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The Portuguese Shadow Toll Concessions: Analysis of Allocation and Valuation of Risks

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ABSTRACT

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As more countries are relying on the private sector for provision of public services, Public-Private Partnerships (PPPs) are at the center of this growing trend. Optimal risk allocation through risk transfer to the private sector is the critical issue for the success of these partnerships in achieving best value-for-money (VfM) for the public sector. Using the Portuguese shadow toll concessions (SCUT), this study aims to analyze and evaluate their allocation of risk between the public and private sectors. Accordingly, the first part of the paper examines how risks in the SCUT concessions were allocated. Our analysis indicates that for the most part, with the exception of demand risk, risks were well allocated. The second part of the paper identifies and evaluates the main risks transferred to the private sector. It also goes further in assessing gains *before* and *after* risk transfer, if any, to the private sector. We find that risks transferred to the private sector account for a very small share of public sector payments. This paper also concludes that the costs to the public sector, through the payment obligations, far outweigh those assumed by the private sector. Consequently, this paper examines whether the SCUT concessions were successful in regards to achieving VfM. The high gains to the private sector may suggest otherwise. However, given that there was no comparison of VfM between the PPP approach and an alternative procurement route, it is not possible to draw any concrete conclusions.

Keywords: risk allocation, risk valuation, value-for-money, NPV-at-risk

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1. Introduction

In recent years, the challenge of bridging infrastructure gaps while working within budgetary constraints have led many governments to seek out new mechanisms of financing public projects. One of these mechanisms involves the private sector financing the provision of public services through Public-Private Partnerships (or PPPs) (Grimsey and Lewis, 2002, 2004, 2005). In its basic form, a PPP is a long-term contract between a government agency and a private operator to deliver a public good or service. Although a PPP arrangement involves many stakeholders, in this study, we focus on two main groups, i.e. the public and private companies. In contrast to traditional procurement models where public infrastructure and services are provided almost exclusively by the public sector, PPPs allow the private sector to take on substantially greater risk, enabling the public sector to capitalize on private sector efficiency through optimal risk transfer (Grout, 1997; Hart et al, 1997; Bentz et al, 2002; Guasch, 2004; Corner 2006). In their study of competitive tendering and contracting, Domberger and Rimmer (1994) find that governments can save up to 20% on service expenditure by applying competitive tendering (qtd. in Grimsey, 2003).

However, PPPs are not without challenges. Their complex structure coupled with potentially conflicting stakeholder interests, different attitudes towards risk, and different skills in risk management make it unsuitable for some projects (Jin and Doloi, 2008). These inherent characteristics expose the parties involved in the contract to high level of risk. As highlighted by Thompson and Perry (1992), if risks are inadequately borne by the public sector, the government "would raise taxes or reduce public services to pay for its obligation." Conversely, should risks be inadequately borne by the private sector, "excess premiums would be charged to government or even directly to the end users" (qtd. in Jin and Doloi, 2008, pp. 708). Thus in the absence of optimal risk allocation, PPPs may fail to generate value-for-money (VfM). VfM is defined "as the optimum combination of whole-of-life costs and quality (or fitness for purpose) of good or service to meet the user's requirement" (qtd. in HM Treasury, 2006). Achieving VfM is the primary objective in PPPs.

PPPs play an increasingly important role in Portugal. Between 2008 and 2010 alone net payments for PPPs more than doubled to €1.128 million (see appendix, Exhibit

1). Similarly, as shown in Exhibit 2 (see appendix), projected gross payments of current PPPs between 2015 and 2018 are set to surpass €2.000 million, of which the road sector makes up the highest share. Moreover, seeing as the projected gross payments of current PPPs for the next three years make up about 1% of gross domestic product (see appendix, Exhibit 3), concerns about the government's ability to finance and sustain these partnerships have been raised. According to Cruz and Marques (2010, pp. 4030), "the annual burden of these projects in a climate of constraining public expenditure has led to an overall negative perception" of PPPs in Portugal. It does not come as a surprise – especially as it concerns the road sector – that some infrastructure projects have been put on hold and others are being modified. The SCUT concessions are a case in point and merit greater analysis.

The shadow toll concessions (SCUT) – one of the major initiatives undertaken by the Portuguese government to develop the national transport infrastructure – were originally approved and contracted to be "without charges to the user," that is, the government, and not the users, pay for the road usage. However, this has proved unsustainable for the Portuguese budget and has led the government to apply tolls to these roads. Accordingly, this study focuses on the seven SCUT concessions and aims to analyze and evaluate their allocation of risks between the public and private sectors. The study seeks to answer the following three main questions:

(i) how are risks allocated between the public and private sectors? Consequently,

(ii) how to best evaluate the risks allocated or transferred to the private sector?

And finally,

(iii) how much risk has the private sector assumed?

Our analyses show that with the exception of demand risk, risks under the SCUT concessions were well allocated between the two parties. The quantitative evaluation shows that the risks transferred to the private sector represent a very small share of what the public sector is paying, and that the costs to the public sector, through the payment obligations, are relatively large. Apart from Grande Porto, all the concessions register after-risk transfer gains (before taxes).

The paper is organized as follows. Section 2 provides a brief theoretical background of the related literature on the concept of VfM and risk allocation with

particular focus on VfM evaluation and risk allocation strategies and identification, respectively. This is followed by a benchmark assessment of countries with shadow toll payment systems. In section 3, a comprehensive background analysis of the SCUT concessions is provided followed by a detailed qualitative assessment of the SCUT concessions in a risk matrix. Section 4 outlines the methodology and basic assumptions. Here, we quantitatively evaluate key risks in each of the concessions through a sensitivity analysis in net-present-value (NPV) terms. A second method, NPV-at-risk, using Monte Carlo simulation is also undertaken. The results are presented and discussed in section 5. Section 6 outlines the limitations of the study and the conclusions reached.

2. Literature Review

While there is no single definition of a PPP, a commonly referenced interpretation is that a PPP is a long-term contract between a public body and a private operator in which arrangements concerning the design, construction, operation, and financing of a public project are made with the aim of enhancing the value of public assets (Guasch, 2004; Grimsey, 2005; OECD, 2008). As advanced by Grimsey (2005), from the viewpoint of the public sector, VfM is the driving principle for procuring PPPs.

2.1. Value-for-Money

The decision to undertake a PPP is based on the principle that they provide greater value-for-money (VfM) through risk transfer. VfM can be defined as representing an optimal combination of cost effectiveness and quality. Six drivers underpin VfM. These are: risk transfer; the long-term nature of contracts (including whole-of-life cycle costing); the use of an output specification; competition; performance measurement and incentives; and private sector management skills (Arthur Andersen and Enterprise LSE, 2000; Grimsey and Lewis, 2005). Of the drivers outlined above, the literature identifies risk transfer to be the most important (Hayford, 2006; Jin and Doloi, 2008; among others). However, as Hayford (2006) rightly asserts, risk transfer to the private sector will only create VfM if the costs assumed by the public sector through the risk transfer are less than the costs it would incur if it were to manage the risk itself. Accordingly, prior to pursuing a project through PPP, the government will need to assess which of the two

procurement options determines best VfM. This requires an ex ante comparison of VfM of both the PPP and traditional procurement (Grimsey and Lewis, 2005; OECD, 2008).

VfM assessment should be based on qualitative and quantitative factors. A qualitative analysis normally encompasses setting objectives based on the scope of the project, regulatory issues, and market assessment (level of competition), as well as desired project outcomes. As will be shown in the coming sections, risk identification is one of the first steps taken towards risk management and its role in facilitating proper risk allocation is unquestionable. A risk matrix is therefore one of the commonly used tools to qualitatively assess VfM.

