Case Study

Dealing with Traffic Risk in Latin American Toll Roads

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Abstract: This paper presents a cross-country analysis of traffic risk allocation in road concessions of Latin America. It shows that some countries such as Chile, Colombia, and Peru have been greatly concerned with mitigating traffic risk, either by putting into practice public guarantees, implementing flexible term concessions, or through availability payment concessions; whereas other countries such as Mexico and Brazil have assigned traffic risk to the private concessionaire by using fixed-term concession contracts without any traffic guarantees. Based on an analysis of data from 1990 to 2010, the paper finds that shifting traffic risk from the concessionaire to the government or users was not confined to the riskiest projects, as one might expect. The analysis also suggests that the implementation of traffic risk mitigation mechanisms in Latin American toll roads has not been very successful in reducing renegotiation rates or in increasing the number of bidders in the tenders. **DOI: 10.1061/(ASCE)ME.1943-5479.0000266.**

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Introduction

Private toll roads have experienced a notable worldwide expansion in the last two decades. The first modern private toll roads were built in Spain in the late 1960s and in France in the early 1970s. By the early 1990s, many other countries also began to offer motorway concessions to private investors, most notably in Latin America and Central and Eastern Europe. In the late 1990s and 2000s, private toll roads spread to countries in Asia, North America, and Western Europe. Latin America was the first middle-and-low income region to launch extensive private toll road programs, and it was also the region where toll road concessions have expanded the most (Table 1).

The two Latin American countries that first launched toll road programs were Mexico and Argentina in the late 1980s and early 1990s. These early concessions experienced many problems from the very beginning. Argentina has not awarded new toll road concessions since that time. Mexico stopped its program in 1994, although it launched a new ambitious motorway concession program in 2003. In the early 1990s, Chile also started to offer road concessions, followed by Colombia and Brazil in the mid-1990s. In the mid-2000s, other countries, such as Peru and Ecuador, also started to grant road concessions.

Previous studies have examined the road concession programs in specific Latin American countries. For example, Acosta et al. (2008) and Benavides (2008) have described the Colombian programs. Engel et al. (2009) and Vassallo (2006) have analyzed the road concessions in Chile. Da Rosa et al. (2009), Senna and Michel (2007), and Ribeiro and Meyer (2006) have focused on the Brazilian programs. Engel et al. (2003) have conducted an analysis of several programs from an overall perspective. Guasch and Straub (2006) and Guasch et al. (2008) have dealt with the renegotiations of concession contracts and what prompted them. However, none of the previous studies has focused on traffic risk allocation in Latin American road concessions and none of them has included all the programs implemented in the region.

The objective of this paper is to carry out a cross-country analysis of traffic risk allocation in road concessions in Latin America and to consider whether the traffic risk mitigation mechanisms implemented in the region were successful. The research is based on the review of the literature, the analysis of data gathered by the authors from government sources, and interviews with numerous government officials of Brazil, Chile, Colombia, Mexico, and Peru (see Appendix).

The paper shows that there have been two very different approaches regarding traffic risk allocation in Latin American road concessions. One approach, adopted by Mexico and Brazil, is to assign traffic risk to the private concessionaire by using fixed-term concession contracts without any traffic guarantees [Da Rosa et al. 2009; Secretaría de Comunicaciones y Transportes (SCT) 2011]. The alternative, adopted by Chile, Colombia, and Peru is to reduce the traffic risk borne by the private concessionaire by providing government guarantees, by implementing flexible term concessions, or through availability payment concessions (Benavides 2008; Vassallo 2006). The analysis also suggests that governments may have been too conservative in shifting traffic risk from the concessionaire to other parties judging from renegotiation rates and number of bidders.

The paper is organized as follows: the first section examines the importance of traffic risk allocation in road concession projects and the possible reasons for shifting some of the traffic risk from the concessionaire to either the government or the users. The second section reviews the main features of private toll road programs in Latin America. The third section analyzes how governments in this region have dealt with traffic risk and closely examines the mechanisms implemented to mitigate it. Finally, the paper analyzes whether these mechanisms may be considered successful.

Traffic Risk Allocation in Toll Roads

Traffic volumes are a key risk to the financial viability of most toll road concessions for two reasons. First, the structure of toll road

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Table 1. Significant Private Toll Road Programs in the World as of December 2010

Western Europe, U.S., Canada, and Australia		Latin America		Central and Eastern Europe		Asia	
Country	Km	Country	Km	Country	Km	Country	Km
France	8,522	Mexico	5,985	Hungary	385	Japan	7,605
Italy	5,694	Brazil	1,3670	Poland	287	India	5,500
Spain	4,168	Chile	3,328	Croatia	205	Malaysia	1,800
Portugal	2,660	Colombia	6,183	—	—	Indonesia	697
Greece	916	Argentina	9,167	—	—	South Korea	470
U.K.	710	Perú	5,363	—	—	Philippines	300
U.S.	418	—	—	—	—	Thailand	176
Ireland	259	—	—	—	—	—	—
Australia	187	—	—	—	—	—	—
Total	23,534	—	43,696	Total	877	Total	16,548

