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**"PPP: DESCRIPTION AND METHODS FOR
EVALUATING THE RETURNS"**

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A handwritten signature in black ink, reading "Compromi Giulio". The signature is written in a cursive style with a large initial 'C'.

Abstract

In this thesis we analyse Public – Private Partnership Starting from the understanding of the motivations and the organization of this kind of collaboration between public and private sector, we emphasise the features about risk allocation and financing system of this contracts, that are principally bear by private partners.

After, we deal with valuation of Public – Private Partnerships where researchers have found a high peak in the level of the discount rate asked by the private partners to start the collaboration; otherwise, entrepreneurs would not have invested in the project. Then we argue that using some assessment methods that can incorporate some flexibility decisions of investors, such as Real Option Approaches, helps increasing the value of the project while decreasing the premium asked. In this way, the project can attract private partners not thanks to the risks' reward but thanks to the guarantees implicit into the exercise of the real option inside of the PPP's contract.

Vorrei ringraziare il professore Michele Moretto per la disponibilità e la gentilezza dimostratami durante il periodo di redazione del presente elaborato.

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Introduction

During centuries, governments and public entities have been providing specific collective services, often with related basic structure, such as security, justice, health, transportation, education and culture in order to improve society's needs. Even if these markets might be attractive to private firms' affairs, these players are not tempted to enter public services and infrastructure procurement because they are not seen as profitable projects; instead, mostly referred to them as "natural monopolies". (Sarmiento et al 2014).

Nowadays, even if public entities are the primary provider of community's services, private sector has begun to be more interested and participated into the contract's possibilities that can be used to deliver them. This willingness has produced the development of contracts in which public and private partners work together to reach a goal useful to the society.

One typology of these contracts takes the name of Public - Private Partnership.

Public Private Partnership, also refers as PPP or P3, have born in the past fifty years as a new form of *"institutional relationships between the state and the private for-profit and/or the private not-for-profit sector, where the different public and private actors jointly participate in defining the objectives, the methods and the implementation of an agreement of cooperation"* (O Ong'olo 2006) with the purpose of providing infrastructure and services to the community. In literature, PPP are considered to be part of a major policy called Project Finance, which was developed in United Kingdom, as a "technique based on lending against the cash flow of a project that is legally and economically self – contained". (Engel et al. 2020)

First appearance of Public - Private Partnership was in the United Kingdom during the second half of the 20th century. It is reported that, in a period of lack of public finance, the British government proposed to employ private financing for the renewal of the national road network and the construction of national railroads (Zapata and Mejía, 2017). From this early approach of collaboration between public and private sector, the magnitude of PPP has begun to spread over different sectors such as mining, oil, gas, telecommunications, utilities, and others. Additionally, it has been developing quickly in other States, from developed countries to emerging ones.

This new governance tool is considered as an improved qualitative effort to unite both actors' skills, rather than isolated capabilities utilization as for public tender contracts and privatisation,

which may produce new services and infrastructure that could not be reached without a public-private collaboration (Hodge, Greve 2007). Two aspects are truly important while dealing with a PPP contract: the risk allocation between parties and the financing system, which falls back to the private partners.

PPP description¹ and understanding might be ambiguous: due that it involves different works as, for example, design, construction, operation, financing and risk transfer that are mostly country-specific, there is no unique method of implementation of this collaboration and also its valuation can be intricated.

Contract's complexity, duration, financing system and risk allocation have unpleasant effects on the required return asked by private investors to engage into Public – Private Partnerships. In fact, literature has found an excessive private premium while confronting PPPs between their ex – ante and their ex – post valuation or to other contracts.

After reporting some motivations for the higher returns asked, we will try to analyse the valuation of PPPs incorporating some management flexibility thanks to Real Options Approach. The aim is proving that when some guarantees/protections are placed on the contracts, private investors are inclined to participate without asking for a higher compensation as before.

The thesis is articulated as follow: Chapter 1 is going to give a description of Public – Private Partnerships talking about sectors' causes that have pushed toward PPPs' choices over other contracts and a brief history of them. Chapter 2, instead, will dive deeply in the structure of PPPs, taking also about their risks. Chapter 3 analyses how P3 are valued with the traditional methos of the Discounted Cash Flows and the Capital Asset Price Model, giving some motivations about the return wanted by private entities. Chapter 4 is a comparative analysis between Discounted Cash Flow and Real Option Approaches in order to provide new methodologies that should assess better the project, giving incentive to entrepreneurs to engage in a PPP even if with low return.

¹To go further in the explication of what the Public-Private Partnerships are and how they work both for public sector and for the private sector, aiming to understanding the return of the capital that the entrepreneur wants, I decided to use the United States and the European Commission terminology and classification for a primary determination of the nature of PPPs.

My decision can be misleading because some countries, like Australia, see PPPs as a policy far away from Privatization while, in United Kingdom, the Treasury considers P3s as an inherited connection to Privatization (Hodge, Greve 2007).

1 Public – Private Partnership description, causes and history

Public – Private Partnerships (from now on, PPP or P3) are a branch of Project Finance, which is a sound financing technique that base its security on project’s future cash flow, rather than on guarantees from the borrower or third parties (Grimsey and Lewis 2004).

According to the findings of Garcia – Bernabeu et al. (2015), any project that follow a Project Finance technique is established through a legally and independent company financed, in form of equity and debt, by one or more sponsors which main interests are the reimbursement of initial investments and the reduction of possible risks. Moreover, during asset’s life cycle, private sponsors want to reach their predetermined rate of return over capital invested, thanks to economic flows and earnings of the asset.

Nowadays, Project Finance has further developed into Public – Private Partnership, a term used to refer to a long – term collaboration between public and private sectors to deliver public assets and services, where private partners are responsible either for operating actions and for raising financing capital.

1.a Definition and causes of the Public – Private Partnership’s rise

Public Private Partnerships denote a wide range of cooperation contracts by which governments outsource to one or more private players some target projects, with the purposes of working together to complete the project and reaching own objectives and interests. (Alfen et al. 2009; Mu et al. 2010) Public aims in PPPs have a major impact over private’s ones. As for that, articles and books reported that the main target of a PPP is the production of public goods, either in the form of services or infrastructure², to improve the well-being of the community (Li et al. 2012; European Court of Auditors Report 2018).

Even so, it is better to emphasise that public and private may not share the same goals (Vining et al. 2008; Mu et al. 2010): therefore, this shift of public’s asset supply to entrepreneurs can made rise of problems such as opportunistic behaviour by one or both sides with possible impact on PPP’s contract prices, failure to achieve goals, and partnership dissolution that traditional procurement or in privatization approach might not have.

²From the definition of the Oxford English Dictionary in “The APMG Public-Private Partnership (PPP) Certification Guide”, an infrastructure is “the basic physical and organizational structures and facilities (for example, buildings, roads, and power supplies) needed for the operation of a society or enterprise”. In addition, infrastructure’s investment should “provide basic services to industry and households”, “be key inputs into the economy”, and “be crucial input to economic activity and growth”. (Grimsey et al. 2004)

Public sector can decide to deliver a public good across three mechanisms: Direct public provision, Privatization and Public – Private Partnerships, each with different variants.

“Figure 1” sorts some examples of possible models by the grade of financing and risk subdivision.

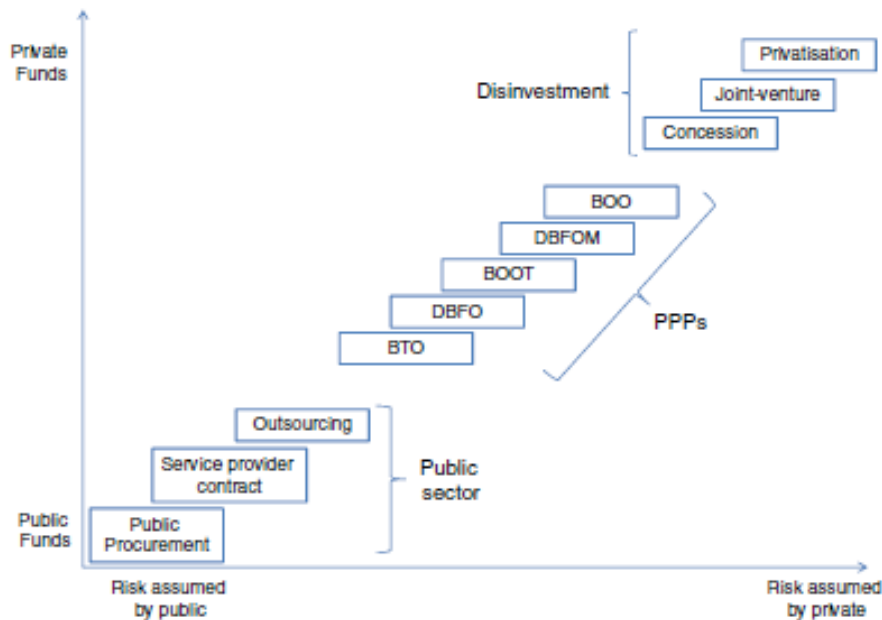


Figure 1: Different procurement systems based on the degree of financing and risk
 Source: Sarmiento and Renneboog 2014.

Direct public provision indicates “the purchase by governments and state-owned enterprises of goods, services and works” (OECD Definition) and it is mostly used by countries that rely on broad taxing power, hoping to realize both efficient scale in technical skills and risks management. (Vining et al. 2008) On the contrary, privatization relies on the presumption of private institutions’ superiority over public which, in practice, refers to the full transfer of asset production’s duties to the private sector, following public’s indications while bearing all the risks and owning the final product. (O Ong’olo 2006; Sarmiento et al. 2014; Wang et al. 2018; Grimsey and Lewis 2004)

The latest possibility, PPP, is the one that recently has fashioned countries all over the world (Vining et al. 2008).

Public - Private Partnerships, compared to other public contracts, are long-term contractual agreement that bundle investment and service provision into a single contract, where responsibilities over different stages of the contract are allocated to the different partners involved, who pursue different purposes, interests and risk preferences (Sarmiento et al 2014).

This contract has on one side a public entity, at a national, regional or local level, that gives mandate to a consortium of private partners to build, manage and maintain an infrastructure or a service that population have the possibility to use free of charge or paying a user fee; the public partner will procure the basic service, leaving private partner in charge for all operation, including finance, to realize the service.

As reported in “**Figure 2**”, we are in front of a middle situation between nationalisation and privatisation.

Moreover, Hodge et al. (2007) emphasise how PPPs are useful for public policy as the collaboration set between the two parties, each with specific qualities and knowledge, when is combined can reach higher results than might not be reached by one party alone.

One can argue that public role may cease during Public-Private Partnerships, but this is not the case: in P3, public sector is still an active player, establishing a more direct controlled

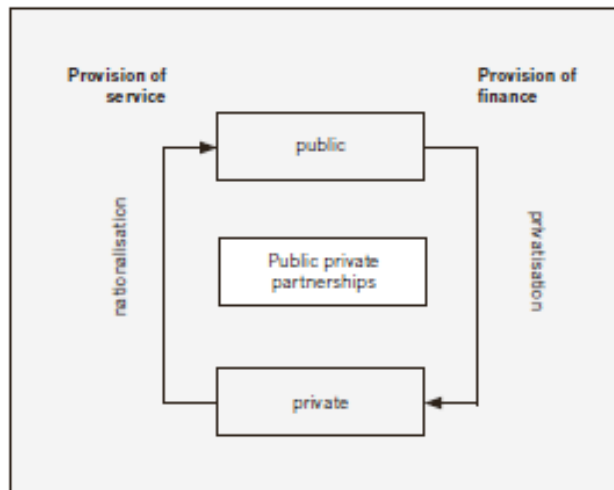


Figure 2: Public – Private Partnership
Source: Winch, Onishi and Schmidt 2012

relationship with the private sector “than any simple market-based and arms-length purchase” for the offering of a public service/infrastructure (Broadbent, Laughlin, 2003).

One essence aspect about P3 where literature is still debating is whether the public entity should purchase the asset or only the stream of service: depending on contract’s terms, at the end of the collaboration, the asset can either become a public’s property or it can remain owned by the private party, allowing government to act as purchaser of service (Grout 2002; Grimsey and Lewis 2004; Engel et al. 2007). This aspect can vary from PPP to PPP, due to typology and to country’s related specifications.

Although we reported some basic notion about PPPs it still tough to find a common definition and relative regulation to share between countries and sometimes even into countries³ because of its adaptation nature to each public sector's economy, culture, political, climate and legal system (Alfen et al. 2009; Sarmiento et al 2014).

This missing common definition is emphasised in the “Green Book on Public - Private Partnerships and Community Law on Public Contracts and Concessions” of the European Commission and in the White & Case LLP's article “The Public-Private Partnership Law Review” published in the United States (from now on “USA”), where both reported how a no common definition shared by all the national government of what a Public-Private Partnership is still lacking.

Since the mechanism of collaboration established with the P3 can take many forms, main characteristics are the follows:

- length of collaboration settled between public and private entity that, normally, last 25-35 years, transforms this contract into a life approach contract longer than typical warranty period under traditional procurement (European Court of Auditors 2018; Authors not Know 2013);
- PPP contract allows to bundle project's investment expenditures with infrastructure costs, reaching higher and efficient trade-off (Engel et al. 2007);
- provision of a post-activity, like maintenance of the public good, leaves part of the financial resources aside while traditional procured projects have no attention to this (European Court of Auditors 2018; Engel et al. 2020);
- efficient gains from the collaboration between public and private sector expertise, both in term of economical and operational advantages, to achieve optimisation of project's scope. Efficiency is obtained also thanks to the application of private law to the PPP's players: from workers to clients, to all the stakeholders that participate to the provision of the public infrastructure/service remembering that PPP is a “new form of procuring infrastructure, not a form of privatizing government assets and functions” (Engel et al. 2020);

³ This missing common definition is emphasised in the “Green Book on Public - Private Partnerships and Community Law on Public Contracts and Concessions” of the European Commission and in the White & Case LLP's article “The Public-Private Partnership Law Review” published in the United States (from now on “USA”), where both reported that a common definition of Public – Private Partnership shared by all the national government is still lacking. Moreover, USA's article states that there are no common laws regarding PPP even between single state of the Federation

- increased Value for Money derived by measurement of risks that can be born within the entire life of the PPPs and its appropriate sharing across partners (Green Book of Public-Private Partnership 2004; Mu et al. 2010; Authors not Know 2013; Pezzuto 2020)
- utilization of private investment capital funding rather than relying solely on public funds which comports faster delivery of the public infrastructure and services, improving overall State's infrastructure (Spackman 2002; European Court of Auditors 2018; Authors not Know 2013);
- the project's major weight is on the shoulder of the private sector, responsible of most of the operating and financing activities necessary to provide the asset, while the public sector's role is focused on the definition of the objectives and control over them, with the intention to reach the designed public interest and the relative quality (Green Book of Public – Private Partnership, 2004).

From this list, we can summarize three peculiar features that help to differentiate PPPs from public traditional procurement and Privatization. Primary, we refer to a cooperation between public and private partners to deliver a social infrastructure or service, thus following public main goal to sustain population's needs. PPP's utilization of private capital investments, instead of only public funding, is the second distinctive aspect. Thirdly, project's risk-sharing between private and public entities following the principle that risks should be allocated to the best suited party that can manage them while being properly compensated for them, having in mind to obtain optimum balance between risk shifting and risk recompense.

Continuing our analysis for understanding Public Private Partnership and their intensification into government policy, we state the principal causes that push public sector and private sector towards this collaboration, emphasizing each partner's goal, that, as reported before, can lead to some problems.

1.a.I Focus on Public Causes

Historically, public sector has suffered different macroeconomic and microeconomics tensions. Only in the last fifty years, at a World level, States have been hit by economies crisis such as Dot.com companies crisis (half 90s – 2000), Subprime Mortgage crisis (2007), Global Financial crisis (2007-2008) and the European Debt crisis (2010) (Consob, website) creating both social and economic repercussions; by the economic boom of Asiatic and African regions; by challenges of urbanization, transportation, infrastructure due to World population growth (Ndonye et al. 2014), and lastly by the effects due to climate changes.