The Public Sector Comparator (PSC), on the other hand, is the main quantitative test for VfM. Although various alternative tests exist, the PSC is argued to be less complex and more flexible than most other options (Grimsey and Lewis, 2005). Its assessment is based on cashflow terms discounted at the public sector rate and then compared to the discounted payments of a 'shadow' or reference PPP. Only after the reference PPP has demonstrated better value than the public provision strategy can the project proceed to the bidding phase (OECD, 2008). PSC estimates the hypothetical risk-adjusted cost if a project were to be financed, owned and implemented by the government. It also provides a consistent benchmark and evaluation tool, and it encourages competition by generating confidence in the market. The latter point is worth noting as competition ***before*** and ***after*** the bidding process, is fundamental to the success of the project. In the event of post-contract renegotiation, for instance, the monopolist (the winning bidder) holds the advantage in comparison to a competitive entity when dictating negotiation terms. Also, the monopolist is more likely to be prone to opportunistic renegotiation (OECD, 2008). Hence, "once the procurement route is well established, competition in the bidding process is relied upon to ensure VFM" (Grimsey and Lewis, 2005, pp. 360).

2.2. Risk Allocation Strategies

The main premise underlying PPPs is that risk should be allocated to the party best able to manage it (Grimsey and Lewis, 2005; Corner 2006). Irwin (2006)[1] proposes a more detailed framework which considers the ability of each party to (i) influence the corresponding risk factor; (ii) influence the sensitivity of total project value to the corresponding risk factor; and (iii) absorb the risk However, the question of how risks associated with PPPs should be allocated is fraught with many complexities. "Why is a particular risk transferred to the private consortium in one project, while retained by the government or shared in another?" (Jin and Doloi, 2008, pp.708). Zou et al (2008) find that to guarantee the success of PPP infrastructure projects, proper risk identification and allocation should be conducted from a life-cycle perspective. That is, it should be conducted from the feasibility study stage to operation and transfer stages with continuous monitoring, all the while ensuring VfM and taking into account public and private interest considerations.

Relevant literature increasingly articulates the paramount role of PPP arrangements in closing infrastructure gaps created through government inefficacies in the conventional provision of infrastructure (Jin and Doloi, 2008), making a case for PPPs and their efficiency of service delivery in comparison to traditional public procurement (Grimsey, 2003; Corner, 2006). Brealey et al (1997) for instance, argue that due to its higher agency costs, the public sector is likely to be less *productively efficient* than the private sector. Early empirical evidence has shown, however, that most of the risk is usually borne by the public sector. According to Arrow and Lind (1970), the government generally holds the advantage of a more efficient distribution of risks because it is able to spread risk among taxpayers. However, a counterargument is that the cause of the public sector's inefficiency is precisely because taxpayers naturally assume a contingent liability, i.e., the taxpayer will always pay the bill (Grimsey, 2003). Nevertheless, Thomas et al (2003) show that under PPPs, "sometimes risks will inevitably be allocated to the party least able to refuse them rather than the party best able to manage them" (qtd. in Jin and Doloi, 2008, pp.708). This goes to show that unless risks are appropriately distributed among the respective entities, a PPP scheme can be

[1] See Irwin (2007) for a thorough discussion of risk allocation.

quite costly. Ideally, "the government has to determine, on a value-for-money basis, what risks it should take back to achieve an optimal risk distribution" (Loosemore, 2007, pp. 70).

Another challenge associated with these types of arrangements is that government guarantees[2] are not subject to the same degree of scrutiny by going through the budget process as regular spending (Irwin, 2007). "A government guarantee legally binds a government to take on an obligation if a clearly specified uncertain event should occur" (Hemming, 2006, pp.30). Furthermore, most PPP projects are recorded off-balance sheet, allowing governments to delay payment and in the process secure private financing and "benefit from the skill and enterprise of private firms" (Irwin, 2007, pp.1). However, this can cause major problems as off-balance sheet financing enables governments to by-pass expenditure controls, which in effect can obscure government liabilities. In the case of Portugal, "it allowed for economically unfeasible projects to go forward" (Cruz and Marques, 2010, pp.4027).

The preceding discussion on risk allocation naturally leads one to ask how risks should be evaluated and how to account for uncertainty as well as risks in PPPs (Grimsey and Lewis, 2002, 2004, 2005). Uncertainty and risk are present whenever a project has more than one possible outcome. Whereas risk can be characterized by some calculable probability on a future event occurring and the corresponding effect it would have on expected outcomes should it materialize (Broadbent et al., 2008), in the case of uncertainty, the future outcome is unclear, hence actual probabilities cannot be assigned (qtd. in Demirag 2010; Grimsey and Lewis, 2004). A likely consequence of uncertainty in these types of arrangements – long planning horizon, complex structures, information asymmetries – and especially in conventional procurement models is optimism bias through cost overruns. However, unlike in conventional procurement models, with PPPs optimism bias is minimized through the project cycle (Flyvbjerg et al., 2003; Flyvbjerg B, 2004).

A fundamental aspect of PPPs is balancing the interests of the public and private sectors. Due in part to different attitudes towards risk and responses to uncertainty,

[2] A guarantee is a form of government intervention intended to reduce the financial costs of risks faced by the private sector and/or by other public sector entities should risks (Hemming, 2006).

differing views abound concerning the appropriate discounting method to use in these types of partnerships. Arrow and Lind (1970) argue that when calculating the present value of returns from a public investment a distinction must be made between private and public benefits and costs. The question then becomes, "whether it is appropriate to discount public investments in the same way as private investments" (Arrow and Lind, 1970, pp. 377). In the U.K., for instance, a 'social time preference'[3] rate of 3,5% is used as the real discount rate for PPPs; meanwhile in Australia the discount rate is based on the risk-free rate adjusted for risk through the standard Capital Asset Pricing Model (CAPM) (Sarmento, 2010).

While some argue otherwise (Grout and Klein, 1997; Modigliani and Miller, 1997), it is widely acknowledged that private sector borrowing costs are higher than the public sector's due to the latter's advantage of borrowing at a risk-free rate. A more unanimous consensus, however, is that projects have to earn at least the weighted average cost of capital (WACC) to be acceptable by investors. Hence, the discount rate allowing for the identification of a viable project is determined by its WACC (Brealey et al, 1997). At the same time, WACC alone does not reflect the required risk premium. Ye and Tiong (2000) show that a combination of the WACC and the dual risk-return methods can provide a better decision for risk evaluation of privately financed infrastructure projects.

For the purpose of this study, four different discount rates are used in evaluating the net present value (NPV) of the seven SCUT concessions. In line with Grout's (2003, C68) argument that the practice of using the same discount rate for conventional procurement and PPPs is inappropriate because it "prejudices private sector provision and favors too much public sector provision," a second discount rate (based on the CAPM) used in this study is adjusted for risk through the addition of a risk margin (reflecting systematic risk), to a risk free rate.

We now proceed to a brief description of the types of risks inherent in PPPs. A more detailed identification of risks specific to the SCUT concessions is provided in section 3 where a risk matrix is used as a way to qualitatively assess the projects in question.

[3] The social time preference takes into account the 'pure time' preference rate plus a catastrophe risk rate and a measure of preference reflecting the idea of decreasing money preference with increasing per capita income.

2.2.1. Risk Identification

As previously highlighted, there are two dimensions to risk allocation through VfM; qualitative and quantitative. Here, we focus on the qualitative dimension, i.e., the type and level of risk allocated and to whom. PPPs rely on a "detailed step-by-step analysis of cost-sharing arrangements, risk mitigation and risk sharing" (Grimsey and Lewis, 2004, pp.87). The ability of PPPs to allow for risk sharing between the parties involved in the contract is driven by VfM, which in essence reflects the risks and uncertainties in these types of arrangements. Risk identification is therefore one of the most critical stages in risk allocation. Hence, a process of due-diligence must be applied to assess the impact of relevant risks and the extent to which they are covered by the contractual agreement as well as to set alternative mitigation measures should the need arise. For instance, operating cost overruns may seriously hinder the creation of VfM. To manage this type of risk, a fixed-price contract can be considered. This type of contract would provide incentives for cost minimization in that the operator "assumes risks relating to the fluctuations in operating costs and makes a profit only if the costs actually incurred are lower than the contract price for services rendered" (Gatti, 2008, pp. 49).

