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RISK-SHARING IN HIGHWAY CONCESSIONS: CONTRACTUAL DIVERSITY IN PORTUGAL

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Abstract

Private sector involvement in road concessions has been one of the main options for governments to engage in large-scale road development plans. Political interference, optimism bias in demand forecasts and the absence of active regulators lead to frequent renegotiations of road contracts and large public remunerations to concessionaires. Because they are unable to deal with the increasing uncertainty in forecasts, governments are turning to availability payment schemes, which appear to be robust solutions that limit public losses. This paper evaluates the allocations of risk in four Portuguese road concessions under a contractual regulatory regime, discusses the types of incentive mechanisms used in each instance and draws lessons from these case studies. This investigation reveals evidence indicating that although contracts are becoming increasingly complex over time, the public sector is assuming more production and commercial risks in the highway development process.

Keywords: Contractual regulation; Highway development; Portugal, Risk-sharing; Road concessions.

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INTRODUCTION

Improving road accessibility has been a major concern of public decision makers ever since the time of the Roman Empire (Bryan et al., 1997; Button, 1993). The importance of this political priority is clearly demonstrated by the large capital sums that governments in both developed and developing economies assign to the financing of road-related investments (Gudmundsson and Hojer, 1996). These investments are designed to achieve two major objectives, namely, improving overall road accessibility by shortening the effective distances between major cities and reducing road casualties. A high level of road infrastructure construction has occurred in recent years, largely due to contractual public-private partnerships (PPPs), such as concession arrangements. Since the early 1990s, these arrangements have been the preferred public procurement model for promoting the development of roads and other infrastructure (Stainback and Donahue, 2005; Barnett, 1989).

Although many policymakers assumed that PPP models provided a means of financing infrastructure with no public expenditure, these models did not produce the expected financial savings because the true cost of concessions was far greater than initially anticipated (Flyvbjerg et al., 2003; Skamris and Flyvbjerg, 1997; Pollock et al., 2002). Instead, renegotiations and bailouts increased the global expense of many concessions to cost levels that were far greater than the expenses that would have been incurred by traditional procurement models for public work contracts (Engel et al., 2003 and 2009; Serag et al., 2008). This reality undermines the argument that private infrastructure financing would allow public resources to be devoted to other sectors without considering the infrastructure investment to be a public expenditure and thereby

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generates doubt about the ability of private infrastructure financing arrangements to effectively mitigate public deficits.

Until the past several years, the interbank market provided financial institutions with ready access to large volumes of capital. However, the recent bankruptcies of large financial groups (e.g., Lehman Brothers and AIG) and the fragile conditions of public accounting in Ireland, Greece, Portugal and Spain launched the euro into an unprecedented crisis, dramatically decreasing the volume of capital that was in circulation. At present, there is low credit availability in both the private and public sectors of many countries.

If financing arguments are either completely invalid or of diminished importance, does it still appear reasonable to develop build-operate-transfer (BOT) schemes? The main motivation for developing these schemes is the principle that higher levels of efficiency can be achieved if risk is transferred to the private partner (Meda, 2007; Nisar, 2007).

The literature on road concessions is quite vast, although relatively little research has addressed the details of contract structure, particularly with respect to risk-sharing. This paper addresses this issue by examining the Portuguese experience in the road sector. This study focuses on four concessions with different contractual structures and assesses the specific compensation mechanisms used and the risk-sharing agreements of these particular concessions.

The main question that this investigation addresses is how risk-sharing agreements have evolved over time. One might expect that the public sector has accumulated more

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knowledge as it has become more experienced in arranging these agreements; thus, by this line of reasoning, the public sector would have moved towards employing PPP models that provide greater value for money (VfM) to the government and transfer greater risk to the concessionaire. Despite this rationale, the risk-sharing mechanisms within the road concession contracts demonstrate exactly the opposite phenomenon; in particular, the value that concessionaires have at risk decreases over time and the grantor typically secures the potential losses of concessionaires. Therefore, the paper will try to elucidate the means by which different contractual structures were implemented (the specific compensation formulas underlying each contract).

After this initial introduction to the current study has been completed, section 2 presents the literature review regarding road concessions. Section 3 then provides the Portuguese organization for road concession development and management, and section 4 analyses four case studies of concession contracts. Subsequently, the contracts are specifically assessed in section 5; finally, in section 6, the concluding remarks are presented.

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LITERATURE REVIEW REGARDING ROAD CONCESSIONS

Road concessions have been privatized for many years, although the results of these privatizations were not always in accordance with expectations, as discussed above. These privatizations have attracted the interest of scholars who, during the last 10 to 15 years, have devoted their attention to PPP contracts in general and road concessions in particular. Research addressing road concessions has spanned a wide range of topics, including financing, risk-sharing, risk mitigation, stakeholder management, toll management, and other factors. Certain researchers have adopted a more theoretical approach to these issues, whereas others have performed their investigations on a case study basis (see Table 1).

(Insert Table 1)

Table 1 provides a general overview of the main literature on road concessions. The majority of the work referenced in this table was conducted during the past ten years, which corresponds both to the period of higher growth for these investments and to the timespan when it was feasible to assess the results produced by the concessions that were developed in the 1990s. Although the literature about road concessions addresses diverse topics, for the purposes of this research paper, the most relevant studies are the investigations regarding risk-sharing and renegotiation in the context of road concessions.

The main risks associated with a road concession are construction and demand risks, though several other types of risk can be found at different levels during the road

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concession process (see Grimsey and Lewis, 2002; Bing, 2005; Marques and Berg, 2009a and 2009b). The issue of risk allocation has been extensively discussed in the literature (Grimsey and Lewis, 2002, 2005; Meda, 2007). Many approaches to this issue are adopted, but there is a general consensus in the field that agents should bear the risks that they are most capable of addressing. In other words, if each agent is responsible for the risks that it can control, then the VfM of the PPP will be increased relative to the VfM of the traditional procurement model, in which the public sector bears almost the entirety of the risks.

