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Master of Science in Business Administration

Public-Private Partnerships in the Healthcare Sector

A REAL OPTIONS APPROACH TO *HOSPITAL DE CASCAIS*

Marta Peste Drago Martinho

Supervisors:
Prof. Ricardo Reis
Prof. Joaquim Miranda Sarmento

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Abstract

Title: Public-Private Partnerships in the Healthcare Sector – A Real Options Approach to *Hospital de Cascais*
Author: Marta Peste Drago Martinho

The purpose of this paper is to analyse the *Hospital de Cascais "Dr. José de Almeida"*, built under a Public and Private Partnerships' program, in order to understand if the private partner will be responsible for the hospital's management until the end of the contract (in 2018) or if it will step out due to financial losses.

Such analysis will be done using a Real Options approach, through the use of abandonment options. Two scenarios will be considered: in the first one the operational costs will follow the same evolution as expected in the Base Case (86,7% of the revenues). In the second scenario the operational costs will be assumed to be 95% of the revenues, to better reflect the past performance of the hospital. Moreover, for each of these scenarios two discount rates will be used to compute the Net Present Value: one is the discount rate used by the government to assess the value of the public sector comparator (PSC): 6,08%; the other is the Weighted Average Cost of Capital (WACC), which changes every year to match with the changing debt ratio.

The results show that in the first scenario the optimal decision is to continue in the project and not do the step out, since the Real Options analysis shows that the stepping out provides savings smaller than the profit they would obtain from continuing. However, in the second scenario the optimal decision is to abandon the project. It is also concluded that the DCF model underestimates the value of the project by ignoring the flexibility HPP has to step out.

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1. Introduction

Nowadays governments are spending more and more on health, with health spending growing faster than inflation due to ageing populations (Exhibit 1), higher incidence of chronic diseases, higher life expectancy (Exhibit 2) and lower infant mortality rates (Exhibit 3). As a result, governments are increasingly looking for new ways of achieving efficiency and innovation, without having to increase the public expenditure (PWC, 2010). PPPs in the health sector emerge as an answer to this situation, with the government partnering with the private sector in order to share the project's risks, build on both parties' different sets of expertise and consequently achieve higher efficiency.

According to the definition, in a PPP the public and private party cooperate and share the risks and responsibilities of the production and delivery of services that are usually considered as public, in order to achieve a common goal (Pomeroy, 1998; Navarro-Espigares and Martín-Segura, 2011). Consequently, it is recognized that a PPP is a "sustainable approach to improving social infrastructure, enhancing the value of public assets and making better use of taxpayer's money" (Li and Akintoye, 2003)

PPPs have been used all over the world, and Portugal is no exception. The first PPP contract dates from 1995 and aimed to build and operate the Vasco da Gama bridge. At the moment, there are 35 PPPs in Portugal (including the ones under construction), 10 of those being in the healthcare sector. Moreover, from 2008 to 2011, the annual public expenditure in PPPs more than tripled, going from 475 millions to 1.822,6 million euros (Exhibit 4). This number is expected to grow to more than 2.000 million euros per year in the period between 2015 and 2018 (Exhibit 5) (Direcção-Geral do Tesouro e Finanças, 2012).

In Portugal, there are two different types of PPPs in the healthcare sector, which came in two different waves. The first one includes *"Hospital de Cascais Dr. José de Almeida"*, further referred to as *"Hospital de Cascais"*, and is characterized by having two private parties: one is responsible for the provision of the infrastructure and the other is responsible for the management (Exhibit 6). In the second wave, PPPs only include the provision of the infrastructure.

Hospital de Cascais was the first hospital in the Portuguese National

Health Service to be concessioned and built as a PPP. The concession was delivered to *"TDHOSP – Gestão do Edifício Hospitalar, S.A"* (Teixeira Duarte) for the construction of the building and to *"HPP Saúde – Parcerias Cascais, S.A."* (HPP – Grupo Amil[1]) for the hospital's management.

HPP Saúde is a reference group in the health sector in Portugal, with over 15 years of experience. It works in an innovative way and is focused on offering high quality of health care. They took over the management of the former *Hospital de Cascais* in January 2009, and the new hospital opened its doors in February 2010. The hospital serves more than 170.000 citizens and expects to have, in 2018, a maximum annual capacity of 115.000 medical appointments, 6.474 surgeries and 67.000 hospitalizations (HPP Cascais, 2013; HPP Saúde, 2013).

The purpose of this study is to evaluate the *Hospital de Cascais* through the use of Real Options, in order to assess if HPP will remain responsible for the hospital's management until the end of the contract (in 2018) or if it will step out due to financial losses. During the valuation process, it will be performed a Monte Carlo simulation in order to estimate the cash flows' volatility and to get some insights regarding the financial viability of the hospital.

The paper proceeds as follows. The next section presents a brief literature review that introduces a PPP overview, as well as the difference between diverse valuation methods. It also describes how PPPs are applied to the healthcare sector. Section 3 describes the methodology used to apply the Real Options approach to this particular case, and presents the scenarios created and data and assumptions used. In section 4 it is presented a brief contextualization of PPPs in the Portuguese healthcare, followed by the application of the model and the results in section 5. Section 6 explains the conclusions of the study and the paper finishes with sections 7 and 8, which deal with the limitations and further work that could be done.

[1] In 2012 *Caixa Geral de Depósitos* sold HPP to the Brazilian group Amil.

2. Literature Review

2.1 Overview

For the past decades governments all around the world have been reaching for the private sector to provide services that they used to provide through public (traditional) procurement. This new way of procurement is called Public-Private Partnerships (PPP), and according to OECD (2008, p. 17) it can be defined as an "agreement between the government and one or more private partners (which may include the operators and the financers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners." As a result of such agreement, governments are able to provide services and to improve social infrastructures without the need to immediately raise taxes or to borrow by using a long-term, sustainable approach that increases the value of public assets (Li and Akintoye, 2003; The World Bank, 2005).

The main rationale to engage in a PPP project is to achieve Value for Money (VFM), that is, the cost of the service provided by the private sector is lower than if that same service was provided by the public sector (considering the same level of quality of services, risk allocation, price and time frame) (Grimsey and Lewis, 2004). This occurs due to the intrinsic motivation the private sector has to be efficient (OECD, 2008), as well as due to the better management skills, risk management expertise, more experience, better access to technology and more innovative and creative approaches and design (Birnie, 1999; HM Treasury, 2003b; Li and Akintoye, 2003; Grimsey and Lewis, 2004). Furthermore, there is also evidence that PPP agreements reduce the cost (or deliver higher quality for the same costs), because of the synergies and economies of scale, as well as the time to implement a project, due to the incentives the private party has to deliver the project on time (Birnie, 1999).

One of the most important issues about PPP arrangements is regarding the risk and its allocation. By engaging in a PPP the government is able to transfer certain risks to the private party, and becomes the buyer of a risk-free

product, in the sense that it does not pay if the product does not match the stipulated criteria (Grimsey and Lewis, 2004). The basic principle is that risks should be allocated to the party who is best able to manage them[2] (Li and Akintoye, 2003; Grimsey and Lewis, 2004; Carbonara et al., 2010). The goal is not to maximize, but to optimize risk transfer. Risks should be appropriately identified, analysed, allocated and managed by the parties, on a project-by-project basis, in order to achieve value for money and thus ensure PPP success (Grimsey and Lewis, 2004; Ng and Loosemore, 2006; OECD, 2008; Carbonara et al., 2010).

2.2 PPPs in Healthcare Facilities

Nowadays, government spending on healthcare is growing at an unsustainable speed, due to challenging demographic and epidemiological trends. Additionally, with the present recession, governments are considering other ways of improving and maintaining the healthcare service without increasing their spending. Despite the fact that healthcare is considered as governments' responsibility, the private sector is becoming more and more a source of capital, expertise, efficiency and innovation. PPPs allow for the government to harness the skills and capabilities of the private sector in order to achieve public sector goals (PwC Health Research Institute, 2010).