Qualitative assessment using a risk matrix helps identify which risks are shared, retained or transferred to the party best able to manage them (Yescombe, 2001). In chronological order, risks can be identified and categorized as follows (Gatti, 2008):

(i) Pre-completion phase risks: activity planning, technological, construction risks;

(ii) Post-completion phase risks: supply, operational, market risks; and,

(iii) Risks common to pre-completion and post-completion phase: interest rate risk, exchange risk, inflation risk, environmental risk, regulatory risk, legal risk, credit risk.

2.3. Benchmark of Shadow Toll Contracting

Although not as widely adopted as actual tolls, shadow tolls are used in some parts of Europe as well as in Canada. The U.K. pioneered the concept and practice of shadow tolls dating back to the early 1990s through its implementation of the Private Finance Initiative (PFI), a strategic economic policy that delegated financing of public infrastructure projects to the private sector.[4] Between 1993 and 1996, the U.K. instituted eight 30-year long shadow toll contracts which accounted for about 35% of all new construction projects between 1996 and 2001. It is estimated that payment for these eight contracts totals £220 million annually, translating into a total cost of approximately £6 billion over the life of the contracts (Shaoul et al., 2006). It is important to stress, however, that the introduction of shadow tolls in the U.K. was seen as a transitory mechanism for moving to a system of real tolls some time in the future (Grimsey and Lewis, 2004, Shaoul et al., 2006).

Besides the U.K., shadow tolls are also in use in Belgium, Canada, Finland, the Netherlands, and Spain. In the Netherlands, one case under a shadow toll scheme is the Noord tunnel, whose competitive tendering process was launched in 1991 (Bousquet and Fayard, 2001). In New Brunswick, Canada, the Fredericton-Moncton highway project has recently been converted to a shadow toll scheme (Taylor et al., 2001), and there are cases where a combination of real and shadow tolling is used, such as the Golden Ears Bridge in British Columbia (Buxbaum and Ortiz, 2009). In Spain, the M45-M501 8km long highway around Madrid has been upgraded through three separate shadow toll procurements and is currently at its pre-design stage (Report, 2009).

Shadow toll concessions take the form of a DBFO scheme where the concessionaire designs, builds, finances and operates the road without necessarily owning the assets used to develop the project (Yescombe, 2002). Usage payments for shadow toll-based projects are made by the public entity and not the users, for whom the infrastructure is free. The public sector pays the concessionaire, at least in part, on the basis of traffic volume and vehicle type, consequently "transfer[ing] usage risk to the private operator without introducing direct user charges" (Grimsey and Lewis, 2004, pp. 60). Under DBFOs, payments can also be made based on performance which is measured

[4] These projects are now commonly referred to as private-public partnerships (PPPs) (Yescombe, 2002).

in terms of road availability (e.g. number of lanes closed to traffic) and road safety conditions. In the event of higher than expected traffic, for instance, the concessionaire is overcompensated, in other words, paid in excess of what was planned but is subject to a capped revenue threshold (Bousquet and Fayard, 2001). Although there are cases in which shadow toll contracting are regarded as availability payments[5], these two forms of payment slightly differ in their approach. While shadow tolls rely on traffic volumes, availability payments are based on other dimensions of service quality, including safety and minimum performance criteria.

It is also worth emphasizing that shadow tolls are not a source of funding in and of itself but rather a tool that allows for the pooling of new sources of capital. Perhaps one of the key advantages of such a payment mechanism is that they are politically appealing and generate little, if any, resistance from users. There is no tendency for reduced traffic, which is often motivated by the limits of the users' willingness to pay the taxes associated with the road sector. In Finland, for example, a shadow toll system was adopted partly as a result of existing high motor spirit, road tax and customs duties. Also, the low level of road usage did not justify the use of real tolls, hence a shadow toll was considered a better and more feasible alternative. The second key advantage of shadow tolls is that there are no expenses associated with toll collection. Whereas under a toll system, additional costs related to the construction, maintenance, and operation of toll collection facilities can be rather significant. It is estimated that an average of about 10% to 15% of revenue is absorbed by toll collection costs (Bousquet and Fayard, 2001).

Despite these advantages, as highlighted earlier, shadow tolls do not generate new sources of capital, a not-so-cost-effective option for the public or the private sector (depending on whether the maximum revenue is capped). Moreover, users are not subject to the real costs of using the road. Further criticism has also been raised by the U.K.'s National Audit Office concerning the appropriateness of transferring volume risk or downside demand risk to the private sector as the latter is unable to influence demand using pricing measures (Grimsey and Lewis, 2004). Overall, shadow toll contracting makes for a feasible payment mechanism for private finance either as an interim

[5] Such as in the case of the Järvenpää-Lahti Highway project (Leviäkangas, 2007).

financing mechanism preceding the application of real tolls or when the levying of tolls prevents or inhibits the use of the infrastructure.

3. The SCUT Concessions: The Case of Portugal

3.1. Background

Following the launch of the National Road Program in 1996, the SCUT concessions were put into tender in 1998 as part of an initiative by the Portuguese government to improve the provision of public infrastructure in relatively poor regions. It consists of seven concessions, namely, Algarve, Beira Interior, Beiras Litoral & Alta, Costa de Prata, Interior Norte, Grande Porto, and Norte Litoral operating under a design, construct and operate scheme. These represent approximately 930 km of new highways, equivalent to 30% of national road concessions at the time. PPPs are project finance, and as such they are financed mainly through debt, usually 70%-90% (Esty, 2004). Under SCUT, which was initially "free of charge to the user" ("Sem Custo para o Utilizador" in Portuguese), payments to the private consortium for road usage are made by the public entity rather than the users. Payments were based on traffic volume at a pre-established rate per vehicle. These were made annually to the private bidders (through tax payers' money) using the following band structure (Sarmento, 2010):

(i) Band A: a payment of x per vehicle per kilometer for the first (a*1000) vehicles per day (vpd)/km;

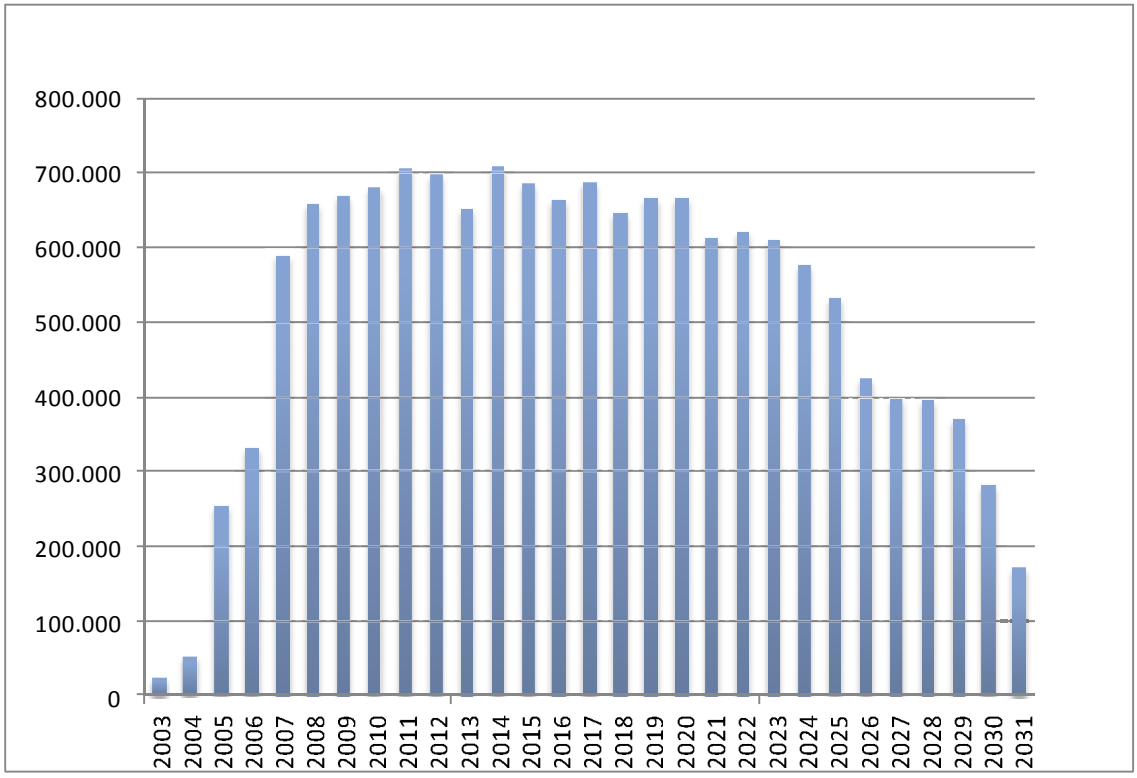
(ii) Band B: a payment of y per vehicle per km for the next (b*1000) vpd/km; and

