions PPPs may be a preferable.

Section 2 of the paper describes the main shortcomings of the traditional model and proposes some changes to the structure of public works authorities. The main problem in developing countries is the lack of maintenance of roads, which leads to increased transportation costs. Other important problems are the inefficient choice of projects and excessive costs of construction. The origin of these problems is that there is no market for roads and thus improvements must combine public governance with privatization and competition, in those functions and tasks where this is feasible and appropriate.

²In some cases, toll revenues are earmarked to investments in roads or maintenance.

We argue that because objective quality standards of road construction and maintenance can be defined and enforced, it is reasonable to prefer performance contracts over unit price and quantity contracts, since they provide stronger incentives for firms. However, these contracts should be allocated in competitive tenders performed by a tendering division of the public works authority.

Furthermore, there are reasons to treat high traffic roads as standard economic goods. Hence, conceptually at least, users should pay to use them and, as in the case of other utilities, fees should fully finance them. This suggests that users should be charged for the damage and congestion they cause using a mixture of tolls and fuel taxes, or other user fees and that the revenues generated by fee-for-services should go into a road fund. Its disbursements should finance maintenance of existing roads and new investments.

Finally, there is a clear case for the separation between operational divisions on the one hand and supervision, both of project selection and contract enforcement, on the other. To the extent possible, contracts and standards should be supervised by an independent superintendency and planning decisions should be subject to social project evaluation.

Sections 3 and 4 discuss PPPs. In section 3 we argue that, contrary to widespread opinion, PPPs do not relieve the public budget. By contrast, by bundling road construction and maintenance and temporarily transferring ownership to private firms, PPPs can improve performance and, at the same time, allow the government to keep authority to plan road networks.

Among the main shortcomings of road PPPs are excessive minimum revenue guarantees and recurrent contract renegotiations, which usually favor concessionaires at the expense of the government, users and taxpayers. They allow the incumbent government to sidestep normal budgetary controls and to anticipate spending which, combined with the lack of intertemporal accounting, fosters excessive spending in roads, pork barrel projects and white elephants. In addition, pervasive renegotiations are likely to attract inefficient concessionaires, whose comparative advantage lies in gaming the system by contract renegotiation. Thus, unless sound accounting rules are introduced and renegotiations are subjected to independent review, it is not necessarily the case that PPPs will work better than the traditional model.

In section 4 we briefly describe the governance and political economy necessary for a successful policy of developing roads with PPPs. As with the traditional model, in many countries the same agency is in charge of planning the road, designing and awarding the PPP contract, monitoring compliance, and renegotiating it. In turn, an external board should review the cost-benefit evaluations that support the chosen projects and the PPP contracts written to implement them. After contracts are awarded, a PPP superintendency should ensure compliance with the contract, monitor performance standards and service quality, and provide information to users and the public. Ideally, a panel of experts should review contract renegotiations.

We also describe the optimal PPP highway contract. It is characterized by a minimum rev-

enue guarantee and a cap on the firm's revenues. We observe that the income guarantees and revenue sharing arrangements observed in practice are flawed because they are not based on the concepts used to define the optimal contract. The optimal contract can be implemented via a competitive auction with reasonable informational requirements. The risk allocation under the optimal contract suggests that PPPs are closer to public provision than to privatization. Contracts along these lines have recently begun to be used routinely in Portugal and Chile.

Section 5 contains suggestions that may be helpful in the design of study proposals for the issue of roads. The first subsection includes ideas that may help design a cross-country study proposal. The second subsection includes ideas that are appropriate to the design of a single country proposal.

2 The traditional model: shortcomings and proposals

2.1 Overview

Governments face three challenges in providing infrastructure services. First, the government must choose which projects should be built, i.e., it must have a plan and a procedure for selecting projects. Second, it must ensure that the projects that are built fulfil their service obligations. Third, it must ensure that the government, or the public in a fee for service model, is not overcharged for the construction, operation and maintenance of infrastructure.

In the case of transportation infrastructure, and in particular, in the case of interurban roads and highways, which are the main focus of the paper, we can be more specific.³ The main problem of interurban roads in developing countries is the lack of maintenance of the roads, which means that transportation costs are much larger than necessary. Other important problems are the inefficient choice of projects and excessive costs of construction. Larcher (1998) describes that during the 1960s and 1970s, the low and middle income countries mobilized substantial resources from international agencies to improve their road networks, but a few years later, the infrastructure had deteriorated through lack of maintenance.⁴ In fact, Rioja (2003) estimates that in Latin America the effect of reassigning 0.5% of GDP from new infrastructure investment to maintenance increases long run infrastructure stock by more than 7%, and that the optimal reassignment is 1% of GDP from new investment to maintenance. While these numbers refer to infrastructure as a whole, and not only to roads, some specifics in Rioja (2003) show the extent of the problem. First, a well maintained road needs to be resurfaced every 10-15 years, but without maintenance, it requires resurfacing after only 5 years (see Section 2.2 for a detailed

³While congestion is a serious road infrastructure problem in LDC urban areas and their environs, these roads are not the main focus of this paper, which concentrates on interurban roads, and, although less, on rural roads.

⁴Larcher quotes Riverson et al (1991), who claim that by 1991, 50% of the roads in sub-Saharan Africa were in poor condition.

discussion on road maintenance). Second, while 6,000 km of new paved roads were built in Brazil in the period 1979-1984, in the same period 8,000 km went from fair or good quality to bad quality, so the total stock of fair to good quality roads decreased.

At the level of rural roads, the main issues are the lack of density of the rural road networks, which means that many peasants have no ready access to markets and other benefits from urban areas. Moreover, these problems are usually combined with lack of maintenance of existing roads.⁵

An important question is what is the source for the misallocation and mismanagement of resources: we posit that it is a combination of the wrong choice of projects, the excessive costs of projects chosen and finally, the insufficient and untimely use of resources for maintenance.

There are various ways in which LDC governments fall short of standards of efficiency that are usually (but not always) common in developed countries. First there is the capture by the political system: presidents and congressmen that want to show new projects or major repair works (in contrast to routine maintenance) in order to help their reelection.⁶ Hence they have little interest in allocating resources to routine maintenance. Moreover, they may pressure the planning office to choose the projects which provide local political benefits, rather than those that are socially profitable.

Second, there is sectoral capture, wherein the construction industry influences the Public Work Authority (PWA) and its choices. In particular, firms try to limit competition (including excluding foreign firms if at all possible), renegotiate their contracts in order to improve their conditions at the expense of the government and the public, and this effect interacts with political capture, exacerbating their individual effects. For instance, firms may suggest to members of congress the need for additional projects, regardless of other needs, or they may threaten to stop new projects (useful for reelection purposes) if congress tries to introduce more oversight into the procurement process.

Third, there may be outright corruption, in which members of congress, and decision makers in public works favor certain projects, firms, or changes on conditions of contracts, in response to direct or indirect payments.

Fourth, political capture reduces the quality of human capital in the public sector, because advancement can be due to political allegiance rather than technical ability, and because talented professionals may prefer not to work in a tainted environment.⁷ In turn, the low quality of human resources leads to inferior technical choices in the projects, and to imperfect super-

⁵Jacoby (2000) estimates that extending the road network to cover all households would increase average incomes by 10% and the median income by 6%.

⁶Cadot, Roller and Stephan (2006) show that that pork barrel projects are a main determinant of transport infrastructure choices in France.

⁷In response to strong government workers trade unions, the public sector in many developing countries has a tendency to pay lower hierarchy workers relatively well, considering job stability, and to underpay skilled personnel, which also tends to reduce the quality of human capital in the public sector.

vision.

Fifth, there is a problem with the institutional design of the PWA. In general there is no independent supervisory authority that enforces contracts and oversees the quality of construction, maintenance and services. Usually, these functions are performed by a division of the PWA and sometimes within the procurement division. The problem is that these are contradictory objectives, as stringent supervision may delay the project and may create conflicts with the private sector, thus threatening future projects.

We argue in Section 2.3 that many of these problems are compounded by the inappropriate institutional design of the PWA. For example, strategic planning in infrastructure is weak or absent in developing countries, or it can be subject to constant change in response to short term political objectives. The main tool to ensure that projects are socially profitable, namely social project evaluation, is not utilized, or is trumped by executive prerogative to satisfy political objectives, leading to white elephants and over-engineering. Even when procedures to filter poor projects are in place, it is usual for costs to be underestimated while demand is overestimated (see Tables 4.1 and 4.2 in Flyvbjerg et al. (2002) for dramatic illustrations).

Most developing countries have little institutional separation between the agencies in charge of strategic planning and policy design, and those involved in execution of projects and of enforcement of contracts. This inadequate institutional design results in an array of problems. First, there are obvious conflicts of interest between these tasks, leading to the emphasis of some responsibilities at the expense of others. For example, new infrastructure projects are politically more attractive than enforcing the complete fulfillment of contracts. Since strict contract enforcement makes it harder to find firms willing to participate in new projects, enforcement is not attractive, except in those respects that are useful to politicians: completion before elections, for instance.⁸ It is therefore not surprising that public works in developing countries suffer delays and cost overruns, and that the bonds posted to ensure deadlines and quality standards are seldom collected, even when deadlines and standards are not satisfied.

Another problem caused by poor institutional design is the lack of maintenance of existing roads. Since building new projects is more attractive politically, governments typically spend too little on maintenance, until the project deteriorates sufficiently that the public complains and the government reacts. The cost of stop-and-go approach to maintenance is much higher than the cost of continuous maintenance.⁹ In addition, there is a higher transport cost due to lower service quality. An experiment in Zambia (Roth, 1996), compared the direct cost of truck

⁸The claim by firms that strict enforcement dissuades participants may be self-serving, but the threat may be effective against politicians who have doubts about their reelection possibilities. Also, stricter enforcement may foster entry of new, more efficient firms, yet this transition may take more time than a politician running for reelection may have.

⁹The 1994 WDR claimed that if US\$ 12 billion had been spent on maintenance in Africa, US\$ 45 billion in reconstruction expenses could have been avoided.

repairs from using poor versus good roads, implying an excess cost of repairs amounting to US 14,000 annually. Moreover, usually there is a lack of relations between the division tasked with planning and overseeing new construction and the division in charge of maintenance.¹⁰ This means that there is no direct link between design and maintenance and operations. This is another contributing factor to the underinvestment in maintenance, which in turn implies that a substantial fraction of the life of a road, it provides poor quality.

Finally, poor institutional design weakens the PWA against pressures from the construction industry and politicians, and makes it difficult to hire high level professionals. Moreover, there is high risk of corruption in public work agencies with poor check-and-balances, since poorly paid government employees must oversee projects involving large investments, in the absence of institutional back up.

Summing up, the poor institutional design of the PWA in most developing countries exacerbates a host of agency problems, resulting in the wrong projects being built, high prices paid for infrastructure services and, most prominently, poor maintenance of existing infrastructure.

In the remainder of this section we describe in more depth the main issues discussed in this overview. In Section 2.2 we provide a more detailed discussion of the road maintenance: the engineering underlying maintenance and its economic implications. This is followed by Section 2.3 where we discuss in more detail the principles that should underly the institutions in charge of the road sector, and analyze the extent to which institutions that exist in different countries come close to this ideal.

2.2 Road maintenance

The Consulta de San José met in late 2007 to analyze the papers it had commissioned to deal with the main challenges facing Latin America and the Caribbean: Democracy, Education, Employment and Social Security, Environment, Fiscal Problems, Health, Infrastructure, Poverty and Inequality, Public Administration and Institutions, and Violence and Crime. For each topic, an author wrote a paper proposing concrete solutions, hopefully supported by cost-benefit analysis of the options, while another provided a paper with an ‘alternative view’. An expert panel considered the proposals that emerged from this process—more than 40—and ranked them in descending order of desirability.¹¹ The proposal of “increasing investment in infras-

¹⁰In more advanced LDCs, there is usually some interaction between these divisions when manuals of construction and standards are developed, but this is a very inflexible interaction and occurs only when new manuals or standards are developed, which occurs rather infrequently.

¹¹The panel members were Orazio Attanasio, Professor of University College, London; Jere Behrman, Professor of the University of Pennsylvania; Nancy Birdsall, President of the Center for Global Development; John H. Coatsworth, Professor of Columbia University; Ricardo Hausmann, Professor of Harvard University; Finn E. Kydland, Nobel Laureate and Professor of the University of California; Nora Lustig, Visiting Professor of George Washington University and Former Director of the UNDP Poverty Group; José Antonio Ocampo, Professor of Columbia University and Former United Nations Under Secretary General; and Andrés Velasco, Professor of Harvard Univer-

structure, including maintenance” was third in the ranking. The panel declared that “boosting infrastructure and improving maintenance [would] yield a very high return on investment, while also providing and increasing access to markets and thus generating more prosperity.” Highways were paramount among the infrastructure the panel had in mind.

The investments in the road structure of a country can be wasted if the country does not have a program of timely conservation, preservation and maintenance of the road system. The failures in this area have been sufficiently important for the multilateral institutions to issue a stream of documents and studies providing recommendations and guidance. In what follows we discuss some of these issues.¹²

2.2.1 Road maintenance

The state of a road can be classified into three somewhat arbitrary categories based on their state, as good, fair and poor. Similarly, road works can be classified into categories reflecting increasing degrees of complexity as routine maintenance, resurfacing, rehabilitation and reconstruction. Box 2.1 provides detailed definitions for both classifications.

BOX 2.1 (Road and Road Works Classification) *According to World Bank (1988) and subsequent studies, roads can be classified, based on their state, into the following categories:*

Good: *Paved roads substantially free of defects and requiring only routine maintenance or unpaved roads requiring routine grading and spot repairs,*

Fair: *Paved roads having significant defects and requiring resurfacing or strengthening. Unpaved roads needing reshaping or resurfacing (regraveling) and spot repair of drainage,*

Poor: *Paved roads with extensive defects and requiring immediate rehabilitation or reconstruction. Unpaved roads needing reconstruction and major drainage works.*

Similarly, there is a classification of road works as follows:

Routine maintenance: *Local repair of roadway and pavement; grading of unpaved surfaces and shoulders; regular maintenance of road drainage, side slopes, verges and traffic control devices.*

Resurfacing: *Regraveling an unpaved road or resurfacing a paved road (with a thin asphalt overlay, a surface treatment, or a seal coat) to preserve its structural integrity and ride quality. A paved road normally needs resurfacing at the transition from good to fair condition.*

sity and Minister of Finance for Chile.

¹²The following analysis is based upon World Bank (1988), Heggie and Vicker (2002), Asian Development Bank (2003), Schliessler and Bull (2004), and Donnages, Geoff and Johannessen (2007).

Rehabilitation: *Selective repair, strengthening, and shape correction of pavement or roadway (including minor drainage improvements) to restore structural strength and ride quality.*

Reconstruction: *Renewing the road structure, generally using existing earthworks and road alignments, to remedy the consequences of prolonged neglect or where rehabilitation is no longer possible. ■*

There is a consensus among the authors about the physical and engineering aspects of road maintenance. First, lack of maintenance leads to slow deterioration initially, which reaches a critical stage at around two thirds of the life of the road without maintenance, at which time the decline in the quality of service of the road is extremely quick. It is at this stage, just prior to the beginning of the period of fast deterioration, that an overcoat of a few centimeters of asphalt can recover the road to its initial quality, at a cost estimated to be approximately 5% of the cost of the road. If this is not done in a timely fashion, the road must be reconstructed, initially in parts and finally *in toto*, at a cost that is a significant part of the initial cost of the road, because the foundation of the road must be rebuilt, and the surface materials must be removed.

The use of a road by a vehicle not only damages the road and increases the cost of maintenance. The damage caused by a vehicle also increases the operating costs of subsequent vehicles. This leads to the second consensus point on road maintenance. While continuous routine maintenance, resurfacing of the roads every 5 years and rehabilitation every 15 years may be more expensive in discounted value terms than neglect and reconstruction after twenty years, once the increase in transport costs due to the state of the roads is considered, the first option is by far the better choice. It is important to realize that the efficient frontier for maintenance is fairly flat close to the optimal point, as shown in World Bank (1988), so choosing a slightly less than optimal maintenance program may be appropriate for a maintenance bureau facing budgetary constraints. First, because small increases in road roughness have a limited effect on vehicle operating costs (VOC), increasing these costs by 6–14%, depending on the type of vehicle. Hence, a 40 millimeter overlay on a paved road, when the roughness index known as IRI (defined in the Appendix) reaches 4.2, may be a good choice when the the government faces budgetary constraints, compared to the same overlay when the IRI reaches 3.5.¹³

Third, another important issue is that the relation between road deterioration and the axle weight of vehicles is highly nonlinear. This insight goes back to a series of Road Tests conducted by the American Association of State Highway and Transportation Official (AASHO) in the late 1950s, measuring road deterioration for a wide range of surfaces and variously laden vehicle types, concluding that the damage caused by a vehicle on paved roads is approximately proportionate to the fourth power of its axle load. Thus weight control is essential to reduce

¹³Once IRI reaches the range of 6 or more, VOC increase by 26–44% of the costs of transport in a good road. An overlay is a layer of material (usually asphalt) on top of the previous surface, without additional treatment.

maintenance costs and frequency. However, this is difficult to achieve, and many countries have chosen to invest in more expensive thick concrete pavement roads, in order to reduce the damage caused by uncontrolled heavy axle loading (and lack of maintenance).