Nonetheless, PPP projects in the health sector are different from the typical infrastructure projects, like toll road projects. First of all, the revenue contribution is usually low (since users only pay a user charge), and thus it demands a large and on going payment from the public party. Moreover, the ongoing expenses of operating a hospital represent the majority of the costs, while in a toll road project the initial investment accounts for the main cost. As result, there must be money available to fund the project after the construction (Stowell and Loening, 2011)

[2] "To best manage risk means to manage it at least cost and thereby reduce the long-term cost of the project. If the cost of preventing an adverse occurrence is less than the cost of dealing with its consequences, then risk should be allocated to the party best able to influence the probability of occurrence." (OECD, 2008, p. 49)

PPPs in the health sector can be of different types, with distinctive degrees of responsibility and risk for the different parties. Figure 1 presents the key types of public-private partnerships in the health sector:

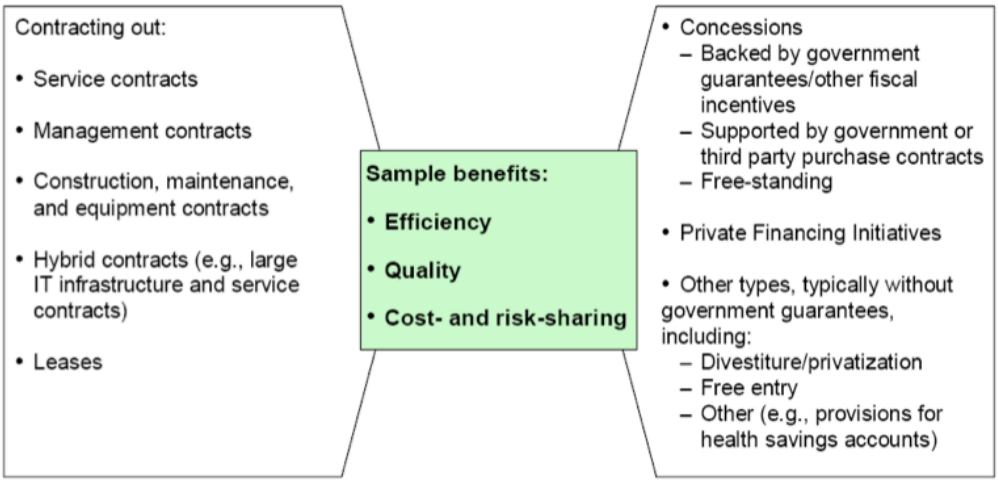

Figure 1: Key types of public-private partnerships in the health sector. (Source: Nikolic and Maikisch, 2006)

In the context of this thesis I will focus in the Private Financing Initiatives, more specifically in DBFO[3] projects. This type of projects is characterized by long-term contracts between the private and the public parties, where the private party is responsible for designing, building, financing, and operating the facilities (Espigares and Torres). In such scheme, the government is responsible for reimbursing the private party for the capital costs and for the costs of the services provided (Nikolic and Maikisch, 2006). The private party is responsible for guaranteeing that the facilities are the most modern, efficient and cost effective (Espigares and Torres). Moreover, the contracts should include well-defined goals, clear division of roles and responsibilities, and risk allocation, as the quality of the contract is of critical importance for the success of the partnership (Nikolic and Maikisch, 2006).

Doing a partnership in the health sector results in many benefits. It not only allows for a reduction in the governments' spending and for a greater efficiency, but it also results in better healthcare management and in leveraged technical and management expertise and higher technology transfers. Such

[3] Design-Build-Finance-Operate.

benefits result in quality improvements, valued by the community. Moreover, the public party can ensure better performance and improved outputs by creating payment and reward mechanisms (Nikolic and Maikisch, 2006).

2.3 Traditional Valuation Methods used in PPPs

Traditionally, the economic viability of projects is analysed by methods based on the Discounted Cash Flow analysis (DCF), using the Net Present Value (NPV) (Cheah and Garvin, 2009; Carbonara et al., 2010). Using this approach, the analyst looks at historical financial data and estimates future cash flows to be generated, which are then discounted to present value with resort to an appropriate discount rate (Hitchner, 2003):

$$\sum_{t=0}^{T} \frac{E(CF_t)}{(1+r)^t} \tag{1}$$

In order to obtain the NPV of the project, the cost of the investment is deducted from the NPV of the stream of future revenues that the project produces (Yescombe, 2007):

$$NPV = -I + \sum_{t=0}^{T} \frac{E(CF_t)}{(1+r)^t} \tag{2}$$

DCF valuations are popular due to the easiness of the calculations, but it is important to pay attention to the choice of the discount rate and to the future cash flows estimation. The choice of the discount rate is not an easy decision, since it should be the expected rate of return, which is hard to measure in the case of non-traded assets (Garvin and Cheah, 2004). The estimation of future cash flows is also of crucial importance. Dotzler (2001) argues that the most commonly used factors when valuation a healthcare facility are profit margins, the current size and predicted growth, and the structure and experience of a solid management team. According to Hitchner (2003) the most important components are net patient revenue, operating expenses (salaries, wages, and benefits, medical supply costs, occupancy costs, insurance, bad debt, general and administrative), working capital requirements (between 10 and 25 percent of net revenue) and capital expenditures.

The NPV rule is the following: the project is accepted if the NPV is positive and rejected otherwise. It is clear that a positive NPV means that the NPV of the future revenues will be higher than the investment, and thus there is value creation for the investor.

However, the NPV method is based on strong assumptions that barely correspond to reality. First of all, the use of a single discount rate suggests that the risks involved in the project are the same throughout its life. Nevertheless, in reality, and especially for a PPP project, this does not happen (Yescombe, 2007). A PPP project is perceived as more risky due to its long duration (Cheah and Garvin, 2009). Moreover, such project is exposed to many different risks that differ through the life of the project. For Kerzner (1989), Smith and Walter (1990), Chapman and Ward (1997) and Thobani (1998) there are at least nine categories of risk in a PPP: technical (engineering and design failures); construction (faulty construction techniques and cost escalation and delays in construction); operating (higher operating costs and maintenance costs); revenue (traffic shortfall or failure to extract resources, the volatility of prices and demand for products and services sold); financial (inadequate hedging of revenue streams and financing costs); *force majeure* (war and other calamities and acts of God); regulatory/political (planning changes, legal changes and unsupportive government policies); environmental (adverse environmental impacts and hazards); and project default.

Furthermore, the DCF method ignores the managerial flexibility in the project management process (Trigeorgis, 1999; Miller and Park, 2002), since it does not take into account the opportunity of changing the project's strategy in response to changes in the market conditions (Tan, 2007; Brandão et al., 2012). The NPV method does not capture this managerial flexibility well, since it does not allow the adjustment of decisions when circumstances change and new information is available. As a result, the NPV method undervalues the project (Cheah and Garvin, 2009).

Also, the investment decisions are seen as "now or never" type of decisions, instead of decisions that can be delayed. The DCF method accepts or rejects a project depending on the NPV, and thus it rejects the projects with a negative NPV, not considering that in some time the project may create value for

the company, and thus delaying it has value (Miller and Park, 2002).

Taking into account the drawbacks previously mentioned, the valuation of PPP projects asks for more complex methods, such as the Real Options approach.

2.4 Real Options Approach

As presented before, the traditional methods of valuation only take into account part of the value of a PPP project. As result, the options' theory arose in order to better assess the value of the project taking into account the managerial flexibility (Carbonara et al., 2010). Real options theory allows analysts to overcome the shortcomings of the traditional methods, allowing for better decisions.

In the early 70s important advances regarding the valuation of options were made by Black and Scholes (1973) and Merton (1973), which led to an increase of the research regarding the pricing and use of financial derivatives (Miller and Park, 2002). The success of the financial derivatives provided the basis for the incorporation of the options' methodology for real-life assets and projects under uncertainty (Brandão et al., 2012), and the term "Real Options" was first used by Myers in 1977. By definition, an option is a right, but not an obligation, to undertake a certain action when facing uncertainty (Cheah and Garvin, 2009; Krüger, 2012). Applying the options framework to assets gives decision-makers the choice to invest, grow, or abandon a project depending on the new information gathered (Miller and Park, 2002).

The real options framework is particularly important when valuing PPP projects, since they are based on incomplete contracts and have very long time frames, making such projects more uncertain, and thus riskier. Myers (1987) and Trigeorgis and Mason (1987) proposed that the use of option valuation techniques is of particular importance for investments with substantial operating or strategic options. Cheah (2004) stressed the importance of balancing risk and value in this type of projects, suggesting that the real option approach could correctly value the flexibility necessary to implement these projects.

It is also important to notice that the real options framework does not

substitute the DCF method. According to Miller and Park (2002) and Lint and Pennings (2001) the real options approach complements the DCF method. In order to valuate a project using the real options approach, the analyst still needs to use DCF tools to compute the necessary inputs, and only after apply more complex techniques. The DCF should be used for unsophisticated projects, without uncertainty, and in a steady environment, while real options should be used in projects with a high degree of uncertainty and that rely heavily in future information.