(iii) Band C: All higher levels of vpd/vkm = no payment.

Burdened by budget constraints and rising fiscal costs, in September of 2010 the Portuguese government announced its decision to discontinue the shadow toll system in favor of a real toll model. An estimate of the costs to the public sector associated with the concessions is presented in Exhibit 4. The renegotiation process for the introduction of real tolls is in progress and at its concluding phase. Phase one of the introduction of tolls came into effect in October of 2010, and encompassed the areas, Costa de Prata, Grande Porto and Norte Litoral. The second and last phase took place in December of the same year, covering the remaining four concessions. The new payment structure allows the concessionaire to charge the respective usage fees which the concessionaire then hands

over to the public sector, Estradas de Portugal, and is remunerated based on road availability.

Exhibit 4. SCUT - Annual Payments over the Life of the Concessions (Euro million)



Source: Court of Audit Report

The introduction of the SCUT concessions was, in many respects, conceived as a provisional arrangement. It was intended that once the regions covered under SCUT reached a GDP per capita equal or superior to 80% of the national level, a purchasing power equal or superior to 90% of the national indicator, and the alternative roads to SCUT achieved one third of the travel time permitted in the SCUT concessions, a move towards real tolling would ensue. Concomitant with the high financial costs incurred through the concessions, part of the controversy surrounding these concessions is also motivated by the fact that of the 930 km area covered under SCUT, only 55% falls under the umbrella of relatively 'poor' areas, a seemingly unfair application that did not fully justify the motivation proclaimed by the government in the first place.

In light of the above, did the SCUT concessions create VfM? Subsequently, how was the risk allocation between the two entities? In order to answer, we now proceed to

an assessment of the concessions starting with the qualitative dimension in the form of a risk matrix.

3.2. Risk Matrix

Table 1 provides the risk allocation for the SCUT concessions. As stated earlier, risk allocation is complex due to the confluence of factors impacting the project. A risk matrix helps identify which risks are retained by the public sector, which are transferred to the private sector, and which are shared. As can be seen in the matrix, some risks do not fall distinctly within the private or public sector and have to be shared between the two parties. Arguably, the allocation of availability risk in service level, for instance, would be better managed if transferred to the private entity as it is a measure of performance concerning the service provided. This way, incentives would be given to the private party to achieve cost minimization. On the other hand, risks due to changes in environmental standards or laws have all been allocated to the private sector although they would have been better mitigated if shared with the public sector as the latter is better able to influence environmental laws.

Literature identifies the demand, construction, financial, and operating and maintenance (O&M) risks as the main risks that can be transferred to the private sector and the rest are merely residual (OECD, 2008). From this Table, we can see that construction (with the exception of unilateral changes and expropriation), O&M (with the exception of unilateral changes, accidents and latent defects which are shared) and financial risks were all transferred to the private sector. The demand risk, on the other hand, was shared until 2010 but later retained by the public sector upon renegotiations based on the new band structure outlined above. Allocating demand risk to the public sector reduces private sector risk, equally reducing incentives for private sector efficiency.

Accordingly, therein lies the scope of this study and the motivation driving it. Assessing the values of these three main risks transferred to the private sector and comparing them against the government payments allows us to determine ‘excessive rents,’ if any, here defined as the gains after risk transfer (before taxes).

Table1. Allocation of Risks within the SCUT Concessions

Types of Risks (i)	Description (ii)	Designation (iii)	Phase (iv)	Impact of Risk (v)	Allocation (vi)
Project and Bidding	Unforeseen variation due to bad planning, loss of transparency in bidding, etc.	Design	Project		Private
		Planning	Project		Public
		Obtaining licenses and necessary approval	Project		Private
		Disinterest on the part of the private tender	Bidding		Public
		Failure to meet deadlines and procedures	Bidding		Private
		Occurence of disputes/complaints	Bidding		Shared
Construction	Unforeseen variation due to faulty construction techniques, construction delays, etc.	Meeting deadlines	Construction	Medium	Private
		Additional costs (extra work)	Construction	Medium	Private
		Unilateral changes	Construction	Low	Public
		Quality/reliability	Construction	Low	Private
		Expropriation (implementation and costs)	Construction	Low	Private
		Expropriation (on publication of the declaration of public utility)	Construction	Low	Public
		Damage to infrastructure (own/third party/injury to workers)	Construction	Medium	Private
Operation and Maintenance	Unforeseen variation due to cost overruns, maintenance delays, etc.	Toll collection	Operation	Medium	Private
		Additional costs (extra work)	Operation	Medium	Private
		Accidents	Operation	Low	Shared
		Unilateral changes	Operation	Low	Public
		Changes to implemented technology	Operation	Low	Private
		Failure to meet quality levels	Operation	Medium	Private
		Latent defects	Operation	Low	Shared
Financial	Unforeseen variation in relevant financial indicators, risk of default, etc.	Inflation	Construction/Operation		Private
		Interest rates	Construction/Operation	Medium	Private
		Default	Construction/Operation	High	Private
Environmental	Unforeseen variation due to adverse environmental hazard	Post-environmental assessment	Project		Private
		Environmental standards/laws	Construction		Private
Demand	Unforeseen variation in the demand for the service generated by the project	Traffic	Operation		Shared
Availability	Unforeseen variation in the supply of service	Disruption in supply	Operation		Private
		Service level	Operation		Public
Regulatory/Legal	Unforeseen variation in regulatory conditions	General legislative ammendments	Construction/Operation		Private
		Specific legislative ammendments	Construction/Operation		Public
Force Majeure	Unforeseen variation due to war, civil disturbance, etc.	Artifacts	Construction		Public
		Natural Disasters	Project/Operation		Shared
		Wars	Project/Construction/Operation		Shared

Source: Columns (i), (iii), (iv) and (vi): Direção-Geral do Tesouro e Finanças (2011). Columns (ii) and (v): Authors' assessment based on Ball *et. al*. (2003) risk composition.

4. Methodology

Based on the main risks identified, three input variables were used as a basis for our evaluation. These are: capital expenditure (capex), interest costs, and operating and maintenance (O&M) costs. It is essential that risks be considered on a project-by-project basis, hence the study assesses risks for each of the concessions. The data used was obtained from the Portuguese Public Road Institute (as shown in Table 2) and from the Court of Audit Report.