While there is a consensus regarding the types of procedures that reduce maintenance costs and preserve the investments in road infrastructure, there is less agreement on the reasons for the neglect of maintenance in the developing world. Nevertheless, the following issues appear to be the most important explanations:

1. Lack of resources. This is the case in some very poor countries, where the road infrastructure was built with foreign aid. In other countries, it is a case of misdirected resources, as new capital investment in roads receives funding at the expense of maintenance. The case of Brazil, in the example mentioned in Section 2.1, where 6.000 km of new roads were built but the network in good state shrank as a result of lack of maintenance, is a case in point, related to the fourth issue below.
2. Misdirected resources, either because they are spread too thinly to have an effect, or because they concentrate on one part of the network, for example, the national highways, at the expense of tertiary roads.
3. Administrative failures at the Ministry of Public Works. In some countries, the Ministry of Public Works has yet to delegate activities to private contractors, and the Ministry does not have the administrative or managerial capabilities required for an efficient maintenance program, specially in rural areas. In some cases, there are failures in the ability to subcontract and supervise independent operators which could perform maintenance more efficiently.
4. Political economy issues. As mentioned in Section 2.1 and discussed in more detail shortly, routine maintenance and resurfacing is less attractive for politicians bent on reelection than restoration (reconstruction and rehabilitation).¹⁴

The problems due to lack of resources can be solved either by redirection of resources from other sectors, or away from new capital investment in roads or in the case of very poor countries, by multilateral aid. The Asian Development Bank (2003) has a complementary explanation for the failure of maintenance programs. According to the ADB, the use of a common threshold rate of return for public investment programs usually indicates enormous expansions (up to ten times) in the maintenance budgets, to levels far above those used in developed countries. The ADB recommends using a much higher cutoff rate, perhaps in the range of 25-30%, for maintenance programs. This would select the projects with the highest cost-benefit ratios,

¹⁴In some countries with a centralized Ministry of Public Works, engineers also find this less professionally interesting.

but would make more difficult to reject them: “Using a high discount rate such as 25% makes it difficult to argue against doing all the maintenance that meets this test.” The problem is that this approach to road maintenance would need a large change in the process of public investment in many developing countries, that have, at a large political cost, achieved the discipline of using economic internal rates of return to decide on how to direct public investment not only within a given sector but also across sectors. We consider the remaining issues in the following sections.

2.2.2 Road maintenance in poor countries

Developing countries have different road infrastructure problems, depending on their level of income and their degree of urbanization (rurality). This means that the focus of proposals has to be modified to adapt to the different circumstances of the countries.

The main problem of poor countries is the lack of resources for building and maintaining their road networks, and of access to remote rural areas. Multilateral aid compensates for the deficiency to some extent, but there remains the problem of project selection (though the multilateral agencies can provide help here too). This may be due to lack of trained cadres, political pressures on the PWA, or inefficiency in the agency.¹⁵ In particular, the choice between investing on new development and on maintenance at the national and regional networks, as compared to investing on the rural access network can have a strong impact on the poverty level, the education attainment and health at the village level (ILO, 2007) in those countries. It is important to realize that in Asia, for instance, rural roads represent between 70 and 80% of the total length of public road networks, while accounting for only 15-20% of the traffic volumes (ILO, 2007). An example of some of the problems we have mentioned and of the solutions proposed by multinationals appear on the box below.

BOX 2.2 (Solomon Islands)¹⁶

The Solomon Islands are an archipelago in Melanesia with a population of slightly more than 550 thousand. It has a 1,391 km road network, and annual rainfalls in the range of 5,000-7,000 millimeters imply that continuous maintenance is a requirement. However, ethnic conflict in the period 1999-2003 led to the neglect of the road maintenance, with the result that by 2003, 90% of the network was in poor condition. At that time, there were no resources, either financial or technical, to reclaim the network. Moreover, there were only two or three road construction contractors in the islands, with no usable equipment. The ILO proposed a plan to train personnel, develop small scale contractors and strengthen the PWA using resources from the ADB and the EU. The plan is based on labor intensive routine maintenance and on the purchase of a small stock

¹⁵The last two problems are not restricted to the poorest countries.

¹⁶Source: Gupta, Mukesh: “Road Rehabilitation & Maintenance Strategy in Solomon Islands, ILO, no date.

of road construction equipment to be rented by contractors for rehabilitation and reconstruction of roads. ■

Routine maintenance in this context consists of drainage clearing, carriageway repair, clearing of silted ditches, bridges and culverts maintenance, grass cutting and potholes repair (see Jones and Petts, 1991, and Ipingbemi, 2008).

2.2.3 Decentralization and local roads

Decentralization is a goal of many governments and multilateral agencies. How far should it go in road construction and maintenance?

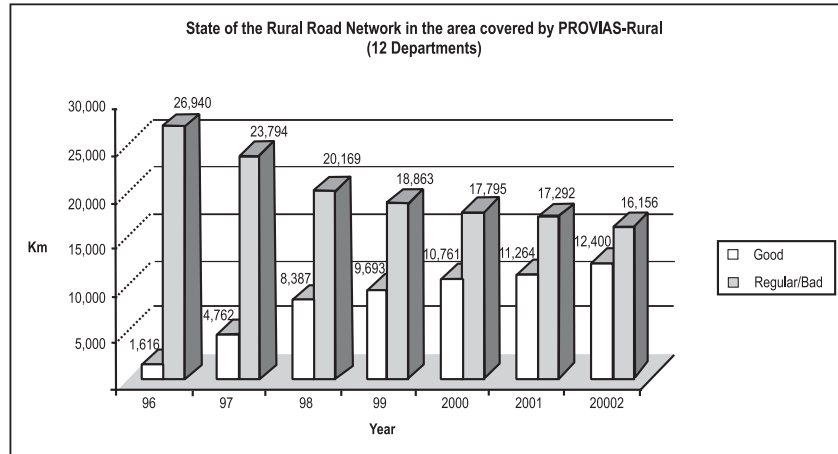
During the 90's excessive centralization was countered by a move towards decentralization and it became common to propose that rural and community roads should be managed by local authorities who are better informed about local needs. The problem is, of course, that municipalities and rural districts usually lack the human capital and the resources necessary for the task. Nevertheless, there is usually sufficient local capacity to supervise a lengthman system of routine maintenance. Periodic maintenance of rural roads, including regravelling and repairs to structures, should be carried out by special units or contracting companies every few years, and requires regional or central finance and supervision. The following example shows a successful use of a combination of appropriate technology and attempts at decentralization.

BOX 2.3 (Labor based road maintenance in Perú) *In 1996, of the 28,556 km in the rural road network assigned to the newly created Rural Road Programme (PROVIAS-Rural) in Peru, less than 6% was in good condition.¹⁷ The aim of the program was to switch from the construction-no maintenance-reconstruction cycle of the past, to a new approach with continuous maintenance. The programme chose labor-based techniques, in the form of micro-enterprises in charge of 25 km (on average) stretches of road, with the requirement that the road be transitable year round. The work consists of filling potholes, clearing drains and culverts and cutting vegetation using hand tools and wheelbarrows. The micro-enterprises receive a fixed payment per km/year.¹⁸ The micro-enterprises were initially set up by PROVIAS-Rural, with the hope that eventually these enterprises will be self-forming. The results of the programme appear in the figure below, which shows the large increase in the fraction of the road network that can be classified as in good state.*

In 2002 PROVIAS-Rural established a program to decentralize in order to increase sustainability of the programme by including local funding and eventually provincial-level management.

¹⁷Based on Quispe, Edgar and Cartier, Serge (2003): "Microenterprise-based road maintenance in Peru", ILO ASIST Bulletin No 15, pp 15-16, March 2003.

¹⁸Later changed to a system of differentiated payments according to service level and difficulty (slopes, existing drainage works, rainfall, etc).



Source: Microenterprise-based road maintenance in Peru, *op.cit.*

The municipalities are required to co-finance 40% of the costs of the program. This is done by deducting the resources from the amounts in the Common Municipal Fund, funded by the central government. Given the centralized nature of the municipal fund, it is not clear that the incentives are appropriate. ■

Another example is provided by some countries in francophone Africa. They have set up project implementation agencies (usually known as AGETIP¹⁹), essentially independent, centralized and private non profit with their own staff. This agency carries out the preliminary engineering, invites bids, and manages projects on behalf of the local governments, who keep the right to select projects and pay for them. The agency is governed by an independent board, its staff is competitively hired and is paid market wages.

AGETIPs seem to be an attractive alternative, combining scale economies with decentralization. It has the additional advantage that it has worked in poor countries, in particular in Senegal. As Heggie and Vickers (1998, p. 43) report, they routinely obtain unit prices that are between 5 to 40% lower than those obtained by governments. The following section describes a theoretical framework of proposals that can be used to address the public policy problems in road production and road maintenance.

2.3 Institutional design: principles and suggested solutions

Many studies point out that the observed misallocation and mismanagement of resources in the roads sector results from the wrong choice of projects, the excessive costs of these projects, and insufficient and untimely maintenance. Behind these shortcomings lie fundamental causes, as summarized by Heggie and Vickers (1998, p. 19):

¹⁹Agence d'execution des travaux d'interet public contre le sous-emploi.

“ [Roads] are not managed as part of the market economy with its formidable pricing dynamic. There is no clear price for roads, road expenditures are most often financed from general tax revenues, and the road agency is not subjected to any rigorous market discipline. These bias managerial incentives. Roads are managed like a social service with multiple goals. Road users pay taxes and user charges, but the proceeds are almost always treated as general tax revenues. Instead of being financed through user charges, roads are thus financed through budget allocations determined as part of the annual budgetary process. These allocations bear little relationship to underlying needs [...] or to users’ willingness to pay. There is [...] no direct link between revenues and expenditures [...], no price to ration demand [...], and expenditures are not subjected to the rigorous tests of the marketplace [...].”

That is, the common root for the problems with the traditional model is that there is no market for road provision. Improvements must therefore mix public governance with privatization and competition, in those functions and tasks where this is feasible and appropriate. As we argue in Section 3, PPPs have the potential to strike the right balance between public governance and privatization. Nevertheless, PPPs require sophisticated governance and, in any case, so far not even developed countries have done them particularly well. It seems, therefore, that improving the traditional model piecemeal is the way to go for most developing countries for the time being.

In what follows we will suggest how to improve the traditional model piecemeal. Many of these improvements have been proposed before one way or another, there is no pretense of originality. Furthermore, in each case one must distinguish between, on the one hand, the economic principle and the ideal institution that would implement it, and on the other hand, how far one can go in each particular country at a particular time. For obvious reasons, while the principles can be explained in a fairly straightforward way, we will have less to say about implementation, which by its very nature must adapt to the circumstances of place and time. Some of our proposals will be inapplicable in particular countries, perhaps because they lack the necessary human capital or because the internal politics makes it infeasible.

Be that as it may, it is important to note three things. First, little can be done without better governance. As Heggie and Vickers (1998, p. 15) point out, “ [until] the institutional framework is strengthened, it will be almost impossible to overcome the numerous technical, organizational and human resource problems that hamper sound road maintenance policies.” Thus, for example “competitive” procurement of maintenance contracts will attain little if the public works authority is corrupt or unaccountable and rules are twisted to ensure that only a few firms qualify. For this reason, our proposals assume at least some capacity and willingness to provide competent governance. Little improvement can be expected when politicians and bureaucrats who have a vested interest in the status quo are pivotal for the reform’s success.

Second, many times analysts quickly conclude that a particular reform was doomed to fail “for political reasons.” We are well aware that in many cases these may well be the case and that the list of failed reforms is by now rather long. But, at the same time, we would like to point out that on closer examination one can conclude that some reforms fail in large part because ideology substitutes for sound economic analysis and the underlying principles are not well implemented.

Last, sound economic principles have been implemented in unlikely places (see the case of AGETIPs in Africa discussed above). Skillful case studies of outliers may reveal more general and replicable lessons about which implementation strategies work.

2.3.1 Production and human resources

Lack of accountability, poor management and productive inefficiency seem to characterize many public works authorities. A perhaps obvious but important step in the right direction is to substitute private contractors for in-house production of construction and maintenance. It is not only that private firms are subject to market discipline and their goal is to maximize profits. It is also that public construction departments tend to be too large and, most likely, well beyond their efficient scale. One approach to move from in-house production to private construction and maintenance is to subsidize workers involved in the former to set up small companies providing the latter.²⁰ This approach should help reduce the opposition to this move from workers involved in in-house production. El Salvador followed this path in the mid 1990s (a careful evaluation of this experience would be an interesting case study).

If possible, the human resource policy of the remaining employees of the public works authority and public institutions should be changed. Employees should be insulated from political interference by having clear career paths and public, open and merit based hiring processes, and be paid market wages. Given the amount of resources that are managed by the Public Works Authority, this is possibly one of the sectors that would benefit the most from such a reform.

One possibility that needs exploring is the model of the *Consejo de Alta Dirección Pública* that began operating in Chile in 2002 (see Box 2.4). In a nutshell, this board is similar to the independent boards that have been appointed to run Central Banks throughout the industrialized and developing worlds during the last two decades. At the lower echelons of the civil service, the independent civil service selection board described above can be coupled with increased labor flexibility, once political capture is no longer a serious problem. In this case, only the highest position in the public works authority would be for a political appointee, charged with the long term objectives of the government.

²⁰See also Larcher and Miles (2000).

BOX 2.4 (The Consejo de Alta Dirección Pública, Chile) *This is an board of five members similar in the generation of its members and the provisos to ensure its independence to the independent Central Bank board. Board members are proposed by the President and need a broad majority of the Senate for confirmation.²¹ Their job consists in selecting the three best qualified applicants for high ranking civil service positions in the executive branch, the President then appoints one of the candidates for a limited time period. A new posting and competitive process is required at the end of the period, even though a well evaluated public servant is likely to be reappointed to the job. ■*

2.3.2 Contracting and procurement

Objective quality standards of road construction and maintenance can be defined and enforced. For example, equipments such as laser/inertial Profilometers, to measure roughness, unevenness, texture, surface skid resistance and rutting problems of a road. Thus, there are compelling reasons to prefer performance contracts over unit price and quantity contracts, since they provide stronger incentives for firms to be innovative. Of course, objective monitoring is necessary for performance contracts to work. Ideally, perhaps, monitoring and enforcement of contract compliance should be in charge of a superintendency outside the public works authority (see below). If that is not possible, monitoring can be subcontracted.

At the same time, contracts should be allocated in competitive tenders performed by a tendering division of the public works authority and, ideally, under the supervision of an independent authority (more on this agency problem below).

2.3.3 Separation of functions and management

Public work authorities usually are responsible for the whole cycle of production: planning, tendering, construction, maintenance, and contract enforcement and supervision. Moreover, they tend to be organized by product, not function. Thus, there is usually a road department, an airport department, a port department, each in charge of the whole cycle for the respective product. This makes accountability more difficult, because individual product authorities have few incentives to review the work of functional units under their authority and become easy targets for industry capture. Once again, the logic of promoting the authority's specific product is likely to dominate over the need to enforce contracts.

Thus we have bad governance twice over: first, the public works authority is not subject to independent review from the rest of the executive; second, the departments of the authority operate with scant supervision of their superiors. Thus, the traditional organizational form

²¹So far, three board members have been close to the government and two to the opposition. Most importantly, board members are distinguished professionals in their own right, whose political affiliation has been secondary to the selections they have made.

fosters lack of accountability and introduces many conflicts of interest that facilitates industry capture.

To moderate these problems, it is better to organize the operational divisions by task (tendering, construction and maintenance), delegate contract enforcement and supervision to the independent supervisory authority, introduce an overseeing Roads Board and a social project evaluation division, and finally, delegate planning in a separate division.

The planning division should centralize the strategic investment decisions on transport infrastructure (and other types of infrastructure if they are subordinate to the authority). These decisions should consider regional and territorial objectives, and should in general be subject to social project evaluation. Though many planning divisions have formal authority over these issues, their real authority is usually undermined by strong operational divisions (road construction, ports, etc.) with their own planning divisions which behave semi-autonomously. In order to preserve the authority of the central planning division, projects should require its approval before being allowed to proceed beyond the planning stage. The division should also plan the maintenance of roads, and view them as assets with a life cycle. Last, it should perform the studies that are necessary to set user fee-for-service charges that should finance road investment and maintenance (more on this below).

Planning decisions should be reviewed in two separate instances. First, they should be subject to social project evaluation performed by a specialized division that oversees all public investments, the Social Public Evaluation Division (SPED) in what follows. If there is a minimal social return rate (often referred to as 'hurdle rate') on approved projects, and if the evaluation division is sufficiently independent, political interference with projects, in general, could be reduced to acceptable levels. We are aware that often such a division will be subject to strong pressures, with opposition at the highest political levels to its very existence. In such cases, social project evaluation internal to a strong planning division could replace some of these roles, at the risk of political capture of the planning division.

Planning decisions should also be reviewed by the above mentioned Roads Board, in charge of providing check-and-balances on strategic decisions (by contrast with the independent supervisory authority that deals mainly with operational level decisions). The Roads Board should also approve their execution and perform periodic evaluations of the performance of the public works authority and oversee the management of the network. Finally, it would probably be in charge of the road fund and act as counterpart of the studies made to fix fee-for-service charges.

The last institution is the independent supervisory authority (ISA), which is needed to guarantee that investments in public works effectively provide the services that are contracted. The ISA should be responsible for reviewing compliance of both the operational divisions of the public works authority and private contractors. Hence, this division would supervise tendering, construction, and maintenance, and verify that operations and service standards of pub-

licly financed infrastructure are met. The ISA (and perhaps the Roads board) should also review contract renegotiations.

2.3.4 Governance

The public works authority should have only technical responsibilities: planning, tendering, construction and maintenance. By contrast, the Roads board, the social project evaluation division and the ISA should not form part of the public works authority.

The Roads board should include the minister in charge of the public works authority, but the majority of its members should be independent, hired for their skills and professional standing. The board's charter would grant it financial and formal independence.

The ISA should be independent from the public works authority. This is essential for it to fulfill its obligations. If it depends on the public works authority, the objectives of promoting new investment and supervising existing projects are at odds, and since the political power usually supports the former, the supervisory activities become secondary to the main objective. An independent supervisory authority, specially if supported by the above mentioned Roads board, has an undivided mandate and thus it will be less likely to deviate from its explicit objective. The actions of the supervisory authority should be public, which disciplines the agency and commits it to its role, apart from informing the public.

Last, in order to have competition among the projects belonging to different ministries, the division that performs the social evaluations should be a high level division of government, independent of the pressures of the individual ministries and, to the extent possible, from the executive branch.

It should be noted that, political economy considerations aside, reorganization by task instead of product should be feasible in most countries. After all, these tasks are already being performed within the existing public works authorities, though separately in each product division. On the other hand, creating an independent road board, and taking supervision and evaluation out of the public works authority is likely to be difficult, because countries may have little experience with independent institutions and face substantial human capital shortages. Having said this, the importance of establishing a competent project evaluation division which can influence investment allocations cannot be understated, and should probably be the first priority.