The use of real options to value infrastructure investments and PPP projects is becoming a booming field of research. Alonso-Conde et al. (2007) studied the Melbourne CityLink (an automated toll road project) contract conditions and how these conditions can be treated as real options and impact the incentive to invest. The authors analysed the option the private party has to defer payments to the public party in case of low returns (a put option) and the government's option to cancel the concession (a call option). The authors concluded that significant value is transferred to the private sector because of the contractual terms. Cheah and Liu (2009) studied how a negotiation band incorporating options can be constructed, through the creation of a guarantee (to guarantee a minimum level of revenue) to attract private interest, while at the same time protecting itself through the creation of a cap on the level of return of the private party, using a wastewater treatment plant in Southern China as case study. Krüger (2012) analysed the execution of expansion options in road infrastructure in Sweden, and concluded that external congestion costs should be assumed by the public party in order to achieve an optimal outcome. Brandão et al. (2012) used the real options approach to "analyse the government guarantees provided in the contract on the value and risk of the project, as well as the cost and the risk of these guarantees to the government". Blank et al. (2009) modelled a hypothetical toll road concession and analysed three real options: a minimum traffic guarantee, a maximum traffic ceiling and an implicit option to abandon.

3. Methodology and Data

The aim of this thesis is to evaluate *Hospital de Cascais* taking into account the possibility that the private partner has to abandon the concession when the new information received contains bad news. According to Hull (1997) an abandonment option can be treated in finance as an American put option on the project's value. This kind of options increases the valuation of the project, since it mitigates the impact of poor investment outcomes. Moreover, the analysis of such options not only gives an estimate of the value of the option, but also reveals when abandonment should be executed (Copeland and Antikarov, 2001), since the decision to step out of the project is optimal when the present value of the remaining cash flows falls below the salvage value.

In general, the value of an option (financial or real) depends on a number of variables. Some of these variables relate to the underlying asset and other relate to the financial markets. Starting by the ones that relate to the underlying asset, there are: (a) the value of the underlying asset, (b) the volatility in the value of the underlying asset, and (c) the expected dividends on the asset. The variables that relate to the financial markets are: (d) the strike/exercise price of the option, (e) the time to maturity, and (f) the risk free rate.

Applying the theory to the present case study, (a) the underlying asset is the project's value, (c) the expected dividends on the asset are the dividends distributed by the SPV to its shareholders, (d) the strike price in abandonment options is the salvage value, which is the value at which the project could be sold at any moment. In the situation depicted in this paper, the private party does not receive any money from stepping out of the management and delivering the hospital to the government. The salvage value will thus be assumed to be the costs that HPP would have to face in case it stayed until the end. (e) The time to maturity is the duration of the concession, in this case is 5 years, since the contract has the duration of 10 years and it was signed in 2008, and (f) the risk free rate is the Portuguese sovereign 10 years bond rate.

Regarding the (b) volatility in the value of the hospital, there is no market data about it, since this is a non-traded asset in the financial market. As result, this value has to be estimated. According to Copeland and Antikarov (2001), Miller and Park (2007) and Damodaran (2011) there are three methods to assess

the volatility of the cash flows of the project. The first is to look at historical data of similar projects (twin security) and use that as an estimate. However, in the case of a hospital built as a PPP project, there is no similar project that has been valued so that we can use the historical data. The second method involves using the volatility in firm value of firms involved in the same business as an estimate. Nevertheless, a PPP project involves the government and a SPV created specifically for the project, and thus this option is not valid. The last and most viable solution is to do a Monte Carlo simulation of future project cash flows in order to estimate the volatility across present values.

Figure 2 summarizes the information previously present, showing the variables used in the options theory and the correspondent in the present case study, as well as the source of the data.

Theory	Present Case Study
Value of the underlying asset	Project's value
Volatility in the value of the underlying asset	Volatility in the value of the hospital
Expected dividends on the asset	Dividends distributed by the SPV to its shareholders
Strike/exercise price of the option	Costs HPP won't have to face in case it steps out
Time to maturity	Duration of the concession
Risk free rate	Portuguese sovereign 10 years bond rate

Figure 2: Variables used in Options Theory.

For the sake of simplicity, the valuation will follow a discrete time approach. Thus, it will be used the option-pricing lattice approach to compute the value of the hospital, since it is possible to reflect the value of abandoning a project through the use of decision trees.

3.1 Methodology

The methodology followed in this thesis is based on the framework proposed by Brandão and Dyer (2005), which is in turn based on the framework developed by Copeland and Antikarov (2001). The analysis will follow a four-step approach:

1. Contract analysis and risk allocation identification;
2. Estimation of the value of the central scenario – project without flexibility;
3. Monte Carlo simulations for the computation of the volatility;
4. Valuation of the hospital using the lattice approach.

The first step will be to analyse the contract signed by the government and HPP for the clinical management of the hospital. The main focus is to reveal the determinants that led to the financial failure that the hospital is proving to be. Following this initial qualitative analysis, I will follow the framework proposed by Copeland and Antikarov (2001) and later developed by Brandão and Dyer (2005) to value the hospital, in order to assess whether HPP will keep on being the establishment managing body until the end of the contract or if they will step out. The valuation will begin by estimating the value of the central scenario, which is the value of the hospital without considering the flexibility of the options, using the DCF approach. After that, Monte Carlo simulations will be performed to assess the volatility of the project, in order to be able to value the hospital using the binomial lattice approach in the last step of the valuation.

3.2 Assumptions

According to Copeland and Antikarov (2001) at least two basic assumptions have to be done:

A.1. Market Asset Disclaimer assumption:

According to this assumption the present value of the project without accounting for the flexibility of the options is perfectly correlated with itself and thus it is the best unbiased estimate of the project's market value. As result, the project is the underlying asset of the replicating portfolio (Copeland and Antikarov, 2001; Miller and Park, 2003; Brandão and Dyer, 2005).

A.2. The variations in the value of the project follow a random walk:

This assumption allows practitioners to combine any number of uncertainties of the project into one single uncertainty. This uncertainty is associated with the stochastic process of the project value, whose parameters are obtained from a Monte Carlo simulation (Brandão and Dyer, 2005).

Some other assumptions also have to be made in order to simplify the computations, but it is believed that no loss of generality comes from such assumptions.

A. 3. The necessary debt is contracted in the beginning of the concession:

According to this assumption, the debt ratio decreases over the life of the concession until there is only equity, due to the debt amortization. This implies that in each year there will be a different weighted average cost of capital (WACC).

A. 4. No dividends distribution:

The payout ratio is assumed to be zero, given the finite maturity of the concession. Moreover, the nature of the PPP arrangement makes the dividends policy irrelevant to the valuation of the project. Nevertheless it is important to mention that this irrelevancy is merely theoretical and for the purpose of this paper. In reality, the SPV has only this project and thus cannot reinvest in other projects. This situation leads to dividends distribution, either during the 10 years of the contract or only at the end of it, in 2018.

3.3 Model

3.3.1 Risk Allocation

As it was already mentioned in the literature review, the risk and its allocation are of crucial importance in PPP arrangements. PPPs allow the public party to transfer certain risks to the private in order to benefit of risk management at a lower cost (OECD, 2008). Risks can be allocated to the private party, remain with the public or be shared between the parties. The choice depends on which party is better able to manage the risk, and that means, which

party is better able to manage the risk at a lower cost (Grimsey and Lewis, 2004; OECD, 2008). It is important to notice that the private party accepts most of the risks, as long as they are paid accordingly for taking them. Nevertheless, the government should think if it is worth to pay the premium asked by the private or if it would be better to accept the risk. Also, there may exist situations in which neither party is in a better situation to manage the risk. (Grimsey and Lewis, 2004).

According to Grimsey and Lewis (2004) there are three aspects that ought to govern the allocation of risk: (1) "specified service obligations"; (2) "the payment/pricing structure"; and (3) "express contractual provisions adjusting the risk allocation implicit in the basic structure". Loosemore, Raftery, Reilly and Higgon (2006) define a series of rules to follow in order to achieve an optimal distribution. These rules are the following: "A risk should only be given to someone who: has been made fully aware of the risks they are taking; has the greatest capacity (expertise and authority) to manage the risk effectively and efficiently (and thus charge the lowest risk premium); has the capability and resources to cope with the risk eventuating; has the necessary risk appetite to want to take the risk; has been given the chance to charge an appropriate premium for taking it."

3.3.2 The Central Scenario

The first step in the valuation is to estimate the value of the central scenario. The central scenario represents the project without including the impact of the real options that may exist due to managerial flexibility. The value of the central scenario will be computed using the NPV approach, and can be expressed by the formula:

$$\boldsymbol{V_0} = \sum_{t=1}^{m} \frac{\boldsymbol{FCFF_t}}{(\boldsymbol{1}+\boldsymbol{r})^t}, \tag{3}$$

where $FCFF_t$ is the Free Cash flow to the Firm in period t and r is the discount rate. The Free Cash -Flow to the Firm is calculated the following way:

$$FCFF_t = Operational\ Cash\ Flow_t \pm \Delta WC_t - CAPEX_t, \quad (4)$$

where Operational Cash Flow = EBIT - Taxes on EBIT + Amortization + provisions (Δ) – all non-cash charges; Δ WC is the investment/disinvestment on Working Capital; and CAPEX is the Capital Expenditures of the PPP, all for period t.