All these phenomena are responsible, in a greater or smaller measure, to the launch of Public – Private Partnerships that began to become a valid answer for the population common requirements.

From the public’s point of view, there are five possible reasons about why government, regional and local entities are keen on PPPs and should try to improve their utilization.

Firstly, the severe restrictions, during latest years, imposed to public budgets and short-term fiscal funds because of economic crisis, have marked a consistent decrease in the available financial resources for public works (Leny Maryouri, 2013). Following the capital-intensive nature of public infrastructures and the limited government resources, public sector has started looking for new partners, private of course, and new form of cooperation to being able to maintain a sufficient level of public infrastructure and services (Alfen et al. 2009; “CNDCEC”, 2016). So, the public partner’s goal to meet population needs within fiscal edges and not seeking an economic profit but rather a social benefit, is supported by a private partner during a PPP project (Hodge, Greve 2007). The construction or renewal of a public infrastructure, seen by the households as a basic service, will therefore improve the quality of life and welfare in the community, while the revenues stream born by the people’ utilization of the infrastructure is part of the financing system itself (Leny Maryouri, 2013). Therefore, this “gap between demand for public infrastructure development and a government’s ability to meet its funding” is the major driver for the outburst of Public-Private Partnership.

In their study, Winch, Onishi and Schmidt (2012) stated that the public sector debt constraint, which causes funding shortage, is the motivation that guides developed public governments: for instance, France, Japan and UK public sector are keen on using private collaboration, in the form of PPP, to provide for the additional public funding capability needed, even if their governments had claimed that costs saving while appealing to PPPs is the real reason behind them. Instead, researchers founded a distinctive motive for developing countries: the rise of the shortage of public funding capability is not due by budget constraints, but by the level of national wealth. Rapid economic growth in developing countries implicates a boom in demand for public infrastructures and services investments, but governments are not capable of procuring enough capital through tax impositions to meet the demand, as country wealth is still low: here comes the necessity of private investment capital. Moreover, with the continuous cycle of private investment- economic growth and more private investment to produce new public infrastructure or services, there is the common idea that the income generated by the

usage of the public structure will repay for itself via national economic development (Winch, Onishi and Schmidt, 2012).

Alfen et al. (2009) have denoted another differentiation between industrialised and industrialising countries when using PPPs: the former, use public private collaboration for education, healthcare services, public building while the latter tends to implement P3 into country's basic sector because of the enormous lack in universal fundamental infrastructures as energy services, transportation sectors and water services, all to support their country's economic growth.

Secondly, public sector had been using Public- Private projects to take advantages of the private sector skills while realizing the best price-quality ratio without damaging the basic guarantees for the community (Pezzuto, 2020). In fact, the second motive in starting PPPs is the opportunity to make use of the know-how that any private firm has development in its field ("CNDCEC", 2016), while allowing private player to access into public monopolies (Ndonye et al. 2014). Public sector then can exploit modern technology and managements skills (Winch, Onishi and Schmidt, 2012), transferring responsibilities to private partners for the construction, the management and the maintenance of the designed infrastructure or service, object of the collaboration (Zapata and Mejía, 2017).

Therefore, public passes from being a mere "direct operator" that provide directly the services and the construction of infrastructure for the society, to be a figure of "supervisor" with a role more linked to the project's organisational side (Green Book of Public-Private Partnership, 2004). Public sector's role is not going to cease for all, it only changes, requiring instead stronger public contractual abilities than under public provision; otherwise, opportunistic behaviour might rise from the private partners (Ndonye et al. 2014) and possible delays in the project's works as well (European Court of Auditors 2018).

In this view, PPPs can be idealized as the best option to switch from an incompetent public party procurement to an efficient private one, when privatization is not possible or convenient.

In achieving social benefits trying to offer public infrastructure and services, governments and local entities must deeply assess their resource with the projects' expenditures. In dealing with infrastructures, Vining et al. (2008) argue that contracting out is the optimum solution for lowering costs due to the economies of scales of private firms; on the other hand it increases transaction costs to monitor the external party. Consequently, Public Private Partnership is perceived as the "efficient answer" where private sector is tied to the delivery of the public

good: without the community utilization of the asset or service, entrepreneur will not repay the investment capital used for the project.

PPPs provide, in fact, a competitive and cost-attractive substitute to traditional public contracts (Ndonye et al. 2014), increasing the efficiency gains not because of private participation per se; on the contrary are the different incentives seek by players that help reach the most suitable efficiency. (Engel et al. 2020)

Efficient gains in costs and risks allocation of the project are reached thanks to the fine labour of upfront design's engineering and the private financing structure, united with the presence of distinctive contracts for each PPP's phases partners and the revenue stream (Grimsey and Lewis 2004). To give some real facts, United Kingdom's Treasury estimated public average savings went from 17% to 25% since the adoption of PPPs in overall sectors where they were used (Alfen et al. 2009).

In a 2016 report about Project Financing and PPPs, the "CNDCEC" enlightens two more families of reasons: the off-balance writing of PPP into Public Entities Balance Sheets and project's risks management.

PPPs are established to be a long-lasting contract, allowing the financial fundings to be committed since the beginning of the project; this characteristic ensures that future capital for PPP is not subject to public authorities' decision to switch funds to other works (European Court of Auditors 2018), while requiring only periodic public expenses to private partners instead of an upfront investment capital (Engel et al. 2020). For this reason, at least in the European Union Accounting Framework (ESA 2010), public entities are allowed to register Public Private Partnerships' movements as "off-balance sheet items", leaving PPP's operation outside fiscal budgets.

However, some authors as European Court of Auditors (2018) argued how this off-balance practice can threaten the rightful assessment of PPP's costs/benefits and the PPP's transparency, while other authors as Sarmiento et al. (2014) are more concerned about the possibility of public debt overhang as PPP's capital will be not inside public fiscal budget capital.

Public – Private Partnerships are also a trust relationship between public and private actors, where responsibilities are shifted, when possible, towards entrepreneurs that can perform with less costs and more efficiently than public sector (Alfen et al. 2009; Mu et al. 2010). To each responsibility is linked a risk.

Consequently, risk management is a core aspect of PPPs: risks are shared between public and private sector, meaning that only the partner which has more knowledge and abilities to deal with the situation that involves a potential danger or loss, should take care of it, trying to minimize the disadvantages. Sometimes, risks are all transferred and borne by the private sector (Mu et al. 2010; Winch, Onishi and Schmidt, 2012).

To summarize, as shown by the growing discussion during G20 meetings (Leigland, 2018), public sector is satisfied in its choice of using a financing alternative, like PPPs, in the infrastructure procurement market because this partnership can increase efficiency through allocation and transference of risks, use of private knowledge and modern technology (Zapata, Mejía, 2017) while letting a higher investment participation of private partners into public infrastructure.

1.a.II Focus on Private Causes

Private partners in a Public – Private Partnership refers to one or more sponsors that deal with the different tasks of the assigned project. Accordingly, their participation causes are various, but we can try to outline below.

To begin, P3 offers new investment opportunities in infrastructure facilities markets that in the past were pure public monopolies (Winch et al. 2012). This private push into looking for further investment possibilities is linked with what economics researchers state as the objective functions followed by private actors: the willingness to pursue economic profit over time. In fact, due to the highest economic private competition over sectors, entrepreneurs have begun to seek different ways towards profit and one of them is to establish a collaboration with public counterparty. However, diverse perspectives of PPPs' stakeholders can lead to different perceptions on the viability of the project itself, threatening it. (Alfen et al. 2009)

It is better to recall that when the collaboration between public and one or more private firms for a public good project is settled, most of the works are going to be performed by the entrepreneurs.

Firstly, private partners must plan resources and qualities of their tasks with a continuous perspective, covering both operation and maintenance aspects of the public good which utilization will carry on after the end of the PPP's contract (European Court of Auditors 2018). For this aspect, particular attention should be placed to the construction quality of the asset by

private player: having a lasting public infrastructure will not only give social incentive, but also it gives credibility to the producer meaning other players, both public and private, would like to have business with him (Fourie et al. 2000). Moreover, the continuous interaction between public and private sectors (and between all private sponsors) about design changes in order to achieve the long-term best solution, permits lower financial costs and commercial incentives (Spackman 2002).

In completing the tasks, private partners gain and retain control over the public infrastructure or service for a lasting determined amount of time; this period should be enough to recover all the investment costs, as example for design, construction, financing, management and maintenance operations, while tidying up entrepreneurs from walking away if project's cash flow are insufficient (Spackman 2002). Furthermore, the duration of PPPs enables the achievement of the required rate of return that entrepreneurs wanted as profit from the contract, in which is comprehended a repayment for transfer of responsibilities from public to private sector, the associated risks relocation to entrepreneurs, plus the pure private earning from the whole collaboration (Alfen et al. 2009; European Court of Auditors 2018). User fees like tolls, water tariffs, ticketing or down payments like availability payments made by the public sector are the most used form to secure the investment's recovery and required rate of return. (Alfen et al. 2009) Therefore, the substantial control over the projects assigned to private firms, that was before on the hands of the public sector, with its intrinsic risks must be compensated through an adequate premium for bearing risks that should be sufficient to deal with risks' consequences. (Vining et al. 2008; Alfen et al. 2009)

During the concession agreement of a PPP, to the private participants is required to design the best solution given specification wanted by public entities. Nevertheless, even if public collaboration may be seen as new profitable markets, private participants will be open to other profit opportunities if these ones let reduce the risks taken sufficiently (Vining et al. 2008).

Hence, profit possibilities and risks compensation might be the major causes of PPPs' choice for private sector, but they must be analysed in the risk adjusted point of view of entrepreneurs: indeed, Vining et al. (2008) states that entrepreneurs are considerably more risk-averse than public sector participants. In the evaluation process, private firms act to maximize risk adjusted profits during the calculus of the "Net Present Value" of the PPP's project. The main NPV calculus is done before entering the contract but, following the private goal of seeking profit, it should be repeated over time to challenge the project versus other profitable ones (Vining et al. 2008).

1.b Brief history of Public – Private Partnership

Public – Private Partnerships were created by the public sector as an alternative mechanism to total privatisation of public infrastructure and traditional public contracts. With this collaboration, public give projects' responsibilities directly to the private players, with the purpose of realizing a public infrastructure, without losing public control over regulatory aspects, such as future fee to charge to society and the quality expectations that the facility should respect (Winch et al. 2012).

First experiences of PPPs can be tracked back to the last years of the 20th century, both in European Countries and in the most developed countries around the World, as Australia, USA and China.

The starting case in Europe is attributable to the United Kingdom, where until 90s the use of private capital for financing public sector projects was formally restricted (EPEC 2012). However, in 1992 the British Government withdrew these rules and launched the “Private Finance Initiative”, or PFI: a huge policy of delegation of public services and infrastructure, aiming to obtain more private capital for supporting and contributing to public works. The purest form of PFI were originally the “Design, Build, Finance and Operate” (DBFO) system where a consortium of private entrepreneurs receives a monthly lease amount for selling “property-based services” to a public sector, which plays as purchaser, for 30 to 60 years. (Broadbent, Laughlin, 2003). Therefore, private partners are obliged to provide a “service package” meaning they are responsible for the necessary and collateral operations to get the service operative, including financing.

Initially, as EPEC (2012) states, PPPs were branded under the Private Finance Initiative. European Economic and Social Committee (EESC) reports that with this initiative the British government entrusted the design, the finance, the construction, the management and the maintenance of a determined public service and/or infrastructure to a private firm. Thanks to the PFI campaign, Public - Private Partnerships⁴ agreement started to be used in all United Kingdom with different areas of application: historically, the easiest sectors in which PPPs

⁴ Over time, the difference between the two types has emerged. Even if PFI and PPP share similarity about the contract's length of time, the major amount of responsibilities, and risks, on the private partners and the high amount of private capital investments, which are going to be compensated by users' fee and/or governments' grants, the differentiation regards the role of public sector, that is present and more relevant in PPP.

found application were transport and urban water supply sectors since users' revenue streams are identifiable and can partly support the investments (O Ong'olo 2006).

PPPs have been for the construction of schools, hospitals, universities and highways. Following what the report of the EESC explained, from 1990s to 2005 in United Kingdom, more than 600 public projects have been started through PPPs following the PFI, covering a commitment worth of €60 billion.

Thanks to the European PPP Expertise Centre ("EPEC")⁵ that collects data regarding PPPs policy across European Countries, in "Figure 3"⁶ we can truly see how transportation has been the primary sector where PPPs have undoubtedly developed with the higher counting values' sectors.

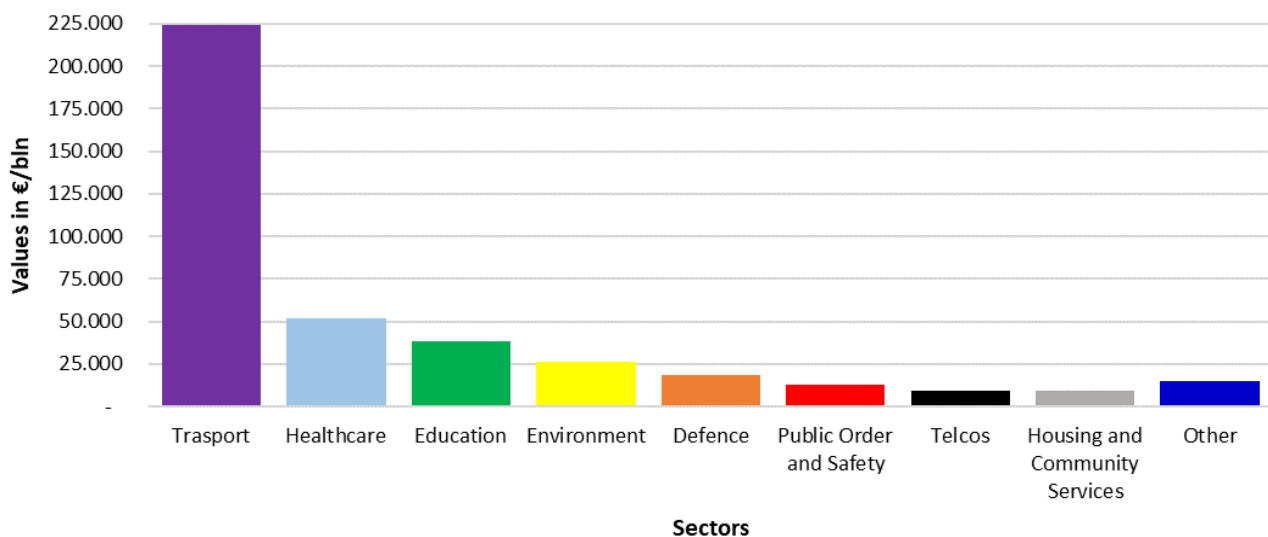


Figure 3: Data about value in €/billions of PPPs sectors through Europe
Source: Author elaboration from EPEC Database

"Figure 3", which shows PPPs' value from 1990 to 2021 of European Countries, moreover, supports all research that expose how PPPs agreements have spread in different sectors, carrying benefit for the whole local society.

⁵ The European PPP Expertise Centre is part of the Advisory Services Department of the European Investment Bank (EIB) aiming to support the public sector across Europe in the phases of the Public Private Partnership projects.
<https://www.eib.org/epec/>

⁶ "Figure 3" data are collected by EPEC for the period from 1990 to 2021, covering transactions that have reached financial close in EU-27 countries, the United Kingdom, Turkey and countries of the Western Balkans (Albania, Bosnia and Herzegovina, North Macedonia, Kosovo, Montenegro and Serbia); transactions structured as design-build-finance-operate (DBFO) transactions, design-build-finance-maintain (DBFM) transactions or concession arrangements that feature a construction element, the provision of a public service and genuine risk sharing between the public and the private sector; transactions financed through project financing; transactions of a project value (defined as the external financing requirements for projects at the time of financial close - i.e. the sum of debt and equity, excluding public capital contributions) of at least €10 million.