Construction overruns in road development projects occur quite frequently (Flyvbjerg et al., 2003; Odeck, 2004); however, these overruns should constitute a production risk that can be borne by the concessionaire. In fact, the PPP model was initially developed to ensure greater control over this risk.

Questions regarding demand risk are less clearly resolvable. First, road demand is highly dependent on economic climate, and there is no managerial flexibility to deal with varying demand with respect to road concessions, in particular. Toll discounts are dependent on governmental decisions; therefore, the notion of dynamic toll management, which was proposed by Nagae and Akamatsu (2006), is typically not feasible. In other types of concessions, such as seaports, airports and public transport, the manager can change or adapt the “service/infrastructure” to accommodate demand changes or induce more demand. For roads, however, these types of adaptations are typically either impossible or relatively difficult to achieve. Second, there is the problem of optimism bias in demand forecasts (Flyvbjerg et al., 2004; Mackie and

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Preston, 1998; Bain, 2009). Traditionally, demand for roads has been overestimated. This is a non-insurable risk that is not controlled by the concessionaire and constitutes one of the main reasons for concession renegotiations (Engel et al., 2008).

The problem of renegotiation arises when the concessionaire is forced to bear uninsurable risks, such as demand risk. The provision of contractually defined lower and upper limits for demand volumes is a form of insurance that minimizes the potential losses for the concessionaire. Thus, in PPP contracts, if the demand decreases below the lower limit, then the concessionaire is entitled to compensation from the grantor.

Many concessions face the problem of asymmetric behavior. If the demand for a road is greater than initial forecasts, then the concessionaire receives the surplus; however, demand that is below initial estimates typically leads to contract renegotiations (Vassallo, 2006).

Demand evolution depends mostly on economic conditions (derived demand); thus it is more difficult to predict and/or influence this factor. For this reason, there is no financial and legal form of protecting the concession against demand deviations, that is, there is no equivalent to the insurance market that is found in other types of concessions, such as oil extraction (Vassalo and Sanchez-Soliño, 2007).
This deficiency is particularly relevant if the road networks of developed countries are reaching a mature level, which decreases the marginal benefit of each new kilometer of highway. The Portuguese case is a textbook example of this phenomenon: the first road

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concessions functioned on a "stand-alone" basis, financing themselves with tolls, whereas the same phenomenon is not observed for more recent tolled concessions.

Engel et al. (2003), in a study of the Latin American experience with highway privatization, found two main reasons for the flaws in many PPP, namely, the "privatize now, regulate later" perspective adopted by governments and the fixed-term franchise approach, which leads to revenue guarantees and renegotiations. Vassallo (2006) analyzed the innovative alternatives to fixed-term franchises that have been adopted in the Chilean case. In this context, several mechanisms have been used to mitigate demand risk, such as the *Minimum Income Guarantee* (MIG), the *Least Present Value of the Revenues* (LPVR) and the *Revenue Distribution Mechanism* (RDM). Vassallo (2006) found that conceptually, the LPVR method behaves properly in terms of avoiding renegotiation and preventing tariff increases, although only 2 out of 26 concessions were awarded with this type of mechanism in place. The low frequency of the LPVR method can be justified because this type of contract limits the upside profitability for the concessionaire and is more complex to plan, decreasing the private sector interest in the concession in question. In addition, the maximum duration of the concession, which is generally defined by relevant legislation, can jeopardize the use of the LPVR model.

Vassallo presents the RDM as the optimal way to cope with these considerations because this approach obliges the government to pay the remaining LPVR at the termination of the concession, thereby restricting the demand risks to the concessionaire. The MIG approach is not recommended because it does not reduce

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renegotiation risk. The problems with respect to highway franchises are essentially the same in each country: the impossibility of avoiding renegotiations (which are harmful to the public interest) due to contract incompleteness (Williamson, 1976); opportunistic behavior by the concessionaire; and deficiencies in regulation, as the entity entrusted with the responsibility to monitor and regulate a concession is also responsible for developing and implementing the concession in question.

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THE PORTUGUESE ROAD SECTOR

The historical context

The first toll road concession in Portugal was awarded in 1972 and included the construction, maintenance and operation of the motorway linking Lisbon to Porto (A1); however, PPP arrangements preceded by a tender procedure and partner selection have only been established during the course of the past decade .

In the period between 1990 and 2009, the Portuguese highway network experienced a significant series of developments (Figure 1).

(Insert Figure 1)

Between 1996 and 2009, the network has increased by more than 110%, primarily due to the increase in the “principal itinerary” network (340%). The distinction between principal and complementary itineraries is based on the road network hierarchy: the principal itinerary network represents the main connections, whereas the complementary itinerary network corresponds to secondary linkages. Currently, there are 12 road concessions in operation, and an additional 10 concessions have been awarded. Significant alterations to the concessionary process resulted from the implementation of the New Road Sector Management and Financing Model (NMGFSR) in 2007; in particular, these changes impact the means by which the private sector interacts with the public sector with respect to concession contracts and their management.

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There are approximately 8,500 km of national road network that have already been constructed in Portugal, of which 2,729 km are motorways and approximately 1,500 km are tolled roads. The remaining roads are either virtual toll roads or roads without tolls, as regional and municipal roads are not included in the statistics provided above. Table 2 summarizes the Portuguese motorway network. Notably, in the past eight years, 1,288 km of roads have come into operation.