The discount rate usually used is the Weighted Average Cost of Capital (WACC) but for the purpose of this paper I will use both the WACC and the one used by the government to assess the value of the public sector comparator (PSC[4]), which is close to 6%. The WACC will be computed in the following way:

$$WACC = k_E \times \frac{E}{V} + k_D \times \frac{D}{V} \times (1 - t) \quad (5)$$

The Net Present Value of the hospital is thus given by:

$$NPV = V_{2013} - I, \quad (6)$$

where I stands for the investment undertaken at the beginning of the concession plus the accumulated results from 2008 until 2012.

3.3.3 Monte Carlo Simulation

The Monte Carlo simulation will be done to combine all sources of uncertainties into one single distribution, in order to determine the project's volatility.

It will be done a simulation of the Arithmetic Brownian Motion (ABM) random walk process of the returns:

$$d\ ln\ V = vdt + \sigma dz, \quad (7)$$

where $dz = \varepsilon\sqrt{dt}$ is the standard Wiener process.

The first step is to simulate the stochastic processes of the relevant project variables in order to determine the impact of the uncertainties affecting them. As a result, the project cash flows become stochastic. According to Brandão

[4] "The PSC estimates the hypothetical risk-adjusted cost if a project were to be financed, owned and implemented by government." (The World Bank, 2011)

and Dyer (2005): "each repetition of the Monte Carlo simulation provides a new set of future cash flows, which are used to compute a new project value $\hat{V}_1$, using the NPV formula above. A sample of the random variable $\tilde{v}$ can be determined from:

(8) $$\tilde{v} = ln\left(\frac{\hat{V}_1}{V_0}\right)$$

where $E(\tilde{v}) = v$ and V_0 is the PV of the Central Scenario.

A full run of the simulation provides a sample set of the random variable $\tilde{v}$ from which the project volatility is then computed."

3.3.4 Binomial Lattice

By now we already have the initial project value V, the discount rate r, as well as the volatility σ. The value of the project can be modelled as a Geometric Brownian Motion (GBM) stochastic process, and it is given by:

(9) $$dV = \mu V\, dt + \sigma V\, dz,$$

where μ is the expected return on the project, σ is the standard deviation of the return, and dz is a Wiener process. On a small discrete time interval, Δt: $\frac{\Delta V}{V} = \mu\, \Delta t + \sigma\, \Delta z$

Using the discrete binomial lattice proposed by Cox, Ross and Rubinstein (1979), the first step is to determine the evolution of the underlying asset, starting with the PV of the Central Scenario. In order to do so, it is necessary to estimate the value of the project during its life, which is given by:

(10) $$V_{t,i}^{u} = V_{t-1} \times u^{i} \times d^{t-i}$$

where V_{t-1} is the value of the project in the previous period; $u = e^{\sigma\sqrt{\Delta t}}$ and $d = e^{-\sigma\sqrt{\Delta t}}$, which measure the size of the up and down movements in the lattice; and i denotes the number of periods that the value of the project increased.

The next step is to construct the American put option tree, starting from the end nodes and working backward through the tree. In the last node, the value is obtained as:

(11) $$\boldsymbol{P_t = MAX[X - V_t; 0]},$$

where X is the exercise price and V_t is the value of the underlying asset in the correspondent node to P_t. In the rest of the nodes, the value is obtained as:

(12) $$\boldsymbol{P_t = MAX\left[X - V_t; \frac{\pi \times P^u_{t+1} + (1-\pi) \times P^d_{t+1}}{(1+r_f)}\right]},$$

where $\pi = \frac{(1+r_f) - d}{u - d}$ is the probability of an increase in the value of the project, $(1 - \pi) = \frac{u-(1+r_f)}{u-d}$ is the probability of a decrease in the value of the project, P^u_{t+1} is the value of the American put option in the following period if it goes up, and P^d_{t+1} is the value of the American put option in the following period if it goes down.

The net present value of the project under the Real Options approach is thus given by:

(13) $$\boldsymbol{NPV = V_0 + P_0 - I}$$

3.4 Scenarios

For the purpose of this paper two main scenarios will be analysed. These two scenarios will also comprise two sub-scenarios, as explained below.

3.4.1 Scenario 1

In the first scenario it will be considered for the Operational Costs the same assumption used in the Base Case (when the public sector comparator was calculated): operational costs are 86,7% of revenues. Moreover, inside scenario 1 two sub-scenarios will be considered in the computation of the NPV of the central scenario. The first will be built by using the discount rate of the public sector to discount the cash flows, and the second using the WACC.

3.4.2 Scenario 2

The second scenario is built because after analysing the past financial performance of the hospital, it was realized that the Operational Costs were the

main responsible for the bad results reported, as they represented on average 99% of the revenues. Taking into account this situation, I believed it was also relevant to analyse if HPP will have the same decision considering a higher value for the Operational Costs. Thus, in the second scenario I will consider the Operational Costs to be 95% of the revenues (the percentage is lowered since the high value of 99% may also be due to the early years). Also for scenario 2, the two sub-scenarios will be considered for the computation of the NPV.

3.5 Data

The valuation of the hospital will be based both in the Base Case scenario proposed by the winner bidder – HPP – and also on some assumptions, for the data that was not available. The market data, such as the inputs for the computation of the WACC, was obtained from Bloomberg.

The following table presents the data and the assumption on data used and the correspondent source.

Data	Source
Revenues	The revenues are available in the Base Case.
Operating expense	The operating expense is assumed to be a percentage of the revenues. In the first scenario this percentage is 87,66%, which is the expected annual OPEX divided by the expected annual operational revenue. In the second scenario the operating expense is assumed to be 95% of the revenues. For both scenarios, each of the items of operating expense is calculated as a percentage of total operating expense.
Depreciation	The depreciation is assumed to be at a constant rate, as (Book Value of Tangibles $_{2011}$ + Book Value of Intangibles $_{2011}$ + $\sum_{2012}^{2018} CAPEX$)/(2018-2012).
Debt Amortization	It was assumed that the net income was first used to pay CAPEX and what is left is used to repay long-

	term debt.
Interests	According to the Base Case, the two parties contracted interest rate swaps in order to hedge Euribor's volatility, which resulted in a fixed interest rate of 5,06%.
Taxes	The tax is assumed to be 25%.
CAPEX	In the Base Case the initial CAPEX is 23.096.000€. From the real financial results by 2011 the CAPEX was 23.309.229€, so it was assumed that from then on there would be no CAPEX.
Investment in Net Working Capital	In order to obtain the Investment in Net Working Capital it was used the Days Sales Outstanding, the Inventory Turnover and the Days Payables Outstanding. These parameters were calculated for the past data, computed an average and assumed that from 2012 onwards they would be equal to the average of the past years. With this it was possible to obtain the value for the Inventories, the Accounts Receivable and the Accounts Payable.
Discount Rate: PSC	The discount rate of the public sector comparator results of the sum of the inflation rate and the real discount rate, both fixed in the order nr. 13 208/2003 (2nd series) by the Minister of Finance as 2% and 4%, respectively.
Discount Rate: WACC	For the cost of equity it was used market data and the cost of debt is the swap contracted.

Figure 3: Summary of the data and correspondent sources used.

4. Contextualization

4.1 Background to PPPs in Portuguese Healthcare Facilities

The provision and funding of healthcare in Portugal is primarily done by the government. The National Health Service (Serviço Nacional de Saúde – SNS) is the dominant establishment responsible for the provision of healthcare in Portugal, under the direction of the Ministry of Health (Ministério da Saúde), in a fair way and almost for free.

However, the public health spending is growing fast (Exhibit 7), with almost 70% of the total expenditure in health being public (Exhibit 8). At the same time, there is a need to develop the health infrastructures and to increase the efficiency. This situation gave rise to the PPP program in the Portuguese healthcare sector, since it would allow for the necessary reform without the need to increase the government spending. The PPP program for the health sector became possible through the approval of the decree law nr. 185/2002, which defined the principles and instruments for the establishment of the partnerships. Such decree stated that the goal of the partnerships was the lasting association of the private and the public sector in order to obtain mutual objectives. Moreover, it also detailed that the partnership could comprise one or more of the following activities: design, construction, financing, maintenance and operation. (Diário da República, 2002). Afterwards, more decrees were published (DL nr. 86/2003 and DL nr. 141/2006) with the objective of introducing some changes, such as the general rules applicable to state intervention in PPPs, as well as measures aiming at more risk and profit sharing between the parties (Diário da República, 2003; Diário da República, 2006; Direcção-Geral do Tesouro e Finanças, 2013).