In the rest of the world, it is possible to affirm that, following the UK’s PPPs wave, Power Purchase Agreement was the first USA version of PPP. (Mirchandani D. et al, 2022). Power Purchase Agreement, as the Public-Private Partnership Legal Resource Center ⁷ affirms, is the “primary contract between” a purchaser that is the public and the privately-owned power producer to underpin a power sector collaboration. Following the wave of the contract between public and private for energy, in USA started the procurement of public infrastructure through PPP model. Mirchandani D. et al (2022) declares that the primary sector affected by the usage of PPPs is the transportation sector, most commonly for the development of roads and related infrastructure. Other sectors, where Public-Private collaboration have been used, are the airport, light rail, water and wastewater areas. Nevertheless, USA governments and USA local States have made less use of PPP agreements respect to their European colleagues, because of problems regarding Federal taxation law and State regulations (O Ong’olo D., 2006). Nowadays, these issues remain in all USA, but the willingness to improve PPPs projects is stronger and moved into more social infrastructure projects as courthouses, prisons, university housing and schools. (Mirchandani D. et al, 2022)

Lastly, it is interesting to combine all available data about Public – Private Partnerships around the World to show the overall increase in their utilization. “**Figure 4**” shows a database of The World Bank Group: it represents the evolution of the PPPs projects both in term of total investments and in number of projects.

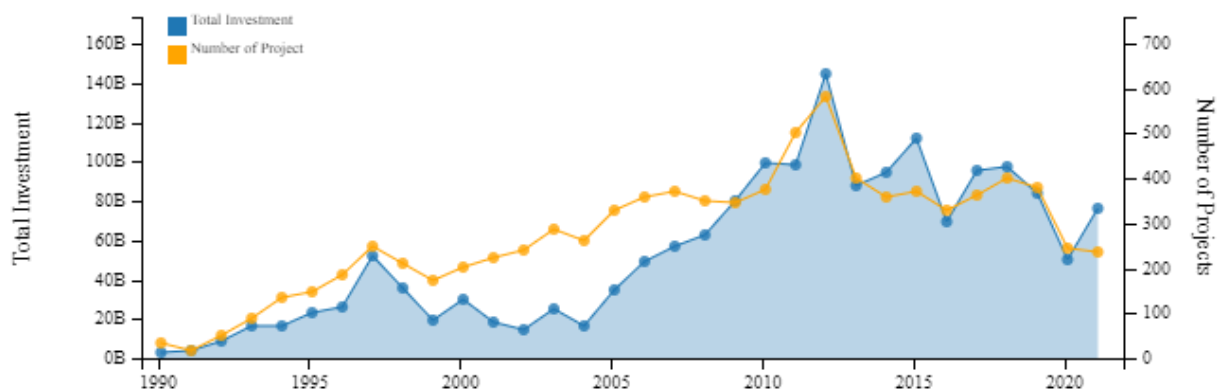


Figure 4: Historical World development of Public – Private Partnerships in term of number of projects and capital investments
Source: PPPs World Bank Group Database

⁷ PPP Legal Resource Center (PPPLRC) is a partner of the World Bank that provides access to sample legal materials which can assist in the planning, design and legal structuring of any infrastructure project — especially projects which involves a public-private partnership (PPP) <https://ppp.worldbank.org/public-private-partnership/about-ppplrc-ppp-legal-resource-center>

In the analysis there are considered both “on going” and “completed” Public – Private Partnerships, while the cancelled ones were not accounted.

From 1990 until nowadays, the World Bank Group have registered 7.257 projects, counting for more than 1.701 billion of dollars, with a continuous increase, in terms of projects started, from 90s until the Financial Crisis stop with a light recovery up to Covid-19 outbreak. For example, in Europe, due to the Pandemic situation, the number of PPP’s projects decreased by 7% compared to 2020, with a loss of 13% in values term. (EPEC, 2022)

However, the report might not be fully comprehensive of the use of the partnership between private and public sector because, as The World Bank Group enlightens, the database “records contractual arrangements for public infrastructure project in low- and middle-income countries (as classified by the World Group)”, where the private sector bears operating risks and has a participation share of minimum 20% in the project. It can be said that the data about United States and Canada, as instance, are not reported and need further research.

Some examples of Public Infrastructure developed through PPPs’ policy around the World and the amount of money invested:

- The LaGuardia Airport Central Terminal B in New York, USA with a deal value of \$5.1bn (Gray et al, 2021);
- The Royal North Shore Hospital and Community Health Services Redevelopment Project in Sydney, Australia which value is approximately of \$1.1bn (Gray et al, 2021);
- The Vienna School Campus in Vienna, Austria, which the European Investment Bank (EIB) financially supported for €47 mms (EPEC, 2022);
- The Tram de Liège in Belgium, with an EIB financing support of almost €200 mms (EPEC 2022);
- The Pedemontana Lombarda Toll Motorway in Italy supported by €544 mms from EIB (EPEC 2022).

2 Structure and typology of Public – Private Partnership

Public – Private Partnership is a typology of agreement that wants to emphasise the “partnership” model that is born between the involved parties (Davis, 2005). However, European Commission definition of PPPs as “form of cooperation” and other authors’ emphasis about the risk – sharing feature of the contract nature, lead to misunderstanding about the framework of PPP’s contract, which, most importantly, gives uncertainty about applicable regulations and laws. Moreover, wide PPPs’ definitions have left each State’s interpretation almost free about structure of Public - Private Partnerships.

Previous statement about regulation, is strengthened by the “Green Paper of Public – Private Partnerships and Community Law on Public Contracts and Concessions” of the European Commission: in their presentation, PPPs are distinguished between a P3 based on contractual links , that is normally indicated as a “concession agreement⁸”, and a second case where PPP is of an “institutional nature” , where the “cooperation between public and private sector within a distinct entity⁹” is witnessed. The latter is the most common case of PPP.

Following the specification of the Green Paper, the authors of “Public – Private Partnership in Infrastructure Development”, enlighten the presence of two different typologies over the Special Vehicle Purpose: PPPs can be “horizontal” or the “vertical” in nature.

“**Figure 5**” displays the two structures: in the “horizontal” model, both public and private parties participate in a Special Vehicle Purpose for providing the object of the contract. Alternatively, “vertical” model is exemplified by the concession agreement that exists between public and private sector, with the latter that form a private Project Company which is obliged to supply the PPP’s target.

⁸ European Commission differentiates concession agreements from tradition public provision contract thanks to the criteria regarding the responsibilities and risks’ transfer of the contract’s project.

⁹ European Law about Public Contracts and Concession do not regulate PPPs where a distinct company is created, because it is a matter of Private Law (Commission of the European Communities, 2004). Even so, when the purpose of the Public Private Partnership is granted within a concession agreement the different with an independent PPP’s entity is small: pure concession agreement between two or more parties without a Project Company, normally, see the private selling the final output directly to final users, while in a Project Company’s concession, the output is bought by Public Administration

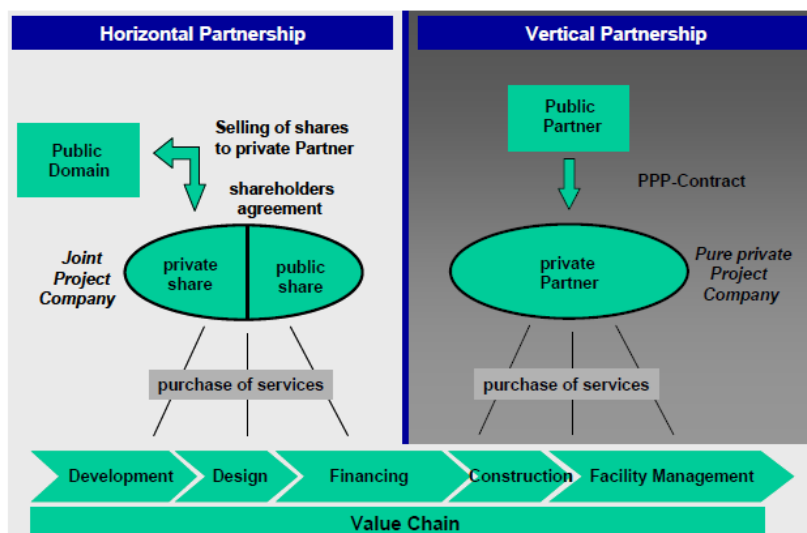


Figure 5: Horizontal PPP and Vertical PPP
 Source: Alfen, Hans Wilhelm et al., 2009

Before going any further, we present a brief timetable of how a PPP should be implemented and its phases. “**Figure 6**” by Alfen et al. (2009) and considerations of Buso et al., 2020, report an example that should be followed by public and private partners while entering in a PPP, even if this sequence of phases is just theoretical and can be different from country to country.

Public – Private Partnership procedure starts with the understanding that a particular society’s

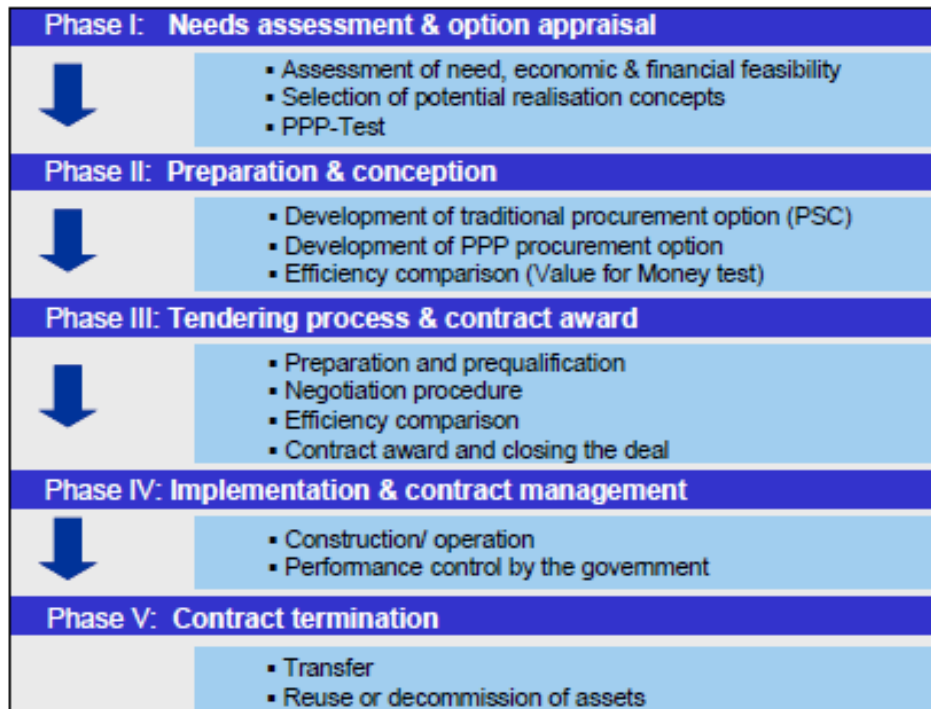


Figure 6: Public – Private Partnership phases
 Source: Alfen, Hans Wilhelm et al., 2009

need can be filled with a public infrastructure or service: therefore, a valuation of possible

policies to use for developing the asset is done through a cost-benefit analysis, considering the financing's typology, its financial sustainability, legal and organisational characteristics.

Subsequently, all precise aspects of PPP are delineated and calculated to demonstrate the efficiency and cost management achievable thanks to the "exploitation" of private sector in a PPPs; for the demonstration, the PPP project should be compared with traditional public procurement through a Value for Money Test. Once PPP is found as the best alternative, more practical tasks start.

This means that during the third phase there is the publication of the tender with the public sector's requirements, such as all asset's detailed specifications and PPP's contract terms. After an analysis of their own feasibility, potential private sponsors submit their willingness to participate through appropriate bids. These bids will be evaluated by government and only the best one suited with the PPP's contract will be awarded.

The next phase regard the real execution of the contract's responsibilities, meaning the design, construction, operation and management of the infrastructure with relative performance control by the government.

At the expiration date of the PPP's contract, when private's responsibilities and financial obligation should be fulfilled, the ownership of the asset could be transferred to the public sector or could remain private, with a continuation of the contract (Grout 2002; Alfen et al. 2009).

2.a Internal Structure of PPPs

To continue, we come back to the subdivision seen in "**Figure 5**" for understanding a theoretical organization structure of a Public – Private Partnership and the relationships between the involved stakeholders.

The variety of player into a PPP is vast: public sector and private sponsors, which can be labelled as a consortium of private actors, are the most important but we can find other stakeholders as financiers, subcontractors, rating agencies, legal advisers, technical advisers and insurers as well. In this big group, each partner is going to keep its legal identity and own responsibility. (Grimsey and Lewis 2004).

Main government's counterparties are the private sponsors, or equity investors, which agree to create a unique Special Purpose Vehicle (SPV or project company) with the aim of dealing with public and other stakeholders, while collecting private partners' responsibilities, risks and goals that can rise during stages of the project's life (Spackman 2002; Sarmiento et al 2014). During

its contract period, a SPV owns and manages only one specific project/concession, and its creation derived by the utilization of a Project Finance scheme (Sarmiento et al 2014). In addition, the utilization of SPV permits to assign risks directly to the project's counterparties. (Sarmiento and Oliveria 2018)

The SPV is therefore the active player that should execute the terms of the PPP contract, that will be established between SPV, which gather private sector partners, and its client, in this case the public sector. In details, the Project Company is responsible over the design and production of defined services, the construction of assets that are needed to meet PPP's purpose, the investment's fund raising, and the fulfilment of qualitative standards wanted by public sector. Therefore, all precedent public activities that are assembled into three macrolevels labelled "*network planning*", "*financing*" and "*operation*" are, in the PPP, private duties of the SPV.

Three reasons rely behind the choice of the SPV's constitution in a PPP contract (Grimsey, Lewis 2004):

- i) the "exploitation" of limited liability nature of SPV that limits personal sponsors' lending;
- ii) project's assets and liabilities will not appear into sponsors' balance sheets, "by virtue of no sponsor having more than 50 per cent of the shares in the SPV and the application of normal consolidation principles when preparing the group accounts";
- iii) project's isolation from potential bankruptcy of one of the sponsors: this is also a big benefit for project's lenders.

Private partners are more attracted by the three economic benefits of the constitution of the Special Purpose Vehicle. However, due the long contract agreement expressed through a PPP, the creation of a SPV has also a social benefit: "equity participation in the SPV is one way of aligning the interests of those involved in delivering the project with policy objectives and the long - term partnership with the government" (Grimsey and Lewis 2004).

Inside the Special Vehicle Purpose, which acts as the concessionaire, the rules and relationship between private investors are established and regulated trough a shareholder agreement: capital proportions, parties' obligations and the possible support of affiliated companies are some examples of elements defined by the shareholder agreement of the SPV (Alfen et al. 2009). Therefore, the private partners that form SPV are the investors who decide to provide equity to the Vehicle, controlling its behaviour during the project in base of their equity shares: major equity holder have more power in the core decision of the SPV (Santandrea et al. 2017).

As said, the SPV deals with its client, the public sector, and for doing this, a project arrangement between them is established, with which Project Company is invested of project’s activities and relative responsibilities. Moreover, the project arrangement is the centre of the complex web from which more technical and financial contracts are based to constitute the whole project contract package (Alfen et al. 2009) while for the public sector, the project arrangement is the legal instrument on the hand of the public authorities that enables them to set out parties’ obligations and risks subdivision.