(Insert Table 2)

Relevant stakeholders

The concession for developing and maintaining the entire principal road network was awarded to Estradas de Portugal (*Roads of Portugal*, EP), which has the Portuguese state as its single shareholder and total financial autonomy. This contract, which was signed in 2007, was awarded for 75 years. For the construction, financing and maintenance of new roads, EP can either adopt a traditional procurement method (public work contracts) or develop PPP arrangements through the concession regime. Technically, EP arranges sub-concessions, as it has received a single broad concession that encompasses the entire system; thus, the PPP arrangements brokered by EP constitute smaller sub-concessions within this comprehensive concession. For the purposes of simplicity, however, these arrangements will simply be referred to as concessions throughout the remainder of this manuscript.

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At present, EP assignments exist in every phase of the concession life cycle, from planning to monitoring. The current legal framework of the PPP implementation process entails the establishment of a number of committees to evaluate and negotiate partnerships: the *monitoring committee* (which conducts the study phase and monitoring of PPP), the *bid evaluation committee* (which assesses the impact of the risks and costs incurred by the public partner as well as the merits of private partner bids) and the *negotiations committee* (which represents the public partner in the negotiations that occur with the private partner).

All of these committees are appointed by joint decision between the *Ministry of Finance* (MFAP) and the *Ministry of Public Works* (MOPTC). These are the two ministries with direct responsibilities for road concessions.

A major recent modification to the concessionary process was the foundation of a regulatory body, the Institute for the Road Sector I.P. (InIR), which has the following responsibilities: supervising and overseeing the management and operation of roads; controlling compliance with laws, regulations and concession contracts; guaranteeing the implementation of the National Road Plan; and ensuring the efficiency, equity, quality and safety of the road infrastructure as well as the rights of road users.

The InIR has displayed many weaknesses as it pursues its mission. Certain of these issues can be justified by its reduced experience, as it was created recently, during the implementation of the NMGFSR. The many setbacks that this implementation has suffered also help explain the current lack of relevance of the InIR. The participation of

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the InIR in contract renegotiation processes is very recent and its role in concession tenders has thus far been nearly non-existent.

In the Portuguese road sector, there are several stakeholders, which are split between the public and private sectors. The state assumes two different (and possibly opposing) roles: it not only has to manage the contract in its best interest but also has to monitor and regulate the relationship between private and public parties. Several public entities are involved in playing both of the roles mentioned above. There may be an overabundance of public entities involved in the concessionary process, particularly given that there are disagreements at times among the various public stakeholders regarding renegotiation, measurement of the VfM or issues related to information asymmetry.

Another public entity with a major role in the road sector is the *Court of Auditors* (TC). The TC is responsible for the supervision and control of public funds and has therefore performed an important role with respect to PPP contracts in Portugal, as all of these contracts are subject to the financial control and approval of the TC. TC also publishes many reports and case study follow-ups that address road concessions subjects. In fact, it is the only Portuguese entity that issues regular publications regarding regulation matters. There are other public entities with responsibilities in the road sector, such as municipal governments, the *Ministry of Environment*, the *General Directorate of Treasury and Finance* (DGTF), and the *General Inspectorate of Finance* (IGF), among others.

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There are many private entities in the road concession business in Portugal; these entities are often associated with large construction companies. The largest private operator in the Portuguese road sector is Brisa, a formerly state-owned enterprise that has now been privatized. In the 1990s, Brisa was the sole concessionaire in Portgual, and it obtained the first concession granted by the Portuguese government. However, in the past several years, another concessionaire, MotaEngil, which is one of the largest construction groups in Portugal, has gained ground in the road concession market. Foreign companies are also present in the shareholder structure of many PPP arrangements (through the use of special purpose vehicles – SPVs) and are important participants in certain concession arrangements. Other important agents include the banks that ensure the provision of financial resources for PPP contracts; several of these banks directly participate in SPVs as part of concessionary arrangements. Finally, there are external consultants who support public and private sector entities. These consultants use of outsourcing, particularly by the public sector, can compensate for deficiencies in experience and expertise.

One of the most important public entities in the road sector is InIR, the regulatory body for this sector. This agency is a public institution with administrative autonomy within the context of the national government, and it pursues MOPTC assignments under the supervision of its minister. The EP and all of the private concessionaires of the Portuguese road network are subject to the jurisdiction of InIR, as are other private operators in the road sector.

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Between 1999 and 2007, an accumulated amount of 1,076 million euros in both real and shadow toll concessions was paid to concessionaires by the government. As expected, the shadow toll highways were the roads for which higher compensation was paid by the Portuguese government (because concessionaires receive no other source of revenue for these roads); in particular, the shadow tolls totaled 867 million euros during the time period in question, whereas the governmental compensation for the true toll highways totaled only 209 million euros. At present, the Portuguese government continues to commit a significant portion of its budget to support the development of the highway concessions program (Table 3). The current annual payments illustrated in Table 3 are directly obtained from the various revenue formulas provided in the next section for each case study.

(Insert Table 3)

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CONTRACT ANALYSIS

Overview

Contract structures have evolved over time. In this section, the following four contracts will be analyzed: the contract of Brisa (the first Portuguese concession), in which the concessionaire constructed tolled highways and collects and keeps the toll revenues; the contract of Beira Interior, in which a virtual tolled motorway was built by the concessionaire; the contract of Norte, EP collects the toll revenues for the tolled motorways built by the concessionaire and then pays that concessionaire using an availability-based model; and the contract of Douro Interior, in which EP pays an availability fee for the non-tolled roads built by the concessionaire. All of these contracts are valid for a 30-year period from the establishment of the concession, except for the Brisa contract, which received a 3-year extension after renegotiation.