The first wave of PPPs is comprised by four hospitals: *Hospital de Cascais*, *Hospital de Braga*, *Hospital de Loures* and *Hospital de Vila Franca* (Figure 4). Together, they are responsible for the provision of medical care to 1,67 million people, about 15% of the Portuguese population.

Hospital's name	Area of influence	Entity responsible for the building	Hospital management	Main company in Hospital management
Hospital de Cascais	ARS – LVT	TDHOSP – Gestão do Edifício Hospitalar, S.A.	HPP Saúde – Parcerias Cascais, S.A.	Grupo HPP
Hospital de Braga	ARS – Norte	Escala Braga – Gestora do Edifício, S.A.	Escala Braga – Gestora do Estabelecimento, S.A.	Grupo José de Mello Saúde
Hospital de Loures	ARS – LVT	HL – Sociedade Gestora do Edifício, S.A.	SGHL – Sociedade Gestora do Hospital de Loures, S.A.	Grupo Espírito Santo Saúde
Hospital de Vila Franca	ARS – LVT	Escala Vila Franca – Gestora do Edifício, S.A.	Escala Vila Franca – Gestora do Estabelecimento, S.A.	Grupo José de Mello Saúde

Figure 4: First wave of PPPs in the healthcare sector.

This first wave of PPPs includes the provision of the infrastructure, as well as the clinical services (hospital management). As the infrastructure and the clinical services are very different, two contracts were made. For the infrastructure, the contract has the duration of 30 years, and the SPV (Special Purpose Vehicle) is responsible for the design, construction and maintenance of the hospital building and fixed equipment. For the clinical services the duration is 10 years and the SPV is responsible for the clinical services, ancillary services and medical equipment acquisition and replacement (Exhibit 6). The infrastructure SPV is paid based on the availability of the services contracted, while the clinical SPV is paid based on clinical production by major lines of clinical activity (emergency, inpatient, outpatient), according to a specific price list, defined within the process tender. In both cases there are payment deductions and penalties related to failure to deliver service and/or quality. For the purpose of this paper only the hospital management will be analysed.

5. Applying the Model

5.1 Identification of the Risks

As mentioned in the methodology section, the Monte Carlo Simulation will be done to combine all sources of uncertainties into one single distribution, in order to determine the project's volatility. In order to do so, it is first necessary to identify the main sources of uncertainty the project is exposed to.

As in this paper only the hospital's management is being analysed, and not the construction of the infrastructure, only the risks regarding to the hospital's management will be examined. Also, according to the Ministry of Finance (2012) the risks associated with exploration activities under the partnership agreement are the most important, having a weight of 41% of the total risks to which the project is exposed.

In terms of allocation, the risks can be allocated to the private party, remain with the public or shared between the two parties. In the case of *Hospital de Cascais* the private sector is exposed to the operational risk, since it is responsible for ensuring the realization of the healthcare service according to the quantities agreed by the two parties in the contract. Moreover, it is also responsible for maintaining the hospital adequately equipped and staffed to fulfil its obligations. The private party is also exposed to the financial risk, as it is responsible for obtaining the necessary funds for the development of all the activities that comprise the scope of the contract. Nevertheless, as the private party contracted interest rate swaps, they hedged against Euribor's volatility. Furthermore, as the private party is compensated for the production it bears the demand risk, since it is not paid for the units not produced nor for the production above the maximum cap defined in the contract.

For the purpose of this paper only the demand risk will be considered. The financial risk was mitigated by contracting interest rate swaps, and as the operational expenses are assumed to be a percentage of the revenues, the real source of the risk is the demand risk.

5.1.1 Revenues

For the purpose of this paper, I will only focus on the remuneration scheme of HPP Saúde, as the aim of the paper is to determine when the private party responsible for providing the medical services will step out due to the bad results it has been reporting.

As already mentioned, the remuneration of the clinical SPV by the public party depends on: the actual production of clinical services contracted annually in accordance with the criteria for recovery and production limits set out in the contract; on the availability of specific hospital services; on the adjustments resulting from the prescription of drugs by doctors; and also on the penalties for the occurrence of performance failures. The remuneration varies depending if the actual production is within the limits of expected (contracted) production (level 1) or above (marginal production, level 2), with a limit of 10%. The production above 110% is not paid, except with regards to emergency where there is not an upper limit to production (it is considered that this service benefits the population, and thus the production in this area is not discouraged by placing a cap in the expected production). The level of expected production for a certain year is fixed in the end of the previous year, either by both parties or, in the lack of agreement, only by the public party. It is determined based on an estimate of the variables that are necessary, such as the production quantity in inpatient and outpatient surgery, the number of visits to the emergency room and the number of outpatient visits, among others.

The remuneration has also an innovative component that consists in the rationalization of prescription medications, performed by comparison with a group of reference public hospitals. This aims at avoiding the excessive prescription of drugs, since it can imply deductions to remuneration if the hospital prescribes more drugs than the reference group. However, such mechanism may undermine the principles of equality and the provision of quality health care, since it since it could constrain the technical autonomy of physicians.

The contract also states that the production relative to private practice can only be of 10% of the contracted production for a certain year in order to ensure that the production for the National Health Service is not compromised.

Regarding the setting of prices and quality standards, the public party chose a reference group of public hospitals considered to be the most efficient in the public sector and with similar dimensions and complexity. From this group, three hospitals with the lowest unitary costs in the two previous years were used to establish the remuneration, and other three were chosen to set the quality standards. However, it is worth to mention that using public hospitals as efficiency reference may not have been the most correct approach, since private hospitals are usually more efficient than public ones.

Moreover, the private party also has as revenues user fees paid by users in its entirety (that are nevertheless deducted from the remuneration paid by the public party), the share borne by third-party payers (like health subsystems and insurance), and third-party commercial proceeds that are to be shared with the public party.

5.2 Central Scenario

The valuation of the central scenario was performed using the Discounted Cash Flow (DCF) method, by calculating the Net Present Value (NPV) of the project for the two scenarios considered.

5.2.1 Scenario 1

As previously said, in scenario 1 the operational costs follow the same evolution as predicted in the Base Case scenario (86,7% of revenues). Moreover, for this scenario there are two sub-scenarios. In the first one, the free cash flows to the firm are discounted using the discount rate of the public sector and, in the second one, they are discounted using the Weighted Average Cost of Capital (WACC).

The table below shows the results for these two scenarios. Under this first scenario, this PPP presents a negative net present value (which means that the cash inflows are expected to be smaller than the investment made, and thus the project does not create value for HPP – the investor). Without flexibility, the hospital represents a loss of 30.372.906 (using the PSC's discount rate) or 27.970.710€ (using WACC). From the ratio NPV/I it is visible that the project is

expected to generate a negative return of -54,64% over the investment if we consider the public sector's discount rate, and of -50,32% if we consider WACC.

Scenarios	I	PV	NPV	Return (NPV/I)
Public Sector's Discount Rate	55.583.757	25.210.851	(30.372.906)	-54,64%
WACC	55.583.757	27.613.047	(27.970.710)	-50,32%

Figure 5: Summarized results from Discounted Cash Flow method. I stands for Investment, PV for Present Value and NPV for Net Present Value.

5.2.2 Scenario 2

In the second scenario, the operational costs follow the evolution of the past data, after a slight stabilization. This means that the operational costs are 95% of the revenues. As well as in scenario 1, two sub-scenarios were built, one using the discount rate of the public sector, and another using the WACC.

The table below presents the results obtained. As shown, the results are not very different than those from the first scenario. In this case, the PPP presents an even more negative NPV. The DCF results show that without flexibility, the hospital is expected to generate huge losses for the private party.

Scenarios	I	PV	NPV	Return (NPV/I)
Public Sector's Discount Rate	55.583.757	6.467.222	(49.116.535)	-88,36%
WACC	55.583.757	6.883.252	(48.700.505)	-87,62%

Figure 6: Summarized results from Discounted Cash Flow method. I stands for Investment, PV for Present Value and NPV for Net Present Value.

5.3 Monte Carlo Simulation

As previously mentioned, the only relevant source of uncertainty arises from the demand risk, represented by the volatility of the revenues. In the Monte Carlo simulation 1.000 possible scenarios for the evolution of the revenues were built, based on the following assumption:

A. 5. The annual changes of the Revenues follow a Normal Distribution with mean 0,063 and standard deviation equal to 0,050.