2.3.5 Financing

Going beyond historical precedent and the practical difficulties involved in collecting tolls and setting the right prices, there are compelling reasons to treat most roads as standard economic goods—they are excludable and, indivisibilities aside, rival. Hence, conceptually at least, users

should pay to use them and, like in the case of other utilities, fees should fully finance them.²²

Because not all roads can be privatized, however, one cannot set up private regulated road utilities. But the principle that they should be financed on a fee-for-services basis instead of general tax revenues that are not linked to the services that users receive can still be applied. Financing roads through fee-for-services ensures that users receive adequate price signals, encourages the public works authority to build and maintain roads that users need, and generates revenues that are sufficient to expand and maintain the road network.

Users should be charged for the damage and congestion they cause. Of course, different users cause different damages, and tariffs should reflect this fact. And, because many roads exhibit economies of scale, an element of average cost pricing is perhaps unavoidable. Tariff structures should be simple, and charging for some roads may be technically unfeasible (though this is changing with advances in technology). For this reason, fee-for-services will comprise a mixture of tolls and fuel taxes. Moreover, because trucks cause far more damage than cars, weight-distance fees should be charged whenever possible.

The revenues generated by fee-for-services should probably go directly into a road fund (see Heggie and Vickers, 1998). This fund should be managed by the above mentioned Roads board and its disbursements should finance maintenance of existing roads and new investments. Loans to finance roads should go directly into the fund.

Note that in this case even fuel taxes are tied to a specific service or cost caused by users. Hence, the source of financing is not earmarking—general taxes that are tied to a specific expenditure but have little relation with goods or services received by the taxpayer. As Heggie and Vickers (1998) argue, funds financed with earmarked taxes have never worked. By contrast, the main advantage of the governance structure outlined above is that it ties services and expenditures on roads.

We are aware that charging for road use is a political hot potato almost everywhere, and it seems unlikely that governments will be willing to introduce tolls for existing roads. At the same time, most countries charge fuel taxes and, conceivably, there is room for improving their level and structure. Moreover, it seems that users are more willing to pay tolls for new roads or when existing roads are substantially upgraded and improved. Careful examination of successful experiences where tolls have been introduced would perhaps reveal that there is room for the gradual introduction of tolls in most countries. In practice, the relevant question is not if implementing the optimal fee-for-service is feasible but whether one can make changes that move countries in the right direction.

²²Of course, some roads may be socially desirable and subsidies for them may be justified—identifying these projects is one of the tasks of the planning department.

2.3.6 Decentralization

Interurban and rural roads can be divided in three classes: major highways; regional roads; and rural and community roads. Major highways and regional road networks are large, and there is agreement that they should be managed at the national level. By contrast, it is often argued that rural and community roads should be managed by local authorities who are better informed about local needs.

The problem is that municipalities and rural districts usually lack the human capital and the resources to do a good job. Furthermore, the problem seems fundamental, as local administrations lack the size to justify recruiting the skilled personnel needed to plan and manage a road network. To some extent, the scope of decentralization seems to be limited by the minimum efficient scale of a road authority.

As Heggie and Vickers (1998, p. 42–44) argue, countries have dealt with the problem of insufficient scale in four forms. First, some have put rural and community roads in charge of the central government. While this solves the problems of scale, central agencies tend to be unresponsive to local needs. Moreover, it is by no means clear that the efficient scale of operation is one central agency in charge of all of the country's roads.

The second alternative is for several local governments to pool resources setting up a so-called 'joint service committee', to whom procurement is delegated. This keeps authority in the hands of local authorities, but because such arrangements tend to be informal and political, they are subject to substantial transaction and coordination costs.

Some local governments contract out planning and management to private consultants. The shortcoming of this approach is that private consultants must be monitored, which brings back the problem that local governments seldom have the staff necessary to monitor competently.

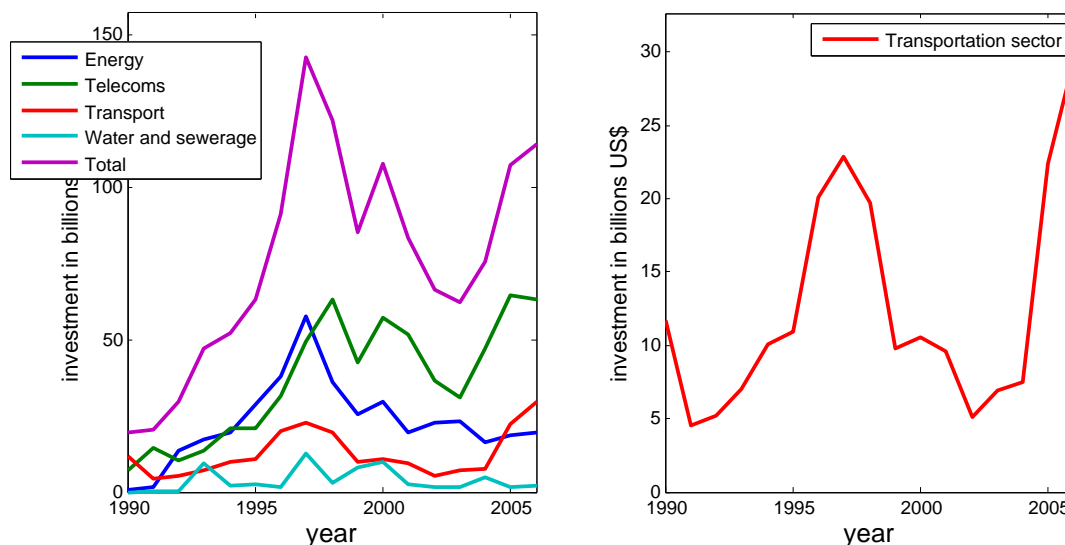
Finally, AGETIP seem to be a promising model to foster decentralization. More generally, it suggests that independent governance has the potential to improve performance.

3 The potential of public-private partnerships

The use of Public-Private Partnerships (PPPs) in the provision of transportation infrastructure services, has increased substantially since the early 1990s. This is illustrated by the right panel in Figure 1, that shows the evolution of investment commitments in transportation infrastructure projects (which correspond to mainly roads) with private participation in developing coun-

tries during the 1990-2006 period.^{23,24} Particularly noteworthy are the cyclical behavior along a growing trend, and the increase since 2004. As shown in the left panel of Figure 1, the latter is either less dramatic (telecoms) or entirely absent (water and sewerage, energy) in other sectors.

Figure 1: Investment in projects with significant private participation: all sectors



Harris (2003) discusses various factors that may explain the downturn in private participation in infrastructure following the East Asian crisis, some of them are supply driven (firms became less interested in bearing the risks associated with PPP investments), others are demand driven (governments became disappointed with the outcome of PPPs). Yet no leading explanation emerges from this analysis, in part because there is significant heterogeneity across geographical areas and sectors. For example, Sub-Saharan Africa and South Asia showed much less of a decline and, more generally, investment flows to low-income (IDA) countries showed no significant decline at all.²⁵ Box 3.1 presents some preliminary evidence on the effect of the ongoing financial crisis on private infrastructure projects in developing countries.

BOX 3.1 (The financial crisis and private infrastructure projects) *A slowdown in private infrastructure projects was already apparent during late 2008: PPIAF reported a 40% decrease in in-*

²³Source: World Bank and PPIAF, PPI Project Database. This does not correspond to the exact concept of public-private partnerships but constitutes a reasonable (and the best available) proxy.

²⁴There exists a rich set of acronyms to describe specific PPP arrangements, including BLT, BLTM, BOT, DBOT, DBFO, DBFO/M, JV and ROT. The B usually stands for build, the L for lease, the R for rehabilitate, the T for transfer, the O for operate, the D for design, the F for finance, and the M for manage. JV stands for “joint venture”.

²⁵It would be interesting to compare the procyclical behavior of private participation in infrastructure depicted in Figure 1 with the well established procyclical behavior of public investment and determine the extent to which they interact with one another.

vestments in projects that reached financial closure during the period August-November 2008, as compared with the same period a year earlier.

Underlying this decrease are higher financing costs and private banks' reluctance to lend at all, which have led to the delay and cancelation of a number of projects. Many of the projects that reached financial closure during this period relied more than planned on local credit banks, as well as bilateral and multilateral agencies.

With the increased perception and awareness of risk in current financial markets, and the resulting flight to quality, private participation in infrastructure is likely to decrease significantly in coming years. This will lead to a higher cost of financing and will make particularly attractive contracts that limit the risk borne by private financiers. Lower debt/equity ratios and more conservative financing structures are also likely. ■

In this section we argue that for medium and high income countries PPPs can help solve the problems with road provision discussed in Section 2. Furthermore, the institutional challenges that must be addressed to have a well functioning PPP system are likely to be less daunting than those needed to improve the traditional model (as discussed in Section 2.3.6). Thus, in a sense, we argue that PPPs offer a second best solution for improving road services. Yet before presenting our argument, we introduce some basic concepts.

3.1 Basics of PPPs

For the duration of a road PPP contract, which can be thirty years or more, the concessionaire will finance, build, manage, maintain and control the road, in exchange for some combination of tolls and government transfers, which are its compensation for the investment and other costs. Government transfers are a combination of subsidies, guarantees, shadow tolls and availability payments.²⁶ Some authors reserve the PPP term for projects that cannot be financed without government transfers, referring to projects that can be financed via tolls as *concessions*. We do not make this distinction and use the terms PPP and concession interchangeably.

There exists no single definition of a PPP, yet most definitions mention participation by the public and private sector coupled to a contract that influences risk sharing among parties.²⁷

²⁶Shadow tolls are paid directly by the government to the firm based on usage of the road; users face no tolls in this case. Availability payments are regular payments made by the government to the firm conditional on the contracted service being available.

²⁷For example, Grimsey and Lewis (2004) define PPPs as "...arrangements whereby private parties participate in, or provide support for, the provision of infrastructure, and [...] a project results in a contract for a private entity to deliver public infrastructure-based services." The U.S. National Council for Public-Private Partnerships defines a PPP as "a contractual agreement between a public agency (federal, state or local) and a private sector entity [whereby] the skills and assets of each [...] are shared in delivering a service or facility for the use of the general public. In addition [...], each party shares in the risks and rewards potential in the delivery of the service and/or facility." According to the Canadian Council for Public-Private Partnerships, a PPP is "a cooperative venture

A defining characteristic of a PPP, compared with the traditional approach to the provision of infrastructure, is that it bundles investment and service provision into a single long term contract.²⁸ By contrast, under the traditional model, the firm that builds the road takes no responsibility for its long term performance after the relatively short term construction warranty has expired.

There exist three broad organizational forms to provide infrastructure in general and roads in particular: traditional provision, PPPs and privatization. Each one of these forms include a number of contractual arrangements. For example, Figure 2.1 in Guasch (2004) considers twelve contractual forms, in increasing order of private participation, and classifies the first four under “public provision”, the next four under “concessions” and the last four under “privatization”. The forms are the following: public supply and operation, outsourcing, performance agreements, management contracts, leasing (also known as *affermage*), franchises, concessions, build-operate-transfer (BOT), build-own-operate (BOO), divestiture by license, divestiture by sale, and private supply and operation. In what follows our definition of PPP includes the four cases grouped by Guasch under concessions — we use the terms PPP and concession interchangeably. We also ignore the option of privatizing roads, since, as discussed in Section 2.1, it involves giving up the government’s role in public planning, and this is unrealistic for most road projects.²⁹

For the two organizational forms we consider —the traditional approach and PPPs— we have that in many countries the firms that build, maintain and operate the infrastructure project are private. The difference between these organizational forms then derives from asset ownership (or control), whether the firm builds and operates the project, and which is the entity in charge of planning.

Under a PPP the same firm builds, operates and maintains the infrastructure, this is referred to as ‘bundling’. By contrast, under the traditional model the firm building the infrastructure has no role in maintenance and operations.³⁰ Also, only a PPP involves asset ownership by the participating private firm. Even though, in principle, the firm is the residual claimant during the contract, while the government is the residual claimant after the contract, these claims are often ambiguous due to contract incompleteness.

between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards.” Finally, according to the BBC, “any collaboration between public bodies, such as local authorities or central government, and private companies tends to be referred to a public-private partnership (PPP).”

²⁸It follows that our definition of PPP involves an upfront investment by the firm either building new infrastructure or rehabilitating existing infrastructure. A maintenance and operations contract does not qualify as a PPP according to this definition.

²⁹Exhibits 14 and 15 in AECOM (2004) suggest that 0.5% of highway projects with private participation around the world, during the 1985-2004 period, correspond to one of the contractual forms described above as “privatization”.

³⁰Under the traditional model building, maintenance and operation are “contracted out” to different firms.

There exist some basic preconditions for PPPs to be a viable option in a given country. Protection of property rights is one such condition, for otherwise firms will be unwilling to finance roads under a PPP contract, since the revenues needed to pay for the upfront investment take a long time to accrue under this contractual form.³¹ Second, financial markets must be sufficiently developed, for otherwise firms will be unable to securitize the road once it is built and will charge a large premium to bear the high risks involved. When the above conditions do not hold, PPPs are not attractive and the best option is to improve the traditional approach for road provision along the lines discussed in Section 2.3.

Many arguments have been given for why PPPs may help governments provide infrastructure in a more efficient manner. Some practitioners and governments claim that PPPs relieve strained budgets and release public funds;³² others argue that PPPs are appealing because finance is delegated to private firms subject to the discipline of financial markets. PPPs have also been heralded for bringing infrastructure provision closer to the advantages of competition, since they are often adjudicated in competitive auctions — competition *for* the field when a road with no close substitute rules out competition *in* the field. Furthermore, PPPs should help filter ‘white elephants’, defined as projects with negative social value, when firms are financed mainly with tolls, since in this case projects that are not profitable will fail to attract a concessionaire.

Despite these seemingly reasonable arguments, the experience with PPPs has been mixed. Whereas in some cases expectations were met, in many other cases contracts were renegotiated in favor of the concessionaire, or conversely, subject to regulatory takings (Guasch, 2004). PPPs were also routinely used to circumvent budgetary oversight and anticipate government spending, while generous government guarantees often canceled the potential of PPPs to filter white elephants. Frequently deadlines were not met, or projects required substantial subsidies to be completed and operated, and these subsidies were added to the original contract in opaque manner and without the benefit of competition.

This does not mean that the traditional approach to infrastructure provision, with the government contracting a private firm to build the project, would have done better.³³ In fact, we argue below that, for many countries, PPPs are likely to do better than the traditional approach for road provision, for various reasons. First, PPPs provide stronger incentives for firms to be

³¹This is evident when the firm is compensated via tolls, but also holds when other forms of compensation, such as shadow tolls and subsidies, are used, since firms have few incentives to maintain the road if these payments are front-loaded.

³²“The boom is good news for governments with overstretched public finances: many local and national authorities have found themselves sitting on toll roads, ports and airports that they can sell for billions of dollars to fund other public services.” *Financial Times*, July 5, 2007.

³³For an early evaluation of infrastructure PPPs, see Economic Planning Advisory Commission (EPAC) (1995), *Final Report of the Private Infrastructure Task Force*, Australian Government Publishing Service, Canberra. For more recent evaluations, see Engel et al. (2003) and Grimsey and Lewis (2007).

efficient because of the bundling of construction and maintenance. Second, PPPs can help filter white elephants, thereby partially substituting for the absence of a well functioning social project evaluation authority. Third, PPPs can help deal with various of the political economy problems encountered by the traditional approach described in Section 2.3.6. For example, under a PPP contract, firms have incentives to better maintain the road and it is less likely that tolls are set at values that are too low.

3.2 PPPs and bundling

The economics literature has identified two main characteristics of PPPs. One is that it bundles financing, building and operation, which are delivered by the same firm. Second, while the PPP contract lasts, the private firm has a degree of control (ownership rights) and autonomy in managing the assets, for instance, in the choice of quantity and quality of the inputs. Thus, as pointed out by Hart (2003) and Bennet and Iossa (2006), the case of PPPs stands and falls on the incentives induced by these characteristics.³⁴

It is obvious that, other things equal, bundling stimulates investments that cut life-cycle costs. Since a firm with a PPP contract enjoys partial ownership rights and keeps most of the gains from cost cutting, these are strong incentives.³⁵ This is important because, to a large extent, operation and maintenance costs for roads depend on investments made during the initial construction stage. Thus PPPs are likely to provide better incentives for the firm to strike the right balance between constructing a stronger, more expensive pavement initially and saving later on maintenance costs, versus saving at the construction stage at the expense of higher maintenance outlays. The well developed area of “life cycle costing” of roads is devoted, precisely, to studying tradeoffs like the one described above.

A potential problem with bundling is that there are investments that reduce life-cycle costs while lowering service quality and consumer welfare, which makes them undesirable. Yet for infrastructures where quality of service is contractible, the government can specify the desired service standards, thereby avoiding investments during the construction phase that skimp on quality standards. For example, as mentioned above, in the case of roads, the quality of the service provided can be ascertained by independent third parties using equipments such as laser/inertial Profilometers, to measure roughness, unevenness, texture, surface skid resistance and rutting problems of a road. Measures of the time needed to remove a broken down car are also useful. We conclude, therefore, that PPPs are the preferred organizational for road provision, at least regarding firm’s incentives and bundling.

³⁴A second strand of the literature studies how PPPs alters incentives and contracting under moral hazard. See Bentz et al. (2001), Martimort and Puyet (2007) and Iossa and Martimort (2008).

³⁵These incentives are even stronger under privatization, because the firm owns the assets completely and indefinitely. Yet, as explained above, this option is not attractive for roads.

3.3 PPPs as a second best

As argued in Section 2, a well functioning social project evaluation authority possibly is the first best solution for selecting public projects in general and roads in particular. Such a program will filter white elephants and contribute to a good allocation of government resources.

Yet few developing countries (and not that many industrialized countries) have good project evaluation programs. In these cases, white elephants can be filtered by selecting an organizational form where the firm that builds and maintains the infrastructure is financed mainly via user fees. Private firms then will participate in the project only if it is privately profitable to do so, a reasonably good proxy for social desirability.³⁶

It follows that PPPs are a second best solution to avoid white elephants for countries with weak social evaluation programs.³⁷ For PPPs to play this role, the main source of firms' income must be derived from tolls, for if shadow tolls or availability payments are used to pay for the project, the contract may be privately profitable without really passing the market test.³⁸ We conclude that roads via PPPs can be a "second best" approach to building socially desirable roads, when the "first best" option—a well functioning social evaluation program—is not feasible.