“Figure 7” reports a typical PPP structure with principal concession agreement between public

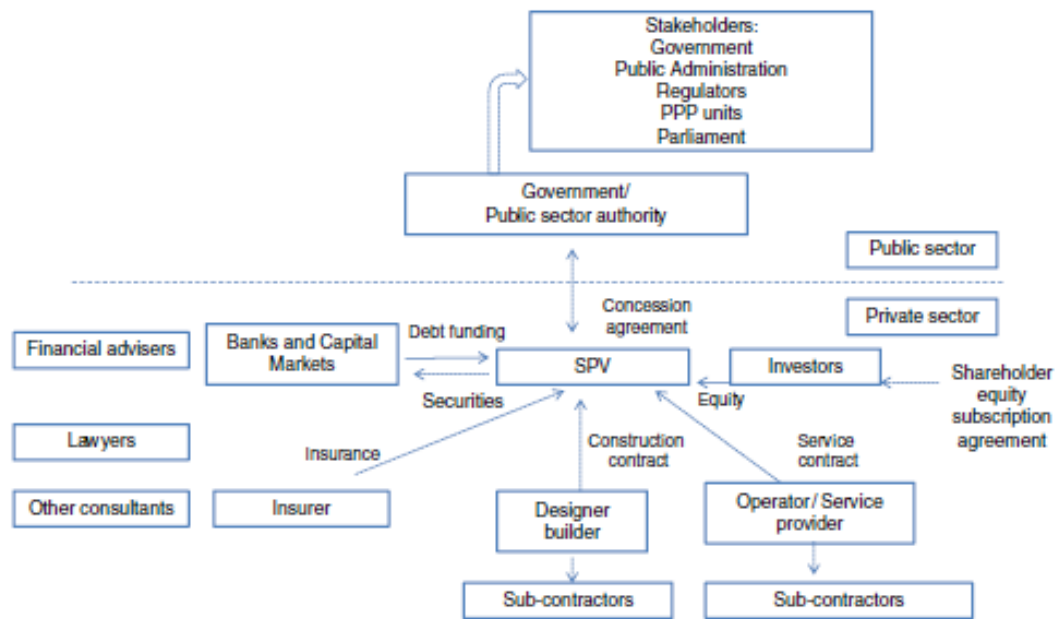


Figure 7: Public – Private Partnership model creation

Source: Sarmiento and Renneboog 2014.

authority and SPV, and the following settlements with additional PPP’s players.

The project agreement or concession agreement is only the first step of the PPP procedure, as the Alfen et al. (2009), Sarmiento et al. (2014) and “The APMG Public-Private Partnership (PPP) Certification Guide” reported. If possible public financial supporting schemes are envisaged between Project Company and Governments to mitigate revenue, financial or other risks, they should be explicitly written in project agreement. (Charoenpornpattana et al. 2003)

Following this initial “contract”, the consortium of private partners starts to institute contracts with other stakeholders: with the subcontractors that are responsible over single procedure, for example the construction, equipment supply, the management of the infrastructure, the SPV will establish “downstream” contracts for every project activity that it is going to delegate for the realization of the infrastructure. Particular element of PPPs, at this point, is the transfer of

risks that follow the transfer of responsibilities to network partners through the “downstream contracts”. Therefore, contracts’ price should include the risk pricing that parties bear (Makovšek and Moszoro 2018)

Other legal formalization will take place with both public and private’s legal, technical, financial advisers, figures who will check the PPP, verifying its phases and processes, and with insurances companies.

To summarize, SPV network spreads out with continuous stakeholders’ agreements during the different phases of the project life and with each contract, the SPV passes activities’ duties and relative risks to the counterparty: for example, construction risks switch to the constructor firm, operational and maintenance risks is bear by management companies and insurers. All of this is done for letting the project in work and achieving the public infrastructure aim.

The Project Company capital is normally composed by 90% of debt and 10% of equity. Grimsey and Lewis (2004) found that, in practice, debt financial agreements are established with either commercial banks, international financial institutions or directly issuing bonds on the capital markets, which can request guarantees and/or credit rating for the underlying debt.

Once the pre-set conditions of the project are met, so the final project design is approved with different partners’ arrangements established, possible lenders’ requirements, as securities over SPV’s rights, are set (Fernandes et al. 2016) and the public authority gives the construction order, the infrastructure can begin. Regarding the financial funds, some public authorities required an initial equity commitment by SPV’s shareholders before possible drawdown of loan amounts, while in other countries the utilization of the sum granted can occur at the same time of capital investment and following fixed percentage. (“The APMG Public-Private Partnership (PPP) Certification Guide”)

Subsequently, the various subcontractors are paid for the starting of the project’s activities, even if in different timing, while the revenues for the SPV, in form of users’ or government’s payments, occur only at the delivery of the infrastructure’s service.

For a better understanding, “**Figure 8**” of “The APMG Public-Private Partnership (PPP) Certification Guide” expresses major contract relationships and cash flows among the partners of the PPP. Thanks to the numeration adopted in the label, there is also the time sequence that these events should follow.

A key financing aspect of Public – Private Partnership is the importance of the revenue stream. Given the PPP’s derivation from Project Financing, investors and lenders are concerned about the future cash flow of the infrastructure, that acts as a push factor for the security of the project,



Figure 8: Public – Private Partnership contracts creation and payments timetable
Source: PPP Certification Website

guaranteeing financial stability for the financing institution and encouraging equity participation.¹⁰ The necessity of independency about cash flow means that an independent company, the SPV, is needed in order to represent itself as an acceptable credit risk (Grimsey and Lewis, 2004). Plus, only the creation of a Project Company, let evaluate the cash flow stream of the project (Sarmiento et al 2014).

A construction company, a facilities manager and a pool of lenders are the minimum players required to create the autonomous and legal entity of the SPV, that also provide the vehicle’s benchmark financing: typically, 90% is expressed by bank debt and bond, plus 10% by equity

¹⁰ However, studies about PPPs in developing countries have registered the long-standing practice of government finance to help projects succeed, because of the not possibility or not willingness of entrepreneurs to privately finance the much longer whole life of the project respect to the concession contract. (Leigland 2018)

provided by SPV's investors (Alfen et al. 2009). Equity formation, as outline before, goes hand in hand with agreements between equity investors about equity investors obligations and percentage of capital, which reflect the relative weight of responsibilities.

Grimsey and Lewis (2004) reported how the generic debt relationship of PPPs with debt financiers is often a syndicate arrangement¹¹ through a bank.

Due that the purpose of the Partnership is the development of a public infrastructure, initial money disbursement is significant, and all financiers are called to put money up front. Public sector or the final users, as Cuthbert et al. (2012) reports, is going to pay for the utilization of the infrastructure only when the asset is fully operative, meaning that, for a lot of years, SPV capital value will be composed by the sum of debt and interests, larger than actual facility's construction costs.

However, thanks to the PPP link between asset' delivery and private's remuneration, lenders can count over the sense of mutual interest over the success of the project, due to the project risks sharing among different participants. (Grimsey and Lewis, 2004).

Therefore, financing is directly linked on one hand to the revenue stream of the project and on the other to the risk allocation between parties. Each of them analyses, before entering in a PPP, the financial appraisal of the project, evaluating cost and benefits through the operation, to get an idea of the capital return they can expect, of the risk remuneration, the funding needed and the debt/equity proportion in the SPV. (Alfen et al. 2009) Moreover, risks affect directly financing funds, leading each financier to procure tailor – made financial packages that can answer both to the demand of funds and also to the risk/return remuneration wanted by lenders.

Recalling the scheme of Project Financing used to finance PPPs, debt is the main financial source and it is seen as a “non-resource debt” as “lenders rely solely on future cash flows for debt service” (Sarmiento et al 2014): here, the link between finance and revenue stream is expressed. In fact, investors pretend to be repaid for each investment they made: for debt owner the repayments are made in form of capital and interests' payments while equity investors cares more about project's profits and the consequent distribution of dividends (Cuthbert et al. 2012). The SPV own only a concession agreement with the public sector for a determined time, meaning that only future project's cash flows act as guarantees of the debt.

¹¹ This statement is supported by the studies of Grout (2002).

Debt is usually in form of senior debt or mezzanine (including junior and subordinated) debt, remembering that the latter will only be repaid after other creditors (except shareholders) as for equity investors. (Sarmiento et al 2014; Grimsey and Lewis 2004) However, since the risks taken by the subordinated debt holder, they would require higher return than senior debt¹².

Usually, financing arrangements are concluded in parallel with concession contract with public sector and subcontracts with other stakeholders, and all financial obligation must be fulfilled within the PPP's contract period (Grimsey and Lewis, 2004). In this way, it is possible to understand the allocation of risks between parties and how they affect financing and contracts' pricing, even if the risks valuation is complex. However, thanks to the transfer of risks to other partners that can better manage them, enhance efficient and transparent risk management, reducing risk premium asked by stakeholders and their weighted average cost of capital as well (Sarmiento et al 2014).

As for risks, other operational and project feature can be interlinked with financing, increasing or decreasing the premium asked by the lenders. David (2005) exposed the construction of a sporting stadium as example showing that the return for private sector financing is connected to the time delivery of the infrastructure, assuming penalties for late competition. Another disadvantage for the PPP's financing system is expressed by the higher transaction costs respect to traditional corporate financing due to the major complexity and incompleteness about PPP contracts (Sarmiento et al 2014).

In entering PPPs, private partners should be capable of long – term commitment, focusing on high financing capacity (Darvish et al 2006) and quality of outcomes, but they are not let completely alone. Governments can, in fact, promote lenders and investors high quality of involvement through payment system's incentives ¹³and abatements. (Grimsey and Lewis 2004). And, when users' charges are not enough to let entrepreneurs cover their investment costs and reach adequate risk compensation, government steps in paying for the service provided by private partner, using periodical public expenses. Public finance is therefore needed and accounted in the annual Public Balance Sheet even if PPPs, normally, have not an initial

¹² PPP's project senior and subordinated debt price is based on the underlying cost of funds to the lender, to which is added a fixed component (or "margin"), expressed in basis points, to cover default risk and the lender's other costs (for example, operating costs). (The APMG Public-Private Partnership (PPP) Certification Guide")

¹³ Incentives serve to attract the private operator in charge of the project to act quickly and efficiently to incidences regarding the infrastructure and for rewarding him of achieving key overall objectives. (Grimsey and Lewis 2004)

public funding investment but the imbursements are diluted considering the whole-life span of P3.

Lastly, we express some distinctions delineated in the years, focusing on the structure and financing organization of Public – Private Partnerships, while holding the basic characteristics outlined in previous sections.

Looking to the remuneration that Private partners aspire to reach to compensate their responsibilities and risks, we would report, firstly, a “payment differentiation” where Public Private Partnerships are divided in:

- “user-pays type” where, for the utilization of the facility, users pay a ticket or the governments pay a shadow toll¹⁴. For example, this is the case of the toll road projects or a licensing fee; (Alfen et al. 2009; Winch et al. 2012)
- “unitary charge type” where the private’s remuneration come from public sector, either on an availability basis or of an annuity-based lease payment commensurate with the level of service provided or upon availability of the infrastructure (Alfen et al. 2009; Winch et al. 2012, Pezzuto 2020)
- a possible mix of the other two type when users’ ticket and government’s funds are used for remunerate private actors (Pezzuto, 2020).

The model of private’s reimbursement is a governmental responsibility which should be selected in base of the nature of infrastructure service as well as political and economic country’s environment. (Alfen et al. 2009)

In addition, Sarmiento, Renneboog (2014) and Pezzuto (2020) expressed a list of the more used form of Public – Private Partnerships, distinguished by their degree of allocation of responsibilities and risks to private sectors.

¹⁴ Using the definition of Grimsey and Lewis, 2004, a shadow toll is “a payment for road usage made by the government, rather than road users, based on vehicles using a kilometre of the project road, in accordance with a tolling structure.”

The following Table summarized the most common types, considering that public laws' environment regarding partnership with private partners is changeable.

Model	Design	Build	Finance	Ownership	Operate	Transfer
<i>DBO - Design, Built & Operate</i>	Private	Private	Public	Public	Private	Public
<i>BLT - Built, Lease & Transfer</i>	Public	Private	Private	Public	Private	Private
<i>BOT - Build, Operate & Transfer</i>	Public	Private	Public	Public	Private	Private
<i>BOO - Build, Own & Operate</i>	Public	Private	Public	Private	Private	Public
<i>DBFO - Design, Build, Finance & Operate</i>	Private	Private	Private	Public	Private	Public
<i>BOOT - Build, Own, Operate & Transfer</i>	Public	Private	Public	Private	Private	Private
<i>DBFOM - Design, Build, Finance, Operate & Manage</i>	Private	Private	Private	Public	Private	Private

2.b Risks

In the previous section, we accentuate the interests of lenders and investors, while engaging in a Public – Private Partnership, into cash flow generation by the project because this stream is the main element to regain their up-front investments and a possible return on capital. However, PPP peculiarity does not come only from financing's typology and the attention on future cash flows, but also from risk subdivision between parties.

Risks, as Webster's dictionary expressed, are the "possibility of loss, injury, disadvantage or destruction", so their core is expressed by not having full control over all information, to be uncertain over something (Rybnicek et al. 2020). Even so, for authors like Grimsey and Lewis (2005), risks and uncertainty are not exactly the same argument. They restated a consideration of economist Frank Knight which proposed, in 1921, a distinction between risk and uncertainty based on the fact that we face uncertainty when we cannot set accurate odds, while we can measure odds even if the outcomes are not clear when we have to do with risks. This difference has importance also on the return that investors will ask if they are bearing one factor or the other or both. This part will be further developed in the next chapter.

Apart from risks inherent to the project, we should recall that, normally, everyone is affected by a risk-aversion behaviour, that lead people to choose the more certain operation (Wang et al. 2019). Therefore, risks affect PPP project perspective and can lead to a completely different scenario from the one thought by stakeholders.

For this motivation, risks' identification, assessment, allocation and mitigation play a crucial role in the life of P3: these four activities establish the "Risk Management" of PPP, a continuous and iterative process to direct and control risks for a determined object, throughout its lifecycle (Rybnicek et al. 2020; Almarri and Boussabaine 2021). In fact, as Darvish et al. (2006) reported, the detailed analysis of risks by their financial, technical, managerial, environmental and social nature, their effectively allocation and management, is a prerequisite for attaining a true costs-benefits gain and a win-win partnership in P3. The rightful risk management passes through finding the effective risk pricing strategy to follow to estimate the cost of risks that will be added to contracts' prices (Almarri and Boussabaine 2021).

Risks can be of various natures: from general specific risks, regarding more country political and legal risks, to project specific risks that can be both inner¹⁵ characteristics of PPP or linked to the phases of PPP's development (Carbonara et al. 2015) .

Central question of risk management is the fair risk allocation and remuneration for every risk conveyed to the entrepreneurs (Darvish et al. 2006): a hard and tricky process that was no necessary for previous traditional public procurement because under conventional procurement systems, risks are totally on the public shoulders. (Grimsey and Lewis, 2004; Almarri and Boussabaine 2021) With P3, public sector purchases an "infrastructure – based service" freeing itself from the relative asset's risks, while paying only if service is delivered and if all contract's standards are satisfied. From government' view, the project's asset becomes a risk – free product. (Grimsey and Lewis, 2004)

Both the switch on risks' allocation, through contracts terms, and the need of private remuneration have an impact on the whole Value for Money consideration of PPP: in fact, in the projects analysed by Ball et al. (2002) the right risk transfer between parties produced a 60 per cent of project costs saving, showing the positive relationship of correct risk allocation to PPP's Value for Money.

Literature agrees to define PPP's risks looking to similar previous projects, the utilization of standard checklists, interview of the partners involved and final users, or brainstorming and workshop sessions (Darvish et al. 2006): subsequently, they are analysed using quantitative and qualitative techniques.

¹⁵ Carbonara et all (2015) and Rybnicek et all. (2020) are also confident in affirming that Public – Private Partnerships per se have "more and a higher degree of risks than other projects" due to the complexity of the collaboration, the number of partners involved and their little experience in the field and the specific rules about financing, taxation and regulation.

The former, which assess risks for their impact on either time or money, can take a deterministic or a probabilistic approach. With deterministic approach, Alfen et al. (2009) comprehend the sensitivity analysis, so the examination of how risks affect model's dependent variables due to change of model's input variables, and the scenario analysis, meaning the creation of different scenarios born by combination of changes in input variables to interpret how the model's output is affected.