(14) $$\Delta Revenues \sim N(0{,}063; 0{,}050)$$

These 1.000 scenarios for the revenues allowed obtaining 1.000 different sets of future cash flows, from which the correspondent present values for the project were computed, using both the public sector's discount rate and the WACC. This simulation was run for both scenarios.

It is important to mention that, as the annual variations in the revenues are assumed to follow a Normal Distribution, the different present values obtained from the simulation also follow such distribution. With the present values it was possible to determine the random variable $\tilde{v_t} = ln\left(\frac{\hat{V}_t}{V_0}\right)$ for each simulation, from which the project volatility was computed.

5.4 Binomial Lattice

The last step was the estimation of the net present value of the project using the Binomial Lattice. The binomial tree was constructed using annual periods and the standard deviation estimation resulted from the Monte Carlo simulation.

5.4.1 Scenario 1

In the following table we can see the results obtained without considering the flexibility of abandoning the project (NPV Central Scenario) and the NPV obtained from the Binomial Lattice for the two sub-scenarios:

Scenarios	NPV Central Scenario	NPV Binomial Lattice
Public Sector's Discount Rate	(30.372.906)	(30.372.906)
WACC	(27.970.710)	(27.970.710)

Figure 7: Comparison between Central Scenario and Binomial Lattice results.

As shown, adding the flexibility to abandon the project in this first scenario does not add value to it. The value of the option is 0€, and thus the NPV from the Binomial Lattice is the same as from the Central Scenario. This is explained by the fact that it is never optimal for the private party to step out, since stepping out allows for lower savings than the profit they would obtain from continuing.

The results from the binomial lattice regarding the option to continue versus abandoning the project are represented in Figure 8. In the table we can see that it will always be optimum to continue regardless of the discount rate used.

Year	Node	Decision PSC	Decision WACC
2017	11	Continue	Continue
	12	Continue	Continue
	13	Continue	Continue
	14	Continue	Continue
	15	Continue	Continue
2016	7	Continue	Continue
	8	Continue	Continue
	9	Continue	Continue
	10	Continue	Continue
2015	4	Continue	Continue
	5	Continue	Continue
	6	Continue	Continue
2014	2	Continue	Continue
	3	Continue	Continue

2013	1	Continue	Continue

Figure 8: Decision to abandon or to continue per node.

5.4.2 Scenario 2

In the following table we can see the results obtained without considering the flexibility of abandoning the project (NPV Central Scenario) and the NPV obtained from the Binomial Lattice for the two sub-scenarios:

Scenarios	NPV Central Scenario	NPV Binomial Lattice
Public Sector's Discount Rate	(49.116.535)	(49.114.963)
WACC	(48.700.505)	(48.697.957)

Figure 9: Comparison between Central Scenario and Binomial Lattice results.

For this scenario, under the binomial lattice model, the net present value equals a loss of 49.114.963€ when the PSC discount rate is used, and of 48.697.957€ with the WACC. In this case, we see that the result confirms the evidence from literature, since it confirms that the DCF underestimates the value of the project. The introduction of uncertainty, translated here as flexibility to abandon the project, added value to it.

For this second scenario, the results from the binomial lattice regarding the option to continue with the project versus abandoning are different than those from the previous scenario. In Figure 10 we can see that in 2013 the best option would be to abandon the project.

Year	Node	Decision PSC	Decision WACC
2017	11	Continue	Continue
	12	Continue	Continue
	13	Continue	Continue
	14	Continue	Continue
	15	Abandon	Abandon

2016	7	Continue	Continue
	8	Continue	Continue
	9	Continue	Continue
	10	Abandon	Abandon
2015	4	Continue	Continue
	5	Continue	Continue
	6	Abandon	Abandon
2014	2	Continue	Continue
	3	Abandon	Abandon
2013	1	Abandon	Abandon

Figure 10: Decision to abandon or to continue per node.

6. Conclusions

Hospital de Cascais was the first hospital from NHS to be concessioned and built under the PPP program in Portugal. It belongs to the first group of PPPs in the healthcare sector, which includes the design, construction, financing, maintenance and operation of the hospital. The hospital has been under the PPP program since 2009, moving to the new building in the beginning of 2010. In the 3 years for which there is historical data, the hospital has shown losses and has been deeply criticized. Such criticism existed even before the hospital was operational, as the contract was failed by the Court of Audit. In the light of these events, the present study aimed at understanding whether HPP would step out of the project before the end of the contract in 2018. The results of the study are the following:

From the implementation of the Discounted Cash Flow method to the central scenario, we did not obtain very different values for the two scenarios considered. In scenario 1, using the operational costs as percentage of revenues defined in the Base Case, we see that the project has a negative net present value of 30.372.906€, using the PSC's discount rate and of 27.970.710€, using WACC. Such values yield negative returns of -54,64%% and -50,32%, respectively. These results are neither unexpected nor surprising if we take into account the present financial situation of the hospital, which has been reporting losses. When we analyse the results of the second scenario built for the purpose of this paper, we see similar results to those from the first scenario. In this case, we can see that the project yields a negative present value of 49.116.535€ when PSC discount rate is used, and of 48.700.505 with WACC. From the DCF analysis, we observe that this project results in huge losses for the private partner, regardless of the evolution of the operational costs.

Adding the flexibility of stepping out of the contract, represented in this paper by the abandonment options, we can see that in the first scenario it did not add value to the results from the DCF approach. The value of the hospital that results from this approach is the same as from applying the DCF. This is explained by the fact that stepping out is never the best decision for HPP. On the other hand, in the second scenario the Real Options analysis shows that the best

option for HPP is to abandon in 2013, since it prevents them to have further losses.

We could also observe that the results obtained from the Real Options approach in the second scenario confirm the evidence from literature: the DCF method underestimates the value of the hospital, since it does not account for the value that flexibility creates for the private party.

Furthermore, it is important to mention that, although stepping out of the project is optimal in the second scenario, HPP should not only consider the financial aspects of this decision but also the reputational issues that would most certainly arise. It is reasonable to think that if a company is having financial losses and has the flexibility to step out and leave, then it should do it. However, with such decision come reputational problems that may affect HPP's financial results more than staying in a project that has only losses. Moreover, such problems could damage the image of Amil, the group that just bough HPP Saúde in March and for whom this acquisition is the starting point for a strategy that does not end with this business.

7. Limitations

It is important to mention that there are some limitations in this work that should be taken into account. The first and most relevant is the lack of data from the Base Case scenario, since the annexes of the contract were not available, and thus I only had access to some data from it. This means that even though there was a Public Sector Comparator it was not possible to use it 100 per cent as a benchmark in this study. Some of the information had to be estimated, which may have caused inaccurate results.

Moreover, it is also essential to mention that the uncertainty considered in this paper only had one source - the revenues - and consequently it was rather small, as the historical data available for the revenues only comprised 3 years (2009-2011). Such led to a very small statistical sample for the computation of the average and standard deviation used to run the Monte Carlo simulation. Therefore, the volatility obtained from the Monte Carlo simulation may over or under valuate the real volatility and be less representative. Furthermore, I believe that if the two parties had not hedged against Euribor's volatility, the results from this study would have been quite different. This belief arises from the fact that the use of the DCF model to value projects like Public-Private Partnerships is mostly criticized for the fact that the discount rate does not take into account the volatility of the interest rate. Thus, if the parties involved had not hedged against this aspect, the expected volatility of the interest rate would have had a great impact in this valuation.

8. Further Work

Due to the lack of historical data I believe it would be interesting to run the model again in one or two years and compare the results of the two runs to see if the decisions to continue or abandon (depending on the scenario) are still the same. It would also be interesting to apply this model to the other hospitals built under the PPP program, such as *Hospital de Braga*, as it has also been reporting financial losses.