Another government failure that occurs with public provision of roads is that tolls are set at a low level in response to political considerations (see Box 3.2 for an example).³⁹ Similarly, under traditional provision some powerful users are often charged below the marginal cost they impose on maintenance and operation.⁴⁰ Since PPPs are more insulated from political pressure, the hope is that this contractual form will make possible charging tolls closer to marginal costs, thereby fostering the efficient use of public resources. That is will also have a positive impact on public finances, by allowing the government to finance a larger share of public works with

³⁶This is an old and powerful idea, going back to Adam Smith "The greater part of public works may easily be so managed, as to afford a particular revenue sufficient for defraying their own expense, without bringing any burden upon the general revenue of society [...] When high roads [...] are in this manner made and supported by the commerce that is carried on by means of them, they can be made only where that commerce requires them. Their expence too, their grandeur and magnificence, must be suited to what that commerce can afford to pay. [...] A magnificent road cannot be made [...] merely because it happens to lead to the country villa of the intendant of the province, or to that of some great lord to whom the intendant finds it convenient to make his court.", *The Wealth of Nations*. V.1.III.1.

³⁷A common problem is that projects are over-engineered, and therefore investment is larger than the social optimum. Standard social evaluation does not filter these projects, so long as their social profitability exceeds the hurdle rate. Linking the firm's revenue to demand realization, as is the case under PPPs, won't filter these projects either.

³⁸Government guarantees, a topic we cover in Section 3, are another factor that reduces the ability of PPPs to filter white elephants, since the lowered risk in bad states of the world can raise the private profitability of socially wasteful projects.

³⁹An extreme case of this situation, of course, is when no toll is charged at all to highway users.

⁴⁰For example, road deterioration is proportional to more than the third power (by some accounts, the fourth power) of axle weight. This implies that tolls paid by trucks are much lower than the maintenance cost that they cause.

user fees.

BOX 3.2 (Indiana Toll Road and toll indexation) *Tolls at the Indiana Toll Road in the United States remained unchanged in nominal terms for more than 20 years, falling substantially in real terms, under state ownership and management. When the road was contracted as a PPP in January of 2006, tolls doubled and were indexed to inflation. Other U.S. states have since adopted toll indexation, among them Florida, Pennsylvania and Texas. ■*

Bundling also makes the firm maintaining a road more accountable to users than the traditional approach (see Box 3.3 for an example). When a publicly provided road deteriorates faster than planned, the firm in charge of maintenance can blame the firm that built the road. Under PPPs, by contrast, the firm providing maintenance cannot use this argument since it also built the road. This is likely to lead to more accountability and better service quality.

BOX 3.3 (A PPP to rebuild 800 bridges in Missouri)⁴¹

In the summer of 2007 Missouri's Department of Transportation selected a single consortium to rebuild or replace 800 bridges, chosen from among those in worse state, and manage them for a minimum of 25 years. The rebuilding and maintenance costs are estimated between US\$400 million and US\$600 million, with the Missouri making annual payments starting once the works have been completed.

Interestingly, the contract provides strong incentives for the consortium, via fines that apply if contract specifications are not met. For example, the company must pay \$500 per bridge per day for delays beyond the original construction deadline, US\$2,000 per day of closure and US\$2,000 per day per structure that fails to meet quality levels set out in the contract. ■

In principle, the first best solution to achieve adequate maintenance under public provision follows from the discussion presented in Section 2.3.6. In particular, an independent authority that monitors road quality can play a central role. Yet, once again, PPPs may provide a second best solution when such an authority is unable or unwilling to do its job.

PPP's also can keep the cost of projects at bay more effectively than public provision. An alternative to the regulator setting tolls that may be too low is having tolls determined via a competitive process. Chadwick argued, long ago, that PPPs avoid regulatory shortcomings when the firm is chosen via a competitive auction, since this dissipates *ex-ante* rents (see Chadwick, 1859 and Demsetz, 1968). Competition *for* the field can be a close substitute for competition *in* the field. For example, if the bidding variable is the toll that will be charged during the highway concession term, a competitive auction achieves second best pricing in the absence of congestion effects.

⁴¹Based on Laberge (2007).

The advantages of competition introduced by Demsetz auctions for PPP contracts needs to be compared with the incentives for competition present under public provision. Under the traditional model, usually a private firm is chosen to build the road, while another firm is selected to maintain and operate it. As mentioned above, an important advantage of PPPs stems from the fact that construction, maintenance and operation are done by the same firm, which leads to efficiency gains. Furthermore, to the extent that the PWA has been captured by the construction sector, thereby softening competition when assigning projects, creating a new PPP agency may be a more viable option than reforming the existing PWA to foster competition in this sector. Under these circumstances, the competition intensity achieved via PPPs will be stronger than under public provision.

A prerequisite to reap the potential benefits from Demsetz auctions of PPPs, is that there is real competition for the contract. Barriers to entry and outright collusion often dictate otherwise. For example, in Brazil the PPP Law passed in 2004 *de facto* excludes foreign participants, by demanding documentation that is only available to domestic firms. In other cases (e.g., Colombia and Argentina in recent years), the government's overt or implicit objective is that concession projects be spread evenly among the main domestic construction firms. In all these cases incentives to compete are diluted and as a result, the cost of infrastructure rises and the quality may be lower.⁴² Last, renegotiations and guarantees, which are pervasive in PPP contracts, are a major pitfall of PPPs. We cover this issue next.

3.4 PPPs from a public finance perspective

The most common argument in favor of PPPs among practitioners and politicians is that they relieve strained government budgets. According to this line of thought, this frees up government resources that can be spent on other projects with high social return. Even though *prima facie* this argument seems unobjectionable, in Engel, Fischer and Galetovic (2008b) we show that the resources saved by the government upfront when choosing a PPP over alternatives such as the traditional model, are exactly offset by the loss of future revenues.

A variant of the budget relief argument in favor of PPPs is that PPPs allow governments to invest in socially desirable projects during periods of severe credit constraints. In this case the choice is not between PPP and the traditional model, but between PPP and not providing the service at all. In order to evaluate the validity of this argument, we need additional information on the cause of the credit constraints.

If the government cannot borrow because there is a high probability that it will default on its

⁴²As pointed out by Oliver Williamson (1976, 1985), the problem with Demsetz auctions is that the competitive process at the time of the auction turns into a bilateral monopoly relationship over the life of the contract. Since the investment is sunk, there is ample opportunity for opportunistic behavior by the government, as the firm cannot take its investment elsewhere. We return to this topic below.

debt, it is unlikely that firms will be willing to invest in a project where they need to collect tolls over a long period of time to make a profit, unless the firm can be given credible assurances that it will collect the income stream generated by the road. However, in many cases such a neat division between the revenue stream derived from the project and other potential sources of government revenue does not exist. In such cases, the viability of the PPP approach is affected by the weakness of the government's balance sheet.⁴³

The case in which borrowing constraints can provide a valid argument for PPPs is when there is good reason to believe that liquidity constraints will be short-lived, since in this case a firm with access to financing at a reasonable cost can build the project now and have the expectation of not being expropriated of its contractual rights to tolls (or *future* subsidies, availability payments or shadow tolls). Users then stand to benefit from the earlier implementation of the project at only a minor additional cost due to risk, when compared with the option of waiting until the government's liquidity constraints have disappeared and it can build the project.⁴⁴

An alternative argument in favor of PPPs, which is also related to public finance, is the "cost of public funds argument." According to this doctrine, the government collects distortionary taxes to finance infrastructure projects, while the private sector can finance projects without these distortions. It follows that PPPs are to be preferred to traditional provision. This argument is incorrect, and in Engel, Fischer and Galetovic (2008a) we show this formally. Intuitively, user-fee and subsidy financing are perfect substitutes at the margin since with every dollar of tolls given up to the concessionaire the government forgoes the opportunity of reducing distortionary taxation elsewhere in the economy by exactly one dollar.

Summing up, once we consider the intertemporal nature of the government budget, the case in favor of PPPs based on the relaxation of the government's budget constraint is weak. The initial savings of government under a PPP are equal, in present value, to the amounts it surrenders in tolls it could have collected under the traditional approach. Thus the main arguments in favor of PPPs are those given above—efficiency gains due to bundling, ability to charge higher tolls and filter white elephants—and not that they save government resources.

3.5 Major pitfalls: renegotiations and guarantees

Minimum revenue guarantees and contract renegotiations seem to be a feature of road PPPs. Governments often argue that revenue guarantees are necessary to reduce the risk borne by concessionaires. Renegotiations, in turn, are sometimes justified as normal fare because road

⁴³Consider Argentina's regulatory takings of PPPs after the 2001 crisis.

⁴⁴Liquidity constraints correspond to the case where the government's cost of funds is infinite. A less extreme version is when the government has access to financing, but at a considerably higher cost than private firms. The same caveats discussed above apply in this case: whether this justifies choosing a PPP will depend on the reason why lenders are prepared to finance the same project at a lower cost when it is carried out as a PPP.

concessions are long-term incomplete contracts. In this section we argue that both allow the incumbent government to anticipate spending which, combined with faulty accounting, leads to excessive current spending in infrastructure. We also present systematic evidence from renegotiations of Chilean road concessions which supports this result. We also argue that countries where renegotiations are prevalent are likely to attract less efficient concessionaires.

3.5.1 PPPs, accounting rules and soft budget constraints

Because PPPs are relatively recent, there is confusion about how they should be accounted for in the public budget. To begin, many believe that PPPs liberate public funds, yet as discussed in Section 3.4, PPPs change the timing of government revenues and disbursements and the composition of financing, but not the intertemporal budget constraint. Second, both guarantees and renegotiations generate obligations for future governments, but they are seldom registered in the budget (see Box ?? for some exceptions).

Consider first minimum income guarantees, which are contingent subsidies paid after the completion of the project if demand turns out to be low.⁴⁵ Clearly, they affect the intertemporal budget constraint and impose obligations on future governments. Nevertheless, as Hemmings (2005, p. 40) notes, under current accounting standards future obligations will probably remain hidden. On the one hand, cash accounting makes guarantees apparent only when they are paid, in which case they appear as current expenditure. Accrual accounting, on the other hand, records the guarantee as a liability only if the government considers that the probability of making a payment is higher than 0.5 and can make a reasonable estimate of the payment. But even then, unless the government makes a provision and sets funds aside, guarantees are recorded only when they are called. Worse, as Hemmings (2005, p. 42) points out, most countries poorly record guarantees and, when information exists, it remains in individual agencies and ministries. Hence, guarantees soften the budget constraint of the incumbent government allowing it to sidestep normal budgetary procedures and congressional oversight, thereby increasing current spending.

Some countries (New Zealand, Colombia, Chile) have undertaken efforts to quantify within an accrual framework government liabilities associated with PPP contracts, such as guarantees, by estimating the expected outlays and correcting for the degree of risk involved (e.g., via VAR-type measures).⁴⁶ An alternative reaction, given the incentives governments have to underestimate the risk exposure associated with guarantees, has been to propose stringent conditions for allowing PPP assets to be classified as non-governmental. For example, when deciding whether a PPP-asset should be classified as governmental or not, Eurostat, the Statistical Office of the European Communities, recommends that the asset should be classified as non-government,

⁴⁵Clearly, guarantees are contingent liabilities. See Appendix 5 in Hemmings (2005).

⁴⁶See Irwin et al. (1997) for details.

and therefore recorded off balance sheet for government, only if both of the following conditions are met: (1) the private partner bears the construction risk, and (2) the private partner bears at least one of either availability or demand risk. As we show in Section 4.6, PPP contracts have implications for the intertemporal budget constraint that are similar to those of public provision, and should therefore be accounted for accordingly.

Consider now renegotiations. It has been routine for concessionaires to renegotiate better contract terms after building and sinking investments. Also, many renegotiations include additional works—i.e. works that were not included in the original project. Concessionaires are compensated for better terms either with direct payments, which are often spread over many years, or by relinquishing future government revenues. These transfers are seldom assessed, let alone recorded in a systematic way. Hence, as with guarantees, the incumbent government can increase its current spending sidestepping normal budgetary procedures and congressional oversight.

3.5.2 Inefficiencies caused by guarantees and renegotiations

Both guarantees and renegotiations stimulate the incumbent government to anticipate spending and foster pork barrel projects. Thus, they alter the timing of expenditures, add socially wasteful projects and hence reduce social welfare.

In addition, it is reasonable to believe that renegotiations attract firms that are better renegotiators, skilled at lobbying, corrupting officials and rallying public support for their positions. Less obvious is that these firms will tend to be technically less efficient as a result of competitive selection—firms that are worse in both dimensions will tend to disappear and a renegotiation-efficiency frontier, which trades off renegotiation ability with technical prowess, will emerge (we formalize this insight in Engel, Fischer and Galetovic, 2009). Hence, if a substantial part of profits are made in the renegotiation stage, less efficient firms will self select. This also means that more efficient firms will be at a disadvantage in countries with a higher propensity to renegotiate contracts and will gravitate to other countries.

Note that revenue guarantees do not favor firms that are better at lobbying—both efficient and inefficient firms are benefited by the revenue guarantee on equal terms. Nevertheless, renegotiations are commonly used to compensate firms for cost overruns—in practice, an implicit cost guarantee. Clearly, such a guarantee stimulates moral hazard.

3.5.3 PPPs vs. conventional provision

Conventional provision is less vulnerable to the anticipation of spending *ceteris paribus*. While in principle the incumbent government can issue debt, the expenditure will appear in the current budget and be subject to congressional oversight. Hence, if Congress does not allow it,

the government cannot commit the revenue generated by the additional infrastructure to pay the debt. By contrast, a revenue guarantee or a renegotiated concession contract earmarks the revenues generated by the infrastructure or the payments of future governments and can be enforced in court. Of course, Congress could limit this tendency by overseeing renegotiations. But given current practice, this “debt” escapes the budgetary process in most countries and is generally hard to oversee.

3.5.4 Evidence on renegotiations and the anticipation of spending

We now briefly present the results of a systematic study of highway concessions in Chile. These suggest that renegotiations are used to anticipate spending. Our goals are, on the one hand, to show that spending anticipation is important. On the other hand, this exercise will suggest which left-hand side data on contract renegotiations should be collected systematically so that cross country comparisons can be made (we return to this in Section 5).

Our evidence comes from a systematic study of the 26 highway concessions that were awarded in Chile between 1993 and 2006 (see Engel, Fischer, Galetovic and Hermosilla, 2009). Renegotiations in Chile can be bilateral (i.e. there is a renegotiation if the concessionaire and the government agree to renegotiate) or before an arbitration committee of three experts (in this case only the concessionaire can initiate the process). Bilateral renegotiations, which occur behind closed doors, are not subject to external review. By contrast, renegotiation before an arbitration committee is subject to external review of the three experts.

Until 2007 there had been 111 renegotiations—on average each concession had been renegotiated 4.3 times. According to original (official) budgets, the 26 highways would cost US\$6.8 billion. After renegotiations, total estimated investment rose by US\$2.4 billion, to US\$9.2 billion. In other words, about one of every four dollars invested was added in a renegotiation. 62 renegotiations were bilateral (56% of the total) and 49 before an arbitration committee. Nevertheless, 87% of the US\$2.4 billion were granted in a bilateral renegotiation—the average amount per renegotiation was much higher in these cases.

Because bilateral renegotiations are not subject to external review, they are a natural venue for governments to anticipate spending and build off-budget. To begin, 53 of the 62 bilateral renegotiations were initiated by the government. Next, 60% of the total amount renegotiated bilaterally can be attributed to additional works not present in the original project. Of the rest, 12% can be attributed to additional payments for the original works, and 28% compensates additional costs incurred to build the original project.

When do bilateral renegotiations occur? In our data 45 of the 63 renegotiations occurred before the road entered into service. 78% of the total amount renegotiated was granted in these 45 renegotiations. Hence, most renegotiations occurred during construction, shortly after the concession was awarded.

How were concessionaires compensated for the amounts they were granted in renegotiations? Direct payments sum US\$1.4 billion, or 69% of the total amount which was renegotiated bilaterally, but only about half of this sum will be paid by the administration that renegotiated the concession. The rest comes either from relinquishing future revenues (most of it by lengthening the term of the concessions) or from users who will be forced to pay higher tolls. All in all, the administration that renegotiates pays only 35% of the amounts renegotiated.

4 Governance and contract design of PPPs

In this section we describe summarily the practical considerations on governance and the political economy of PPPs that are required before proceeding with a successful policy of developing roads based on this mechanism. We also consider some issues of institutional design, in particular, the design of the PPP unit within the government and the legal environment necessary for a reasonably successful program of PPPs. Finally, we analyze in some detail efficient PPP contracts under different demand and contractual conditions.

4.1 Two basic contractual principles

Renegotiations of PPP contracts have been pervasive and are often inefficient. There are many motivations, but two contractual premises seem to make them the normal state of affairs. One is the so-called “principle of financial equilibrium”. As Guasch (2004, p. 35) points out, in regulated markets firms expect revenue streams that ensure reasonable profits. If unable to earn these profits, they expect a change in contract terms. Second, the firm is responsible for all investment and has the exclusive right to use the assets and exploit the project. Thus any change in the project must be agreed with the firm. Both premises are reasonable and necessary—investors should earn a normal expected rate of return and ownership rights are a hallmark of PPPs. Nevertheless, they must be complemented and their scope narrowed to ensure proper incentives.

First, service standards should be a central part of the PPP contract and the firm should bear the costs of meeting them. Ex ante financial equilibrium should follow from a prudent bid, not from ex post renegotiation justified by costs which are higher than expected. Guasch (2004, p. 37) refers to this principle as “the sanctity of the bid”. Focusing on quality standards also provides incentives for appropriate maintenance.⁴⁷

Similarly, if the government decides to raise service standards and additional investments are needed to meet them, the firm should be compensated at market values. Thus, additional

⁴⁷Additional incentives for maintaining the infrastructure toward the end of the contract term may be needed, such as bonds posted by the firm.

investments should be tendered in competitive auctions and revenues increased only to ensure a normal return on additional investments.⁴⁸ Any renegotiation should be subject to independent review, a topic we discuss next.