Table 2. SCUT – Data

	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral	TOTAL
Capex	438.000	499.000	243.000	298.000	584.000	753.000	228.000	**3.043.000**
Debt - %	90,60%	98,00%	83,10%	91,30%	80,00%	91,20%	76,00%	**88,30%**
Debt	396.828	489.020	201.933	272.074	467.200	686.736	173.280	**2.687.071**
Equity - %	9,40%	2,00%	16,90%	8,70%	20,00%	8,80%	24,00%	**11,70%**
Equity	41.172	9.980	41.067	25.926	116.800	66.264	54.720	**355.929**
Debt/Equtiy	10	49	5	10	4	10	3	**8**
Cost of Debt	8,83%	6,09%	6,30%	5,92%	5,70%	6,33%	7,38%	**6,57%**
Cost of Equity	13,00%	13,18%	7,72%	11,89%	12,20%	13,10%	6,41%	**11,06%**
Tax	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	**25,00%**
WACC	**7,22%**	**4,74%**	**5,23%**	**5,09%**	**5,86%**	**5,48%**	**5,75%**	**5,64%**
IRR (before tax)	7,35%	9,59%	6,67%	8,43%	9,50%	9,24%	6,68%	**N/A**
BI	4,11	18,88	2,34	4,44	2,00	4,39	1,69	**3,33**
CAPM	**27,13%**	**108,31%**	**17,39%**	**28,89%**	**15,50%**	**28,63%**	**13,78%**	**22,82%**

Source: Court of Audit Report. WACC, βl, CAPM calculations by Authors.

4.1. Evaluation Methods

First, the net present value (NPV) of government payments and those of the costs (capex, interest costs, O&M costs) were calculated. In calculating the NPVs, four different discount rates were applied, namely,

(i) the Portuguese risk free rate of 4,5% based on a 10-year yield on government bond (before 2008 financial crisis);

(ii) the legal Portuguese discount rate, as of 2003, for PPPs of 6%;

(iii) WACC-based discount rates incorporating both equity and debt financing; and

(iv) CAPM-determined discount rates reflecting the level of systematic risk associated with each project.

Second, a sensitivity analysis of the main input variables using the four discount rates was carried out to test the robustness of the results obtained from the NPV analysis.

Third, we computed the NPV-at-risk for the base case NPV of payments and NPV of costs discounted at WACC. As shown by Ye and Tiong (2000), standard measures of risks and returns are limited in their scope and application of risk assessment and financing methods. NPV-at-risk on the other hand, combines a risk-adjusted discount rate method (WACC) and the dual-risk return method, capturing both the size of the acceptable deviation and the appropriate confidence levels in its assessment. Here, the project's WACC is the appropriate discount rate since it does not overestimate risks. Further, since the distribution functions of returns are not known, Monte Carlo simulation was conducted to generate the distribution of the possible NPVs assuming a normal distribution. Using Ye and Tiong's (2000) paper as a guide, we calculated the NPV-at-risk for each concession taking into account the NPVs of payments and of the three main costs. NPV-at-risk is then given by: NPV-at-risk = NPVμ - Z(α)*σ

Where Z(α) – is the number of units of standard deviation corresponding to α

α – is the confidence level

σ – is the standard deviation

Lastly, a comparison between NPV-at-risk with NPV of payments and NPV-at-risk with NPV of costs allowed us to measure the value of risk for each project and estimate the gains in each project, respectively.

4.2. Basic Assumptions

The assumptions made in our analyses are as highlighted on Table 3. In addition, the literature considers the level of transferred risk on transport to be low or medium low (Sarmento, 2010). An unlevered beta of 0,5 based on Damadoran (2012) is used in our analysis. Accordingly, the risk-adjusted rates based on the CAPM were determined using each of the projects' levered betas calculated as $\beta l = \beta u\ [1 + D/E\ (1 - t)]$; where D/E stands for the debt-to-equity ratio, and t, the tax rate. The CAPM for a single project is calculated using the following formula:

CAPM : $Ri = Rf + \beta l\ (Rm - Rf)$

Where Ri – is the required return on the project

Rf – is the risk free rate (4,5%)

βl – is the levered beta and

Rm **–** is the expected return

Table 3.

Variable	Assumption
Capex	Capex (Table 2): 5 years (constant) Major repairs every 10 years = 10% Capex + 3% annual inflation
Interest Cost	Debt (Table 2): Maturity = 20 years (principal repayment on a constant annual basis) Interest rate = Cost of Debt (Table 2)
O&M Cost	Real data until 2010 based on Company Financial Report Inflation = 3% annually

5. Results

Table 4 indicates the NPV payments using the four discount rates. As can be seen, NPV payments are quite sensitive to the discount rate. For instance, the 0,36% differential between the 6% and WACC rates amounts to a differential of approximately €300 million in total NPV payments.

Table 4. Discounted NPV Payments (Euro million)

Discount Rates	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral	Total
NPV at Rf 4.5%	1.708.733	1.278.366	661.475	920.370	915.064	1.824.554	800.282	**8.108.845**
NPV at WACC	1.307.958	1.242.567	601.108	860.564	762.022	1.610.192	666.497	**7.061.600**
NPV at 6%	1.469.447	1.074.629	545.349	778.311	748.221	1.509.669	643.314	**6.768.941**
NPV at CAPM	339.681	10.529	184.005	143.879	265.904	210.451	253.761	**1.581.652**

Source: Authors.

To reflect the uncertainty inherent in the projects, sensitivity analyses in NPV terms were performed for each of the concessions: using downside and upside assumptions regarding the capex, interest costs and O&M costs (applying the four discount rates). The results of the sensitivity analyses are set out in Tables 5, 6, 7 and 8 (see appendix). Here, we also see that the discount rates have a profound impact on the NPV of costs and that the NPV of costs show significant downside and upside variations. Moreover, these results illustrate why the determination of the appropriate discount rate for evaluating these types of projects (especially as it concerns the appraisal stage) is one of the most critical, and the most debated in the literature.

In determining the NPV-at-risk (using the project's WACC), a Monte Carlo simulation (with 1000 iterations) was run based on the base case distributions (mean and standard deviation) for each of the main risks identified (capex, interest, O&M) as well as the risks associated with government payments. The reason we consider payment risk is because it represents country risk. With a 95% confidence level, the results of the assessment are shown in Table 9. The "NPV-at-risk Total Costs" captures the three main risks allocated to the private sector. In absolute value, concessions Beiras Litoral & Alta, Beira Interior, and Interior Norte (in descending order) are the most expensive to the state. Capex and payment risks are the most important.

Table 9. NPV-at-Risk Assessment (discounted at WACC)

Indicators	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral	TOTAL
NPV-at-risk Payments	54.273	35.544	20.632	20.024	31.664	65.206	19.815	247.158
NPV-at-risk Capex	58.794	76.849	36.304	45.157	83.745	111.502	33.022	445.373
NPV-at-risk Interest Costs	13.419	7.855	5.145	6.444	9.848	16.690	5.050	64.451
NPV-at-risk O&M Costs	31	26	20	34	41	13	27	192
NPV-at-risk Total Costs	**126.516**	**120.274**	**62.102**	**71.659**	**125.299**	**193.411**	**57.914**	**757.175**
NPV-at-risk Total Costs (excluding payment risk)	**72.244**	**84.730**	**41.469**	**51.635**	**93.634**	**128.205**	**38.099**	**510.016**
NPV Payments	**1.307.958**	**1.242.567**	**601.108**	**860.564**	**762.022**	**1.610.192**	**666.497**	**7.050.908**

Source: Authors.