7. Appendix

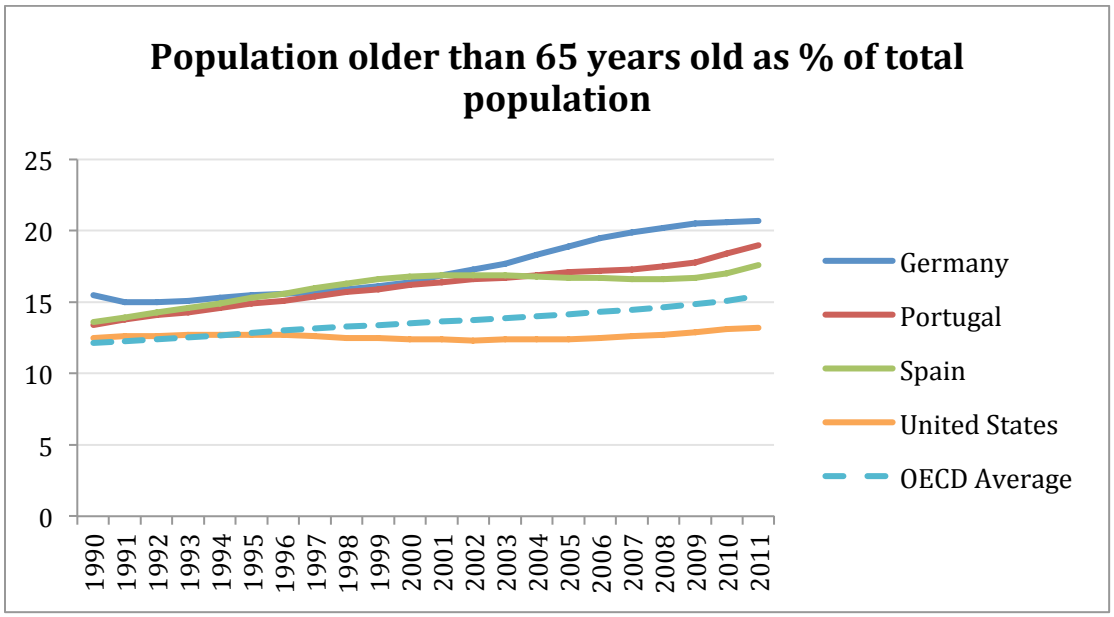

Exhibit 1: Ageing population (source: OECD Statistics).

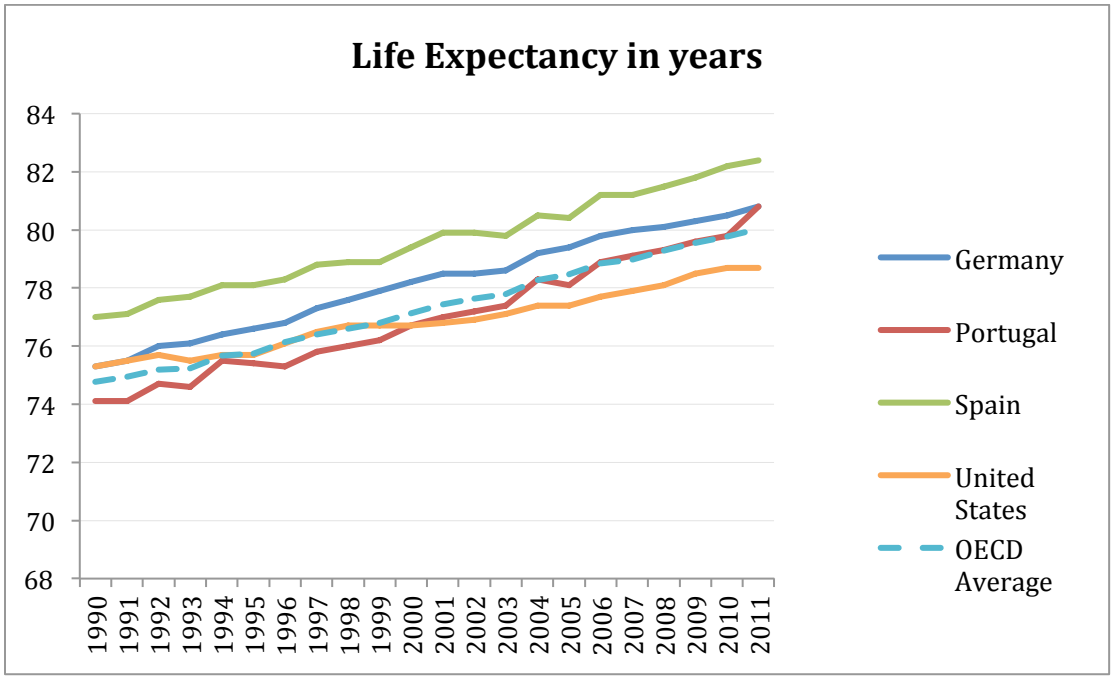

Exhibit 2: Life expectancy (source: OECD Statistics).

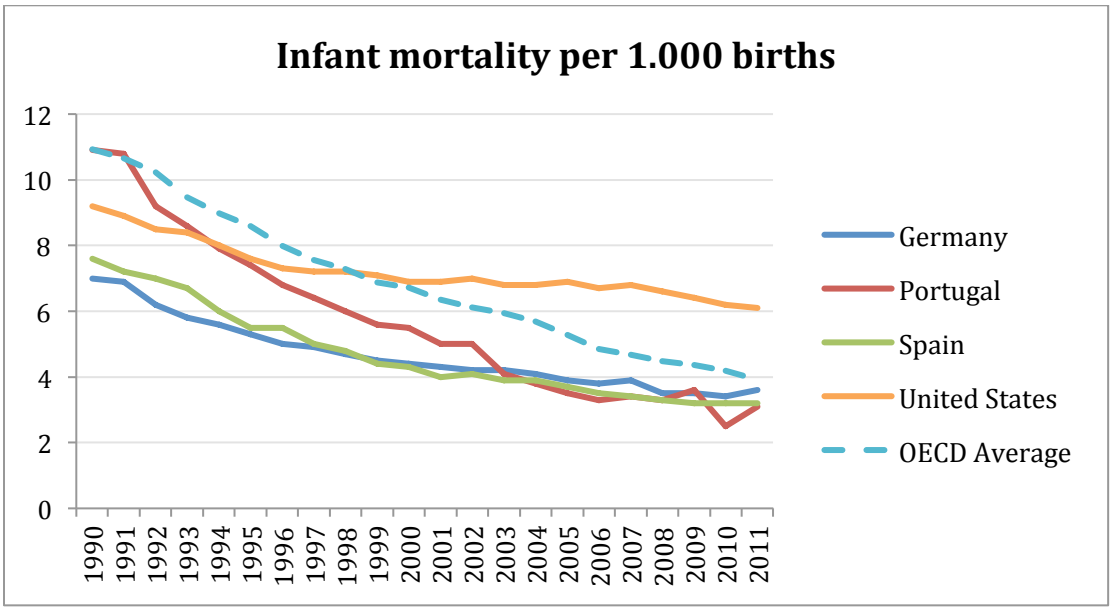

Exhibit 3: Infant mortality (source: OECD Statistics).

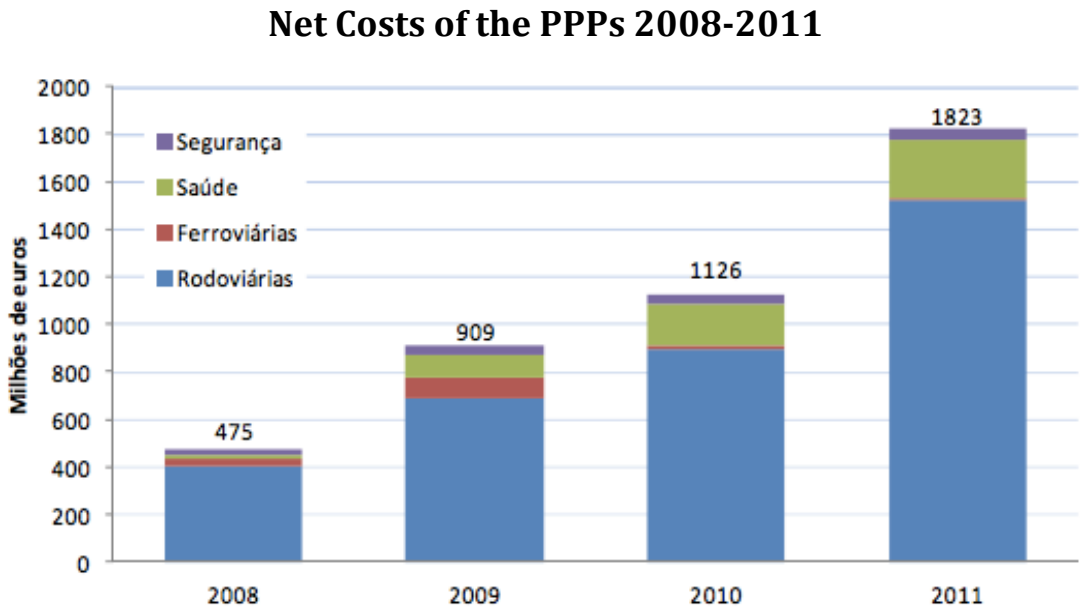

Exhibit 4: Net Costs of the PPPs between 2008 and 2011 (source: Direcção-Geral do Tesouro e Finanças, 2012, p. 6)