Instead, the probabilistic approach attributes a probability distribution function (PDF) to each risk variable and then, thanks to the random sampling of a Monte Carlo simulation, several possible scenarios are established, and the probability distribution function of the model is derived. (Alfen et al. 2009)

For the qualitative techniques, Alfen et al. (2009) refers to an approach more descriptive where partners describe the most probable project's risk and their consequences thanks to the information known.

All these phases are necessary for understanding who should be the party responsible for bearing each possible project's risk, because of its ability to better manage it: in fact, a risk should be managed by the ones that pay the lowest effort, both in term of price and resources (Almarri and Boussabaine 2021) .

PPP's subjects want to take risks only if they are rightfully compensated for them, so pricing risks strategies, inside partners' contracts, are held while thinking on maximise returns (Almarri and Boussabaine 2021).

Therefore, some risks that might be better managed by private entities, in reality, remain on the public's sphere: public sector could decide to hold some risk that private party would charge to much for, threatening the whole project's costs-benefits trade-off. (Davis, 2005) Looking to a social perspective, instead, governments always bear residual delivery risks: they act as guarantor for providing the infrastructure in the case of a financial failure of the Project Company (Gray et all, 2021).

Moreover, in understanding risks, even if each partner seems to be scattered concentrating on own goal, only a proper whole project risk-returns trade-offs, achieved simultaneously, satisfies each participant's risk-return trade – off (Ye et al. 2000).

Demand risk is one of the toughest: most of the times it is allocated to the private partners as Carbonara et all (2015) examined, but researches' studies found that governments, sometimes, step in to ensure that project's revenues reach private expectations. Further examples come from Ye et al. (2000) study, where the analysis of some Chinese BOT transportation projects

proved the obtaining of governments support, directly or indirectly, showing how an unattractive project, even for private party, requires public financial aid to see the light.

In fact, literature states that it is best for public sector to step in. Governments interventions wants to support the project while mitigating private's perception of project's risks: using, for example, legal and regulatory systems to protect of foreign exchange risks, debt security arrangements, direct financial contribution, through loans and equity, and tax incentives. In this mode, governments find the right forms of motivating private sector's involvement, according to the project's viability (Ye et al. 2000; Carbonara et al. 2015). Other studies over project's risk reported how state environment plays a fundamental role in rising the confidence of private partners about government, stimulating the cooperation between public and private sector (Wang et al. 2019). At the same time, the financing self-supporting statement of PPP, due to its Project Finance scheme, is negated.

Allocation of risks can lead to big changes over life of Public – Private Partnerships: both public entities and private should participate to find the right subdivision, with governments more prone to improve state environments, like regulations, law, economic stability, while SPV's manager further involved in communicating risks' level to all project's players in order to pass risks whilst alleviate their effects together (Wang et al. 2019). In order to minimize risks, each party should be aware of the risks' mitigation strategies like insurances, guarantees, clauses on contracts between subjects that can reduce the chances of risks occurring and their consequences (Alfen et al. 2009; Carbonara et al. 2015).

To summarize, even if there can be some risks like operational, financing and design risks more incline to be bear by entrepreneurs while other like macroeconomic, natural and social risks that should be shared between public and private sector, Carbonara et al. (2015) study affirms the inexistence of a universal list of risks and a risk allocation strategy for all PPP projects, due to sectors, firm sizes and countries biases. Nevertheless, the correlation risk – return must be remembered while deciding to proceed into a Public - Private Partnership.

3 Analysis of economic value of Public – Private Partnership for private sector

Private partners, in procuring the rightful infrastructure and services for respecting the PPP’s contractual terms, are concerned about the level of costs and profits of the project: only if gains are bigger than possible losses, sponsors would participate into a P3, otherwise they would look for more convenient and remunerative investments. So, investors should be interested in P3 only if the “expected return equals or exceed the market price of the risk they will bear”, as Vecchi and Hellowell (2018) declare.

Remembering that risk management is necessary to the well – being of a Public – Private Partnership, as discussed before, we examine the method used by investors to value PPPs, and after that we investigate why the rate of return wanted by private partners is adequate to the risks/resources involved.

3.a The analysis of PPP’s profitability

Private and public analysts apply the process of capital budgeting for understanding if a long - term infrastructure will procure economic and financial stability, where economic aspect focuses on project’s ability to create/destroy value while financial examines if the generated project’s profit is able to repay investments in term of equity and debt. “**Figure 9**” expresses the process followed by both parties, aiming to understand viability, profitability, and bankability of the PPP.

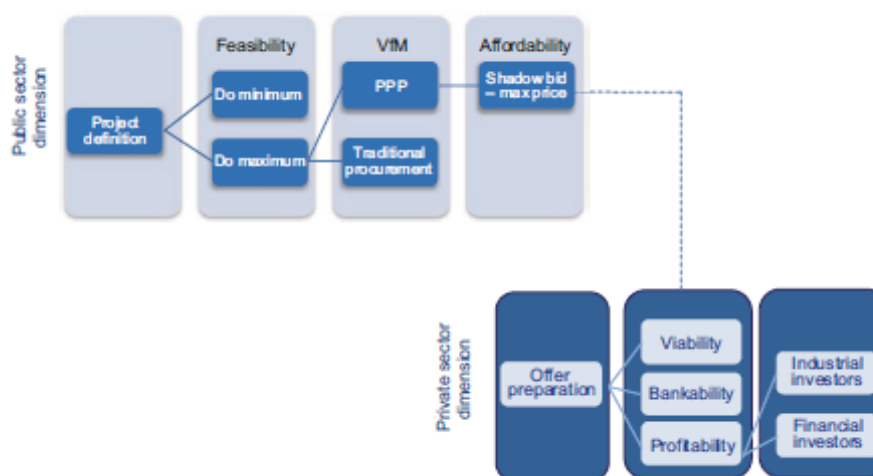


Figure 9: Public and Private PPP Value Analysis
Source: Vecchi and Casalini 2018

Briefly, the process consists of calculating the pro-forma financial statements of the PPP, meaning balance sheet, income statement and cash flow statement, for calculating the Net Present Value (or NPV) of each forecast. (Vecchi and Casalini 2018)

Whereupon, both private and public partners confront the future PPP's profitability to other possibilities: private sector will challenge PPP against potential private investments, while public entities confront P3 against the traditional public provision for delivering the same infrastructure. The latter is a theoretical model for achieving the realization of the same asset and it is seen as a benchmark that takes the name of Public Sector Comparator (PSC). Remembering the difference in financing system, analysts should also carefully count for risk management across parties and its pricing when evaluating PPP and its alternative traditional procurement (PSC) because in the latter, financing and risks are only on public authorities.

Hence, PPP will be confronted to PSC to perform the Value for Money test (VfM), aiming to show the economic advantages of Public – Private Partnership. (Grimsey and Lewis 2005) As reported by Grimsey and Lewis (2004), Value for Money is the proof “that, on a whole-of-life cycle basis, the cost to the community of the relevant service provided by the private sector is lower than for the same service provided by the public sector, so long as there is a proper allowance for the quality of services, price, time frame, risk apportionment and certainty of process in order to render the two alternatives comparable.”

Public authorities require the Value for Money test every time they are beginning a collaboration like P3, even if practically this not always happens for two reasons. Firstly, governments know that if VfM expresses PPP's costs greater than PSC'S costs, in reality, they do not have enough public funds to support a public procurement, so public infrastructure will not be done (Grimsey and Lewis 2005). Secondly, PPP can be written off governments' balance sheet book, showing less debt deficit. (Leigland 2018)

In the analysis of the NPV of a project, economists are united in the conviction that calculating the Discounted Cash Flow, from now on DCF, of the asset is the best strategy to derive its rightful present value. Once future cash are discounted, we just have to reduce the initial investment cost from them in order to have the Net Present Value of the project. Only if the net project value estimated is expected to be major than zero, investors are predisposed to start the project.

The DCF operation, as specified in lessons about “Fundamental Analysis” of Corporate Finance, consists in finding the stream of future expected costs and revenue of the asset and

applying to their difference a discount rate with the purpose of representing the intrinsic today's value.

Adding all up, the Net Present Value formula can be expressed as

$$\text{Net Project Value} = \frac{\sum_{i=0}^T \text{Project Cash Flow}}{(1+r_p)^t} - \text{Investment Cost}_{t=0}$$

where the numerator report positive and negative cash flows for revenues and costs on investment each and the denominator report the discount rate used to report the present-day value of the asset.

In the formula, an important matter for profitability analysis of PPP and PSC is the rate to discount cash flows. All costs, benefits and risks occurred during the period of the project, for example for design, construction, finance, management, etc., are discounted to calculate the NPV (Alfen et al. 2009) and this metric is sensitive to the rate used (Grout, 2002): for example, starting from the same stream of cash flows, at a higher discount rate, comes a lower NPV.

The discount rate represents the standpoint of a particular agent involved in the project and it is not unique for all PPP's partners: the rate is affected by the agents' perspectives about the activities involved in the contract, the purpose they want to reach, the risks they are facing, the potential wanted return, the interest rate for borrowing money in the market and so on. (Cuthbert et al. 2012) When we refer to the private sector, corporate finance is incline into the utilization of two different rate, one applied by the equity investors and one used at a more project level (Vecchi and Casalini 2018).

The first one is the Cost of Equity or K_E , while the second one takes the name of Weighted Cost of Capital or WACC.

In a case of debt-equity project, the cost of capital (given by equity plus debt) is used to find the present value of the project. The formula of the WACC requires information about the capital structure (i.e. debt-to-equity ratio) of the shareholders, so analysts can weight cost of debt and cost of equity properly, to evaluate the Free Cash Flow of the investments.

Nevertheless, following Esty intuition about the particular PPP's capital value which suffer of significant changes due to the reduction, over time, of the amount of outstanding debt, "a PPP project should be assessed through equity cash flow using the cost of equity, which remains constant over time." (Kokkaew and Tongthong 2020). That is why our interest will be focused in this rate only.

The Cost of Equity (K_E) is derived using the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965), which is the most common theoretical model used by equity investors. K_E communicates “the minimum return to invest the firms’ resources” (Da Silva, 2015) that should be commensurate with the risks taken (Darvish et al. 2006). So, then it represents the return necessary for a given project to be generated to stimulate private capital investment in it (Kokkaew and Tongthong 2021).

The formula can be expressed as

$$K_E = r_f + \beta * (r_m - r_f)$$

Where r_f = risk – free rate;

β = Beta coefficient, that expresses the correlation between the asset and its market;

$(r_m - r_f)$ = Equity Market Risk Premium as a difference of the expected market return (r_m) and the risk – free rate (r_f).

Equity risk premium is made by the “ $\beta * (r_m - r_f)$ ” part of the K_E equation (Hellowell and Vecchi 2018)

From the formula of CAPM can be deduced the relationship between expected required return of investors and the systematic risks given by the market (Sarmiento and Oliviera 2018; Almarri and Boussabaine 2021).

Normally, risk – free rate source is the government bond rate yield because it implies the absence of default risk in securities issued by State central bank in its currency, while bonds issued by firms carry their risks of not meeting debt obligations.

The risk - free rate applied in K_E depends on the currency in which the project is assessed but when evaluating project in emerging countries, investors should clean the bond yield of the intrinsic credit default spread before arriving to the real risk – free rate, because developing countries are not considered riskless or do not have track records about bond yield. Therefore, the best choice is using the USA bond rate as the risk – free rate benchmark for evaluating PPP and alternatives.

Beta coefficient (β) is the expression of the volatility of the asset to its market, therefore a measure of systematic risk, which formula is made by dividing the “weighted covariance of the projected excess return on the investment with the average excess return on the market as a

whole” (Hellowell and Vecchi 2018). In financial words, it shows how much a return of a security tends to follow the return of the stock market as a whole. When Beta is 1, the asset moves with the same risk speed than the market, while if the Beta is higher than 1 it means that the asset in question is riskier than the relative average market (Hellowell and Vecchi 2018; Sarmiento and Oliviera 2018). The assessment of this coefficient, together with the Equity Market Risk Premium, is tough for PPP’s private investors.

Expected return of the market minus the risk – free rate is the formula of the Equity Market Risk Premium (EMRP) and this difference expresses the excess return that an investor wants to gain for investing in a riskier asset rather than investing in a risk - safe treasury bond. So, this return is seen as a reflection of the risks bear by the equity investors in the project. (Hellowell and Vecchi 2018) EMRP is not easy to estimate due that it depends on the market’s perceptions, methods, and implications that an investor wants to represent with it, even if the most common technique used is the “Historical risk premium approach” which Damodaran explains as the “average return earned on equities over a long time period (..) compared to the average return on a risk-free security”. Even so, historical data about the movements of the market or about the asset to evaluate might not be present. (Hellowell and Vecchi 2018)

Now that basic information is given, how do they fit in PPPs’ environment?

The high volume of capital needed, the possible operational features and the risk allocation understanding are PPPs’ levers for the required investors’ premium; however, Sarmiento et al. 2014 reported how PPPs discount rates, prior 2008 Financial Crisis, were not above the risk-free rate, meaning PPPs were considered low risk projects. On the other hand, article as of Leigland (2018) about the UK PPP Health Sector found that from 1990s to 2005 there was a tendency towards an increase in private rate of return: they are 60 percent higher than the one theorized.

Also, studies conducted by European Investment Bank (EIB) and the UK’s National Audit Office validated the statement that normally PPPs are more costly than traditional procurement approach, with higher risk premium required by equity investors. As example in article “Excess returns in Public – Private Partnership: Do Governemtns pay too much?”, Whitfield (2017) findings expresses that average PPPs’ private required rate of return were of around 12%-15% above those of a corporate portfolio or other equity assets. Additionally, Makovšek and Moszoro (2018) reported that, on a National Audit Office investigation over 118 PPPs project, 71% of them show excepted return above the return estimated at the project’s financial closing.

Following these cases studies, a pattern of problems and misunderstanding during the assessment of PPP's NPV can be defined. Leaving out the "faulty techniques", as Leigland (2018) called them, and casual techniques as "optimism bias" and "strategic misrepresentation", that can affect the projection of expected cash flow, the tough choice is the rate to use to find the present value which can be easily manipulated by agents.

Remembering that "the most uncertain element of the cost of capital, up to the point of financial close, is the cost of equity" (Hellowell and Vecchi s.d.), in the moment of confrontation between PPPs and other alternatives, the ongoing debates over the level of discount rate that the two main PPP's counterparties should use and why private tends to express a higher premium in the ex-post valuation of the project rather than in the ex-ante are still open. Should the discount rate be the same for both public and private partners or the private sector is legitimate in increasing the discount rate for asking a premium due to be the subject bearing more risks and putting the financing in this public collaboration? In the following section, we look to various possibilities that can put pressure on discount rate's decision.

3.b Basic Discount Rate Nature

"Despite this lack of unanimity there is a tendency for economists to favour the use of similar discount rates in the idealised situation of complete markets. Similarly, there is tendency for governments to use the same discount rate for a project whether it is publicly provided or is to be provided to the government by the private sector", the latter meaning through a PPP. (Grout, 2002)

Some countries practises validate these statements: for example, UK public sector uses a 6% real rate to discount and compare PSC to a PPP alternative, while Ireland permits to discount both projects using a rate based on the risk-free cost of debt (Almarri and Boussabaine 2021). However, even in model cases with perfect competition capital markets, same cost of financing between public and private sector and "no distortionary taxation", PPP's discount rate should be above the PSC discount rate. Indeed, in the investigations reported by Grout, 2002, it is not correct to use a unique rate because during a PPP the works related to the provision of the infrastructure are not responsibilities of public sector, while the comparable alternative theorized with PSC sees the public sector as the active player in all the project's operation. Therefore, while calculating the Net Present Value of the two possible approaches, the discount rate should reflect, for PPP approach, the cost of building the infrastructure while the other should reflects a complete stream of positive and negative flows, valued at the price in the contract. This is just one motivation to have PPP discount rate higher than public provision

project due that in P3 we value a system of costs, revenues and even risks that happens during the collaboration contract between private and public sector.