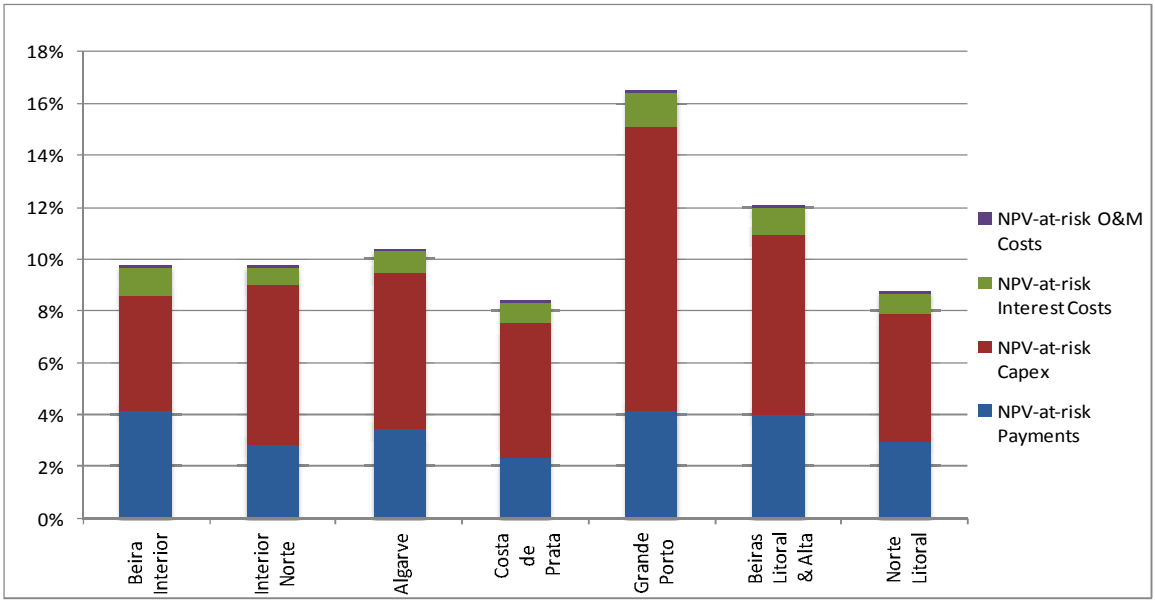
Further, as shown in Table 10, on average, 11% of payments (including payment risk) went to cover risks of which capital expenditure is the highest at 6%. O&M risks on the other hand, are almost negligible. Grande Porto and Beiras Litoral & Alta indicate the highest share of risk as percentage of payments both with and without payment risk (see also Exhibit 5).

Table 10. Weight of Risks as Percentage of NPV Payments

Indicators	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral	Average
NPV-at-risk Payments	4%	3%	3%	2%	4%	4%	3%	4%
NPV-at-risk Capex	4%	6%	6%	5%	11%	7%	5%	6%
NPV-at-risk Interest Costs	1%	1%	1%	1%	1%	1%	1%	1%
NPV-at-risk O&M Costs	0%	0%	0%	0%	0%	0%	0%	0%
NPV-at-risk Total Costs	**10%**	**10%**	**10%**	**8%**	**16%**	**12%**	**9%**	**11%**
NPV-at-risk Total Costs (excluding payment risk)	**6%**	**7%**	**7%**	**6%**	**12%**	**8%**	**6%**	**7%**

Source: Authors.

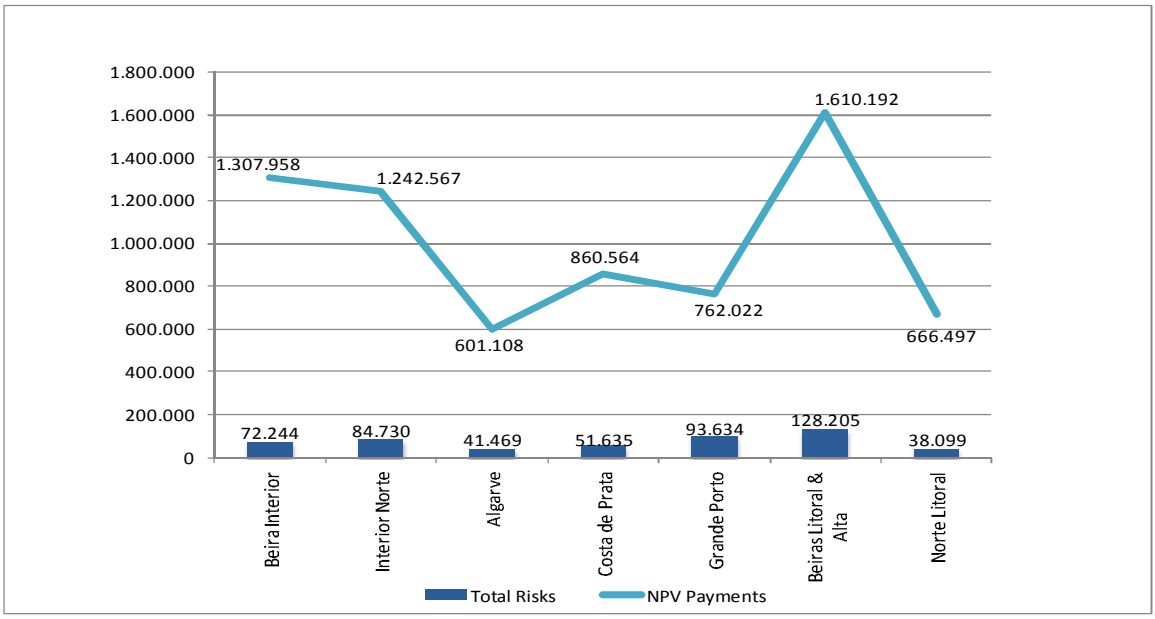
Exhibit 5. Weight of Risks as Percentage of NPV Payments



Source: Authors.

Exhibit 6 shows the difference between what the government is paying and how much it is getting in terms of risks, with the greatest NPV payment and total risk differential registered by Beiras Litoral & Alta and the smallest differential by Algarve.

Exhibit 6. NPV-Payment and Total Risk Differential (excluding payment risk)



Source: Authors.

The main results of our analyses regarding NPV-at-risk are shown in Table 11. Here, total risks also include payment risks. As can be seen in the last column of the Table, with the exception of Grande Porto, all the SCUT concessions show gains after-transfer risks (before taxes), indicating that the costs incurred by the public sector through the contract payments, far outweigh those assumed by the private sector.

Table 11. Gains Before & After-Risk Transfer (before taxes)

Concessions	NPV Payment	NPV CAPEX	NPV Interest Costs	NPV O&M Costs	NPV Total Costs	Gains before Risk Transfer	NPV-at-risk Total Risk	Gains after Risk Transfer
Beira Interior	1.307.958	358.515	224.279	1.220	584.013	723.945	126.516	597.429
Interior Norte	1.242.567	438.172	220.645	854	659.671	582.896	120.274	462.622
Algarve	601.108	210.666	91.226	779	302.672	298.436	62.102	236.334
Costa de Prata	860.564	259.846	116.117	1.861	377.824	482.740	71.659	411.081
Grande Porto	762.022	499.961	181.350	1.770	683.081	78.941	125.299	-46.357
Beiras Litoral & Alta	1.610.192	646.895	306.341	1.154	954.390	655.803	193.411	462.392
Norte Litoral	666.497	194.913	89.452	837	285.201	381.295	57.914	323.381
TOTAL	**7.050.908**				**3.846.852**	**3.204.056**	**757.175**	**2.446.881**

Source: Authors.

Finally, Table 12 reports the gains to the private sector as percentage of the NPV of payments *before* and *after* risk transfer. In descending order, Norte Litoral, Costa de Prata, and Beira Interior register the highest gains before and after risk transfer. Further, Grande Porto and Beiras Litoral & Alta provide for an interesting analysis. Among the concessions, they are the two that took on the most risk as percentage a of NPV payments (both when assessed with and without payment risk); this is also shown by the fact that both register above average share of risk (refer to Table 10). Correspondingly, they are the two concessions that report the smallest gains (or loss in the case of Grande Porto) as a percentage of NPV payments *before* and *after* risk transfer.