Note: It includes only concessions actually built and under construction; it does not include concessions awarded but never built. Elaborated by the authors based on information provided by some countries' Ministries of Transport, ASECAP (2010), Carpintero (2010), Gomez-Ibañez (2009), Federal Highway Administration (FHWA 2009), Oxford Business Group (2009), and Japan Expressway Holding and Debt Repayment Agency (JEHDRA 2009).

revenues and costs makes profitability highly sensitive to traffic volumes. Tolls from users are the primary source of revenue for most concessions, so a shortfall in traffic typically results in a proportional reduction in concession revenues. But a shortfall in traffic does not result in a proportional cost saving since, once the road is built or improved, most of the costs of a concession are fixed and do not depend on traffic. Less traffic may result in some savings in maintenance, for example, but the largest share of the concessionaire's costs are the payments it owes to lenders and equity investors for the money raised to build the road. The fact that revenues are proportional to traffic while costs are almost insensitive to it means that profitability is very sensitive to traffic.

Second, traffic volumes are notoriously difficult to forecast, especially for greenfield projects. In practice, traffic estimates for toll roads have proven to be very inaccurate and significantly biased toward overestimation, as shown by Bain (2009), Lemp and Kockelman (2009), and Flyvbjerg et al. (2006). It is necessary, however, to make a distinction between brownfield projects (those concessions based on an already existing facility) and greenfield projects (those concessions that have to be built from scratch). Forecasting traffic is much easier in brownfield projects than in greenfield projects since the former have a track record of traffic upon which to base the forecast. As explained in the next section, most private toll road projects in Latin America are brownfield projects.

Moreover, which party should be assigned traffic risk is unclear because both the concessionaire and the government exercise some control but no one party has very much control. The government can influence some factors affecting demand such as urban development and competition with other modes of transport. The concessionaire also has some control over other factors affecting demand such as pricing policy and quality of service on the road. However, much of the traffic risk is not under the control of either party and is pure uncertainty.

There are two reasons why governments might want to absorb some of the traffic risk instead of leaving it all to the concessionaire. The first, which is most often cited in the literature, is to reduce the probability that the concession contract will have to be renegotiated [European PPP Expertise Centre (EPEC) 2011; Organization for Economic Cooperation and Development (OECD) 2008; Rus and Romero 2004]. A common reason for renegotiating is that traffic levels have proven to be either much lower or much higher than anticipated in the concession contract. Traffic guarantees and other similar measures reduce the need for renegotiation by sharing the potential burden of low forecasts. Renegotiation of concessions contracts should be avoided because they are by definition a bilateral game, lacking all the advantages of competitive bidding, most notably transparency. Furthermore, the possibility of renegotiation induces opportunistic behavior (Estache et al. 2009).

The second reason for the government to absorb some of the traffic risk, which is more often mentioned by the government officials that were interviewed, is that the risk is so large that it threatens the financial viability of the concession to the point that there may be no or very few bidders. If the lenders think that traffic risk is too high, then the financial cost will also be high and the project may not be bankable at all. Therefore, the government's mitigation of traffic risk is needed in some projects in order to create competition for the project, which in practice means to attract at least two and hopefully several more bidders.

Worldwide there have been many different approaches regarding traffic risk allocation in toll road programs. Many countries have opted for transferring most of traffic risk to private sponsors. This is the case of most countries in Latin America, North America, and Western Europe, although many projects have mitigated this risk in one way or another. Other countries, however, have ended up retaining most of the traffic risk, as have most countries in Central and Eastern Europe [Vassallo and Izquierdo 2010; Carpintero 2010; Yescombe 2007; C. Pérez et al. "Pasivos contingentes: Cuántos son y dónde están," working paper, Consejo Superior de Política Fiscal, Ministerio de Hacienda y Crédito Público, Bogotá, Colombia (in Spanish)]. It is hard to analyze the results of these approaches because there are so many factors that affect the performance of any toll road program beyond the allocation of traffic risk. The analysis in the following sections aims at providing some evidence to this debate.

Private Toll Roads in Latin America

Latin American private toll road programs have some common features that distinguish them from those in other regions. Some of these features were inherited from the Spanish toll road concession model, which has had a great influence due to the prominent role that Spanish construction and toll road operating companies have played in Latin American concessions. Though these features are not unique to Latin America, they are found more consistently in this region than elsewhere.

These concessions are purely private in the sense that they are granted to private consortia through a competitive tender process. Moreover, the public sector never participates as a shareholder together with private companies in the concession. The government's role is that of procuring the concession, establishing the contract terms and conditions to regulate the concession, and monitoring

the fulfillment of the terms of the contract. In some cases, the government can provide public guarantees to mitigate certain risks but in general these guarantees are not very significant [Fay and Morrison 2007; C. Pérez et al. "Pasivos contingentes: Cuántos son y dónde están," working paper, Consejo Superior de Política Fiscal, Ministerio de Hacienda y Crédito Público, Bogotá, Colombia (in Spanish)].

All road concessions in Latin America have been granted through a procurement procedure based on open procurement, contrary to the concessions in many other middle-income or emerging countries like those in Central and Eastern Europe or Asia where they have sometimes used negotiated procurement (Carpintero 2010). In open procurement, the concession is awarded to the best offer as judged by a set of criteria previously established by the government. In negotiated procurement, however, the terms of the award are based on a negotiation between the government and a few preferred bidders who have been prequalified by the government. The concession contracts in the open procurement follow a standard pattern, while in the negotiated procurement they are tailor made. There is a tradeoff between the open and the negotiated procedures. Open procurement is often cheaper, faster, and more objective than the negotiated procurement (Sánchez Soliño and Gago 2010). The contracts resulting from open procurement tend to be less complete, however, and thus are more likely to be renegotiated.