4.2 The governance of PPPs

In many countries the same government agency is in charge of planning, designing, awarding, monitoring compliance and renegotiating PPP contracts.⁴⁹ As discussed in Section 2 in the context of public provision, this is bad governance. One reason is that public works agencies tend to be biased in favor of building as much as possible—project selection is inefficient and building is a goal in itself. Also, there is an inherent conflict of interest between promotion on the one hand and regulation and monitoring compliance on the other. Last, contracts are usually renegotiated behind close doors and bilateral agreements are not reviewed independently. This allows public works agencies to cover up their mistakes and stimulates their carelessness when designing and awarding PPP contracts.⁵⁰ An appropriate governance fosters independent project selection and evaluation; separates contract design and award from contract monitoring; and subjects renegotiations to independent review.

The recommendation is to relieve the unit that writes and awards PPP contracts from planning, project selection, and contract enforcement. Before awarding contracts, a planning agency should design, evaluate and select projects. In turn, an external board—the Roads board mentioned in Section 2.3—should review the cost-benefit evaluations that support the chosen projects and the PPP contracts written to implement them. After contracts are awarded, a PPP supervisory agency should ensure compliance with the contract, monitor performance standards and service quality, and provide information to users and the public. This could be the job for the Independent Supervisory Authority (ISA) discussed in Section 2.3 if such an agency exists, yet if it does not exist, it may be easier to create such an agency specifically for PPPs than for the entire public works sector. At the same time, a panel of experts should review contract renegotiations and adjudicate conflicts. As mentioned above, when evaluating renegotiations the panel should ensure that the contractual modification neither increases nor decreases the project's profitability, thus eliminating the firm's incentives to behave opportunistically. The panel should also inform the public of the extent to which poor contract design motivated the renegotiation, thereby providing incentives for the unit that writes and awards PPP contracts to avoid careless project design.

As discussed in Section 2.3, the planning agency and the PPP unit must execute the incumbent government's policies, although they should probably be staffed by career civil servants.

⁴⁸More precisely, to ensure zero change in the firm's net present value of profits.

⁴⁹Of course, this problem is analogous to that discussed in Section 2.1 for the traditional approach.

⁵⁰It also allows governments to anticipate spending—see Sections 3.5.1 and 4.6.

On the other hand, the external review board, the independent supervisory authority, and the panel of experts should be financially and formally independent from the executive and their acts should be subject to strict transparency requirements.

4.3 Legal environment

PPPs are long lived contracts and their viability depends on the legal environment and the protection both of property rights of the private firm and of the rights of the public. In the absence of rule of law, honest investors in PPPs can expect to be fleeced, or suffer from regulatory takings, so that they will not participate in PPP projects in those countries. Instead, the firms that will be attracted are those with expertise in gaming the system. Alternatively, honest firms that participate will ask for such high rates of return to cover the risk of expropriation, that the country may be made better off by the traditional approach to road projects, since this approach may attract firms that would not dare participate in a long term PPP.

Poor countries sometimes have the option of resorting to international financial institutions (IFIs) such as the World Bank to provide insurance against expropriation for investors. Involvement by IFIs is justified by arguing that they have better information than conventional banks and that they can threaten to withdraw aid that is valuable to the government should it act opportunistically with the concessionaire. Nonetheless, this approach may be useful for a small number of projects that are expected to provide major externalities, it is unlikely that this approach can be the basis of a fully fledged PPP program.

The policy recommendation is to improve the legal environment and the protection of property rights prior to attempting to introduce PPPs, since they are more sensitive to deficiencies in this area than the traditional model for providing roads.

4.4 Risk allocation and PPPs

As mentioned in Section 3.3, PPP contracts serve as a market test to avoid white elephants. We also mentioned that this filtering ability is reduced in the presence of government guarantees. However, most PPP contracts include different forms of insurance against revenue risk, and this insurance is ultimately paid by taxpayers. The risks that are usually insured against are demand risk, construction and maintenance risk, as well as policy risk (see Box 4.1 for a description of risk factors).

Firms ask for guarantees so they can unload demand risk. This risk is large, since making accurate demand forecasts, even in a medium term horizon, is extremely difficult. Firms are unable to diversify these risks, possibly due to agency problems both within the firm and between the firm and financiers. As we argue in Section 4.5, the right way of dealing with this problem is by choosing the appropriate auction mechanism. A second source of the demand

for guarantees is construction and maintenance risk. Here, firms often press for cost-sharing agreements with the government even though they control the sources of risk.

BOX 4.1 (A classification of risks faced by a concessionaire) ⁵¹

With a typical road concession contract, where the concession term is fixed in advance, and in the absence of government guarantees, the concessionaire faces the following risks:

Demand risk. *This risk arises when demand forecasts are unreliable, which happens most of the time. Demand forecasts are based on estimates of future growth of the overall economy, and deviations from this growth rate by the region in the country relevant for the project at stake. An increase or decrease by one or two percentage points of the demand growth rate over a long time period can have huge effects on the project's returns. Demand forecasts also depend on estimates of the macroeconomic cycle, which are tied to the aggregate performance of the economy, and on estimates of microeconomic conditions, which reflect local demand fluctuations. Box 4.2 shows that both sources of demand risk are important in Chile, even during the most stable decade in the country's history. Box 4.3 shows that, even in industrialized countries, where the quantity and quality of information available to make demand forecasts is considerably larger than in developing countries, demand forecasts can be very imprecise, even in the short run.*

Demand risk may also be due to uncertainty on the changes in the income-elasticity of demand for motor vehicles and on uncertainty about the toll rate elasticity. Either of these sources of risk may throw off demand forecasts, which are usually inaccurate in the short term (three to five years) and all but useless in the long term.

Construction and operating risk. *Construction and operating risk exists because the costs of building and maintenance generally differ from projections. These risks can be large for specific infrastructures, such as tunnels.*

Policy risk. *Many private infrastructure projects are subject to policy-induced risk, which may take two forms. Actions by different government agencies may unintentionally affect the profits of the concession. For example, a devaluation may lead to a major reduction in the concessionaire's return, especially if this firm is foreign owned and values its returns in foreign currency. Or a change in environmental standards may require additional investments. In these cases the government is not acting opportunistically, since these policies would be implemented by the government even if it internalized the cost it imposes on the concessionaire.*

A second class of policy risks occurs when the government implements policies which affect the profitability of the concessionaire without increasing overall welfare (see Box 4.4 for an example). The government may build or expand a road that competes with the concessioned road and charge subsidized tolls, for example, or it may reduce tolls in response to political pressures.

⁵¹Based on Engel, Fischer and Galetovic (1997e). An extensive analysis of risk allocation and valuation in PPPs appears in Irwin (2007).

Distinguishing between both kinds of policy risk may be difficult in practice. It is also sometimes difficult to distinguish between demand and policy risk, since many kind of policy decisions can affect demand (Box 4.3 illustrates this point). ■

BOX 4.2 (Demand uncertainty is very high in Chile) ⁵²

Table 1: DEMAND UNCERTAINTY IN CHILEAN TOLLROADS

	'86	'87	'88	'89	'90	'91	'92	'93	'94
Angostura:	8.8	15.0	11.7	4,5	8.7	12.4	6.7	7.8	9.4
Zapata:	21.5	14.4	13.1	8.1	7.2	5.2	2.9	3.9	4.9
Lampa:	3.8	13.4	15.9	8.9	6.8	18.0	8.8	16.2	12.5

Table 1 shows the increase in the number of motor vehicles paying tolls during the 1986–1995 period in three of the main tolled roads in Chile.⁵³ Since tolls remained approximately constant (in real terms) during this period, fluctuations in growth rates are due mainly to demand fluctuations. Macroeconomic risk is reflected, for example, in the fact that vehicle flows grew much faster during 1988 than during 1990. Microeconomic risk is apparent in most years: the growth of vehicle flow fluctuates considerably around the annual average from one tollbooth to another. ■

BOX 4.3 (The Dulles Greenway: Demand and policy risk) ⁵⁴

The Dulles Greenway is a 14 mile road joining Leesburg, Virginia, with the Western end of the Dulles toll road in the Washington DC area. When the concession was granted in the mid 1990s, two consulting companies independently forecasted a ridership of 35,000 daily vehicles if the toll was set at \$1.75. Actual traffic turned out to be 8,500 daily vehicles, partly because public pressure led the State of Virginia to widen an untolled alternative. ■

BOX 4.4 (Policy risk for Argentine utilities) *The contracts signed by the government of Argentina and foreign utility companies during the 1990s set user fees in dollars. After the crisis and devaluation of 2001, the Argentine government kept user fee values constant in local currency, which implied a reduction of two-thirds in foreign currency. ■*

⁵²Based on Engel, Fischer and Galetovic (1996).
⁵³The rates correspond to the growth in the flow of vehicles from one year to the next. For example, the vehicle flow through the Angostura tollbooth grew 8.8% between 1986 and 1987. These flows are representative, covering the three busiest highways near Santiago.
⁵⁴Based on Engel, Fischer and Galetovic (2006a).

A basic principle in optimal risk management is that the agent best positioned to manage a specific risk should bear this risk. Or, more precisely, each risk should be allocated to maximize project value, taking account of moral hazard, adverse selection and risk-bearing preferences (Irwin, 2007, p. 14). This suggests that firms should bear construction and operating risks. Regarding policy risk, it is unrealistic to have government bear the risk associated with unintended consequences of its actions. Furthermore, there is no reason why the government should bear specific policy risks. For example government often grant foreign concessionaires insurance against devaluations. Not only does this discriminate against local investors, it also discriminates against foreign firms in other sectors of the economy that must bear exchange rate risk. By contrast, the risk of “intentional” government actions can be mitigated by an appropriate contract, that explicitly rules out the most likely risk factors of this type, and by an effective conflict resolution mechanism, as discussed in Section 4.2. Finally, to the extent that demand risk is largely beyond the firm’s control, there is no reason why the firm should bear this risk, an idea we develop next.

4.5 The optimal PPP contract

We have argued in favor of PPPs based on efficiency gains and their ability to provide second best solutions to various shortcomings of traditional provision. In this section we argue that the advantages of PPPs are further enhanced if they are implemented via a flexible term contract that lasts longer in low demand scenarios.

What follows is an informal presentation, based on the formal results we derived in Engel et al. [1997a, 2001, 2008). The following assumptions are central to our analysis. First, the main source of uncertainty is demand uncertainty, which is mostly beyond the control of the concessionaire. This is a very reasonable assumption for roads. Second, firms face important limitations diversifying risk across projects, and therefore charge a premium for the demand risk they have to bear. Third, all firms have identical technologies (this simplifies our analysis but is not essential). Finally, the concession is assigned in a competitive auction.

Under the above assumptions we describe the optimal contract and discuss how this contract can be implemented via a competitive auction.

4.5.1 No tolls

When it is impossible to charge tolls that pay for a relevant fraction of the costs of the road, there are three alternatives to provide for the project. First, the government can use conventional provision. Second, it is possible to use shadow tolls, where the government pays the private operator a fixed fee for each user of the infrastructure. Finally, it can pay a fixed periodic fee, contingent on quality of service standard being met, under an availability contract. These three

options have advantages and disadvantages in different environments, so the choice of contract is not unique but depends on the characteristics of the project.

Shadow tolls introduce demand risk, and this will increase the risk premium included in the winning bid. Since having the firm bear this risk brings no countervailing benefit, this approach should be deprecated. The purported benefit of shadow tolls is that, as they are demand dependent, they avoid white elephants. Consider, however, that a project in which all the payments are made by the government is a project that should be subjected to careful social evaluation, so the benefits of filtering white elephants are limited, if present at all. For example, these benefits disappear if shadow tolls are set too high.

4.5.2 Tolls and high demand roads

Despite the high demand uncertainty faced by highway concessions, it is often the case that tolls will eventually pay for the project, the question being how long it will take. For these projects, which we refer to as 'high demand' projects, we argue in favor of using a present-value-of-revenue (PVR) auction to assign the PPP contract. Under this mechanism, the planner sets the discount rate and toll schedule, and firms bid the present value of toll revenue they desire. The firm that makes the lowest bid wins and the contract term lasts until the winning firm collects the toll revenue it demanded in its bid.

A PVR contract reduces risk: When demand is less than expected, the franchise period is longer, while the period is shorter if demand is unexpectedly high. Under the assumption that the project is profitable in the long run so that repayment eventually can occur, all demand-side risks have been eliminated. This can reduce the risk premium demanded by the firm significantly compared to fixed term concessions (e.g., by one third in the case considered by Engel et al., 2001).

The United Kingdom was probably the first country to use a contract similar to PVR. Both the Queen Elizabeth II Bridge on the Thames River and the Second Severn bridges on the Severn estuary were franchised for a variable term. The franchises will last until toll collections pay off the debt issued to finance the bridges and are predicted to do so several years before the maximum franchise period. Chile was the first country to use an outright PVR auction.⁵⁵ In February of 1998, a franchise to improve the Santiago-Valparaíso-Viña del Mar highway was assigned in a PVR auction. The reason for choosing the PVR option was that it is easy to calculate fair compensation for the concessionaire should early termination of the contraction be desirable for the government (see Box 4.5 for details). PVR auctions were used recently in Chile to auction Route 160 (February, 2007), the road accessing Santiago's main airport (December, 2007), the Melipilla-Camino de la Fruta highway (January, 2008), and the Vallenar-Caldera high-

⁵⁵Colombia ran a flexible term auction a couple of years before where firms bid on total income, without discounting.

way (January, 2008). Portugal also recently adopted flexible term contracts for all its highway concessions (see Box 4.6 for details).

BOX 4.5 (First PVR Auction) *The Route 68 concession, joining Santiago with Valparaíso and Viña del Mar, was auctioned in February of 1998. It was the first road franchised with a PVR auction. The Route 68 concession contemplated major improvements and extensions of the 130 kilometer highway and the construction of three new tunnels. Five firms presented bids, one of which was disqualified on technical grounds. For the first time in the Chilean concessions program, minimum traffic guarantees were not included for free, but instead were optional and at a cost. That the pricing of guarantees by the government was not way off the mark can be inferred from the fact that two of the bidders chose to buy a guarantee, while the winner declined. Bidders could choose between two rates to discount their annual incomes: either a fixed (real) rate of 6.5% or a variable (real) rate given by the average rate of the Chilean financial system for operations between 90 and 365 days. A 4% risk premium was added to both discount rates. Three firms, including the winner, chose the option with a fixed discount rate. Somewhat surprisingly, the present value of revenue demanded by the winner turned out to be below construction and maintenance costs estimated by the Ministry of Public Works (MOP).⁵⁶ One possible explanation for this outcome is that the regulator set a risk premium (and hence the discount rate) that was too high, neglecting the fact that PVR auctions substantially reduce the risk faced by the franchise holder. A return on capital in the 10–20% range is obtained if a more reasonable risk premium (in the 1–2% range) is considered.*

It is also interesting to mention that, apart from the pressure exerted by the Ministry of Finance, the main reason why MOP decided to use the PVR mechanism is that it facilitates defining a fair compensation should the ministry decide to terminate the franchise early. This feature of PVR is relevant in this case since MOP estimates that at some moment before the franchise ends, demand will have increased sufficiently to justify a substantial expansion of an alternative highway (La Dormida) that competes with some sections of Route 68. Thus, the contract of the Route 68 concession allows MOP to buy back the franchise at any moment after the twelfth year of the franchise, compensating the franchise holder with the difference between the winning bid and the revenue already cashed, minus a simple estimate of savings in maintenance and operational costs due to early termination. No such simple compensation is available if the franchise term is fixed. ■

BOX 4.6 (Flexible term highway concessions in Portugal)⁵⁷

The first generation of highway concessions in Portugal began in 1999, using shadow tolls to finance the concessionaires. This led to a sizeable and increasing burden for the budget: by 2004

⁵⁶The winner bid US\$374 million while the MOP estimated costs to be US\$379 million.

⁵⁷Based on *Project Finance*, February 2005.

it became clear that shadow toll obligations for the public sector, estimated at 660 million euros per year by 2008, a sum close to the total annual road budget. Thus, it became attractive to shift towards financing schemes that relied on user charges. In addition, the Portuguese government wanted to limit the upside for the private sector on real (not shadow) toll projects.

This led to a second generation of highway concessions, that began with the 98.4km Litoral Centro highway along the Atlantic ocean, linking Marinha Grande and Mira, at an estimated cost of 795 million euros. This was Europe's first variable-term toll concession and was adjudicated to the Brisal consortium.

The concession period depends on when (and whether) the net present value (NPV) of toll revenue reaches the 784 million Euro mark. If it is reached before year 22, the concession lasts 22 years; if it is reached between years 22 and 30, the concession ends once this mark is attained; and if it has not been reached this value by year 30, the concession ends. Toll revenue is discounted using the 12-month Euribor rate, which provides a natural interest rate hedge: an increase in this rate reduces the NPV of toll revenues and therefore extends the concession term. The project benefits from annual toll increases in line with Portuguese consumer price index.

The project won the Eurofinance prize for project of the year 2004 and the Portuguese government has announced that it will use flexible term franchises for all future highway concessions.

■

PVR franchises should attract investors at lower interest rates than traditional Demsetz franchises with fixed terms.⁵⁸ Toll revenues are the same under both, but the franchise term is variable under PVR. If demand is low, the franchise holder of a Demsetz-awarded contract may default; in contrast, a PVR concession is extended until toll revenue equals the bid, which rules out default. Of course, under PVR, the bondholders do not know when they will be repaid, but that is less costly than not being paid at all.

PVR schemes also reduce the need for guarantees because the risk to investors is much smaller (as illustrated by the example in Box 4.5). Thus PPPs are more likely to filter white elephants under PVR contracts.