Table 12. Weight of Gains before and after Risk Transfer

Concessions	Gains before Risk Transfer (% NPV Payment)	Gains after Risk Transfer (% NPV Payment)
Norte Litoral	57%	49%
Costa de Prata	56%	48%
Beira Interior	55%	46%
Algarve	50%	39%
Interior Norte	47%	37%
Beiras Litoral & Alta	41%	29%
Grande Porto	10%	-6%
Average	**45%**	**35%**

Source: Authors.

6. Conclusion

The objective of this study was threefold: first, it examined the allocation of risks between the public and private sectors in the seven SCUT concessions, namely, Algarve, Beira Interior, Beiras Litoral & Alta, Costa de Prata, Interior Norte, Grande Porto, and Norte Litoral. We concluded that for the most part, with the exception of demand risk, risks under the SCUT concessions were well allocated between the two parties.

Then this paper identified the main risks transferred to the private sector and how to best evaluate them. Through a risk matrix we identified these risks to be the construction, financial and O&M risks. We used a valuation technique developed by Ye and Tiong (2000), NPV-at-risk, which incorporates both the WACC and the dual-risk return methods, thereby capturing both the size of the acceptable deviation and the appropriate confidence levels in our variables of interest.

Last, this study evaluated the main risks transferred to the private sector and compares them to the public sector's payment obligations adjusted for the time value of money to measure the gains, if any, for the private sector before and after risk transfer. We find that the risks transferred to the private sector represent a very small share of what the public sector is paying. On average, risk transferred to the private sector represents 11% of NPV payments which is in fact slightly higher but close to that of the Australian benchmark. The Australian benchmark of transferrable risks (based on other sector projects) is set at 8% (OECD, 2008). We also find that the costs to the public

sector, through the payment obligations, far outweigh the costs taken in by the private sector. More specifically, with the exception of Grande Porto, all the concessions register after risk transfer gains (before taxes). On average, the concessions register before and after risk transfer gains (as percentage of NPV payments) of 45% and 35% respectively.

Limitations in this study are that the risk analyses and the subsequent valuation methods employed are limited to the projects in question and would not necessarily lead to the same conclusion in other projects. Other valuation methods may very well lead to different results. Another limitation is that this valuation exercise, as any other, is subject to the assumptions and expectations set by the authors, rendering it subjective.

Was risk crucial to achieving VfM? When looking at the high gains, doubts arise as to whether VfM was achieved. On the other hand, no conclusion can be drawn seeing as no alternative approach was analyzed. However, in a broader context and more in line with the existing literature on SCUT, when compared against the use of a PSC, Sarmento (2010) finds that procuring the projects through the PPP approach was far more expensive and did not add VfM to the public sector. Arguably, a substantial part of the inefficiency suggested from our analyses can be traced back to the appraisal process itself. The lack of public sector comparators in assessing the projects meant that cost estimates from bidders were not properly assessed and thus there was no way of assessing whether the PPP approach offered a superior outcome. Similarly, the absence of a legal and institutional framework for PPPs coupled with the significant number of PPP deals undertaken within a short time frame undermined, to a great degree, the performance and execution of the projects in question. The SCUT case strongly suggests the need for a more coherent and rigorous appraisal of infrastructure projects in Portugal.

The current study can be expanded by conducting more detailed analysis on risks. Similarly, a more comprehensive risk valuation exercise can be performed using other valuation methods. In addition, an interesting analysis can be had by comparing these projects with similar projects in other countries.

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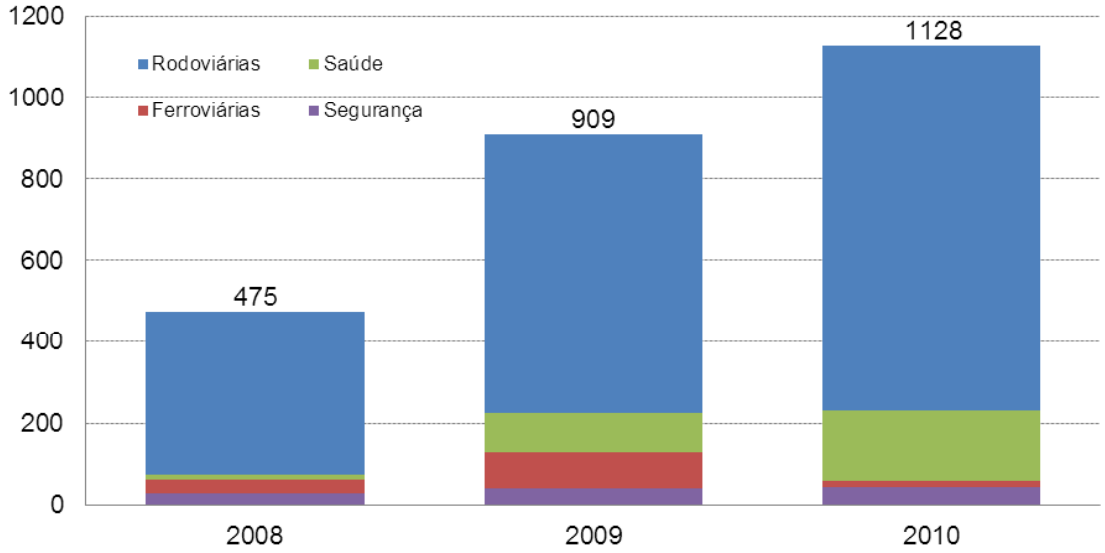
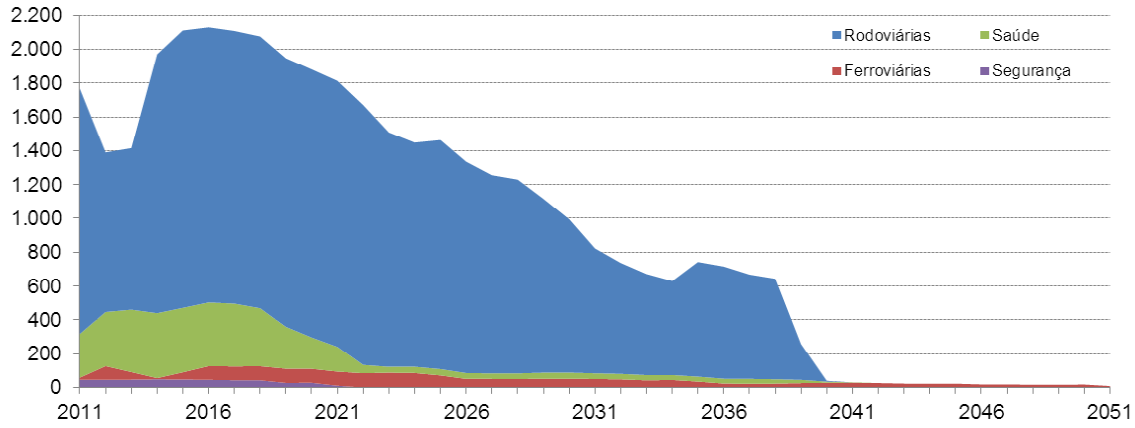
8. Appendix

Exhibit 1. Net Payments of Public-Private Partnerships 2008-2010 (Euro million)