No financial close is required from the bidders before the contract is signed. The bidders have to submit a financial plan in the tender, but this plan is merely referential. Consequently, the concessionaire is allowed to achieve the financial close after the contract is awarded. This approach substantially reduces the transaction costs for the bidders, but does introduce uncertainty about the ultimate ability of the concessionaire to find resources for funding the project (Vassallo and Izquierdo 2010).

Latin American road concessions have been mostly for brownfield projects, the exception being most of the Mexican concessions (Table 2). Most concession contracts in the region have involved the rehabilitating and/or upgrading of already existing roads, as well as their operation and maintenance. The main reason for this is the low population density of Latin American countries, which makes having two or more competing roads in the same corridor economically unviable. As explained in the previous section, it is easier to forecast traffic in brownfield projects (those concessions based on an already existing asset) than in greenfield projects (those concessions that have to be built from scratch).

Latin American governments have often allocated traffic risk to the concessionaire. However, they have used various ways to mitigate it. The experience of two decades of dealing with this kind of risk constitutes a valuable source of lessons that are explored in the following sections of this paper.

How has Latin America Dealt with Traffic Risk?

The ways Latin American governments have dealt with traffic risk have evolved over the years, both in the extent to which such a risk has been shifted from the concessionaire to other parties and the mechanisms used for this shifting. Following the tradition of the Spanish toll road concession model, many of the first toll road concession programs launched in Latin America during the early and mid-1990s allocated all or most of the traffic risk to the concessionaire. However, during the last two decades there has been a variety of traffic risk allocation approaches. Road concession programs in Latin America are classified into three groups, depending on the extent to which traffic risk is borne by the government, the users, or the concessionaire (Table 3).

Table 2. Main Road Concession Programs in Latin America (1989–2011)

Country	Granted	Kind of projects	Km	Number of concessions
Argentina				
	1990	Brownfield	8,877	13
	1992–1994	Brownfield	290	3
México				
First program[a]	1989–1994	Greenfield	3,225	30
Second program	Since 2003			
Toll roads program		Greenfield	1,306	18
Service providing projects		Brownfield	563	7
Assets exploitation		Brownfield	891	2
Chile	Since 1993	Brownfield	3,328	33
Brazil				
Federal first program	1994–1997	Brownfield	1,493	5
Federal second program	Since 2007	Brownfield	2,600	7
State of Sao Paulo first program	1997–2000	Brownfield	3,470	12
State of Sao Paulo second program	Since 2007	Brownfield	1,715	6
State of Paraná	1997–2000	Brownfield	2,543	6
State of Rio Grande do Sul	1997–2000	Brownfield	1,849	8
Colombia				
First program	1994–1997	Brownfield	1,595	11
Second program	1997–1998	Brownfield	1,041	2
Third program	Since 2001	Brownfield	3,547	14
Peru	Since 2003	Brownfield	5,363	14

Note: Elaborated by the authors with data provided by OSITRAN (Peruvian Public Agency for Supervision of Investment in Transport Infrastructure), Coordinacion de Concesiones (Chilean public agency in charge of transport concessions), INCO, Colombia, General Directorate for Road Development (Mexico) and ANTT, Brazil. Data for Argentina have been taken from Vassallo and Izquierdo (2010).

[a]Out of the 52 concessions of the first program; only the 30 concessions that were granted to private concessionaires were considered; the other 22 were granted to state governments (19) and to Banobras (3).

Traffic Risk Borne by the Government

Minimum Income Guarantees

Minimum income guarantees (MIG) have been implemented in almost all Chilean concessions, in the early Colombian concessions (1994–1997) and in some Peruvian concessions. Through MIG, the government guarantees that the concessionaire will receive at least a minimum level of revenues each year irrespective of the actual traffic demand. Consequently, if the real annual revenue collected by the concessionaire falls below the minimum guaranteed in the contract, the government provides the difference between the guaranteed and the actual revenues. In the Chilean case, this guarantee is accompanied by the obligation to share with the government part of the extra revenues collected by the concessionaire above a certain minimum fixed in the contract. This results in a symmetrical risk profile between the government and the concessionaire.