The PVR approach also reduces the likelihood of opportunistic behavior. Traditional fixed term road contracts are renegotiated by extending the length of the concession, increasing tolls, or providing a government transfer. Extending the concession term with a PVR contract is not possible because, by definition, the term is variable. Increasing tolls is ineffective because it shortens the concession term without increasing overall income. Government transfers are not logically impossible under PVR but, because the concessionaire cannot claim that it will receive less toll revenue than expected, a government transfer would be difficult to rationalize to the public. Also, to the extent that firms are more likely to act opportunistically under financial

⁵⁸Traditionally firms bid on the lowest toll, the shortest contract term, the lowest subsidy or the highest payment to the government. In all these cases the contract length is set before knowing demand for the road.

duress, PVR contracts reduce the incentives firms have to engage in “bad faith” renegotiations, since scenarios with losses for the firm are less likely under PVR.

PVR concessions allow for more flexibility in setting tolls (see Box 4.7). And, as illustrated by the case studied in Box 4.5, they also allow adaptation to changing circumstances not easily possible in standard fixed term contracts.

BOX 4.7 (PVR, urban highways and toll flexibility) *Setting in advance the appropriate toll schedule for an urban highway project during the entire concession period is very difficult. Unless traffic forecasters are unusually fortunate in their estimates as to the sensitivity of traffic to prices, the resulting tolls are likely to eventually be incorrect – either so low that they create congestion or so high that the highway is underutilized. One possibility is to allow fees to respond directly to congestion so they are never too low. But the result can be monopoly pricing as in the case of the Orange County 91 Express Lanes (see Engel et al., 2006a).*

Under PVR, transit authorities can include toll flexibility in the concession contract. The guiding principle of the PVR franchise is to allow the winning bidder always to collect its required present value. In order to induce the franchise holder to accept toll flexibility, however, the contract has to recognize that lower tolls not only increase the time required to earn the desired revenue, but also increase traffic and therefore increase maintenance costs. Under fixed term contracts, by contrast, no simple approach to incorporate toll flexibility exists, since the concessionaire’s profits are very sensitive to variations in tolls.

Because maintenance costs are roughly proportional to road usage, the original PVR contract could be specified so that the revenue target is net of maintenance costs. With that adjustment, the only effect of a change in tolls is a change in the total operational costs over the length of the contract – costs that are predictable and represent a minor fraction of total costs. PVR franchises then allow the transit authority to change tolls to the efficient level without harming the franchise holder. Of course, a lower limit must be set for tolls because, otherwise, the franchise holder might never obtain the revenue stipulated in the winning bid. ■

While PVR schemes have a big advantage in terms of reduced risk, the downside is that the concessionaire has few incentives to increase demand for the infrastructure project because any action that increases demand will shorten the term of the franchise. Projects earn their income regardless of efforts of the concessionaire. By contrast, demand increasing investments are more attractive under fixed term franchise. That suggests that the PVR method is applicable only in cases in which quality of service is contractible. Also, an important assumption underlying our analysis is that major investments are not needed frequently. Thus roads and ports are natural candidates for PVR while mobile telephony is not.

It is worth speculating on why flexible term contracts have not been adopted more broadly throughout the world, given their many desirable characteristics. Opposition has come mainly

from the concession lobby, which fears that a PVR contract will limit their ability to renegotiate contracts. In most countries, the Public Works Authority tends to support the position of the concession lobby, since its governance structures usually provides incentives for road building rather than supervision and regulation that eventually benefits users. This requires good relations with future bidders for concessions.

By contrast, the Ministry of Finance usually favors PVR contracts, since they reduce the demand for guarantees given the lower demand side risk. It is not surprising, therefore, that flexible term concessions have been adopted when the budgetary authority has the upper hand over the public works authority. This happened in Portugal after the massive deficits caused by the first wave of highway concessions (see Box 4.6). In the case of Chile, after the Ministry of Public Works overspent during the 2000–2003 period, the Ministry of Finance was able to push for a major overhaul in the Public Works ministry. The secretary of public works was removed and a priority of the following administration was reform of the governance of public works, and particularly of the concessions division, along the lines described in Sections 2.3 and 4.2. The new Minister of Public Works was a close ally of the new Minister of Finance and early in his tenure he defined PVR contracts as the ‘standard’ approach for highways.

More generally and to the extent that the above conjecture turns out to be correct, it suggests that the trial-and-error process essential to the democratic process may be central for passing reforms that enhance efficiency in the roads sector. This process is usually absent in non democratic societies, and it is therefore possibly no coincidence that the leading countries reforming their PPP programs are democratic.

4.5.3 Tolls and intermediate/low demand roads

When there exist many demand scenarios where a road will not generate enough revenue to pay for itself, there are essentially two sources to finance a concessionaire in a PPP scheme: tolls and government subsidies (where the latter includes a variety of means by which governments transfer resources to concessionaires, among them shadow tolls, guarantees and availability payments). In Engel et al. (2008a) we derive the optimal contract for these roads, under the additional assumption that tolls are a more efficient way of putting money in the hands of the concessionaire than subsidies. Thus, we not only have that governments raise revenues via distortionary taxes, but also that they are inefficient in transferring the money they raise to the concessionaire, say, because the private sector pays lower overhead or because it is less corrupt and less bureaucratic.

Even when subsidies are costly, it is still feasible to provide full insurance, as does the PVR contract for high demand roads. This option, however, may not be optimal, since the savings that come from not having the firm bear any demand risk may be more than offset by the cost of financing the firm via subsidies. The challenge is to find a contract that balances optimally

demand risk, user-fee distortions, and the opportunity cost of public funds. In Engel et al. (2008a) we show that such a contract combines a minimum revenue guarantee and a revenue cap. When demand realizations are low, the contract lasts indefinitely (or as long as the law allows) and the minimum income guarantee is binding, so that the government complements the concessionaire's income to attain the guaranteed level. By contrast, when demand is high, the revenue cap sets in and the contract ends when discounted revenue equals the cap. As in the case of a PVR contract, for high demand scenarios the franchise term is shorter when demand is higher. Even though it differs in the details, the first flexible term highway concession in Europe has many elements similar to the optimal contract described above (see Box 4.6): the upside is limited via a revenue cap that applies after the concession reaches 22 years, while downside risk is reduced by extending the concession to a maximum of 30 years. Interestingly, since this contract entails no government subsidies it provides strong incentives to filter white elephants.

The number of vehicles using the road needs to be monitored by a party unrelated to the concessionaire to provide adequate incentives for toll collection. For otherwise, say, the concessionaire will have few incentives to collect tolls in low demand scenarios, where its total income does not depend on toll collection, since the minimum income guarantee applies. The technology to monitor road usage has been available for more than a decade and has been used successfully in many countries. Furthermore, the tax authority will also be interested in independent measures of toll revenue, which should provide additional motivation for the PPP authority to monitor road usage.

In Engel et al. (2008a) we also show that the contract described above can be implemented via a competitive auction with realistic informational requirements, where firms bid both on the toll revenue cap and the minimum income guarantee and both numbers are combined by a simple scoring function. In the case where demand for the road is so low that it cannot finance itself via tolls in any scenario ('low demand' roads), the optimal contract provides full insurance, as with a PVR contract. PPPs do not filter white elephants in this case, since the concessionaire's revenue is unrelated to demand realizations. This is not surprising, since low demand roads, by definition, are not profitable without subsidies. Thus social project evaluation is particularly important for these projects.

When the road can be financed via tolls in some scenarios but not in others ('intermediate demand' road), both the revenue guarantee and the revenue cap are relevant and it is optimal to have the concessionaire bear demand risk. When expected toll revenue is large enough to pay for the upfront investment and risk borne by the concessionaire, a PPP will help filter white elephants.

The two thresholds that characterize the optimal contract differ in important ways from income guarantees and revenue-sharing agreements observed in practice. Minimum income

guarantees are routine in highway PPPs. However, most real world contracts have a fixed term and therefore do not follow the prescriptions laid out above. These contracts would be closer to the optimal contract if their durations were longer in low demand states, when guarantees are paid out. Thus, real world contracts pay excessive guarantees in low demand states.

Real world revenue sharing agreements also do not coincide with the revenue cap that characterizes the optimal contract.⁵⁹ When governments impose revenue sharing arrangements, they split revenues in excess of a given threshold with the concessionaire in fixed proportions. By contrast, the optimal contract described above suggests assigning all the revenue in excess of a given threshold to the government—the windfall profits tax rate should be 100%.

More generally, the rationale behind real-world guarantees and revenue sharing schemes is to reduce the risk borne by the concessionaire. By contrast, the rationale behind the optimal contract is to optimally trade off insurance on one hand, and the use of user fees and subsidies on the other. This is why the concession lasts indefinitely when subsidies (i.e., guarantees) are granted; the term is variable in high demand states; and the concessionaire's revenue in high demand states is higher than in low demand states.

4.5.4 Availability contracts

Availability contracts have become increasingly popular in many countries (e.g., France, the United Kingdom and the United States). Under these contracts, the government provides incentives to the firm to provide the service standards specified in the concession contract by making regular payments conditional on the contracted service being available.⁶⁰ These contracts are often auctioned to the firm that demands the lowest annual availability payment. The resulting contract then is the same as the optimal contract described above for a low demand road. Availability payments pay for the upfront investment and the concessionaire makes a normal profit on this investment regardless of demand realizations. This contract is optimal if no tolls can be charged or tolls are insufficient to pay for the road in all demand scenarios. As mentioned above, the ability of filtering white elephants is lost while the government does not need to compensate the firm for bearing risk. Also note that, as illustrated in Box 3.3, availability contracts can be used to provide maintenance for a network of roads (or bridges).

4.6 Budgetary accounting

The results on optimal PPP contracts can be used to argue that, as far as the risk profile of the government's budget is concerned, PPPs are much closer to public provision than to privatiza-

⁵⁹Profit sharing agreements should be avoided altogether, since firms can (and do) use transfer pricing and other gimmicks to inflate their costs and thereby avoid sharing profits.

⁶⁰When operational costs are significant and vary with demand, the government makes an additional payment to the concessionaire that reflects operation costs.

tion. Our starting point is that the relevant metric to study risk allocation for alternative organizational forms to provide roads what matters is the *intertemporal* risk profile of cash flows, not the year-to-year risk profile.⁶¹ This has interesting implications: for low and high demand projects, the optimal PPP contract replicates the net cash flow streams of conventional provision, state by state (see Table 2, which assumes an additive risk premium and denotes the upfront investment by I , present discounted tolls by PVT and the corresponding average by $E[PVT]$). For simplicity we also assume no maintenance and operational costs, and that the road does not depreciate, all these assumption are not essential).

The optimal PPP contract has no government outlay upfront, but the firm that wins the competitive auction demands and collects a PVT equal to I . The government is the residual claimant for toll revenue and collects, in present value, $PVT - I$ after the contract ends, once the firm has collected tolls equal to its winning bid. Under public provision the government pays I upfront and then collects tolls throughout the life of the contract. The present discounted surplus generated by the road therefore also equals $PVT - I$, even though the timing of revenue is rather different from the PPP case. Essentially, both under PPP and public provision all residual risk is transferred to the government and equal to the risk in the present value of toll revenue.

Table 2: Average discounted budget: public provision vs. PPPs

	Public provision	PPP	Privatization
Upfront surplus:	$-I$	0	$E[PVT] - I - \text{Risk Premium}$
Discounted user fees:	PVT	$PVT - I$	
Total:	$PVT - I$	$PVT - I$	$E[PVT] - I - \text{Risk Premium}$

Under privatization, the project is sold for a one-time payment and all risk is transferred to the firm. Moreover, the link between the project and the public budget is permanently severed. This is not the case with a PPP, where at the margin cash flows from the project always substitute for either taxes or subsidies. The conclusion, then, is that from a public finance perspective there is a strong presumption that PPPs are analogous to conventional provision—in essence, they remain public projects, and should be treated as such for budgetary accounting purposes.

5 Empirical strategies

The object of this section is to provide suggestions for studies that may be useful in the design of study proposals. In this section we present proposals for two types of case studies. The first

⁶¹This underlies the logic of accrual accounting.

one is a proposal for a cross-country study of the institutional determinants of efficiency in road quality. The second one allows for within country studies at a local level.

5.1 Cross country study of road maintenance efficiency

One of the problems facing empirical investigations in this area is the lack of objective measures of the road quality of a country that is comparable across countries. There are some subjective estimates that can be used for cross country analysis, such as the one reported in The Global Enabling Trade Report 2008 as *6.07 Quality of roads* or the one included in the World Bank Logistics Performance Index (LPI).⁶² An alternative source that might have more fine grained evaluation of road quality which is comparable across countries is the use of Tourism Guides such as *Lonely Planet*, which have a description of road quality.

The deficiency in left hand side variables dictates the following strategy:

1. For the desired set of countries, compute a five year average of the total real expenditure on road infrastructure.
2. Compute a measure of expenditures per km of roads (include only national and secondary roads in the km).

If the countries were similarly efficient in their expenditures, there should be a simple relationship between the subjective measures of road quality (from WEF and LPI) and the expenditures per km, after adjusting for orographic factors and the different ratios of national to secondary roads and other control variables.⁶³

Hence, it is possible to have a regression with road quality on the left hand side, and expenditures per km on the right hand side, plus control variables (orographic conditions, national to secondary roads, GDP per capita) plus institutional variables such as:

1. Use of earmarked finance or from central revenues.
2. Fraction of roads under PPPs (better when using the weighed average of national to secondary roads).
3. An index of decentralization of public investment decisions.

⁶²Given the nature of the survey sample used to construct both these variables (Executive Opinion Survey 2006, 2007 for the WEF and a survey of professionals trading with the country in the case of the LPI) it is reasonable to believe that the road infrastructure variables relate to national and secondary roads, but do not include rural or local roads.

⁶³An improvement is to weigh national and secondary roads according to traffic flows when constructing the above measure of efficiency.

4. Proportion of total maintenance and construction expenditures by government employees.
5. An index of corruption.
6. An index of economic and or political freedom.

5.2 Country studies

At the country level, the lack of information about road quality is even more serious, except for special countries. Even in the cases of countries with road quality data, there are few in which the data allows more than one observation. Hence, a study requires constructing indexes of road quality at regional or subregional levels that allow for tests regressions or tests of statistical significance. Of course if these indexes exist in a specific country at that level, they should be used.

In order to construct the quality variable, it appears that the appropriate method is to use surveys of users at the desired subnational level.⁶⁴ The first choice would be to copy the approach used by WEF and the World Bank: use a similar questionnaire adapted to local conditions to survey either local executives and entrepreneurs or local transport specialists. There should be sufficient subnational units in the study that statistical tests are possible.

Then follow a procedure similar to the one for the cross country studies:

- Obtain information on the total expenditure on roads within the subnational unit during the last five years. If possible, this data should be separated according to the type of roads (national, secondary, local and rural).
- Obtain information on the proportion of expenditure from the different levels of government (national, regional, and the subnational unit itself).
- Compute a measure of expenditure per km (if possible, also according to the different types of roads).

Then it is feasible to repeat the regression of road quality on expenditure per km as in the cross country study, with the possibility of adding additional regressors of interest. So a regression of road quality at each subnational unit, on expenditure per km, using control variables and possible variables of interest on the right hand side would be:

1. Central or higher subnational unit funding of road expenditure as a percentage of total expenditure.

⁶⁴An objective variable, using IRI, for instance, would be desirable, but appears to be extremely expensive and would take too much time.

2. An index of local corruption (from the survey)
3. Dummy variables for the existence of mechanisms to channel complaints about road quality.
4. A dummy if subnational unit leadership is in opposition to central government.
5. A variable that measures the political allegiance of the subnational unit to government.
6. A subnational index of corruption (obtained in the same survey used to determine road quality).
7. Central supervision of the use of public funds for roads.

A Appendix: Country studies of concession programs

A.1 Argentina⁶⁵

The Argentine franchise program began in 1990 and was the second major franchise program in Latin America, after Mexico's.⁶⁶ In 1989-90, the first stage of franchises, the government auctioned twelve 12-year intercity concessions (see table 3 for the main characteristics of the concessions). Traffic levels on these roads were sufficiently high (2,000 to 2,500 vehicles/day) for the private viability of maintenance, rehabilitation and capacity improvements, but were not high enough to build totally new roads (see Estache, 1999).⁶⁷ There was no toll revenue guarantee nor a profit sharing mechanism. Tolls were indexed to inflation to protect franchise holders. Service quality was measured by a quality index which was supposed to improve over the life of the concession. It was estimated that the service quality requirements would demand large investments in paving during the first few years of the franchise. Among other things, concessionaires were required to make the improvements before collecting tolls. This first round of auctions was very successful in attracting bidders, with more than a hundred bids for the simultaneous auction of the twelve franchises.⁶⁸ The most important bidding variable in this

⁶⁵The sources used for this case study are Estache (1999), Nicolini (2001), Cipoletta and Sánchez (2008) and World Bank (2008).

⁶⁶At this time, there are two classes of concessions. First, two remaining highway systems franchised in the 1990's, the Corredores Viales N°18 (Caminos del Uruguay) and N°29 (Caminos del Valle), with expiration dates in 2018 and 2013, respectively. Second, 6 Corredores Viales franchised in 2003 for a period of 5 years, these last consisting of almost 8,000 km of roads.

⁶⁷Tolls were set uniformly across all concessions on the basis of distance and type of vehicle. Tolls were set as multiples of the basic toll for cars of US\$1.50/100km.

⁶⁸Note however, that participation was restricted to domestic firms, and that the award process was marred by criticisms of lack of transparency, see Cipoletta and Sánchez (2008).

first round of auctions was the rent (or *canon*) that would be paid to the government.⁶⁹ The total amount bid in canons was US\$890 million a year in 1990 dollars.

However, in the first instance of a pattern that was to repeat itself regularly, after only five months the government decided to renegotiate the contracts.⁷⁰ The main reason was the new policy of *convertibilidad*, which declared illegal all indexing provisions in contracts. Two further reasons to renegotiate the contracts were, first, that several concessionaires were collecting tolls before performing the investments required in their contracts, and second, the pressures by users unsatisfied with paying tolls. During a period lasting from January to April 1991, tolls were suspended until contracts were renegotiated. After the renegotiation, tolls were reduced by 50% and in exchange, the canon was eliminated. In fact, the government granted subsidies totalling US\$57 million per year to the firms.⁷¹ The program of road improvements changed. Though the road franchises became less attractive as business propositions, firms were receiving money rather than making payments. The resources for the compensations came from a trust fund created by a fuel tax.