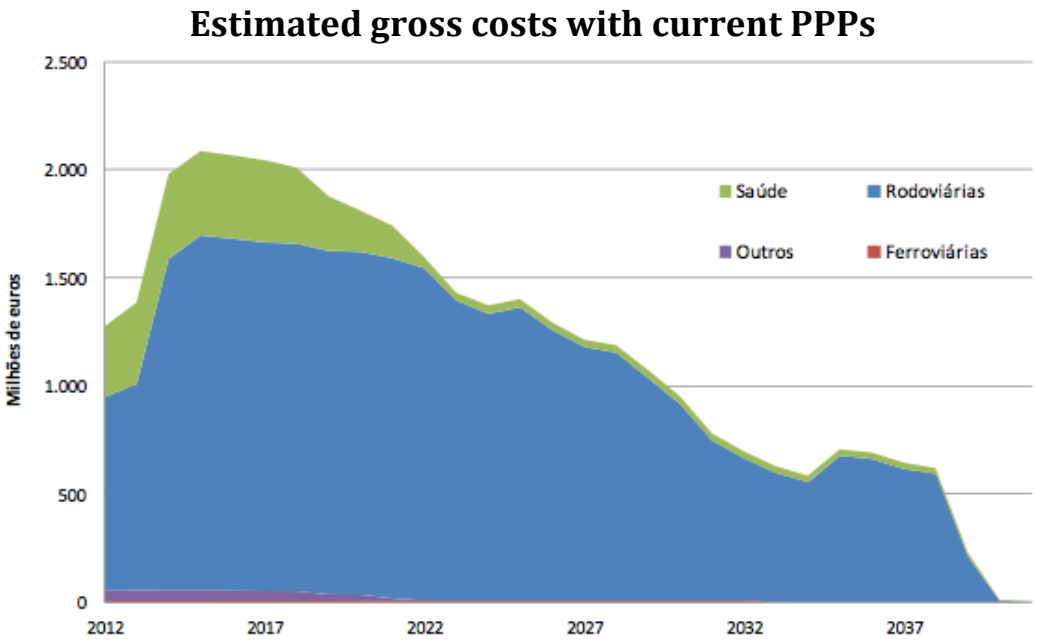

Exhibit 5: Estimated gross costs with current PPPs (source: Direcção-Geral do Tesouro e Finanças, 2012, p. 6)

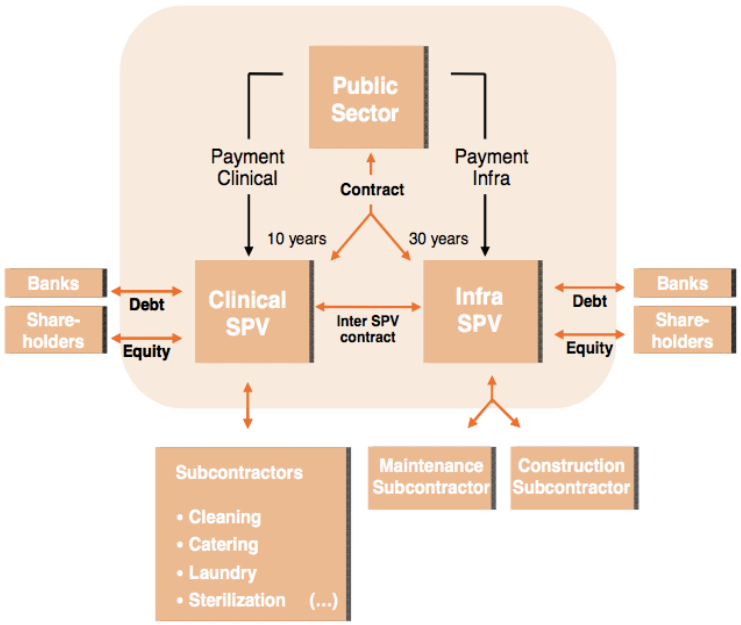

Exhibit 6: Contractual structure (source: http://www.unece.org/fileadmin/DAM/ceci/documents/2012/ppp/ppp_days/Day1/Abrantes.pdf).

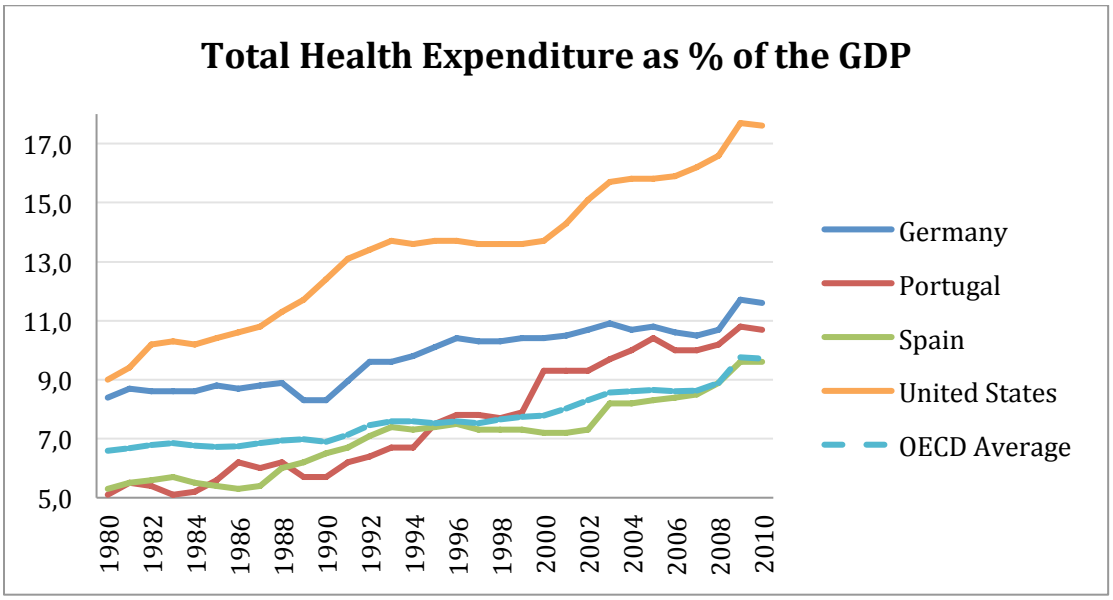

Exhibit 7: Total health expenditure as percentage of GDP (source: OECD Statistics).

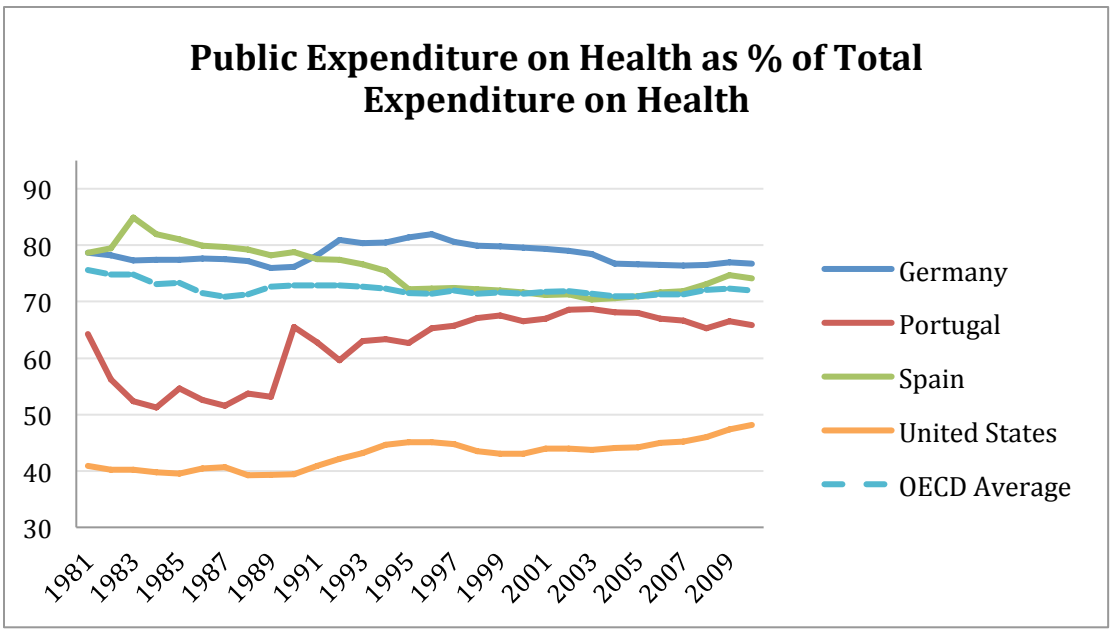

Exhibit 8: Public expenditure on health as percentage of total expenditure on health (source: OECD Statistics).

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