Minimum income guarantees are well received by the lenders who feel protected by the government in case the project's revenues become insufficient to pay back the debt. This is the reason why this mechanism substantially contributes to reduce the financial return required by the concessionaire, lender and equity investors (Vassallo and Sánchez Soliño 2006). However, while this mechanism reduces the traffic risk borne by the concessionaire, it does so at the expense of transferring part of the traffic risk to the government. Consequently, the government has to evaluate the future impact—the contingent liability—that the implementation

Table 3. Taxonomy of Traffic Risk Allocation in Road Concessions in Latin America (1992–2010)

Traffic risk borne by	Contractual mechanism	Concessions
Government	MIG	Chile: 32 concessions (1992–2009) Colombia: 11 concessions (1994–1997) Peru: 5 concessions (2003–2010)
	DSLG	Colombia: 10 concessions (2001–2007) Mexico: Offered in 12 concessions (2003–2008)
	Availability payments	Mexico: 7 concessions (2005–2010) Peru: 9 concessions (2005–2009)
Users (flexible concession term)	LPVR	Chile: 4 concessions (1998–2003)
	RDM	Chile: 6 concessions (1992–2000)
	Accumulated revenues (not discounted)	Colombia: 10 concessions (2001–2007)
	Accumulated revenues (discounted)	Colombia: 4 concessions (2010)
	The government promised to extend the concession period if real traffic fell below forecast	Mexico: 30 concessions (1989–1994)
Concessionaire		Mexico: 18 concessions (2003–2010) Brazil: 7 federal concessions (2007–2010) Brazil: 10 concessions in the State of Sao Paulo (1994–1997) Brazil: 6 concessions in the State of Paraná (1997–2000) Brazil: 8 concessions in the State of Rio Grande do Sul (1997–2000)

Note: Elaborated by the authors with data provided by OSITRAN (Peruvian Public Agency for Supervision of Investment in Transport Infrastructure), Coordinacion de Concesiones (Chilean public agency in charge of transport concessions), INCO, Colombia, General Directorate for Road Development (Mexico) and ANTT, Brazil.

of these guarantees might have on the public budget in the future. One of the main criticisms of the MIG approach is the problem of moral hazard: MIG may discourage the lenders from assessing the financial performance of the project as closely as they otherwise might since the revenues are guaranteed by the government (Engel et al. 1996).

Minimum income guarantees have had a low fiscal cost in Chile but they have turned out to be very costly in Colombia. As of late 2011, none of the Peruvian concessions had activated the minimum income guarantee. By that time, however, three out of the five concessions with MIG in Peru had only recently entered in operation. As of 2011, only six out of 33 concessions in Chile had activated the MIG: Ruta 5 Santiago Los Vilos, Ruta 5 Talca Chillán, Camino Nogales Puchuncaví, Red Vial Litoral Central, and Acceso Nor Oriente a Santiago. Between 1998 and 2010, the total contribution paid by the government totalled US$122.8 million, which is only 1.9% of the total investment carried out in all 32 Chilean road concessions which have MIG (information provided to the authors by *Concesiones de Chile*, the Chilean agency in charge of concessions). In addition to that, 68% of the MIG payments came from a single project, *Santiago-Los Vilos* concession, whose traffic estimates turned out to be quite inaccurate (Gobierno de Chile 2010).

In Colombia, by contrast, the fiscal impact of the minimum income guarantee has been very significant. As of 2011, nine out of 11 concessions had activated the MIG. Between 1995 and 2004, the public contribution paid by the government totalled US$ 257 million, which amounts to 70% of the investment initially committed to the 11 Colombian concessions, which have MIG (the concessions awarded in the period 1994–1997). Almost one-third of the contribution was connected to a single project *Desarrollo Vial del Oriente de Medellin y del Valle del Rio Negro* (Acosta et al. 2008).

Arguably, the main reason for the huge difference between the experiences of Chile and Colombia with minimum income guarantees lies in the accuracy of the traffic estimates. In Chile, the government conducted thorough traffic studies, which were then provided by the government to the bidders. The government of Chile was able to spend enough money on careful traffic studies, in part because it incorporated a clause in the bidding terms whereby the concessionaire had to reimburse the government for the cost of the traffic studies. In Colombia, however, the concessions of the first program (1994–1997) had substantial deficiencies because of the lack of experience and the rush to implement the program (Acosta et al. 2008; Benavides 2008). One of the most important deficiencies was the low quality of the traffic and engineering studies. In fact, for the first program, the government simply used projections based on weekly traffic time-series data associated with estimates of the future economic growth of the country (Velasquez and Moreno 2001). On average, in the first years of operation traffic was 40% lower than predicted by the government (Engel et al. 2003). Another relevant deficiency of the early Colombian concessions was that the contracts were awarded according to a multivariable formula. This procurement procedure facilitated opportunistic behavior and renegotiations (Estache et al. 2009; Strong et al. 2004). In spite of those problems, some authors such as Cárdenas et al. ["La infraestructura de transporte en Colombia," working paper, Universidad de los Andes, Bogotá, Colombia (in Spanish)] mention that the result was not so bad, because the new concessions enabled the country to enjoy the benefits of new infrastructure that otherwise would have been provided only after much greater delay.

Debt-Service-Liquidity Guarantees

Debt-service-liquidity guarantees (DSLGs) have been implemented in Colombia, and were offered in the second Mexican program. They consist of liquidity guarantees granted by the government in order to make it easier for the concessionaire to comply with the repayment of the loans set up in the financial contract. This is especially important during the first few years of the concession, when traffic levels might be insufficient for the concessionaire to comply with its obligations to the lenders.

Colombia has offered DSLGs to the bidders from 1997 to 2007 as a replacement for the minimum income guarantees that were offered in the first Colombian program. The DSLG was offered for the first time in the two contracts of the second program (1997–1999). This guarantee, however, was not taken on by the bidders since requesting it was penalized in the criteria for awarding the tender. In addition, the implementation of this guarantee in Colombia coincided with the implementation of flexible-term contracts (Benavides 2008; Acosta et al. 2008).