Another round of renegotiations began in 1995, because higher than expected traffic led to congestion and the need for new investments. The government threatened to auction the expansion projects in order to force the franchise holders to accept extensions of the franchise term in exchange for the required investment.⁷² The negotiations were direct and dragged on until November 2000, except in the case of CV N°18, which signed an agreement in 1996, extending the concession until 2018. Nevertheless, at least US\$900 million in improvements agreed to in the 1995 renegotiations were not built before the franchises ended, in 2003.⁷³

The negotiations were completed by December 2000. These specified additional government grants for the franchise holder, mainly because previous grants had not been paid. In exchange, the franchise holders agreed to some additional investment, and to a freeze in tolls until the end of the concessions. It is noteworthy that the ratio of normal expenditures (routine maintenance, exploitation, administration, and user services) to total revenues of the concessionaires averaged over the length of the franchises was 46%, with the remaining paying for the 20% of the franchised network that was reconstructed, the 35% that was repaved and profits.⁷⁴

In 1994 there was a second round of franchises for the four freeway accesses to Buenos Aires, which run down to 2018. These contracts were better designed than the interurban contracts,

⁶⁹Other variables like lowest toll, highest quality or investment were also used, but only occasionally.

⁷⁰See World Bank (1999) or, for all the details, Cipoletta and Sánchez (2008).

⁷¹In 1992, a further renegotiation increased the government payments to US\$63 million, both extended the contracts and postponed the date of enforcement of quality standards by one year, and erased all complaints, sanctions and penalties against the concessionaires.

⁷²According to Estache (1999), who quotes the Public Works Secretary, the franchises were extremely profitable, at least until 1998, with rates of return between 26 and 38%.

⁷³One of the reasons being that not all the government payments agreed upon were not made in full, because the resources in the trust funds were directed towards other projects.

⁷⁴Nicolini 2001, using data from the Secretaría de Obras Públicas de Argentina.

Table 3: Characteristics of the 1990 interurban franchises, Argentina

Corridor	Road	Length in equivalent Km. (6)	Toll Tariff \$/100Km (1)	AADT (Average per Toll Station) in 2000 (4)	Provincial Location	Concessionaire	Main Firms
1	3 and 252	690	1,84	2649	Buenos Aires	SEMACAR S.A	Dycasa; Perales Aguiar
2	205	305	1,84	3302	Buenos Aires	SEMACAR S.A.	
3	7	524	1,93	3590	Cordoba-S. Luis-Mendoza	CAMINOS DEL OESTE	Techint; Santa Maria
4	8 and 193	729	1,67	3217	Buenos Aires-Santa Fé-Cordoba-San Luis	CAMINOS DEL OESTE	
5	7	503	1,84	2770	Buenos Aires-Cordoba	NUEVAS RUTAS S.A.	Necon; Chediack
6	188	487	2,10	1409	Buenos Aires-La Pampa	COVICO U.T.E.	(2)
7	9, A012	489	3,05	10974	Buenos Aires-Sant Fe	SERVICIOS VIALES	Sideco Americana (Macri);
8	11, A009	743	1,27	1888	Santa Fe-Chaco	SERVICIOS VIALES	Lippstad SA
9	33	241	1,82	3691	Santa Fe	SERVICIOS VIALES	
10	9	497	1,89	4516	Rosario (Sta. Fe)-Cordoba	COVICENTRO S.A	Caminos Australes (Roggio);
11	34	722	1,78	2640	Santa Fe-Sant. del Estero	COVINORTE S.A	CCI (Aragon); Supercimiento; Dyopsa
12	9 and 34	490	1,86	282	Santiago del Estero, Tucuman y Salta y Jujuy	CONCANOR S.A.	
13	16 and 12	954	2,17	2541	Corrientes-Chaco-Misiones	VIRGEN DE ITATI UTE	Chacofi; EAC; Nazar; Supercimiento; Dyopsa
14	19	288	1,90	2617	Santa Fe y Cordoba	RUTAS DEL VALLE	Geope; Sycic; Luciano
16	226	413	1,98	2466	Buenos Aires	CAMINO DEL ABRA	Coarco S.C.A.; Equimac
17	5	548	1,93	3386	Buenos Aires-La Pampa	NUEVAS RUTAS S.A.	Necon; Chediack
18	12,14,193,15, 117,13	700	2,21	n.a.	Buenos Aires-Entre Rios-Corrientes	CAMINOS DEL RIO URUGUAY	Welbers; Conevial; Babic; Codi; Eaca; Parenti Mai
20	36,38,A5	358	2,41	2474	Cordoba	RED VIAL CENTRO	Roggio; Afema; Boeto; Romero Cammisa; Arvial
Total		9681					
Average			1.97	3298 (5)			

Notes:

(1)January 2001 Toll Tariff Including 21% Value Added Tax

(2)Nordeste, Glikstein; Estructuras; Delta; Asfalsud; ICF; Enretto Bonfanti; Coemic; Guerechet

(3)Toll Station Revenue divided by the Basic Toll Rate.

(4)Of the 8860 Km network, 821 Km have two lanes per direction

Source: Nicolini, 2001.

and franchises were awarded solely on the basis of the smallest toll, with franchise lengths of 22 years and no subsidies. The number of bidders was small, with at most two per franchise. The contracts These franchises have involved investments of around US\$ 1.7 billion, and represent 2,291 equivalent km, and had revenues of US\$ 290 million in 2000.⁷⁵ It is interesting to note that the Buenos Aires contracts contained a *trigger clause* that limited the profit rate. In the cases in which the target profit rate was reached, either tolls would have to fall or the franchisee would have to undertake additional investments. As in the first-round franchises, contracts were amended frequently, five times since 1996, due to the trigger clause. Since these investments are not auctioned competitively, franchisees—which are owned by construction firms—chose to make additional investments, so as to avoid sharing profits with the government, keeping the extra revenue within the firm. Note that these trigger clauses may lead to inefficiencies. On the one hand, if the road generates large revenues, it is probably close to congestion so lowering tolls may be inappropriate. On the other hand, unlimited expansion due to the trigger program may lead to overcapacity or congestion at the points at which the franchised highway interconnects with the rest of the road network, as there is no coordination with the rest of the highway network.

Clearly the quality of roads improved as a result of the franchise program (Nicolini (2001), also Cipoletta and Sánchez (2008)). Intercity traffic increased from 73 million to 106 million traffic equivalent units from 1991 to 1998 (see World Bank [1999]), though it remained approximately constant between 1996 and 1999 and declined after the economic crisis of 2001. Intercity toll revenues were approximately US\$275 million a year (pre-2001 crisis), plus an additional promised US\$68 million in grants from the central government, i.e., approximately US\$ 350 million per year until the crisis (See Table 4). This is a large sum, considering that the franchises only had 821 km of two lane intercity highways. As a comparison, the budget for public expenditures in roads was only around US\$500 million of which 35% went to pay interest. Note, however, after the crisis the peso was devalued to one third of its former value, so during the last two years of the franchises, the revenue of the interurban concessions ran to about US\$ 150 million.

The Argentine experience in this first period shows the social costs that may be caused by franchise contracts that overlook important issues. For instance, since the location of the toll booths was not specified, *in some cases* the franchise holder placed them strategically so as to maximize revenue, by charging relatively high tolls to users of small sections of the franchised highway. This led to a much higher average cost per traveled kilometer than the originally anticipated rate of approximately 1.5 US cents/km, because the average trip was short but paid the full toll. In fact, it has been shown that for the average 25 km car trip, users were worse off

⁷⁵An exception to this story is the La Plata-Buenos Aires access, which was awarded during the 1980's, and is well behind schedule, but continues to collect tolls.

Table 4: Total revenue of Argentina interurban concessions 1990-2003, current A\$

Period	Toll revenue	Gov. Compensation	Total revenue
1(11/90-10/91)	61.915.532	17.841.259	79.756.791
2(11/91-10/92)	168.579.592	55.069.267	223.648.859
3(11/92-10/93)	207.937.218	69.998.802	277.936.020
4(11/93-10/94)	253.501.989	57.664.699	311.166.688
5(11/94-10/95)	258.125.574	74.203.689	332.329.263
6(11/95-10/96)	282.388.326	29.139.259	311.527.585
7(11/96-10/97)	316.812.644	81.467.654	398.280.298
8(11/97-10/98)	354.137.219	80.484.808	434.622.027
9(11/98-10/99)	343.811.007	86.248.220	430.059.227
10(11/99-10/00)	286.671.542	85.871.227	372.542.769
11(11/00-10/01)	246.484.285	514.145.100	760.629.385
12(11/01-10/02)	166.712.305	280.490.496	447.202.801
13(11/02-10/03)	186.633.478	278.159.155	464.792.633
TOTAL	3.133.710.711	1.710.783.635	4.844.494.346

Source: Cipoletta and Sánchez, 2008.

than before the franchises.⁷⁶

Another remarkable fact is that reported operating costs of the inter-urban franchises ranged between 40 and 60% of net-of-VAT toll revenues. What is most surprising is that a large fraction, which has been estimated at around 40% of expenditures, was spent on administration and collection, and that of this fraction, more than two-thirds was spent collecting tolls. In fact, 21% of gross toll revenues were spent on administration and collection, which is similar to expenditures on maintenance. A possible explanation for these costs is that many intercity roads had low traffic densities, which means that collecting tolls can be expensive. In fact, according to Nicolini (2001), routine maintenance costs, which are equivalent to US\$ 5,960/km, are also fairly high by international standards. An alternative explanation is that profits were being diverted in order to delay the application of the trigger clause that would have franchise holders share revenues with the government. This is consistent with the large gap that existed between profit rates estimated by the association of concessionaires (12.4%) and independent estimates (26–38%, see footnote 72). Note that in addition to toll revenue, we must add the annual compensations agreed to in 1997 after the tolls were reduced, which amount to 26% of total toll revenues. Recall that these franchises did not require new construction, but rather rehabilitation, maintenance and capacity improvements.

We can try to obtain rough estimates of the gross margins of the interurban concession-

⁷⁶See World Bank (1999).

aires. There are estimations that investment levels for the years 1-9 of the intercity franchises were US\$1,448 million for the 9,681 km of the twelve initial concessions, or approximately US\$ 15 thousand/km/year.⁷⁷ Adding the US\$ 12.5 thousand/km/year in routine maintenance, exploitation, administration and user services, we obtain average expenditures on 27.5 thousand/km/year. We can compare these annual expenditures with average yearly revenue of US\$ 41.3 thousand/km (toll revenue of US\$ 30,5 thousand/km/year plus compensation subsidies amounting to US\$ 10,8 thousand/km/year).⁷⁸ The profitability of the franchises depends crucially, therefore, on the timing of the initial investments.

In October of 2003 the National Comptroller (*Auditoría General de la Nación*) published a lengthy report reviewing the main conclusions of its audits of franchised highways during the 1993-2003 period. The report provides further evidence on weak enforcement of franchise contracts. For example, the equipment needed to measure a highway's friction coefficient had been out-of-service since 1994, so that this index had not been measured for any franchised highways since then (p. 34 of the report). The rugosity index, however, has been collected by the Dirección Nacional de Vialidad (1990) and the Órgano de Control de los Corredores Viales Nacionales (later years), and it shows an improvement, going from 3.52 (1990) to 3.03 (1997 and 1998), reflecting the public perception of an improvement in road quality during the period.

More generally, highway quality immediately after construction had typically been considerably below specifications, and had often deteriorated faster than allowed by the contract specifications. Building delays had also been recurrent, while fines to which the government was entitled had seldom been collected and were eventually canceled in the 2003 auctions.

When the 1990 concessions ended in 2003 (excluding the aforementioned CV N°18 and 29), the government proceeded to reauction 17 franchises, grouping them into 6 new "Corredores Viales", representing 7,951 km of highways. Under the new scheme, concessions would last only 5 years and the firms' responsibility for the highway was limited to maintenance and operations, with all new investment financed by the government, under the aegis of the Sistema de Transporte Integrado (SIT), funded by the fuel tax. Toll were set by the government and toll revenues were pooled and then distributed according to a predetermined scheme, which was the basis for the adjudication of the franchises. Less than 1,350 km of the 7,951 km of franchised roads were assigned to previous concessionaires (Cipoletta and Sánchez, 2008). During this period road quality worsened, because lack of supervision meant that not all the necessary maintenance work was performed. The revenue of the firms was substantially lower than under the previous regime, reflecting the less ambitious character of the new scheme. Moreover, the SIT, which was supposed to use its resources (from the fuel tax fund) to finance additional investment in roads, began to use the resources to provide additional compensation to con-

⁷⁷Cited in "Financing the Road Sector in Argentina: Lessons from the Past".

⁷⁸Data from Nicolini 2001.

cessionaires (because of toll reductions decreed by the government), but specially to subsidize transport by buses, trains and trucks. Government inefficiency and led to delays in realized investment, which impacted the quality of the roads. Thus, for the period from the award of the franchises to October 2007, the total amount invested in the 6 Corredores Viales amounted to only A\$421 million.

Summing up, the original Argentine concessions program succeeded in providing a significant upgrade to the country's highway network. Yet this upgrade appears to have been expensive, in particular because of the incentives to pad costs in maintenance, administration and collection, and the continuous process of renegotiations that seem to have benefited concessionaires at the expense of toll users and tax payers. The failures of the original program led the Kirchner administration to move toward a hybrid system, where new projects and significant additions to capacity are financed directly by the government, with results that appear to be much worse than the original approach. Perhaps the main conclusion of this country study is the importance of stable rules in the successful development of a franchise program.

A.2 Chile

Chile has, by now, a mature and successful highway concession system, specially when compared to the countries described above. Nevertheless, there have been problems, the major one being the magnitude and generality of renegotiations of the original contracts (see table 5).

In 1991 the Chilean congress passed a law that allows the government to concession most public works, including roads, seaports, airports, reservoirs, hospitals and jails.⁷⁹ By the end of 2007, all main highways, most airports and several other projects had been concessioned. The total cumulative investment in 50 concessions awarded by the Ministry of Public Works (MOP), which is summarized in Table 5, is about US\$11,3 billion, about 10% of current Chilean GDP.⁸⁰ Around 88% of that amount has been invested in highways.

Concessions must be awarded in competitive auctions open to any firm, national or foreign. The law is quite flexible, leaving ample room to adapt the contract to each project. For example, the tendering variables can include user fees, a subsidy from the state, the term of the concession, income guaranteed by the state, revenue paid by the franchise holder to the state for preexisting infrastructure, risk assumed by the bidder during the construction or operation stages, quality of the technical offer, fraction of revenue (beyond a certain threshold) shared with the state (or users), and total income from the concession.

The usual procedure to finance a concession involves several stages. To begin, bidders must offer bonds (*bonos de garantía*) that can be called in by the government if the bidder cannot finance the project. Moreover, similar bonds are callable if construction targets are not achieved

⁷⁹DFL 164 and DS 240, 1991.

⁸⁰This figure does not include seaports, which are concessioned in a separate program.

Table 5: Main characteristics of the Chilean PPP system(UF)

	Budgeted cost	Total renegotiated value	Total Investment	Fraction of total	Number of works	Fraction of total	Average length of franchise
Ruta 5	71.885.711	20.544.456	92.430.167	0,33	8	0,16	23,8
Interurban highways	52.951.424	10.453.407	63.404.831	0,22	13	0,26	27,7
Urban highways	60.613.607	33.288.928	93.902.535	0,33	5	0,1	31,6
Highways	185.450.742	64.286.791	249.737.533	0,88	26	0,52	27,3
Airports	8.798.114	1.202.048	10.000.162	0,04	10	0,2	13,1
Jails	7.414.824	2.661.785	10.076.609	0,04	3	0,06	22,5
Reservoirs	4.131.579	413.094	4.544.673	0,02	2	0,04	27,5
Transantiago	4.884.764	645.599	5.530.363	0,02	5	0,1	15,8
Public Infrastructure	4.243.082	24.153	4.267.235	0,02	4	0,08	23,2
Other concessions	29.472.363	4.946.679	34.419.042	0,12	24	0,48	18,8
Total or average	214.923.105	69.233.470	284.156.575	1	50	1	22,7

Source: Engel, Fischer, Galetovic and Hermosilla, 2009.

Note: Currently, 1UF=US\$ 40.

by predetermined dates or quality maintenance standards are not met. Once the concession is awarded, banks lend money for construction of the road. The law stipulates that banks are the only financial institutions that may lend to finance construction. Last, a construction is completed, the concessionaire can issue bonds backed by toll revenues (securitization). These coupon bonds are usually bought by private pension funds and insurance companies. The law stipulates that the franchise owner cannot securitize more than 70% of the debt in order to induce good behavior in the maintenance and operational phase of the franchise.

The law states that the concessionaire must build the project within the time limits established in the contract, providing thereafter an uninterrupted service of a quality consistent with the terms of his bid. MOP supervises the construction and operation of the project, and is allowed to fine, suspend or even terminate the concession should the franchise holder fail to meet his obligations. The law also establishes a dispute resolution mechanism to review conflicts between the state and the concessionaire.

Highway concessions 26 highways were concessioned between 1993 and 2007 (Table 5), involving investments of about US\$10 billion. Projects can be classified into three groups:

- The Pan-American Highway (Ruta 5), which runs from La Serena in the North to Puerto Montt in the South, which was divided into 8 double lane segments and extends over approximately 1,500 kilometers.
- 13 interurban highways. They include some that join Santiago with nearby cities (Los Andes, San Antonio, Valparaíso), and a number of local roads (e.g., Camino de la Madera, Nogales-Puchuncaví, Acceso Norte a Concepción);

- Five urban highways in Santiago

The program was launched in 1993 with the 23-year long El Melón tunnel concession. The auction was unnecessarily complex (see Box A.1), but this can be forgiven as the initial test of a new system.