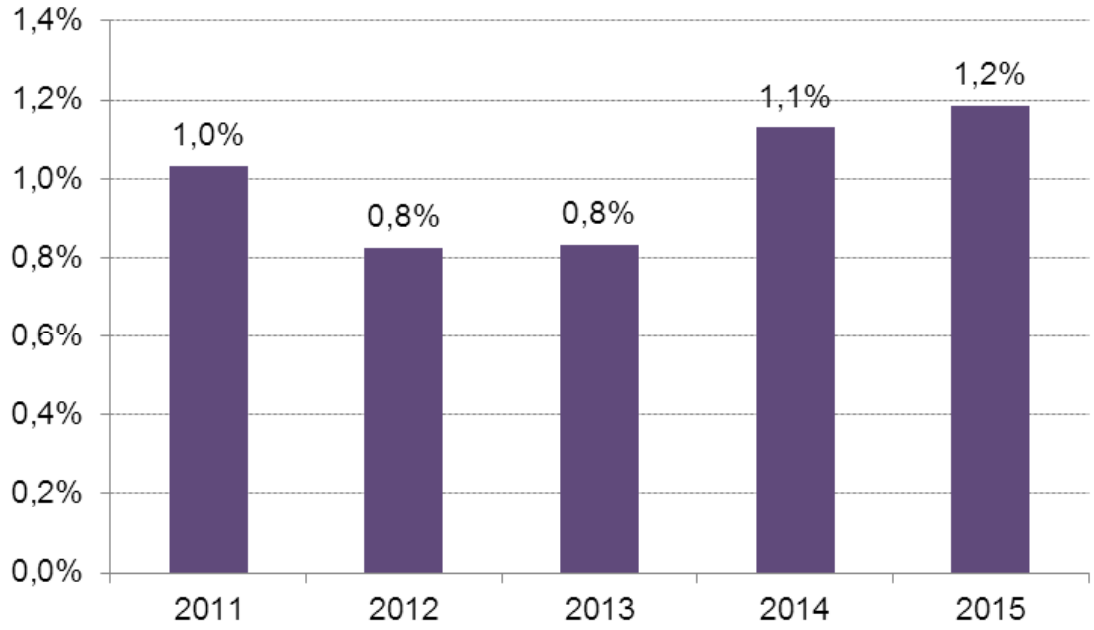
Source: Direção-Geral do Tesouro e Finanças.

Exhibit 2. Projected Gross Payments of Public-Private Partnerships (Euro million)



Source: Direção-Geral do Tesouro e Finanças.

Exhibit 3. Weight of Public-Private Partnership Payments as a percentage of GDP



Source: Ministry of Finance.

Table 5. Sensitivity Analysis at 4.5%

Variation	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral
50%	991.681	999.956	468.298	581.369	1.083.719	1.492.980	451.514
20%	793.345	799.965	374.638	465.095	866.975	1.194.384	361.212
15%	760.289	766.633	359.028	445.716	830.851	1.144.618	346.161
10%	727.233	733.301	343.418	426.337	794.727	1.094.852	331.111
Base case NPV	**661.121**	**666.638**	**312.199**	**387.579**	**722.479**	**995.320**	**301.010**
-10%	595.009	599.974	280.979	348.821	650.232	895.788	270.909
-15%	561.953	566.642	265.369	329.442	614.108	846.022	255.858
-20%	528.897	533.310	249.759	310.063	577.984	796.256	240.808
-50%	330.560	333.319	156.099	193.790	361.240	497.660	150.505

Source: Authors.

Table 6. Sensitivity Analysis at WACC

Variation	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral
50%	876.020	989.506	454.008	566.736	1.024.622	1.431.584	427.802
20%	700.816	791.605	363.206	453.389	819.697	1.145.268	342.241
15%	671.615	758.622	348.073	434.498	785.543	1.097.548	327.981
10%	642.415	725.638	332.939	415.607	751.389	1.049.829	313.721
Base case NPV	**584.013**	**659.671**	**302.672**	**377.824**	**683.081**	**954.390**	**285.201**
-10%	525.612	593.704	272.405	340.042	614.773	858.951	256.681
-15%	496.411	560.720	257.271	321.151	580.619	811.231	242.421
-20%	467.211	527.737	242.137	302.259	546.465	763.512	228.161
-50%	292.007	329.835	151.336	188.912	341.541	477.195	142.601

Source: Authors.

Table 7. Sensitivity Analysis at 6%

Variation	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral
50%	924.603	937.883	439.818	545.518	1.018.896	1.400.919	423.344
20%	739.683	750.306	351.854	436.414	815.117	1.120.736	338.675
15%	708.863	719.043	337.193	418.231	781.154	1.074.038	324.564
10%	678.042	687.781	322.533	400.047	747.190	1.027.341	310.453
Base case NPV	**616.402**	**625.255**	**293.212**	**363.679**	**679.264**	**933.946**	**282.230**
-10%	554.762	562.730	263.891	327.311	611.338	840.552	254.007
-15%	523.942	531.467	249.230	309.127	577.374	793.854	239.895
-20%	493.122	500.204	234.569	290.943	543.411	747.157	225.784
-50%	308.201	312.628	146.606	181.839	339.632	466.973	141.115

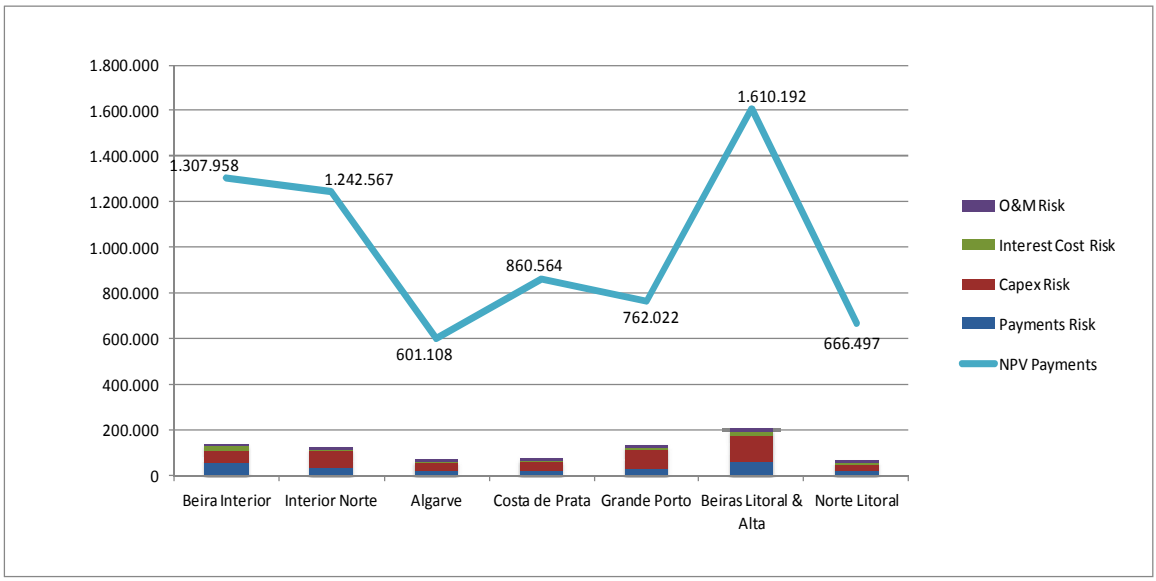
Source: Authors.

Table 8. Sensitivity Analysis at CAPM

Variation	Beira Interior	Interior Norte	Algarve	Costa de Prata	Grande Porto	Beiras Litoral & Alta	Norte Litoral
50%	460.425	152.363	298.645	274.909	736.281	707.237	318.592
20%	368.340	121.891	238.916	219.927	589.024	565.789	254.874
15%	352.993	116.812	228.961	210.763	564.482	542.215	244.254
10%	337.645	111.733	219.006	201.600	539.939	518.640	233.634
Base case NPV	**306.950**	**101.575**	**199.097**	**183.272**	**490.854**	**471.491**	**212.395**
-10%	276.255	91.418	179.187	164.945	441.768	424.342	191.155
-15%	260.908	86.339	169.232	155.782	417.226	400.767	180.535
-20%	245.560	81.260	159.277	146.618	392.683	377.193	169.916
-50%	153.475	50.788	99.548	91.636	245.427	235.746	106.197

Source: Authors.

Exhibit 7. NPV-at-Risk Assessment (including Payment Risk)



Source: Authors.