The third Colombian program (started in 2001) made this debt-service-liquidity guarantee mandatory, and the DSLG was applied to the 10 concessions granted between 2001 and 2007. These concessions were awarded on the basis of the minimum accumulated revenue requested by the bidders in such a way that the contract expired when the revenues originally requested had ultimately been received by the concessionaire. The DSLG was designed in such a way that if public contributions through the DSLG became necessary, the contributions provided by the government would be subtracted from the accumulated revenues originally requested by the concessionaire. Consequently, the DSLG mechanism meant that the concessionaire received greater revenues initially to repay its loans, at the expense of receiving a shorter revenue stream in the future. In the last four concessions of the third program (granted in 2010) the government did not offer DLSG because it considered that the guarantees were no longer needed to attract financing for the concessions.

A different kind of DSLG was offered in the second Mexican program started in 2003. The guarantee offered in Mexico was called Compromiso de Aportacion Subordinada (CAS), which can be translated as Government Commitment for Subordinated Contribution. It represented the amount of revenues, discounted to present value, requested by the concessionaire from the government in the tender, to help the concessionaire to pay back the debt service in case the cash flow of the project should prove insufficient. The concessionaire, however, had the obligation to return any CAS disbursed by the government at an interest rate equal to that of the debt service (SCT 2003). This guarantee was in essence merely a liquidity guarantee since the concessionaire had to pay the government for using it. The CAS mechanism proved to be generally unhelpful since no bidder ever requested it and the Mexican government decided not to offer it after 2008. The bidders failed to request CAS because doing so made their bids less competitive since the awarding criterion was the present value of the public contributions requested, which would necessarily have included the CAS request (SCT 2011). The Mexican government also offered potential concessionaires the possibility of requesting an upfront public contribution named Compromiso de Aportación Inicial (CAI)—Government Commitment for Initial Contribution. This contribution comes in the form of a nonrefundable upfront public subsidy, to help the concessionaire attain competitive profitability. As the CAI is not to be refunded, it is much more advantageous for the bidders than is the CAS (SCT 2011).

Availability Payments

One way for the government to assume almost all the traffic risk is to make the concessionaire's revenue dependent primarily on the availability of the road to users rather than on actual traffic volumes. As of late 2011, this approach has been implemented in seven concessions of the second Mexican program and in nine Peruvian concessions. In the case of Peru, the concessionaire's revenues depend only on the availability of the road. The annual amount was proposed by the potential concessionaires in their bids. In order for the concessionaire to receive the availability payment, the road must meet some technical standards related to factors such as pavement quality and absence of obstacles in the road.

In the Mexican case, the concessionaire's revenue consists of a fixed payment dependent on the availability of the road and a smaller variable payment dependent on the traffic. Both amounts—which are updated annually with a formula linked to the rate of inflation—were offered by the concessionaire in the bid. In order for the concessionaire to receive the availability payment, the road has to meet some technical standards related to pavement quality, level of service, etc. The payment dependent on traffic is based on the number of vehicles no matter which kind (e.g., cars, trucks) and is capped by a number of vehicles established by the concessionaire in the bid (SCT 2006).

Traffic Risk Borne by the Users

In some concessions, traffic risk is allocated to users through a flexible concession term. This approach has been implemented in four projects in Chile and numerous projects in Colombia. This mechanism is based on fixing the termination date of the concession as the time when the accumulated revenue—discounted or not—reaches a specific amount established in the concession contract. If traffic is less than expected, the users of the road will have to pay tolls for a longer period. Chile and Colombia have implemented flexible-term concessions in somewhat different ways. In Chile, the present value of the revenues was the key variable of the tender, while in Colombia that variable was only one of the criteria relevant to the awarding of the concession. Chile also used a discount rate for the revenue to determine the ultimate duration of the concession contracts. Colombia, initially, did not discount the revenues, but in the four concessions awarded in 2010 it applied a discount rate similar to that used by Chile.

The Colombian government started to implement flexible-term concessions in 1997. The main reason was the high fiscal cost of the minimum income guarantees offered in the first program (1994–1997). From 1997 to 2010, all 16 concessions granted in Colombia have been based on flexible-term contracts.

The Chilean government started to implement the least present value of the revenues (LPVR) mechanism in 1998; however, it has not been extensively used. From 1998 to 2010, the LPVR was used in only four out of 33 road concessions. Arguably, the main reason was the strong opposition by private concessionaires since the LPVR mechanism eliminates any possible upside for the concessionaire. Moreover, the downside is not fully removed because the concession contracts have a maximum term; if at the end of the contract the LPVR requested has not been reached, the concessionaire could incur a significant loss.

In Chile, some toll road concessions that were originally designed with fixed terms were converted into flexible-term concessions through the implementation of what was called the revenue distribution model (RDM). The economic recession suffered by Chile between 1998 and 2002 led to a reduction of the expected traffic in many road concessions. This fact, along with the government's desire to carry out additional investments in the road concessions, caused the government in 2002 to initiate an extensive renegotiation of the fixed-term road concession contracts granted before 2000 to turn them into flexible-term concession contracts. Through the RDM, the government provides a guarantee that assures the concessionaire of receipt of a preestablished amount of revenues in present value by changing the duration of the concession from fixed to variable. This amount of the revenues guaranteed by RDM included additional investment imposed by the government on the concessionaire (Vassallo 2006). RDM was very favorably received by the concessionaires, because it mitigated traffic risk. However, this guarantee was roundly criticized by some scholars such as Engel et al. (2009) because the renegotiations were not carried out in a competitive environment, so concessionaires may have benefited more than they should have at the expense of the users.