BOX A.1 (The First Chilean Concession) *The auction mechanism used for El Melón tunnel was unnecessarily complex. Firms bid on a weighted average of seven variables: annual subsidy by or payment to the state, toll level and structure (composed by six different tolls, with different weights for different classes of vehicles), term of the franchise, minimum income guarantee, degree of construction risk borne by the franchise holder, score on the basis of additional services, and CPI adjustment formula. While only two of these variables (toll rate structure and payment to the state) were given weights that would have an effect on the final outcome, the result of the tender was unexpected. Four firms presented bids for the franchise and they all demanded the maximum toll and franchise term allowed by the auction. The selection was decided solely based upon the annual payment to the state. This outcome was inefficient, since a lower toll and a smaller annual payment to the state would have been better. Apparently, the weights on the toll rate variable were set incorrectly. Another surprise was that the winner outbid the second-highest bid by almost a factor of three. ■*

Subsequently MOP experimented with other tendering mechanisms. For example, the Acceso Norte to Concepción, the Nogales-Puchuncaví Road, and the Santiago-San Antonio (Ruta 78) highways were awarded to the firm bidding the lowest toll. By contrast, most segments of the Pan American highway were auctioned using a mechanism that made firms compete first on tolls and then, when a lower bound was reached, on either the shortest franchise term or a yearly payment to the state (which was described as a “payment for preexisting infrastructure”) since the government wanted similar tolls per kilometer in all of the Pan-American highway. Moreover, some segments, which were thought to be privately unprofitable, were awarded subsidies, which were supposed to be similar to the amounts collected as payments for existing infrastructure. The highway that joins Santiago with Valparaíso and Viña del Mar in the coast was the first that awarded with a PVR auction (during 2008, several additional projects were awarded using a PVR auction). Most tenders were reasonably competitive, because with few exceptions, the number of bidders was between three and six.

The particulars of concession contracts vary, but they also share common features. Fifteen out of the 26 highway concessions have been awarded with subsidies and all of them received minimum income guarantees. Thus, direct and contingent subsidies are almost a given when it comes to highways. At the same time, 22 highway contracts include revenue sharing between the state and the concessionaire.

One of the main virtues of the Chilean concessions program is that legislation has been effective at dispelling fears of expropriation. An important part of the credit rests with the reforms implemented in Chile since the mid-seventies which considerably strengthened property rights. Perhaps the most evident indicator that there is little fear of expropriation is that concessionaires have been quite happy with the “build now, regulate later” approach followed by MOP—so far there is no independent regulator of concessions, an idea that the industry has vigorously opposed. Another merit of the Concessions Law is that it specifies that all concessions must be awarded in competitive auctions, open to foreign firms. This proviso limits the scope for regulatory capture and outright corruption.

One of the main shortcomings of the Chilean concessions program, however, is the lack of an external regulatory framework. MOP has been in charge of designing, implementing, supervising and renegotiating contracts. Each project has been designed independently and its rules are defined by the specific contract. The tension between the pressures for the success of a concessions program measured in terms of construction and the enforcement of contracts is evident. MOP, as most sectoral ministries under similar circumstances, has opted for development over regulation. Moreover, because MOP renegotiates the contracts it has awarded, it has incentives and the opportunity of covering up its mistakes. (For an example, see Box A.2 which describes the case of Tribasa.)

BOX A.2 (MOP as contract supervisor) *Tribasa, a large infrastructure company, had been an important participant in the first stage in Mexico’s franchise program. At the time, it was saved from bankruptcy by the Mexican government. Notwithstanding that experience, it became an important and aggressive participant in the initial stages of Chile’s infrastructure program and was awarded three major franchises: Acceso Norte a Concepción, Chillán-Collipulli and Santiago-Los Vilos (which had complementary contracts worth almost 50% of the original project).*

After completing the Acceso Norte a Concepción it ran into liquidity problems and sold Chillán-Collipulli in July 1999. Moreover, Acceso Norte a Concepción has been plagued by unconfirmed rumors of deficient construction and supervisors of the projects at MOP are under investigation. In the year 2000, Tribasa was late in completing the stages of the Santiago-Los Vilos section of the Pan American highway. Surprisingly, MOP was willing to allow the delays to accumulate without collecting the guarantees Tribasa had posted.⁸¹ Eventually, public pressure forced MOP to acknowledge there was a breach of contract. The franchise was transferred from Tribasa to another concessionaire without a formal auction procedure. ■

There is also evidence that MOP has been lax in enforcing concession contracts. For example, a report issued by the National Comptroller (*Contraloría General de la República*) in

⁸¹At the time Tribasa was filing for bankruptcy in Mexico, and later went bankrupt in Chile as well.

October of 2002 concludes that the ministry relies solely on traffic data provided by franchise owners, having neglected to set up independent procedures to collect this information.⁸² This is worrisome, since government guarantees are triggered by low traffic flows, so that firms have incentives to underreport traffic.⁸³

Finally, MOP has probably auctioned projects with low social returns. Chile has had a social evaluation program of government financed projects for more than three decades. This procedure, which is performed by the Ministry of Planning, ranks projects according to their social return and screens projects with low returns. On occasion, MOP seems to have subverted this procedure, by removing the least cost-effective parts of the projects submitted to the Planning Ministry. The omitted components were reincorporated after the approval and adjudication of the project, via so-called *complementary contracts* with the franchise holder, which are negotiated in private.⁸⁴ MOP has often mentioned that it has estimated the expected outlays generated by traffic guarantees, but these estimates have never been made public. In those cases in which subsidies have been provided, the social project evaluations that justify the subsidies have not been made public either.

It has been fortunate that MOP's objective of attracting bidders conflicted with those of the Ministry of Finance, which is responsible for the budgetary process. This has forced a more independent evaluation of the toll road program. Indeed, press reports suggest that on more than one occasion the Ministry of Finance successfully stopped MOP from offering particularly generous government guarantees to franchise holders. The Ministry of Finance worries that the budget will be affected if guarantees become effective. More generally, however, MOP can transfer rents to franchise owners via favorable regulations. These transfers are unlikely to worry the Ministry of Finance if the budget is not affected.

Renegotiation of concession contracts During the early years of the franchise program, the government avoided renegotiations even in those cases in which they would have increased welfare, as in the case of the El Melón Tunnel, perhaps to build a reputation for not renegotiating (see Box A.3) Indeed, renegotiations were limited until 2001. Substantial amounts were renegotiated in 2001, 2003, 2005 and 2007. As of the end of 2007, the 50 concessions that MOP awarded between 1993 and 2007 had been renegotiated 144 times, averaging 2.9 per concession. Highways tend to be renegotiated more. The 26 concessions have been renegotiated 109 times, 4.2 per concession. Most renegotiations have led either to increase the payments received by the concessionaire for the original project or to upgrades to the original project.

Renegotiations can be either bilateral or under the supervision of a commission set up to

⁸²“Contraloría critica sistema de control de concesiones”, *La Tercera*, April 22, 2003.

⁸³Moreover, in the case of Route 68, the concession length is inversely related to traffic flows.

⁸⁴See “Informe de la U. de Chile revela suerte de embaucamiento del MOP a Mideplan,” *La Segunda*, May 13, 2003.

Table 6: Renegotiations and total investment in PPPs in Chile (UF)

	Budgeted investment (Technical offer)	Bilateral renegotiation	Conciliations and arbitration	Total nego- tiated	Total invest- ment	Renegotiation as fraction of budgeted	Renegotiation as frac- tion of investment
Ruta 5	71.885.711	15.866.047	4.678.409	20.544.456	92.430.167	0,29	0,22
Interurban roads	52.951.424	6.972.069	3.481.338	10.453.407	63.404.831	0,2	0,16
Autopistas urbanas	60.613.607	33.288.928	0	33.288.928	93.902.535	0,55	0,35
Highways	185.450.742	56.127.044	8.159.747	64.286.791	249.737.533	0,35	0,26
Airports	8.798.114	1.139.836	62,212	1.202.048	10.000.162	0,14	0,12
Jails	7.414.824	0	2.661.785	2.661.785	10.076.609	0,36	0,26
Reservoirs	4.131.579	197,212	215,882	413,094	4.544.673	0,1	0,09
Transantiago	4.884.764	0	645,599	645,599	5.530.363	0,13	0,12
Public Infrastructure	4.243.082	24,153	0	24,153	4.267.235	0,01	0,01
Other concessions	29.472.363	1.361.201	3.585.478	4.946.679	34.419.042	0,17	0,14
Total or average	214.923.105	57.488.245	11.745.225	69.233.470	284.156.575	0,32	0,24

Source: Engel et al. 2009b.

Note: Currently, 1UF=US\$ 40.

adjudicate disputes. In a bilateral renegotiation MOP and the concessionaire reach an agreement which is not revised by an independent third party. If, on the other hand, the parties fail to agree, they can appeal to a commission which first tries to conciliate and then arbitrates. A little above half of all renegotiations (74 out of 144) have been bilateral. Nevertheless, as can be deduced from Table 6, about 83% of the additional amounts conceded to concessionaires have been granted after a bilateral renegotiation, hence without external scrutiny (see Box A.3 for an example). Almost all bilateral renegotiations have been initiated by MOP and occurred before the project was completed. By contrast, most renegotiations with a commission have adjudicated conflicts that have occurred after the project was completed.

BOX A.3 (Renegotiation without supervision by third parties) *After signing the concession contract for Route 78, MOP required additional works that were not included in the original contract. The franchise holder asked for a compensation for the additional construction and the ministry decided to increase tolls by 18.1% during a five year period. No further explanation was given (public opinion learned of the agreement only after it was signed), and the calculations that led to the compensation were not made public.*⁸⁵ ■

The amounts renegotiated are substantial. As can be deduced from Table 14, of the US\$11.3 billion invested in 50 concessions, US\$ 2.7 billion were added after a renegotiation. Of these, at least US\$ 1,4 billion were additional works. In other words, about one in every four dollars invested has been added after the contract was awarded. Alternatively, the total amount invested has been increased by about one-third after contract award.

There are several means to increase the concessionaire's revenues or compensate him for additional works, among them direct payments from the government, tariff increases and term

⁸⁵See "Estado compensará a privados por concesión", *El Mercurio*, July 15, 1997, page C8.

extensions. Nevertheless, the most used form of compensation is a direct payment from the government—almost 70% of the total amount renegotiated. This does not mean an immediate impact on the public budget, however. Indeed, two thirds of these direct payments will be paid by future administrations.

B On the International Roughness Index (IRI)

The World Bank has proposed the International Roughness Index as a standard index to measure the quality of the surface of a road. The IRI is based on the average rectified slope (ARS), which is a filtered ratio of a standard vehicle's accumulated suspension motion (in mm, inches, etc.) divided by the distance traveled by the vehicle during the measurement. IRI is then equal to ARS multiplied by 1,000.⁸⁶ It is important to realize that the IRI index has been criticized because, as it tries to convert all the information on rugosity into one index, it fails to distinguish between types of irregularities.⁸⁷ The figure shows the IRI for different types of roads:

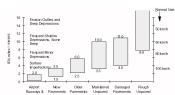


Figure 2: IRI Roughness Scale (replotted from Sayers et al., 1986)

⁸⁶See http://www.google.cl/search?rlz=1C1GGLS_esCL291CL304&sourceid=chrome&ie=UTF-8&q=htm

⁸⁷For example, Koprác, O. and Múčka, “Be careful when using the International Roughness Index as an indicator of road unevenness”. *Journal of Sound and Vibration*, 287, 4-5, 989-1003, November 2005.

References

- [1] Asian Development Bank, “Road Funds and Road Maintenance: An Asian Perspective”, 2003.
- [2] AECOM Conulst, Inc., “Synthesis of Public-Private Partnerships Projects for Roads, Bridges & Tunnels From Around the World — 1985-2004.” Public Works Financing. Westfield, NJ, October 2004.
- [3] J. Bennett and E. Iossa, “Building and Managing Facilities for Public Services,” *Journal of Public Economics*, **90**, 2143–60, 2006.
- [4] A. Bentz, P. Grout and M. Halonen, “What Should Governments Buy from the Private Sector—Assets or Services?,” mimeo, University of Bristol, 2005.
- [5] E. Bitrán. Personal communication.
- [6] Cadot, O., L. Röller and A. Stephan, “Contribution to productivity or pork barrel? The two faces of infrastructure investment,” *Journal of Public Economics* 90, 1133-1153, 2006
- [7] E. Chadwick, “Results of Different Principles of Legislation in Europe,”
- [8] G. Cipoletta and R.J. Sánchez, “Análisis del régimen de concesiones viales en Argentina”, CEPAL, February 2008
- [9] H. Demsetz, “Why Regulate Utilities,” *Journal of Law and Economics*, **11**, 55–66, 1968.
- [10] C. Donnges, E. Geoff and B. Johannessen, “Rural Road Maintenance: Sustaining the Benefits of Improved Access”, ILO, 2007.
- [11] E. Engel, R. Fischer and A. Galetovic, “Licitación de carreteras en Chile,” *Estudios Públicos* **60**, 5–37, 1996.
- [12] —————, “Highway Franchising: Pitfalls and Opportunities,” *American Economic Review Papers and Proceedings* **87**, 177-214, 1997a.
- [13] —————, “Infrastructure Franchising and Government Guarantees,” in T. Irwin, M. Klein, G.E. Perry, M. Thobani (Eds.), *Dealing with Public Risk in Private Infrastructure*, Washington, D.C.: The World Bank, 1997e.
- [14] —————, “Least Present Value of Revenue Auctions and Highway Franchising,” *Journal of Political Economy* **109**, 993-1020, 2001.
- [15] —————, “Privatizing Highways in Latin America: Fixing What Went Wrong,” *Economia*, **4**(1), 129–158, October 2003.
- [16] —————, “Privatizing Highways in the United States,” *Review of Industrial Organization*, **29**, 27–53, 2006a.

- [17] ———, “Renegotiation without Holdup: Anticipating Spending and Infrastructure Concessions,” NBER Working Paper No. 12399, June 2006b.
- [18] ———, “The Basic Public Finance of Public-Private Partnerships,” NBER Working Paper No. 13284. 2006. Last updated February 2008a.
- [19] ———, “Public-Private Partnerships: When and How,” 2008b.
- [20] ———, “Renegotiations and Corruption,” 2009a.
- [21] ——— and M. Hermosilla, “Renegociación de concesiones en Chile,” forthcoming in *Estudios Públicos*, 2009b.
- [22] Estache, A., “Argentina’s Transport: Privatization and Re-Regulation,” Policy Research Working Paper 2249, Washington, DC: World Bank, 1999.
- [23] Flyvbjerg et al, 2002
- [24] D. Grimsey and M. Lewis, *The Economics of Public-Private Partnerships*. Northampton: Edward Elgar, 2004.
- [25] D. Grimsey and M. Lewis, “Public Private Partnerships and Public Procurement,” *Agenda*, **14**(2), 2007.
- [26] J. L. Guasch, *Granting and Renegotiating Infrastructure Concessions: Doing it Right*. Washington: The World Bank, 2004.
- [27] C. Harris, “Private Participation in Infrastructure in Developing Countries: Trends, Impact and Policy Lessons,” World Bank Working Paper No. 5, 2003.
- [28] O. Hart, “Incomplete Contracts and Public Ownership: Remarks and an Application to Public-Private Partnerships,” *Economic Journal*, **113**, C69–C76, 2003.
- [29] I. Heggie and P. Vickers, “Commercial Management and Financing of Roads”, WB Technical Paper 400, 2002.
- [30] R. Hemming, “Public-Private Partnerships, Government Guarantees and Fiscal Risk”. Washington, DC: IMF, 2006.
- [31] O. Ipingbemi, “Exploring Labour-Based Approach for Rural Road Maintenance in Nigeria”, *Journal of Social Science*, **17**(2): 103-111, 2008).
- [32] E. Iossa and D. Martimort, “The Simple Microeconomics of Public-Private Partnerships,” Mimeo, 2008.
- [33] T. Irwin, *Government Guarantees: Allocating and Valuing Risk in Privately Financed Infrastructure Projects*. Washington: The World Bank, 2007.
- [34] T. Irwin, M. Klein, G. Perry and M. thobani (eds), *Dealing with Public Risk in Private infrastructure*, Washington, D.C.: The World Bank, 1997.

- [35] H. Jacoby, "Access to Markets and the Benefits of Rural Roads, *Economic Journal* 110, 713-737, 2000
- [36] T. E. Jones, and R. C. Petts, "Maintenance of minor roads using the lengthman contractor system", in *Fifth International Conference on Low Volume Roads*, Raleigh North Carolina, 19-23 May 1991.
- [37] M. Laberge, "Road repairs and public-private partnerships," Montreal Economic Institute, October 2007.
- [38] P. Larcher, "Privatizing Road Maintenance in Developing Countries", *The International Journal of Public Sector Management* 11, 116-125, 1998
- [39] P. Larcher and D. Miles, *Roads and Realities: How to Promote Road Contracting in Developing Countries*. Leicestershire: IDE Loughborough University, 2000.
- [40] D. Martimort and J. Pouyet, "To Build or Not to Build: Normative and Positive Theories of Private-Public Partnerships," to appear in *International Journal of Industrial Organization*.
- [41] J.L. Nicolini, "Toll Road Concessions in Argentina", Instituto de Investigaciones Económicas, Universidad de Buenos Aires, June 2001.
- [42] F. Rioja, "Filling Potholes: Macroeconomic Effects of Maintenance versus New Investments in Public Infrastructure", *Journal of Public Economics* 87, 2281-2304, 2003
- [43] Riverson et al, 1991
- [44] G. Roth, *Roads in a Market Economy*, Aldershot: Adelbury Technical, 1996.
- [45] A. Schliessler and A. Bull, "Road Network Management Roads: A new Approach for Road Network Management and Conservation", UN-ECLAC, 2nd pdf version, 2004.
- [46] M. Waissbluth. Personal communication. 2005.
- [47] O.E. Williamson, "Franchise Bidding for Natural Monopolies-In General and with Respect to CATV," *Bell Journal of Economics*, 7, 1976, 73-104.
- [48] O.E. Williamson, *The Economic Institutions of Capitalism*, New York: The Free Press, 1985.
- [49] World Bank. "Road Deterioration in Developing Countries: Causes and Remedies", June 1988, WB Policy Study 13370.
- [50] World Bank, Annex 1 to the World Bank Seminar on Asian Toll Development in an Era of Financial Crisis, "Financing the Road Sector in Argentina: Lessons from the Past," 1999.