Coming back to the ex-ante and ex-post discount rate analysis, Sarmiento and Oliveria (2018) restarted the discussion about risks allocation and pricing as one of the key components of abnormal premium asked by private sponsors. Firstly, they reinforce the conviction that risks are represented differently for public and private sector: public can rely on the presence of taxpayers that can bear, for example, the cost overruns and other ex post risks of the project, while private, normally, have no “buffer zone” and risks are expressed ex ante in the required rate of return. For this, a difference between the investors’ required rate of return and the public cost of borrowing is logic to be present, asking for a higher discount rate than of any possible corporate investment. Secondly, in the case of efficient market theory in PPPs, financing costs for PPP and its traditional public alternative should be equal: public and private partners risks - return will express the efficient cost of the project’s risks and be almost the same with difference laying into project’s management skills. However, as also the article of Makovšek and Moszoro (2018) reports, real world is far from theory: we do not live in a full competitive environment, so risks can be overpriced or under-priced in the project’s contracts with a higher charge asked by private investors. Moreover, for them, risk pricing efficiency passes across a separation assessment for each part of the total project risk assigned to the different PPP parties, but in practise, there are no information on how quantify them. This lack of information, therefore, combined with the risk transfers through fixed contracts to subcontractors, guide to high-risks premiums of investors in all stage of a PPP contract and lower competition between firms to start a PPP.

3.c Risks allocation impacts

A lot of concern in literature about discount rate regard its connection with risks and uncertainty: risk management, in fact, steer the possibility to minimising or eliminating their monetary impact. Nevertheless, once a subject took one or more risks, “their price for the service” in the project “will reflect” the risk, provoking an additional charge to the public sector (Almarri and Boussabaine 2021). Entrepreneurs accept only risks if they are remunerated above the risk-free rate (Almarri and Boussabaine 2021) and equity investors are the first in line to deal with the projects’ losses that risks and uncertainty can unleash and/or increase (Geddes and Goldman 2020): another motivation for the increase in investors’ premium can be found in

the trade off between risks and returns¹⁶. Moreover, literature agreed in saying that the less risks are bear by public sector in a PPP, the “higher is the discount rate that should be applied to the cost stream”, due that risks’ costs are not a public sector burders. (Almarri and Boussabaine 2021)

We know, actually, that PPP partners’ goals and perceptions can diverge: this also apply to their thoughts about PPP’s risks and uncertainties. For private partners, risks are factors that can increase or decrease the level of private’s attention and of compensation that they require for investing: logically, higher uncertainty about the perception of the project’s cash flow, maybe born by the long amount of time necessary to repay investments, comports a higher project’s intrinsic risk that is reflected in the investors’ request for a premium in the discount rate (Ye et al. 2000; Vecchi and Casalini 2018).

If partnership’s period can be one of the levers for risks/uncertainties, from studies conducted by Klein in 1997, macro-economic stability, governments’ succession during PPPs’ life and regulatory regime play crucial part into defining level of risk exposure, even in the same country, affecting therefore the discount rate, which can move from 5%-8% for less risky countries to 12%-13% in highly risky considered countries. In this scenario, also contracts terms might be applied when specific situation occurs as, for example, the application of an addition premium when State economy drops, which was not counted in the primary valuation. (Visconti 2005; Vining et al. 2008)

Beyond these reported “outside” risks and source of uncertainty, it is better to recall a fundamental proposition of Behavioural Economics: people tend to be risk-averse during their lives and even in business affairs, increasing attentions about project’s return (Ye et al. 2000). In addition, entrepreneurs don’t think at PPP as a project able to increase their diversification: due to the different nature of investors involved, higher risks are perceived than other corporate investments increasing the ex-post valuation of the discount rate (Hellowell and Vecchi 2018). Other corporate finance theory expresses the fact that normally, rates should adjust themselves to the real level of risks to the project. However, researchers found a “prevailing norm” regarding the presence of a higher premium than the one theorized: for PPPs the motivation can be either for the project risks and for the low level of investors’ competition which enable the presence of premium is always possible. (Colla et al. 2015)

¹⁶ Literature agreed in saying that an efficient frontier line is present for every risk bearer, which, at some point, will discourage the person to take other risk, due that the reward will be not enough large to compensate the risk. (Hellowell and Vecchi 2018)

These are just considerations to express how sensitive is the valuation to objective and subjective factors: all possible cases reported above have true impact in the required private investment's return.

3.c.I Focus on Systematic Risk

Of all risks, one big importance for the investors' premium problem is the systematic risk or market risks, which refers to "the correlation between returns on an individual asset and returns on all assets¹⁷"(Davis 2005) of the market: it affects all investments, so it is a not diversifiable risk for nature.

It differs from the non-systematic or idiosyncratic risks because these are linked directly to the projects and they should be eliminated or mitigated through portfolio diversification, modellization of the project's expected cash-flows or with adding mark-ups. (Makovšek and Moszoro 2018; Vecchi and Hellowell 2018)

In the article "PPPs and Infrastructure Investment", David 2005, the author states that PPP's risks are suffered by a wide range of investors meaning that the impact for each partner is relatively small in the overall project position. However, this not truly apply to the "market" or "systematic" risk.

Consequently, the return expected by investors, which is part of the discount rate, is higher than the risk – free interest rate, reflecting the idea that equity investors claim a premium for participating into a risky project. In fact, in a survey of Kokkaew and Tongthong (2021), more than a half of the interviewers respond that systematic risks are the real command of investors' premium.

Systematic risk was further investigated by Vecchi and Hellowell (2018), Gray et all. (2020), da Silva (2015). These authors summons the Beta coefficient, expressed as the covariance between market and asset divided by the market variance, as the representation of the risk of the firm or sector against the whole market.

In literature, betas are available only for listed companies and when assessing a project, analysts should refer to the sector beta of firms that procure equity inside the SPV. However, both Vecchi and Hellowell (2018) and da Silva (2015) reported that PPPs' betas are quite

¹⁷ Systematic (Market) risk embodied in the PPP reflects the risk "inherent to the market as a whole, reflecting the impact of economic, geopolitical and financial factors". (Investopedia definition). Instead, specific project risks are born within the project and the sector to which the project belongs. For these reasons, researchers are united in saying the projects risks should not compare in the CAPM formula. (Vecchi and Hellowell 2018)

problematic since SPVs are “completely new business established with the sole purpose of delivering contracted infrastructure”.

Normally, Project Companies are formed by partners that are not listed in the stock markets and by firms that are part of different economic sector: for these, there are no true “historical dividends” or “share price data” about firms and financial markets to which one can base the Beta calculation.

Da Silva (2015) point of view in addressing the Beta coefficient problem is to construct a weighted average between Betas involved sectors in the PPP multiplied by the percentage participation of each partner to the whole project, instead of using the PPP’s predominant sector Beta.

Vecchi and Hellowell (2018) agree with this method but recall that the Beta available for listed firms in commercial database as *Bloomeberg*, *Thomson Datastream* and *OneBanker* are all Equity Beta and some adjustments are needed as to arrive to the deleveraged Beta, that then will be re-leveraged with the average project’s financial leverage and will be adjusted according to Blume Theory¹⁸. Moreover, in the case of emerging markets, if no Betas are available and the analysts use Beta of other economies, a country risk should be added.

In practice a slight difference was found by the evidence of the UK National Audit Office: instead of using benchmarks of the appropriate involved sector in the PPPs, equity investors use corporate beta of their business to evaluate the discount rate. This Betas will reflect higher level of risks than the appropriate PPP’s Betas: an increase in the premium will be the consequence (Vecchi et al. 2013).

Systematic risks apply a premium to the Cost of Equity formula because it cannot be easily eliminated by portfolio diversification. Hence, discount rate should take in consideration uncertainty market perceptions.

P3 investors normally perceive this market riskier than any other possible investments, leading to charge higher expected rate of return, because of the complexity of the contract, the low historical data available, the difficult in risks management and the presence of many partners involved. However, Hellowell and Vecchi (2018), suggests to not charge systematic risk inside the Beta coefficient, but to add the relative premium to the equity risk premium coefficient. In fact, as Project Companies have no historical data for the Beta, it is not truly correct to increase even more its value based on risks’ perceptions.

¹⁸ Blume Theory states that, normally, betas show a propensity to revert to the market mean (i.e., 1) over time.

The EMRP coefficient can be “manipulated” and after a risk’s matrix to understand which partner deal with each risk, the investors can add a premium for the bearing. However, even if Hellowell and Vecchi (2018) reported this view, they do not give a mathematical approach on how calculate the “add – ups” for the risks bear.

Grimsey and Lewis (2005) in their investigation regarding discount rate of PPP and PSC added new insight about risk/uncertainty on discount rates. On one side, looking to the perspective of government, they agreed to the need of having two totally dissimilar discount rates for evaluate PPP and the public procurement approach, therefore denying the UK version of a single discount rate for both. The authors suggests that the public procurement (PSC) should be evaluated looking to the “Social Time Preference Rate¹⁹” and adding some small project risk adjustments. On the other hand, researchers highlight that, practically, public authorities do not consider systematic risks and uncertainty due that in PPPs, governments are insured about them since the projects are outside their portfolio, moving those risks to the private sphere.

Instead, the private sector bears the systematic risks and the uncertainty of the whole PPP: following the study of PWC (2002) over the rate of return of some Project Finance cases, the difference of 2.4 percent between the private’s wanted project return and the cost of capital is found. This difference, in the study, is justified by the higher cost for private partners to borrow capital (about 0.7 percent) and by the unrecovered bid costs on other projects (about 1 percent) leaving only 0.7 percent as the real ”excess return” asked by private to participate in a PPP, due to “structural issue” of the collaboration as its length and the bid costs. However, Grimsey and Lewis (2005) argue that the PWC’s researchers ignored the uncertainty margin that private may request and some excess return can be explained by this.

Lastly, Grimsey and Lewis (2005) resume the risks consideration of Grout exposed before and add an interesting proposition: if investors follow the Knightian²⁰ consideration which sees a distinction between risks and uncertainty, the discount rate of PPP project should incorporate an allowance for the “true” uncertainty, beyond the premiums for systematic risks and project risks. As stated by Demirel et al. (2020), uncertainty is considered by investors as unknown and

¹⁹ Social Time Preference Rate (STPR) refers to the rate that community agree to pay to obtain something now rather than in the future. In a lot of countries, authorities use the long-term borrowing rate as a proxy for the STPR and risks adjustments, which is below a private risk-adjusted discount rate.

²⁰ The economist Frank Knight in 1921 proposed a distinction of the notion of uncertainty from the one of risk: uncertainty refers to situation where we miss some needed information to set accurate odds, while risk applies when we can accurately measure odds even if outcome is not known. Moreover, Knight states that a fundamental discrepancy lies” between the reward for taking a known risk and that for assuming a risk whose value itself is not known,”. For the researcher, a known risk can be “easily converted into an effective certainty,” while “true uncertainty is not susceptible to measurement.” (MIT News Website)

uncontrollable, so realizing the existence of uncertainty increases private discount rate above the public discount rate. It also increases post private discount rate against ex-ante discount rate. Continuing the risk's focus, while analysing waste treatment project in Korea, Hwang and Kim (2021) examine the demand risk (or revenue risk). After recalling the difference about the "payment differentiation" in user-type PPPs and unitary charge type, that authors called toll-base model and annuity-base model respectively, they outlined one significant effect that is correlated with this differentiation: the treatment of the demand risk of the project. Following the distinction, in the user type only the users' fee will be the repayment of private investors, and for this the demand risk is on the shoulder of private sector, while on the unitary charge or annuity-based model the same risk is on public sector. This discrepancy in the level of demand risk reflects of the return: in the user type the sponsors "have incentive to exaggerate the risk" and will require a higher rate of return for bearing the full demand risk than in the unitary charge type or annuity-based model. In the model, Hwang and Kim (2021) confirms the higher return which include the premium for bearing demand risks in the user-type PPPs, showing a difference of 3.47% in the average rate of return between user and unitary charge type (here governments have no reason on providing an additional risk premium), even if the Net Present Value is lower in the annuity – based model.

3.d Public – Private Partnership financing

Risk – free rate, as reported before, should not produce big problems and it is linked with the government bond yield. However, using only this rate to assess PPPs is wrong due that it does not truly report the particularity of PPP financing scheme: the presence of large investors sponsors and lending actors, and their relationships inside PPP. This feature expresses a "hidden financing cost" compensated by a return required by private to contribute to the collaboration financing (Grimsey and Lewis 2005).

Instead, some authors reported that risk – free rate can value the alternative possible project like the PSC, because all activities, including financing, are entirely public responsibilities. Moreover, traditional procurement, while assesses with risk – free rate, reflect the public borrowing capabilities to find financial funds at a lower rate than the private sector cost of capital. (Grimsey and Lewis 2004; Gray et al. 2021)

We should recall that after global financial crisis and the Eurozone sovereign debt crisis, the banks have reduced the amount of funds available for loans in private capital market, due to

banks' balance sheet problems and the capital base increasing required by Basel III and European Banking Authority (Hellowell, Vecchi et al. 2017)

For a better understanding, in comparative research about the theoretical return for equity and debt investors and real returns on Portuguese PPPs in the highway sector, Sarmiento and Oliveria (2018) discovery a practical investors market risk premium of around 10 Percent, much higher than the 6 percent used to calculate the theoretical CAPM. Authors suggest a regressions model considering length of the contract's period, domestic or foreign shareholders, financial crisis (2008 crisis) and public payments to find answers to the abnormal level of risk premium. The results explain the increase in investors' premium through the positive correlation of the length and financial crisis variable. The first one cause suggests that increases in size/ period of the PPP's contract are perceived as increase in uncertainty: the contract became more complex and prone to various contingences, with investors demanding higher risks premium. This validates again the already discussed consideration about time.

The second one, instead, is related to the reduction of liquidity as a consequence of a financial crisis: the financial risks tend to increase and the investors become more conservative on the capital invested in projects (Sarmiento and Oliveria 2018). Therefore, the financial capitals are borrowed at a higher cost of capital meaning a high WACC, while for equity investors this rate increase is automatically reflected adding a premium risk.

In addition, the higher premium in the post valuation of PPPs projects, required by private, hides the adversity faced by them in borrowing capital, at a reasonable rate, for the entire lifespan of the PPP's contract, when the sole operational life of the infrastructure is shorter. In exposing this discrepancy in time affecting capital financing, Leigland (2018) suggests that a possible solution can be obtained with governments' financial aids that beyond the lower price than capital borrowing rate, can reduce the premium asked by private.

3.e Partners relationships

Public – Private Partnerships are contracts that last for long period of time and that should be prepared carefully: these time-consuming projects involve large amount of preparation costs regarding legal, financial, technical, commercial and organizational expenditures that will occur by both public and private sector before even starting to collect revenues. All these costs are higher than preparation costs for normal traditional procurement and relapse on the parties, leading sometimes to private sponsors' discouragement to even start the competition process to engage in a public collaboration. In effect, Fernandes et al. (2016) reveal that PPPs market show

high barriers to entry due to the complexity and costs of the collaboration. On the other hand, barriers produce lower competition between private partners, leaving the few left with ample bargain power. So, a non-competitive and diversified PPPs market automatically leaves entrepreneurs the freedom of asking for the premium they want and the public sector will accept otherwise the infrastructure is not going to be realized.

In reality, competition is one of the causes of higher discount rate: in real UK PPPs' cases it was, in fact, shown that an excess return about 9.3% was asked by private investors. Analysts found the motivation on the lack of competition between PPPs' participants that leads public sector to attract the only partners remaining offering to increase return (Vecchi et al. 2013).

Moreover, the necessary time to complete all the procedure for a PPP, including its comparison with other projects, reduces the perception of future private net benefits and this though stops private to participate (Leigland 2018), unless they receive a premium higher than any corporate investment.