Because it was not feasible to present and discuss all road contracts, the authors selected only the four contracts listed above, which are representative of the various types of concessionary arrangements that currently exist in Portugal. In addition, these contracts represent distinct time periods, as the Brisa concession took place in 1981, whereas the Beira Interior and Norte concessions were established in 1999, and the Douro Interior contract occurred recently in 2008.

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Brisa Contract

Brisa was originally a public company but was privatized in the 1990s, allowing the public sector to realize a capital inflow of 1,875 million euros. Brisa owns and manages 1,094.7 km of roads.

Brisa contract is a "stand-alone" concession, as no compensation from the government was incorporated into the contract. Renegotiations of the original concessionary contract have occurred, and these renegotiations resulted in a contract extension, as mentioned above. Today, Brisa is a company listed on the Portuguese stock exchange, which is known as the PSI 20. Brisa holds 6 concessions in total: the main concession, which resulted from the privatization of the company and includes a total of 1,136 km of roads (with a contract that ends in 2035), and 5 smaller concessions, each of which is between 68 km and 129 km in length.

Beira Interior

The Beira Interior concession was awarded to the concessionaire SCUTVIAS and began operating in 2003 under a shadow toll regime. It comprises a total length of 176.5 km; of this length, 82.3 km had to be constructed, 47 km were refurbished and the remainder was existing road. This concession involved a total construction cost of 590.4 million euros, and a full life-cycle cost of 2,379.2 million euros (these figures represent prices from 2003).

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Payments from the grantor to the concessionaire are made based on demand. In particular, three intervals of demand are defined: upper, reference and lower [formula (1)]. For each of these intervals a shadow toll is established, consisting of a rate of compensation per vehicle.kilometer; this rate is highest for the lower demand interval and lowest for the upper demand interval. Thus, the rate of compensation decreases as demand rises; moreover, if demand increases beyond the upper interval, then there is no additional payment for each additional vehicle.kilometer. In effect, this compensation structure ensures that there is a maximum limit on the amount that the grantor must pay for the concession in question.

$$TR_t = (1 - k_t^1 - k_t^2) \times \sum_l P_l \tag{1}$$

where

TR_t is the total revenue of the concessionaire;

k_t^1, k_t^2 are the reduction factors that apply until the entire concession is built (the concession is not built at one time, and thus, these factors provide an incentive for the concessionaire to complete the construction), which, in this case, are $k_t^1 = 0.12$ and $k_t^1 = 0.05$; and

P_l is the payment for each interval l (lower, reference and upper).

Penalties are established for capacity constraints. In particular, if the motorway availability is below a given threshold, then the following penalties can be applied; between 7 and 21 hours, the quantity of unavailable lane x kilometers x hour cannot exceed 30,000 per year. During the remaining times, the quantity of lane x kilometers x hour cannot exceed 50,000 per year. For each fraction of 1,000 by which these availability metrics exceed the given thresholds, a penalty of 2,500 euros (for daytime

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excesses) or 5,000 euros (for nighttime excesses) can be applied. (These prices are from 1999 and are subject to adjustment in accordance with fluctuations in the Consumer Price Index (CPI).) The difference between these thresholds provides the concessionaire with an incentive to concentrate maintenance during nighttime hours.

Regarding casualties, there is a *bonus/malus* system to incentivize casualty reduction. A casualty index (CI) is calculated using formula (2), and the CI results are compared with the weighted casualties index (WCI) of the previous year. The WCI is a ratio of the concession casualties to the total casualties in the entire network. If the CI for a given year *t* is lower than the WCI for year *t-1*, than the concessionaire is granted a premium, whereas a penalty is imposed if the CI is higher than the previous year's WCI.

$$CI_t = \frac{N_t \times 10^8}{L \times AADT_t \times 365} \tag{2}$$

where

N_t is the number of accidents in the concession in year *t*;

L is the total length of the concession and

$AADT_t$ is the annual average daily traffic in year *t*.

The particular *bonus/malus* is calculated from the CI in accordance with the following formulas:

Bonus

$$2\% \times TR_t \times \frac{WCI_{t-1} - CI_t}{CI_t} \tag{3}$$

Malus

$$2\% \times TR_t \times \frac{CI_t - WCI_{t-1}}{CI_t} \tag{4}$$

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Norte Concession

The Norte concession was fully opened in 2006 and consists of two highways, A7 and A11, which have a total length of 175.1 km and are administered under a real toll regime. The construction cost for this concession was approximately 808 million euros, and its total life-cycle cost is expected to be 1,490 million euros. The risk-sharing aspects of this contract changed dramatically over time. The concession was initially projected to be fully financed by toll revenues; under the initial plan, tolls would go directly to the concessionaire, who would assume a large portion of the commercial risk. However, this concession was redirected towards an availability payment model in which the public sector assumes the entirety of the commercial risk. The toll updates follow the same formula as that of the Brisa contract.

Concessionaire revenues are calculated using the following formula:

$$TR_t = AvR_t = AvD_t \pm AcP_t \quad (5)$$

where

TR_t is the total revenue for the concessionaire in year t;

AvR_t is the availability revenue in year t;

AvD_t is the availability deduction (using a *bonus/malus* scheme) in year t; and

AcP_t represents the premium/penalty for the accidents of the concession.

The availability revenue is calculated as follows:

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$$AvR_t \pm \left[ADR_t \times \frac{CPI_{Dec_{t-1}}}{CPI_{Dec_{2009}}} \times 0.25 = ADR'_t \times 0.75 \right] \times n_t \quad (6)$$

where

ADR_t is the daily availability rate in year *t*;

ADR'_t is the non-updated daily availability rate in year *t*;

$CPI_{Dec_{t=1}}$ is the consumer price index (excluding housing) in December of year *t-1*; and

$CPI_{Dec_{2009}}$ is the consumer price index in December (excluding housing) of the year 2009.