In the first Mexican program (1989–1994), the government offered the possibility of extending the concession period if traffic volume fell below the forecast provided by the government. This guarantee proved in the end to be useless, however, since the problems arising from the concessions in the first Mexican

program went far beyond the lack of traffic. As a consequence, 23 out of 52 concessions in the first program were finally taken over by the government in 1997, and the others had to be renegotiated. The main reasons for this failure may be found in (1) short concession periods and high tariffs; (2) optimistic construction cost and demand estimates by the government; (3) lack of moral hazard for investors; (4) little hedging of dollar-denominated debt; and (5) the government's goal to build 5,000 km of high-performance highways in a few years—more than doubling the then existing network—was too ambitious (Carpintero and Gomez-Ibañez 2011).

Traffic Risk Borne by the Concessionaire

Traffic risk is borne by the concessionaire in all Brazilian concessions and in most of the concessions of the second Mexican program that started in 2003. The two most prominent Brazilian road concession programs are the first federal program (1994–1997) and the first program of the State of Sao Paulo (1997–2000) (Table 2). Both the federal government and the state government of Sao Paulo started to offer motorway concessions again in 2007, and they had only recently been completed and opened to traffic at the time of writing this paper. In the late 1990s, the states of Paraná and Rio Grande do Sul also launched ambitious programs for toll concessions. These programs were controversial due to their lack of transparency and the high level of governmental intervention. For example, the governors in both states forced the concessionaires to reduce the toll rates shortly after entering in operation (Da Rosa et al. 2009; Senna and Michel 2007). In Paraná, tolls were readjusted in 2002 to compensate for the loss occurred during this period (World Bank 2009).

In the first program launched by the State of Sao Paulo, the government allowed an extension of the concession period for most of those road concessions but only if the government raised the taxes to be paid by the concessionaire or required investments not initially planned (Da Rosa et al. 2009).

As of 2011, none of the concessions of the first federal Brazilian program had been renegotiated. These contracts, however, include a clause that allows toll increases based on additional investments required by the government. And some observers claim that this mechanism has been abused to provide relief to concessionaires suffering from traffic shortfalls. It is hard to judge the extent to which this claim is true, although it is striking that between the contract signing date and 2008 (an average period of 13 years) the tariff in real terms increased in four of the five concessions by 185, 36, 16, and 8%. In the fifth concession, the tariff was reduced in real terms by 9% (Veron and Cellier 2010).

Traffic risk has also been borne by the concessionaire in 18 out of the 25 concessions of the second Mexican program. These were greenfield projects totalling 1,203 km. As of late 2011, nine concessions (817 km) were already in operation and none had been renegotiated.

As part of the second program, the Mexican government started in 2007 to grant packages to the private sector consisting of concessions that were taken over in 1997—in these concessions traffic risk is borne by the concessionaires. As of late 2011, the government had granted two packages totalling 11 projects and 891 km.

Have Traffic Risk Mitigation Mechanisms been Successful?

Presumably the government mitigates traffic risk only in the riskiest concessions, the ones that otherwise would attract few or no bidders or be very likely be renegotiated. If traffic risk mitigation were being used sensibly, one would expect to see mitigation in types of projects with inherently higher traffic risk. In addition, one would expect the average number of bidders and frequency of renegotiation to be fairly similar in the concessions where risk was borne entirely by the concessionaire and the concessions where it was mitigated. If the number of bidders is higher and the frequency of renegotiation lower, then that implies that the government has shifted more risk from the concessionaire to itself or users than is necessary to compensate for the inherently riskier nature of these projects. Similarly, if the number of bidders is lower or the frequency of renegotiation higher then the government has not transferred enough risk to compensate for the inherently riskier nature of these projects.

For the goal of this paper, traffic risk mitigation mechanisms may be considered successful if they have helped increase the number of bidders and reduce the frequency of renegotiation. This relation is not easily identified because the number of bidders and renegotiation are not only related to traffic risk allocation. Ideally one would like to perform a multivariate analysis of the effects of risk shifting on the numbers of bidders and frequency of renegotiation, controlling the inherent level of traffic risk and other characteristics of the concession that affect bidding and renegotiations. Unfortunately, information on the many relevant variables is not readily available. Simple correlations between risk shifting, the level of traffic risk and the numbers of bidders and frequency of renegotiation are suggestive nonetheless.