3.f Asymmetries and agency costs

Public – Private Partnerships suffer of information asymmetries and agency costs between partners. Asymmetries rise because, normally, each partner has news that the other is not aware of and, if there is not incentive in a sharing environment, the information translate into economic advantage. On the other hand, in a firm, when owners are distinct from managers (agents), agency costs represent the costs arise for monitoring and controlling managers as well as costs from losses due to agents' failure to follow the owners' aims. Managers are responsible for the well performance of the project, and they are rewarded for it: a good performance can increase the private reward, while a bad one no. In addition, if managers perceive the project to manage as riskier than other private investment, they will ask for larger incentives and owners, in this case the SPV, will ask for a charge to the public sector. (Hellowell and Vecchi 2018) In large-scale project as a PPP, where ownership is dispersed and there are a lot of people in charge to take decisions, these problems matter.

Both asymmetries and agency problems lead equity investors may increase the premium asked. For Geddes and Goldman (2020) both a strong corporate governance structure and the reduction of information asymmetry between managers and shareholders reduce the cost of equity.

Moreover, asymmetries information affects negatively the efficiency of risk transfer. To counterbalance this effect, governments are willing to pay premiums to attract private partners and to transfer risk to them, giving also more room to influence the risk allocation negotiations. Also, once the project has started, partners truly understand who have asymmetries and their

impact on project's management, asking for more profits from the project and increasing discount rate.

For Shrestha et al. (2017) a possible solution can be found with private competition: in its article, three PPPs cases were analysed and the intensification in private parties' rivalry during the project procurement initialization risk produced an increase in the allocation of risks to private at an acceptable price.

Moreover, the authors cover some other risks like force majeure, inflation risks or other exogenous risks factors for which the private partners can ask for a premium: the better management is to mitigate those risks with the public sector through the provision of a public variable contract's fees (price adjustment mechanism) and/or compensation mechanisms for the extra costs due to external reasons.

3.g Intrinsic PPP factors

Supplementary papers about Public – Private Partnerships highlight certain qualities that can pose an increase in the discount rate because of higher premium for private investors. For example, Demirel et al. (2020) states that the rise of the Cost of Equity in PPPs is a result of the projects' incompleteness and complexity "mainly due to the impossibility of specifying every element ex ante in the context of a long-term partnership". Additionally, Grimsey and Lewis, 2004, added how the bundling of different functions into a Partnership arrangement is more costly than reaching the same solution with separate contracts.

Santandrea et al. (2017) research, even if applied to Project Finance findings, outline other intrinsic factors that can increase private discount rate. Through a regression analysis they found that equity investors control on the management of the project and the presence of large group companies in the SPV, especially a financial lobby, increase the available bargain power of private sector that affect the return required to public sector in both the ex-ante and ex-post valuation. Moreover, during the large life of the PPP project, turnover over the private investors in the SPV and in the network contracts, can affect the return asked with an increase of it if the turnover is high.

This relates to the fact that the large amount of time of the PPPs automatically increases the project's risks perceptions.

To summarize, the increase in the level of premium requested by private investors, that affects the discount rate used, can be due to risks perceptions, both project risks and market risks, the sector of the infrastructure to be build, the possibility to find private financial capitals in the

market, the length of the collaboration, the low level of competition between partners, the presence of asymmetries and agency costs, the complexity of the project itself.

This factors, when examined in the ex-ante valuation, report a premium which is different to the ex – post valuation because during the running period of the project, investors can recalculate the economic advantage they want for bearing these risks, asking for higher premium during time, for compensate the money they put at risk.

Literature have found this discrepancy in private premium requests, suggesting qualitative approaches like constructing a project's risk matrix to know the allocation of risks between private and public sector and involving experts to address risks between parties. Nevertheless, a truly mathematical formula on how to adjust ex-ante private discount rate to cover all risks, uncertainties and other project's problems factors has not be discovered yet.

Even if the private required return problem, Grimsey and Lewis (2005) suggest that the required return is offset by the private sector's efficiencies in managing the PPP and by the fact that with traditional procurement the infrastructure will not be provided, because of the low levels of available public funds.

4 Real Option Approach

Public – Private Partnerships have proved to be necessary for public authorities to ensure the provision of public infrastructure and services. In order to assess its profitability, Net Present Value approach has been the major financial method used, thanks to the alignment of NPV approach to the maximization of shareholders' purpose. It remains, however, the problem about the private required return of the project, due to its increase to account for adjustments that entrepreneurs can make to cover for the high exposure to project's risks and uncertainty. Only through the request of a higher discount rate, investors desire to participate in a PPPs.

Lately, various recent studies have criticized the utilization of NPV because of its incapability to capture project's "management's flexibility", that can lead investors to change, revise and even abandon their initial investment's decision. For example, while analysing a Build, Operate & Transfer PPP, Ho and Liu (2002) reported three main characteristics of BOT that traditional evaluation, so NPV and DCF, fails to consider. Even if the authors refer to BOT typology, these features are present in almost all PPP types. Their findings concerned the fact that some project's risks, for example operating, demand, revenue risks as well as possible governments guarantees, negotiation options and even probable bankruptcy of SPV during the collaboration, are sometimes not calculated in the NPV of PPP or are not appropriately valued.

Hence, different researchers suggested a new methodology to mitigate risk and include investors decision flexibility into the valuation of PPPs contract: the Real Option Approach (also known as ROA) (Rakić and Rađenović 2014; Ho and Liu 2002).

The method of Real Option, theorized by Myers in 1977, derives from the financial option theory but it is used to valuing non-financial assets: it is used for assessing entrepreneurs' investment decisions.

A real option, as a financial option, "gives the holder the right", but not the obligation, "to take decisions concerning an asset or a project at a predetermined price or pre-specified time over the life of the option" (Rakić and Rađenović 2014). Exercise time is crucial in option approach. The two most used option contracts are the European option, when the holder can exercise its right at the end of the option period, while American option can be exercised at any time before or on its expiration date.

As stated by Brealey and Myers (2003) in Rakić and Rađenović (2014), “when you use discounted cash flow (DCF) to value a project, you implicitly assume that all assets are held passively. But managers are not paid to be dummies. After they have invested in a new project, they do not simply sit back and watch the future unfold. If things go well, the project may be expanded, if they go badly, the project may be cut back or abandoned altogether. Projects that can easily be modified in these ways are more valuable than those that do not provide such flexibility... Options to modify projects are known as real options”.

In this way, PPPs valuation with ROA can exploit the opportunities that option gives to minimize losses and maximize profits and can assess project's risks and uncertainty better. (Rakić and Rađenović 2014) In fact, there are a lot of real options that addresses to the various changes that can occur during the life of PPPs' project like option regarding the possibility to earn an economic guarantee from the public sector like a minimum traffic guarantee or a shadow toll but also option to abandon, option to defer, to growth (Charoenpornpattana et al. 2003; Vadoros and Pantouvakis 2007).

Placing an option that gives entrepreneur the possibility to change his idea during the long period of a Public – Private Partnership has proved to increase the value of the whole collaboration. In fact, some examples about toll roads and highways (Charoenpornpattana et al. 2003; Blank et al. 2009; Vadoros and Pantouvakis 2007; Rakić and Rađenović 2014; Zapata and Mejía 2017; Berk and Podhraski 2017; Esmaeeli and Heravi 2019), airports (Ho and Liu 2002; Martins et al. 2014), port investments (Lee 2011) show that the Net Present value of the partnership increases when considering the utilization of one of the various option possible, also increasing the attractiveness of the project itself.

To analyse the managerial flexibility post with options and to challenge the discovered necessity of high required rate of return for attracting private partners to engage into PPPs, we will address an option valuation with the traditional NPV method of the DCF and with Real Option Pricing Approaches.

We will show how Real Option Approach can affect the whole value of the project, with benefit results for private actors.

4.a Practical experiment for PPP's valuation

Keeping in mind the demand of private partners of higher return on investments with traditional valuation, that have led to a peak into PPPs' discount rates, to compensate the complexity of the contracts, we will show that if we move to more elastic methods, private can decide to participate into public collaboration even if the discount rates are lower, but with the overall value of the project largely positive. We present a real case with some modifications and assumptions made to test better the methods used.

I took revenues, investment costs and operating costs of the article by Charoenpornpattana et al. 2003 that comes from either the real value of the Australian PPP for the M2 Toll Road and from authors' modifications. The project lasts 30 years. I decided to use American Dollars as currency²¹ and converted them before starting the analysis of the project. We assume all investments are done by equity partners in order to use the CAPM approach to find the discount rate needed to the NPV valuation.

All calculations were performed using Microsoft Excel program and in the Appendix I here reported some calculation sheets used.

²¹ The cash flows were converted in American Dollars using a May 2014 exchange rate coming from Investing. Year 2014 was selected because the PPP project is not recent, but it is not possible to collect some data from Damodaran website for the valuation before 2014 for emerging countries.

In “Table 1”, shows the Cash Flow of the project, considering a tax value of 40% that was the same considered by Charoenpornpattana et al. 2003 for an Australian Project. It was also calculated the Value Added of the project, as the sum of all its cash flows minus the initial investment costs.

This metric, that accounts for \$1.177.367, is necessary to analyse the modification of the

Years	Revenues	Investment Costs	Operating Costs	Pre - Tax Cash Flow	Taxes	Taxed Cash Flow
0		\$ -294.753		\$ -294.753		\$ -294.753
1	\$ 67.241		\$ -295	\$ 66.946	\$ -26.778	\$ 40.168
2	\$ 68.585		\$ -309	\$ 68.276	\$ -27.310	\$ 40.966
3	\$ 69.957		\$ -325	\$ 69.632	\$ -27.853	\$ 41.779
4	\$ 71.357		\$ -341	\$ 71.015	\$ -28.406	\$ 42.609
5	\$ 72.784		\$ -358	\$ 72.426	\$ -28.970	\$ 43.455
6	\$ 74.240		\$ -376	\$ 73.864	\$ -29.545	\$ 44.318
7	\$ 75.725		\$ -395	\$ 75.330	\$ -30.132	\$ 45.198
8	\$ 77.239		\$ -415	\$ 76.824	\$ -30.730	\$ 46.094
9	\$ 78.784		\$ -435	\$ 78.348	\$ -31.339	\$ 47.009
10	\$ 80.360		\$ -457	\$ 79.902	\$ -31.961	\$ 47.941
11	\$ 81.163		\$ -480	\$ 80.683	\$ -32.273	\$ 48.410
12	\$ 81.974		\$ -504	\$ 81.470	\$ -32.588	\$ 48.882
13	\$ 82.794		\$ -529	\$ 82.264	\$ -32.906	\$ 49.359
14	\$ 83.621		\$ -556	\$ 83.066	\$ -33.226	\$ 49.839
15	\$ 84.458		\$ -530	\$ 83.928	\$ -33.571	\$ 50.357
16	\$ 85.302		\$ -613	\$ 84.690	\$ -33.876	\$ 50.814
17	\$ 86.155		\$ -643	\$ 85.512	\$ -34.205	\$ 51.307
18	\$ 87.017		\$ -676	\$ 86.341	\$ -34.536	\$ 51.805
19	\$ 87.887		\$ -709	\$ 87.178	\$ -34.871	\$ 52.307
20	\$ 88.766		\$ -745	\$ 88.021	\$ -35.208	\$ 52.813
21	\$ 88.766		\$ -782	\$ 87.984	\$ -35.193	\$ 52.790
22	\$ 88.766		\$ -821	\$ 87.945	\$ -35.178	\$ 52.767
23	\$ 88.766		\$ -862	\$ 87.903	\$ -35.161	\$ 52.742
24	\$ 88.766		\$ -905	\$ 87.860	\$ -35.144	\$ 52.716
25	\$ 88.766		\$ -951	\$ 87.815	\$ -35.126	\$ 52.689
26	\$ 88.766		\$ -998	\$ 87.768	\$ -35.107	\$ 52.661
27	\$ 88.766		\$ -1.048	\$ 87.718	\$ -35.087	\$ 52.631
28	\$ 88.766		\$ -1.100	\$ 87.665	\$ -35.066	\$ 52.599
29	\$ 88.766		\$ -1.155	\$ 87.610	\$ -35.044	\$ 52.566
30	\$ 88.766		\$ -1.213	\$ 87.552	\$ -35.021	\$ 52.531
Total	\$ 2.473.064	\$ -294.753	\$ -19.529	\$ 2.158.781	\$ -981.414	\$ 1.177.367

Table 1: Project Cash Flows
Source: Author’s calculation

discount rate.

In fact, the method used to confront Net Present Value Approach and the Real Option Approaches was the following: firstly, we found the NPV of the project at a specified rate, then we calculate how an option of abandon the PPP, in the form of a Put Option, changes the value of the project. Lastly, we try to find the discount rate by which the Value Added would have given the same value found with the ROA, discussing if Option are able to increase project's value while reducing private discount rate and therefore the investor's required premium by adding some management flexibility. Moreover, I decided to prepare different cases by changing some parameters to see how this affect the project's value and the discount rate.

Project's Net Present Value calculation is calculated by using a discount rate calculated from the Beta available in Damodaran site for the "Construction" and the "Heavy Construction" sector and adding a Country Risk Premium for Australia, all for a 2014 basis. The discount rate estimates in this way will be labelled as "Starting Case". The other two discount rates are just formulated by increasing or decreasing of 3% the Australian Country Risk Premium.

In "Table 2" are reported the Net Present Value of the Project for each discount rates, plus the Value Added which do not change in the three cases.

Net Present Value Approach			
	Discount Rate		
	Decrease Country Risk Premium	Base Case	Increase Country Risk Premium
	10,09%	13,09%	16,09%
Value Added	\$ 1.177.367	\$ 1.177.367	\$ 1.177.367
NPV	\$ 134.848	\$ 41.926	\$ -20.909

Table 2: Project Net Present Value Approach
Source: Author's calculation

We can see that the Project generates positive value for two cases, while if the discount rate is higher, because of higher risks, the project should not even start.

Keeping in mind the three different cases, we now use Real Option Approaches to see the value of the project and the discount rate changes. Mun (2002) in Charoenpornpattana et al. 2003 refers to numerous option pricing methodologies that can be used to calculate the value of a real option like Black-Scholes Model, Monte Carlo simulation, decisional tree model and so on.

At the beginning a Decisional Option Pricing Model of Cox, Ross and Rubinstein developed in 1979, based on a binomial tree²² for valuing options by applying a risk-neutral probabilities approach was set up (Rakić and Rađenović 2014) because of its flexibility and easily understanding. Binomial tree pricing model is a discrete-time model that starts by calculating the value of the underlying asset, the Net Present Value, knowing that it can go only in two possible directions expressed by two coefficients: up (u), so the value increases, or down (d) with a decrease of value because $u < d$. These parameters were randomly chosen, while the risk – neutral probability is calculated from these values using the formula taken from lectures of “Economic Analysis of Investment Projects”

$$p = \frac{(1+r) - d}{u-d}$$

So, the value of the project (S) changes, in this case, every year by the u and d coefficient. Considering the precedent cases for the discount rates (r), I constructed a European Put Option that give entrepreneurs the possibility, only at maturity, to sell the project back to the government when the underlying, for real option is the project’s NPV, is less than a determined strike price (K). Recalling some basic definitions, a Put Option is convenient to be exercised only when the sell price (K) is greater than the value of the underlying asset (S).

For the binomial pricing model, moreover, it is necessary to set some parameter:

- $u = 1.5$ and $d = 0.8$, randomly chosen;
- r is the discount rate in the precedent cases and influence the risk – neutral probability p ;
- time between each variation is assumed to be 1 year so $t = 1$;
- strike price is decided to be the 20%, the 40% and the 60% of the Value Added of the Project to be in line with the intrinsic value;
- the maturity or time at which the Option can the executed that is set to 10 years, 15 years or 20 years from the start of the project.