Availability penalties can be calculated as follows:

$$AvD_t = \left[ADR_t \times \frac{CPI_{Dec_{t-1}}}{CPI_{Dec_{2009}}} \times 0.25 + ADR' \times 0.75_t \right] \times D \times m(D) \times d(D) \quad (7)$$

where

D is the ratio between the number of kilometers of unavailable road and total length;

$m(D)$ is the magnitude coefficient of the failure, with $m=0$ indicating total unavailability and $m=0.5$ indicating relative unavailability;

d(D) is the duration coefficient of the failure, which is equal to 0.3 if failure takes place between 22h00 and 06h00, 0.7 if the failure takes place between 06h00 and 22h00 $d=0.7$, and 1 if the failure lasts for 24 h.

Bonus calculation

$$AcP_t = 2\% \times AvR_t \times \frac{NFI_{t-1} - CFI_t}{CFI_t} \quad (8)$$

Malus calculation

$$AcP_t = 2\% \times AvR_t \times \frac{CFI_{t-1} - NFI_t}{CFI_t} \quad (9)$$

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where

$NFI_{t=1}$ is the national fatalities index in year *t-1* (national average) and

CFI_t is the concession fatalities index in year *t* (the average for the concession itself).

Also in the Norte concession, all revenues from the rest stops and service areas belong to the concessionaire. The payment is based on an availability level, but the revenues from tolls are collected by the concessionaire and then delivered to the grantor (EP). The contract also states that if the revenues exceed the initial forecasts of the base case scenario, the concessionaire will be granted a 25% bonus. One can argue that this is an incentive for the concessionaire to attract more demand; however, because the payment is made on availability, the quality standards are correctly monitored, and concessions constitute a monopolistic sector that experiences little or no competition, this "extra bonus" does not appear to satisfy any economic rationale. Instead, the bonus simply provides additional rent potential for the concessionaire, as the concessionaire does not have any value at risk but is allowed to potentially acquire extra revenues.

The production risks are assumed by the concessionaire, with the exception of environmental risks. If the road layout must be changed to obtain the environmental permits, then the concessionaire is entitled to receive appropriate compensation. It is important to note that environmental risk is one of the most significant hazards involved in building a road.

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Douro Interior

The Douro Interior concession will consist of 242 km of motorways, which will be divided between two roads (IP2 – 111 km, and IC5 – 131 km). Although this concession is not yet in operation, its analysis can provide useful lessons, as we will attempt to demonstrate.

The contract for this concession was awarded in 2008, but the Portuguese TC did not approve the contract for several reasons. First, there was no calculation of the Public Sector Comparator (PSC). PSC is the risk-adjusted cost of the project if developed using traditional public work contract methods (Cruz and Marques, 2012). The calculation of the PSC allows us to determine whether the PPP model provides VfM or whether traditional contracting is the best solution; moreover, this calculation is required by Portuguese regulations.

The second reason that the Douro Interior concession was not approved was that the winning bid was worse after the negotiation phase (which involves stating a best and final offer (BAFO)) than during the initial selection phase. The main criterion for awarding the concession was the magnitude of the governmental compensation to the concessionaire (with a 50% weight, whereas technical matters and legal issues accounted for 40% and 10%, of the decision-making process, respectively). The bidder claims that between the first offer (698.6 million euros required compensation) and the BAFO (757.7 million euros), the financial assumptions of the bid changed significantly, creating the difference of 58.8 million euro between these offers. The TC claims that if worse conditions are allowed to affect the negotiation phase, which occurs between the

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tender of an offer and the signature of a final contract, then there will be an incentive for bidders to present predatory prices in the initial phase; these bidders will presumably expect to reach a break-even point during the negotiation phase, after they have already been selected. Engel et al. (2009) also present evidence of this behavior.

The third reason that the TC did not validate the contract was that an environmental permit for one of the road sections was still missing. Former concessions in which this deficiency occurred have demonstrated that it may result in heavy future compensation. If the Environment Agency requires the layout of the road to change, then the concessionaire is entitled to compensation because the object of the concession would have changed (in a manner that was not anticipated by the concessions contract). The calculation of this compensation is accomplished in a monopolistic environment; no competition for the concession would exist after the concession in question had already been awarded. Ultimately, the political calendar and the pressures of public opinion often cause an overpayment of compensation in these cases.

The payment scheme for this putative concession is the most complex of all of the contracts examined in this study:

$$TR_t = AvR_t + SeR_t = PAD_t = EAcD_t \pm \hat{A}\epsilon P_t \quad (10)$$

where

SeR_t are the compensations for effective service provided by the concessionaire;

PAD_t are the deductions for performance and availability failures; and

$EAcD_t$ are the deductions for environmental externalities and road accidents.

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$$AvR_t = \sum_j R \times n_j \times \frac{l_j}{L} \tag{11}$$

where:

R is the daily rate;

j is the road section;

n_j corresponds to the number of days that the section was open;

l_j is the road section length; and

L is the total length of the concession.

The compensations for the service that is provided by the concessionaire are as follows:

$$SeR_t = \sum_j l_j \times SR_j \times AADT_t \times n_j \tag{12}$$

where

SR_j is the daily service rate and

$AADT_j$ is the annual average daily traffic.