A database of all toll road projects implemented in Latin America between 1990 and 2010 has been elaborated for the purpose of this research. The projects have been classified according to the party that bears traffic risk (government, users or concessionaire) and by the mechanism implemented to mitigate traffic risk. The distinction between brownfield and greenfield projects has been used as a simple measure of traffic risk. Within this research, two different analyses have been carried out. First, the frequency of risk shifting for 146 brownfield and 48 greenfield concessions in Latin America were compared. The results show that it is unclear if the governments have been shifting risks mainly for the riskiest projects (Table 4). Since traffic risk is usually thought to be higher in a greenfield than in a brownfield concession, one would expect risk shifting to be more common in greenfield concessions. However, the government or users assumed some of the traffic risk in 55% of the brownfield projects but did not assume traffic risk in any of the greenfield projects, as shown in Table 4. This result is strongly affected by the first Mexican program, which accounts for most of the concessions classified as greenfield. Indeed, the discouraging experience of this early Mexican program is partly responsible for the emphasis on brownfield projects in other countries and later

Table 4. Traffic Risk Shifting in Road Concessions in Latin America

Parameter	Brownfield	Greenfield	Total
Number of concessions	146	48	194
Traffic risk borne by the government or users (%)	55	0	—

Note: Elaborated by the authors with data provided by OSITRAN (Peruvian Public Agency for Supervision of Investment in Transport Infrastructure), Coordinacion de Concesiones (Chilean public agency in charge of transport concessions), INCO, Colombia, General Directorate for Road Development (Mexico) and ANTT, Brazil. Data for Argentina have been taken from Vassallo and Izquierdo (2010).

Table 5. Cross-Section Analysis of Road Concessions in Latin America According to Traffic Risk Allocation

		Traffic risk borne by						
		Government			Government and users	Users		
Category	Number (%)	Availability payments	MIG	DSLG	DSLG and flexible term	Flexible term	Total government and users	Concessionaire
Projects	Number	16	44	0	12	8	80	114
	%	8	23	0	6	4	41	59
Renegotiated	Number	7	36	—	12	4	59	71
	%	44	91	—	100	50	74	62
Bidders (average)[a]	—	1.8	3.2	—	4.0	3.3	3.2	6.2

Note: Elaborated by the authors with data provided by OSITRAN (Peruvian Public Agency for Supervision of Investment in Transport Infrastructure), Coordinacion de Concesiones (Chilean public agency in charge of transport concessions), INCO, Colombia, General Directorate for Road Development (Mexico) and ANTT, Brazil. Data for Argentina have been taken from Vassallo and Izquierdo (2010).

[a]The result does not include the concessions of the states of Sao Paulo, Paraná, and Rio Grande do Sul because it was not possible to obtain that information.

programs. Moreover, the distinction between brownfield and greenfield is somewhat arbitrary and not the only factor that influences traffic risk. Many brownfield projects involve a fairly substantial investment in improving the existing road, for example, and that investment can make them very vulnerable to traffic risk.

In the second analysis, we have compared the renegotiation frequency and the number of bidders in the projects that have some traffic risk mitigation and those where the concessionaire bears all traffic risk. The results show that traffic risk mitigation mechanisms do not appear to have been successful in increasing the number of bidders or in reducing the frequency of renegotiation. As shown in Table 5, the rates of renegotiation were slightly higher in the projects that had some kind of traffic risk mitigation (74%) than in the projects where traffic risk had been fully allocated to the concessionaire (62%). Regarding the average number of bidders, it was only half as much in the projects that had some kind of traffic risk mitigation (3.2 bidders) as in the projects where traffic risk had been allocated fully to the concessionaire (6.2 bidders). Both of these results suggest that there is not a clear linkage between the implementation of traffic risk mitigation mechanisms and an increase in the number of bidders or a reduction of the frequency of renegotiation. Consequently, the claim cannot be from the data that traffic risk mitigation mechanisms make concession contracts more successful.

Conclusions

In sum, Latin America has experimented with a variety of approaches to the allocation of traffic risk. Mexico and Brazil have used fixed-term concession contracts without implementing substantial mechanisms to mitigate traffic risk for the concessionaire. However, Chile, Colombia, and Peru have been greatly concerned with mitigating traffic risk in road concessions, either by putting in practice public guarantees, by implementing flexible term concessions, or through availability payment concessions.

The paper also shows that shifting traffic risk from the concessionaire to the government or users was not confined to the riskiest projects as one might expect. Indeed the opposite was true since there was no risk shifting in the greenfield projects, the ones supposed to be the riskiest ones. However, this result may be influenced too much by the pioneering Mexican experience.

Finally, the analysis also suggests that the implementation of traffic risk mitigation mechanisms in toll roads in Latin America has not been very successful in reducing renegotiation rates and increasing the number of bidders. The number of bidders was lower and frequency of renegotiation higher in the projects where traffic risk had been mitigated. This suggests that traffic risk mitigation was not enough to make these projects as attractive as the concessions where traffic risk was borne entirely by the private concessionaire.