If $20{,}000 = AADT_j = 25{,}000$, then the daily service rate will be 75% of its pre-defined value, whereas if $AADT_j = 25{,}000$, the daily service rate will be 50% of its pre-defined value;

The deductions relative to availability are calculated similarly to formula (3). The deductions with respect to externalities and road accidents are calculated as follows:

$$EAcD_t = S_t \times UC_t \tag{13}$$

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where

S_t is the score obtained according to a measurement scale and

UC_t is the unitary cost of points.

The measurement scale accounts for several different variables; in particular, to address environmental aspects, it incorporates the factors of air quality, noise level, water quality and habitat disruption, whereas for road accidents, the scale considers the number of "black spots" of the concession and the concession's accident gravity index. "Black Spots" is a name given to road sections of less than 200 meters in length where accidents that have involved a cumulative total of 5 or more injuries have taken place over a 1-year period.

The computation of deductions in this contract differs from the computations used in previous contracts. First, the assessment for deductions does not use the performance of other concessions as a benchmark; instead, this evaluation is based on how the performance of the concession in a year compares with the previous year's performance for that concession. This analytical approach accounts for the specific nature of the Douro Interior concession (notably, the road layout is not a highway and therefore does not have separate lanes) and provides incentives for the concessionaire to improve every year.

The concessionaire must pay a management contract fee, which is calculated as follows:

$$MCF = K \times \frac{\sum_j AADT_j \times l_j \times 365}{1{,}000{,}000} \tag{14}$$

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where K=100 euros (in December 2007 prices, adjusted in according with changes in the CPI).

Discussion

These contracts highlight completely different contractual structures and principles. It is clear that the grantor (EP) of these concessions has grown increasingly concerned over time about monitoring the concessions and providing performance incentives for concessionaires; these performance incentives are intended to produce positive externalities such as decreasing motorway casualties and maximizing environmental benefits. However, there are also more profound differences in the evolution of concession contracts over time. In the first contract, the concessionaire cost recovery was fully based on real tolls collected; thus, both commercial and production risks were entirely allocated to the private partner. As stated above, this contract was the initial concession in Portugal, and thus it included the first, most profitable, highways in the nation. During the beginning stages of road network development (the 1980s and 1990s), the priority of developers was to provide links between the most important and denser areas of the nation. Second, demand forecasts were not a concern at this time because the motorization rate was growing significantly, a social impetus existed for fast travel, there was an increase in commuting, and the GDP per capita was growing; therefore, there was no significant demand risk.

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Brisa was not awarded the contract through a tender process. In fact, the company was publicly owned and was only subsequently privatized; an economic group bought Brisa shares in the absence of any competition. The contract is also silent with respect to renegotiations; however, more meaningful regulations are required that extend beyond simply verifying compliance with contractual terms. The absence of incentives to improve performance lead to a "quiet life" by the concessionaire; although there is no proof for this statement, it appears likely that the unmonitored nature of the concession produces the abusive appropriation of economic surpluses (Marques, 2010).

The Beira Interior concession is now shifting towards a "real toll" scheme that will more closely approximate the Norte concession model and will include an availability payment. However, this change is more directly related to governmental revenue needs than to the failure of the Beira Interior's conceptual model. In addition, this change does not significantly affect the risk-sharing equilibrium of the concession, given that the grantor was already assuming a large portion of risk in the original shadow toll mechanism. However, in the Norte concession, the original mechanism of the concession involved the concessionaire assuming the majority of the risk, whereas subsequent contractual changes shifted the majority of the risk was to the public sector. The benefits of this transition are not clear and require more attention towards *ex-post* regulatory mechanisms.

The Douro Interior contract is the most complex and complete of the four contracts examined in this study by a significant margin. This complexity reflects the concessionary expertise that has been accumulated over time and incorporates several

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relevant regulatory aspects. It will be important to evaluate, in the medium to long term, how these regulatory mechanisms work, and whether their results are sufficient to compensate for the higher transaction costs that arise from greater complexity.

From a risk-sharing perspective, concessionary contracts can be divided into two categories in accordance with the entity that assumes the majority of the risk. In the Brisa and Beira Interior concessions, demand risk is assumed by the concessionaire, although in Beira Interior there is are upper and lower bounds that limit the potential losses of the concessionaire. Conversely, in the Norte and Douro Interior concessions, the public sector assumes the entirety of the demand risk.

This diversity in contractual arrangements can be explained by the fact that commercial risk (revenue uncertainty) for the initial concessions was low, whereas demand was high; thus, full cost recovery on a toll-only basis was feasible. However, these conditions did not remain constant during the past 10 years; over this period, demand has remained relatively stable and the highway network has continued to increase, producing greater commercial risks. Regardless of the economic conditions, a political commitment had been made to link all main cities to the national highway system. This commitment produced the "build at all cost" approach that was described earlier in this paper.

The contractual heterogeneity raises certain questions during the design of a global regulatory model. However, it is difficult to establish common guidelines for a broadly applicable model because in certain cases, regulation should be focused on contractual

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monitoring, whereas in other instances, regulation should be "outside" the contract. In fact, over time, the grantor has not only assumed the demand risk of concessions but also begun to compensate the concessionaire for environmental risks (as may occur in the case of the Douro Interior concession).

All four of the examined contracts are similar with respect to the rules for contract renegotiation. The concessionaires are entitled to renegotiate when one or more of the following conditions take place: unilateral changes from the public sector concerning the activities integrated in the concession; toll mechanisms that change from shadow tolls to real tolls; reasons of force majeure; law changes that directly impact the revenues or costs of the concession; or new roads that can provide competition for the concession in question.

The contract proceeds to renegotiation if the occurrence of any of the events specified above results in a reduction of 0.01% in one or more of the following indicators: the debt service coverage ratio (DSCR), the loan life coverage ratio (LLCR) and the shareholder's internal rate of return (IRR). The Brisa contract is somewhat careless in this respect, as the concessionaire can *per se* ask for the renegotiation process to be opened at any time. This contractual feature implies that a great deal of attention from regulators may be required to prevent opportunistic behavior regarding renegotiations. Contract renegotiation can take several forms: changes in contract duration (extension or earlier termination), direct payments (compensations by the Government), and changes in fare policy (increased tolls); however, the first two of these options are more

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frequently addressed during renegotiation because increased tolls can foster public unrest.

In the Norte concession, the contract foresaw a contract extension, whereas in the Beira Interior concession, changes in tolls were allowed. Nevertheless, in all of the examined contracts, there exists a clause stating that the compensation from a renegotiation can take any form that is agreed upon by both parties. One may argue that this clause allows for virtually anything to occur and therefore that it does not make sense to set forth given compensation methods, as these methods could be changed at any time. However, the rationale underlying this clause is to allow for greater flexibility in designing solutions. This flexibility can be a benefit if and only if renegotiations are fair and transparent, which is often not the case (Guasch, 2004); in the absence of accountability, this flexibility can jeopardize the public interest by leading to the overcompensation of the private partners of a concession.

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CONCLUSION

The initial goals for the highway development plan of *i)* increasing accessibility and *ii)* reducing casualties were completely fulfilled; highway development has resulted in an average travel time savings of 140%, and the average number of fatal casualties was reduced from 144.1 per 1000 km of highway in 1995 to 63.2 per 1000 m of highway in 2004 (a 56.1% reduction in a 10 year period). Nevertheless, concessions were developed using completely different contractual models, although certain features are common among these models, most notably the contract duration and the requirements that must be fulfilled to trigger mechanisms for restoring financial equilibrium through renegotiation. The Portuguese road sector landscape is extremely rich and diverse, as contractual forms vary from the fully privatized risk management of the Brisa concession to the availability model used by the Norte and Douro Interior concessions. However, the benefits of this variety of contractual types are not known.

The complexity of contracts has increased significantly over time as accumulated experience and expertise have allowed more complete contracts to be designed. Nevertheless, uncertainty and the negative outcomes of renegotiations have led to changes in risk allocation that have generally shifted the commercial risk of concessions from the concessionaire to the grantor. This change has necessitated a more extensive monitoring of quality-of-service criteria as well as increasing contract complexity and transaction costs.

This evolution of risks appears to contradict rational expectations of PPP development. As the public sector acquires greater experience with PPP development and

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management, it should be able to increase the level of risk that its private partners assume in PPP models.

The only performance incentives in the Brisa contract are the price cap formula (which is also present in other contracts that include real and virtual tolled roads) and an inarticulated potential sanction regime. The Beira Interior contract currently includes performance incentives rewarding or penalizing the concessionaire depending on the frequency of road accidents as well as certain specific penalties for infrastructural unavailability. However, this contract will shortly be changed, and a real toll method will replace the virtual toll one that currently prevails.

The Norte contract, which was recently altered, incorporates a penalty scheme for deficiencies in performance or availability, a feedback mechanism that provides punishments or rewards depending on the accident rate for this concession and financial incentives if extraordinary revenues are received by the EP. Finally, in the Douro Interior contract, there are rather complex regulation mechanisms; these mechanisms may have arisen because there are no toll revenues in this concession, and therefore the concession will not provide direct income to the EP. For this concession, in addition to the aforementioned regulatory mechanisms, there is also a complex classification scheme that assesses negative environmental externalities and accident ratings. Thus, the Douro Interior concession exemplifies the clear trend toward increasing contract complexity of concessions over time.

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Conversely, there has been a tendency over the last years to shift toward availability schemes (e.g., through the renegotiation of former SCUTs). It is interesting that although one of the main arguments for the success of PPP models is efficient risk-sharing, these models are evolving towards the elimination of the (demand-based) commercial risk of the concessionaire. Several reasons for this trend can be determined; however, it is highly probable that the primary motivation for this alteration in risk-sharing is the inability of the government to design contracts in which the compensations for forecast deviation were reasonable. Therefore, the government decided to shift towards more "stable" models of availability, instead of encouraging commercially aggressive management by the concessionaires. This policy change lead to renegotiations, and, as expected, to the long-term growth of the public financial burden of concessions. In addition, the changes in concessionary risks also raise a question about the shareholder rate of return. Private shareholders generally assumed a portion of the commercial risk of a concession at the time that the initial concessionary contract was signed, and these risks were reflected in their expected rates of return. Under an availability model, there is no commercial risk for these private shareholders; however, the renegotiated contractual clauses generally guarantee that their rate of return will not change, despite the fact that their risk is significantly reduced.

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Figure 1 – Portuguese main road network development

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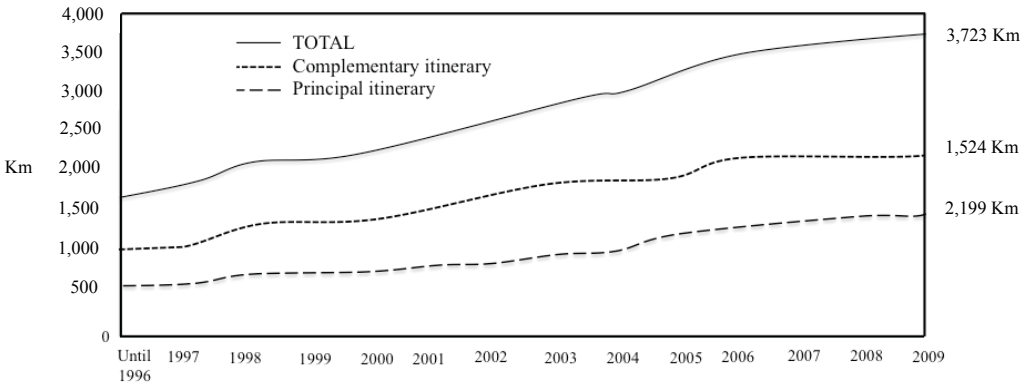