Appendix. List of Interviews

Person	Date	Topics addressed
Henrique Oliveira Mendes, Especialista Sênior em Infraestrutura, Departamento de Outorgas da Secretaria de Política Nacional de Transportes, Ministério dos Transportes, Brasil	August 1, 2011	How many bidders were there in each one of the projects? What is the difference (as of 2010) between the real traffic and the forecast traffic? Have the contracts been renegotiated? Why do you think that toll roads in Brazil have performed so well without having any kind of traffic risk mitigation mechanism?
Ronaldo Magalhães, Superintendente Executivo Agência Nacional de Transportes Terrestres (ANTT), Brasil	August 1, 2011	For both the first and the second Federal program: How many bidders were there in each one of the tenders? How do you measure success in the implementation of a traffic risk mitigation mechanism?
José Hidalgo Gorostegui, Jefe Promoción de Inversiones, División de Desarrollo y Licitación de Proyectos, Coordinación de Concesiones, Ministerio de Transportes y Telecomunicaciones, Chile	August 8, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Sergio Hinojosa, ex-Jefe de estudios y ex-asesor principal, Coordinación de Concesiones, Ministerio de Transportes y Telecomunicaciones, Chile	August 23, 2011	How many bidders were there in each one of the tenders? How do you measure the success in the implementation of a traffic risk mitigation mechanism?

Appendix (*Continued.*)

Person	Date	Topics addressed
Oscar Rosero, Jefe de Explotación, Instituto Nacional de Concesiones (INCO), Ministerio de Transporte, Colombia	August 9, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Mauricio Castro, Asesor de la Gerencia de Participación Privada en Infraestructura, Departamento Nacional de Planeación, Colombia. Anteriormente fue Asesor de la Subgerencia de Estructuración y Adjudicación, INCO, Ministerio de Transporte, Colombia	August 10, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Cesar Peñaloza, Jefe de la Oficina de Planeación del Ministerio de Transporte, Perú	August 8, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Carlos Fierro, Coordinador de Gestión Regulatoria, Organismo Supervisor de la Inversión en Infraestructura de Transporte de Uso Público (OSITRAN), Perú	August 9, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Sergio Bravo, Ex-viceministro de Transportes y Comunicaciones, Perú	August 19, 2011	Toll road programs in Peru: How many bidders were there in each one of the tenders? Which projects have been renegotiated and what was the main result of the renegotiation?
Henrry Zaira Rojas, Director General de Planificación y Presupuesto, Ministerio de Transportes y Comunicaciones, Perú	August 23, 2011	Toll road programs in Peru: How many bidders were there in each one of the tenders? Which projects have been renegotiated and what was the main result of the renegotiation?
Jose Antonio Gutiérrez, Asesor Financiero y Estructurador de Procesos de Concesión, Agencia de Promoción de la Inversión Privada (PROINVERSION), Perú	August 10, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Gabriel García, Ex-viceministro de Transportes y Comunicaciones, Perú	August 10, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Ivan Mauricio Fierro, Subgerente de Estructuración y Adjudicación, INCO, Ministerio de Transporte, Colombia	August 9, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Carolina Ardila, Asesora Financiera, Subgerencia de Estructuración y Adjudicación, INCO, Ministerio de Transporte, Colombia	August 17, 2011	Toll road programs in Colombia: How many bidders were there in each one of the tenders? Which projects have been renegotiated and what was the main result of the renegotiation?
Daniel Eduardo Alvarez, Asesor Técnico Subgerencia de Estructuración y Adjudicación, INCO, Ministerio de Transporte, Colombia	August 10, 2011	Toll road programs in Colombia: How many bidders were there in each one of the tenders? Which projects have been renegotiated and which was the main result of the renegotiation?
Silvia Davalos, Asesora Financiera, Dirección General de Concesiones en Transportes, Ministerio de Transportes y Comunicaciones, Perú	August 17, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure the success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Maria do Carmo Cattani, Assessora de Gestão Estratégica, Secretaria de Infraestrutura e Logistica, State of Paraná, Brasil	August 15, 2011	Toll road programs in the State of Paraná: How many bidders were there in each one of the tenders? Which projects have been renegotiated and what was the main result of the renegotiation?
Salvador Lucio, Director de Concesiones, Dirección General de Desarrollo Carretero, Secretaría de Comunicaciones y Transportes, México	19 August 19, 2011	Toll road programs in Mexico: How many bidders were there in each one of the tenders? Which projects have been renegotiated and what was the main result of the renegotiation?
Pablo Zamorano Maldonado, Asesor financiero, División de Desarrollo y Licitación de Proyectos, Coordinación de Concesiones, Ministerio de Transportes y Telecomunicaciones, Chile	August 19, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism? Have the contracts been renegotiated?
Amado Athié Rubio, Director General Adjunto de Formulación de Proyectos, Dirección General de Desarrollo Carretero, Secretaría de Comunicaciones y Transportes, México	August 22, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism?
Mario Fernández, Director Nacional de Vialidad, Ministerio de Transportes y Telecomunicaciones, Chile	August 23, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism?
Oscar de Buen, ex-Vicesecretario de Comunicaciones y Transportes, México	August 24, 2011	How many bidders were there in each one of the tenders? Have the traffic risk mitigation mechanisms been successful? How do you measure success in the implementation of a traffic risk mitigation mechanism?

Appendix (*Continued.*)

Person	Date	Topics addressed
David Villalba, Ex-viceministro de Transporte y ex-Gerente del INCO, Ministerio de Transporte, Colombia	August 23, 2011	Toll road programs in Colombia: How many bidders were there in each one of the tenders? Which projects have been renegotiated and which was the main result of the renegotiation?
André Castro Carvalho, legal adviser of the Brazilian Highway Concessionaires Association	August 9, 2011	Traffic risk allocation in toll road programs in Brazil: Mechanisms of mitigation

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