Figure 1 – Portuguese main road network development

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Table 1 – Summary of literature review on road concessions

Area	Authors
Financing	Blanc-Brude and Strange, 2007; Shaoul et al., 2006; Fayard, 2005; Vassallo, 2007; Debande, 2002; Odeck and Brathen, 2002; Brown, 2007; Bell and Foote, 2009; Brearley et al., 2000; Fishbein and Babbar, 1996; Bousquet and Fayard, 2001; Rus and Romero, 2004; Bel and Fageda, 2005;
Procurement process	Blanc-Brude and Strange, 2006; Li et al., 2005; Edkins and Smyth, 2006; Grimsey and Lewis, 2007; Soliño and Santos, 2010; Spackman, 2002; Nombela, and Rus, 2001); Ubbels and Verhoed, 2008;
Risk management/sharing	Quiggin, 2005; Ke et al., 2010; Lemos et al., 2004; Nisar, 2007; Shen et al., 2006; Bennett and Iossa, 2006; Loosemore, 2007; Meda, 2007; Tanaka et al., 2005; Singh and Kalidindi, 2006; Viegas, 2010; Matsukawa and Habeck, 2007; Abednego and Ogunlana, 2006; Scandizzo and Ventura, 2010; Nombela and Rus, 2004); Nicolini-Llosa, 2002; Vassalo, 2006; Checherita and Gifford, 2008; Bain, 2009;
Renegotiation	Brux, 2010; Engel et al., 2009; Guasch, 2004; Guash et al., 2007, 2008; Guasch and Straub, 2009; Paredes and Sánchez, 2004; Estache et al., 2003; Athias and Nunez, 2008; Benavides and Fainboim, 2002; Klein, 1998; Albalate and Bel, 2009;
Stakeholders management/Governance	Devapriya, 2006; El-Gohary et al., 2006; Fischer et al., 2006; Koch and Buser, 2006; Crampes and Estache, 1998;
Toll management	Kraus, 1982; Small, 1983; Ouville and McDonald, 1990; Labbé et al., 1998; Brotcorne et al., 2001; Ferrari, 2002; Yang and Meng, 2002; Zarrillo et al., 2002; Yan, 1996; Nagae and Akamatsu, 2006; Ward and Sussman, 2006; Xiao et al., 2007;
Public sector comparator	Bain, 2010; Blanc-Brude et al., 2009; Heald, 2002; Quiggin, 2004;

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Table 2 – Portuguese motorway network in 2010

Concessionaire	*Type of highway*	*Length (km)*
EP	No toll roads	127.3 (5%)
Private concessions	Toll roads	1,446.0 (56%)
	No toll roads	246.8 (9%)
	Shadow toll roads	909.2 (35%)
		2,602.0 (95%)
TOTAL		2,729.3

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Table 3 – Governmental compensation to existing concessions

Concession	Beginning of the contract	Toll	Year (units: 10^3 Euros)									
			1999	2000	2001	2002	2003	2004	2005	2006	2007	TOTAL
Lusoponte	25/03/95	Real			14,983.5	15,977.7	17,854.4	17,801.7	16,215.0	14,442.2	19,310.9	116,585.3
Oeste	21/12/98	Real	3,163.4	2,472.4								5,635.8
Norte	9/07/99	Real		19,334.0	23,540.5	49,096.2	41,313.4	31,178.5	5,128.9			169,591.3
Litoral Centro	30/09/04	Real							-46,745.0			-46,745.0
Brisa	DL 297/94	Real										0.0
Grande Lisboa	10/01/07	Real									-35,750.0	-35,750.0
Total Real Tolls			*3,163.4*	*21,806.4*	*38,524.0*	*65,073.8*	*59,167.8*	*48,980.1*	*-25,401.2*	*14,442.2*	*-16,439.1*	*209,317.4*
Beira Interior	13/09/99	Shadow	364.1	1,642.4	1,743.3	1,815.2	6,551.1	11,758.4	123,893.1	83,247.3	133,629.2	364,644.2
Algarve	11/05/00	Shadow		97.0	496.8	2,026.2	3,247.7	21,036.5	29,778.4	32,204.3	33,472.9	122,359.7
Costa de Prata	19/05/00	Shadow		497.6	902.6	929.5	965.5	914.8	34,343.4	37,389.8	75,849.1	151,792.2
Interior Norte	30/12/00	Shadow			516.3	603.2	777.0	1,311.5	3,090.2	6,182.4	12,280.6	24,761.3
B. Litoral e Alta	29/04/01	Shadow			1,279.5	2,001.1	2,078.7	2,140.3	2,416.7	3,122.1	90,844.2	103,882.7
Norte Litoral	17/09/01	Shadow				1,867.4	1,590.2	1,637.2	1,943.8	2,981.3	51,326.7	61,346.7
Grande Porto	16/09/02	Shadow					1,362.2	1,128.6	1,152.4	2,579.6	32,385.1	38,607.9
Total Shadow Tolls			*364.1*	*2,236.9*	*4,938.6*	*9,242.7*	*16,572.3*	*39,927.3*	*196,618.0*	*167,706.8*	*429,787.8*	*867,394.5*
TOTAL			**3,527.5**	**24,043.3**	**43,462.5**	**74,316.5**	**75,740.1**	**88,907.4**	**171,216.9**	**182,149**	**413,349**	**1,076,711.9**