For proceeding for the valuation, I found the path of the project’s NPV for every year, multiplying by 1.5 and 0.8 until I arrived at the 10th, 15th and 20th year of the decisional tree, which corresponds to the moment of possible exercise of the option. Each movement up creates

²² Binomial Option Pricing is a discrete model which results comes from applying a replicant portfolio approach or a risk-neutral probabilities approach. In this case, due do it is not easy to find a market-traded asset that can replicate the value of the PPP project as the replicant portfolio approach would have wanted (Rakić and Rađenović 2014), I decided to use the risk – neutral probability.

a V^+ project while the down project's movement is labelled as V^- . At the end time I analyse if the strike price is higher than the same time value of the project, keeping only the maximum value. Once did it, I proceed backward in order to find the value of the project with the Put Option applying the formula

$$\text{Value of the Project at each node} = \frac{p*V^+ + (1-p)*V^-}{e^{r*t}}$$

The findings are reported below, considering possible sensibilities about the discount rates, the strike prices and the exercised time of the Put Option. Each table represents one of the discount rate cases with the value of the project in case of a Put Option and with an additional table that reports which would have been the necessary discount rate at which the Value Added of the Project would have produced a NPV, using the CAPM rate, equal to the value found with ROA.

Decisional Real Option Model				
Discount Rate		Maturity (years)		
10,09%		10	15	20
Strike Price	\$ 235.473	\$ 151.786	\$ 137.684	Not Convenient
	\$ 470.947	\$ 210.583	\$ 168.040	\$ 144.652
	\$ 706.420	\$ 281.453	\$ 204.877	\$ 165.342

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Strike Price	\$ 235.473	9,66%	10,02%	NA
	\$ 470.947	8,35%	9,27%	9,84%
	\$ 706.420	7,07%	8,47%	9,33%

Table 3: Decrease Country Risk Premium case with Decision Tree
Source: Author's calculation

Decisional Real Option Model				
Discount Rate		Maturity (years)		
13,09%		10	15	20
Strike Price	\$ 235.473	\$ 72.826	\$ 51.110	Not Convenient
	\$ 470.947	\$ 130.753	\$ 77.347	\$ 53.059
	\$ 706.420	\$ 192.128	\$ 106.914	\$ 67.005

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Strike Price	\$ 235.473	11,95%	12,73%	NA
	\$ 470.947	10,20%	11,79%	12,65%
	\$ 706.420	8,74%	10,87%	12,15%

Table 4: Base case with Decision Tree
Source: Author's calculation

Decisional Real Option Model				
Discount Rate		Maturity (years)		
16,09%		10	15	20
Strike Price	\$ 235.473	\$ 47.115	\$ 21.075	\$ 9.427
	\$ 470.947	\$ 94.231	\$ 42.150	\$ 18.854
	\$ 706.420	\$ 141.346	\$ 63.226	\$ 28.282

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Strike Price	\$ 235.473	12,88%	13,96%	14,50%
	\$ 470.947	11,25%	13,08%	14,06%
	\$ 706.420	9,92%	12,28%	13,65%

Table 5: Increase Country Risk Premium case with Decision Tree
Source: Author's calculation

From the table reported, we can assume that considering a Put Option which give the opportunity to entrepreneurs to leave the project, after 10, 15 or 20 years from its start, it decreases the discount rate that should have been asked to reach the same project value in case of a normal DCF model. These suggest that the flexibility added with the Real Option Approach help to address better the risks and uncertainties that are correlated to the project. Only when maturity approaches the end of the project, meaning the 20th year, the option remains convenient to be exercised when Strike Price are high.

In addition, the discount rate is inversely proportional to the strike price chosen meaning that increasing the value at which private partners can sell the PPP project, reduces the consideration about its risks due that they are covered with a major sell price.

I have also tried to build the same decisional approach with an American Put Option, so leaving private party to be able to exercise the option whenever the strike price would have been above the underlying value. I found out that the value of the project will always be higher than with a European Put Option, confirming this well – known statement of “Mathematics for Financial Risks and Derivatives”²³. Nevertheless, due to the maturity advantage for the holder, the inverse calculation of the CAPM discount rate necessary was problematic because of potential mismatch in the time valuation of the projects.

After the utilization of these discrete – time model to find PPP’s value with ROA, I tried to use a continuous model: the Black and Scholes model of 1973 to find the price of the Put Option, based on the Geometric Brownian motion of the underlying asset and a log-normal distribution. This model can be applied also to investment decision and produces a more precise price of the option based on the value of the underlying and the strike price.

For simplification, I decided to use the revenues present values of the project as underlying value (S_0) while the present investment and operating costs are reported as strike price value (X).

As for the interest rate r , the different cases of discount rates are used, whereas the volatility of the cash flow (σ) is a changeable parameter sets as 20%, 40% and 60% to be of the same percentage as the ones used in the discrete model. At last, time refers to the difference between the valuation year and the maturity year: to a better analysis I decided to keep in line with the assumptions before so 10, 15 and 20 years.

The formula used from Econometrics and Mathematics lectures where the followings:

$$d_1 = \frac{\ln(S_0 / X) + (r + \sigma^2 / 2)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln(S_0 / X) + (r - \sigma^2 / 2)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

$$p = X \cdot e^{-r} \cdot N(-d_2) - S_0 \cdot N(-d_1)$$

²³ Literature and lectures about Mathematics for Financial Derivatives reports that an American Put Option always produces a greater value than a European Put Option due to its nature to be exercised at any possible time. This consideration it is true also for Real Options.

So, values considering the different discount rates which will affect the value of the strike price and of the underlying value as well, maturity times and volatilities are grouped in the subsequent tables.

Black and Scholes Option Pricing Model				
Discount Rate		Maturity (years)		
10,09%		10	15	20
Volatility of Cash Flow	20%	\$ 370.992	\$ 427.329	\$ 469.456
	30%	\$ 427.329	\$ 486.839	\$ 528.552
	40%	\$ 469.456	\$ 528.552	\$ 567.416

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Volatility of Cash Flow	20%	5,77%	5,08%	4,61%
	30%	5,08%	4,43%	4,02%
	40%	4,61%	4,02%	3,67%

Table 6: Decrease Country Risk Premium case with B&S
Source: Author's calculation

Black and Scholes Option Pricing Model				
Discount Rate		Maturity (years)		
13,09%		10	15	20
Volatility of Cash Flow	20%	\$ 257.510	\$ 304.406	\$ 339.365
	30%	\$ 304.406	\$ 353.770	\$ 388.299
	40%	\$ 339.365	\$ 388.299	\$ 420.430

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Volatility of Cash Flow	20%	7,48%	6,71%	6,20%
	30%	6,71%	6,00%	5,55%
	40%	6,20%	5,55%	5,16%

Table 7: Base case with B&S
Source: Author's calculation

Black and Scholes Option Pricing Model				
Discount Rate		Maturity (years)		
16,09%		10	15	20
Volatility of Cash Flow	20%	\$ 180.286	\$ 220.453	\$ 250.343
	30%	\$ 220.453	\$ 262.649	\$ 292.129
	40%	\$ 250.343	\$ 292.129	\$ 319.541

Discount Rate needed to have Value Added equal to Real Option Model				
Value Added		Maturity (years)		
\$ 1.177.367		10	15	20
Volatility of Cash Flow	20%	8,99%	8,16%	7,60%
	30%	8,16%	7,39%	6,90%
	40%	7,61%	6,90%	6,48%

Table 8: Increase Country Risk Premium case with B&S
Source: Author's calculation

Put Option increases the value of the project while decreasing the discount rate. In this way, placing an option that can regulate the uncertainty of management decision, reduce the level of risks perceived by investors.

4.b Results

The experiment conducted to the cash flows of the Australia M2 Toll Road between a traditional valuation approach using discount rate for equity and Real Option Approaches have produced some interesting conclusions.

Focusing on the Base Case, we have that the NPV in “**Table 2**” is influenced by the return asked from private investors, producing a positive amount of almost \$42.000 with a discount rate of 13,09%.

Risk and uncertainties perceptions of investors are the motivations of the large rate required by investors to participate in the projects, that otherwise would not have been started.

On the other hand, when conducting the valuation with a Real Option Approach we see an increase in the total value of the project with a decrease in the return asked. For the same Base Case, in the Decisional Approach the value goes from \$51.110 to \$106.914, proportional to the Strike Price, thanks to an option to abandon the project after 15 years. Moreover, a decrease on the private discount rate can be seen.

So, adding some flexibility to the project produce a benefit to the whole valuation and to the perception of investors that are willing to engage in a PPP thanks to the protection given by the possibility to exercise the option, even if the reward is lower.

This finding increases the idea that a project should be assessed not only for the cash flow that can generate, but also for the future opportunities that can face, both negative and positive for investors. This is done by adding flexibility to the investments through options.

In this way, public sector attracts private capital and resources not through returns but with guarantees on the contract itself. Both decisional tree approach and Black Scholes formula have given a positive net value of the project, clearly higher than the DCF method.

With ROA, risks and uncertainties are not truly negative aspects (Martins, Marquez and Oliviera Cruz 2014), but they increase project’s valuation when option’s protections are placed, leading investors to start a PPP with less reward.

Normally, through higher discount rate, private investors incorporate risks but with PPPs discount valuation goes out of the track, asking for major return and threatening the possibility of starting the project. However, a better attitude to assess the project should be adding some probabilities events that can decrease the perceptions of risks.

In fact, to attract entrepreneurs, governments should step in and ensure some “guarantees” to the private partners. Chen, Qui and Long, 2012, Zapata and Mejía, 2017 and the experiment conducted confirms that a minimum revenue guarantee priced through a real option approach or other options, incentive the willingness of private partners to participate into the public procurement activities.

5 Conclusions

Public – Private Partnerships, as collaboration between the private and the public sector, have brought advantages for both the implicated parties, increasing the level of society's welfare thanks to the infrastructures that have been developed with these contracts. If the agreement had not started, the public asset would have not been built for the lack of public funds. Literature, however, is still debating about the true assessment of the PPP's project due to its complexity and its large time duration.

On one hand it is hard to be able to rightfully price and allocate parties' risks and on the other hand, some risks and uncertainty are even difficult to predict due to the missing data about replicant projects available in the financial market that can be used to assess PPP.

In fact, the basic model of Corporate Finance has proved to not be sufficient for determining the true value of the partnership: Betas' estimations are biased for not relying on PPPs historical data, risks and uncertainties of the PPP's sectors can affect the perceptions of the entrepreneurs and non – idiosyncratic risks of the project can threaten its whole valuation. Other problems that should be remembered are the large amount of people involved in the contract which harm each other perceptions about the ability to manage risks, the large amount of time that intrinsically increases the risks of achieving the required project's return, the low competition about the private actors in establishing the collaboration with the public sector and private bargain power during the settling of the agreement. These factors act as lever for the private partners, inducing them to seek for a higher return of the project during its lifetime, even greater than the return of a corporate finance project.

It was shown, through real cases analysis, that the presence and the mix of the above factors have been responsible for the increasing of the discount rates needed to find the Net Present Value of the project: rate which are higher in the ex – post valuation of the project rather than in the ex – ante valuation. This supports the idea that entrepreneurs, while engaging in a PPP project, fear the risks and uncertainties arising during the life of the collaboration, requiring to be compensate efficiently.

Therefore, using Corporate Finance formula have produced some irregularities in the private discount rate with higher levels to reward risk perceptions.

Recently, some authors have tried to understand the value of PPP collaboration using the Real Options Approach, giving the holder of the option the right, but not the obligation, to leave the

project, to ask for government financial interventions, to extend the time of the collaboration and so on. In this way, it is possible to add some flexibility into the decision of the partners in the Public – Private Partnerships. Therefore, the holder of the Option is more protected against potential project's risk due to the possibility to enact the option.

Through the calculations made while confronting the value of the same PPP project, the Australian M2 Toll Road, using a Net Present Value Approach and two Real Options Approach, the Decisional Tree and the Black – Scholes Model, thanks to the incorporation of an option, in my cases a European Put Option, the value of the project increases. One of the possible explanations is that the entrepreneur, the option's holder, feels safer about possible oscillations of expected changes in the PPP project because he is aware of the “guarantee” that the option provides to him. Moreover, thanks to the option's protection, the discount rate asked by the private partner decreases: this reaffirms the precedent “guarantee” consideration because of the option's ability to reduce the risks' perceptions bear by the private partners.

The problem of valuation of PPPs can be viewed differently: Vecchi, Hellowell and other researchers have reported how the higher discount rate should be necessary for attract the private investors into the project, but they were not aware of flexibilities of investors decisions. In fact, when assessing a P3 using ROA, the investors know that they have risks in the project, and they incorporate them with some options to protect their investments. In this way, the value of the project rises and partners are inclined to engage into a PPP even with lower return, because of the possibility to exercise the option which will give them some return when the project is losing value, for example.

Therefore, Real Option Approaches seem to be a more valid method for assessing the Public – Private Partnership values as a result of options nature to embody risk and then reallocate them to the partners that will be receive the project after the exercise of the option, usually the public sector.

Newest PPPs contracts that have some minimum guarantees over revenues, some shadow tolls mechanisms, or some options to abandon the project or to enlarge its period, are constructed with a major view about risks and uncertainties, since the start of the collaboration. During DCF approach risks and uncertainties considerations are not all placed ex-ante, leading investors to participate only when compensating by return very high. So, ROA valuation keeps better track about possible changes in the project life and of the investors decisions as well, protecting investors that participate in the project even when discount rates are between normal levels. In

this way, it is the protection given by the options that, in an indirect way, increases the perceptions of the investors' returns because they have a possible way out that can help them not to lose everything.

However, even Real Options have limitations such as the assumptions about volatility of the expected cash flow, the paths that the project is predicted to follow, the time decision which can be different from the time decision of entrepreneurs. If the same limitations are less strictly in Financial Options because of the possibility of relying on historical market data or the movements of similar assets in the capital market, real investments do not have the same background that one can look for a perfect identical precedent case.

With this consideration, even proving the validity and the better valuation of Public – Private Partnerships using Real Option Approaches, the implicit features of these collaboration contracts and the lack of available historical data do not assure private and public partners about the possibility of finding the true value of the project and the fair returns that can be asked by involved actors. Due to the complexity of PPPs, more investigations should be carried on in the future in order to construct a solid base, for private and public sectors, to rely on for the project's assessment and its risks allocation.

Bibliography

- Alfen H. W. et al., 2009. *Public-Private Partnership in infrastructure development: Case studies from Asia and Europe*, Bauhaus-Universität Weimar editor, No. 7, ZBW.
- Almarri K. and Boussabaine H., 2021. *Re-evaluating the risk costing agenda in PPP projects*, Built Environment Project and Asset Management, Vol. 11, No. 1.
- ANON, 2013. *07 Public Private Partnership*, Healthcare UK, UK Trade & Investments.
- Bain R., 2008. *Private Finance Rates of Return: evidence from the UK's PFIs Road Sector*, Association for European Transportation, Conference Paper 2008.
- Ball R., Heafey M. and King D., 2003. *Risk Transfer and value for money in PFI Project*, Public Management Review, Vol. 5, No. 2.
- Berk A. S. and Podhraski D., 2018. *Superiority of Monte Carlo simulation in valuing real options within public-private partnerships*, Risk Management, Vol. 20.
- Blank F. F., Baidya T. K. N. and Dias M. A. G., 2009. *Real Options in Public Private Partnership – Case of a Toll Road Concession*, Annual International Real Options Conference, 2009 Conference.
- Broadbent J. and Laughlin R., 2003. *Public private partnerships: an introduction*, Accounting, Auditing & Accountability Journal, Vol. 16, No.3.
- Buso M., Moretto M. and Zormpas D. 2020. *Excess returns in Public – Private Partnerships: Do governments pay too much?* , Marco Fanno Working Papers No. 246.
- Carbonara, N., et al., 2015. *Risk Management in Motorway PPP Projects: Empirical-based Guidelines*, Transport Reviews, Vol. 35, No. 2.
- Charoenpornpattana S., Minato T. and Nakahama S., 2003. *Government Supports as Real Options in Built-Operate-Transfer Highways Projects*, Annual International Real Options Conference.
- Chen H., Qui R. and Long S., 2012. *An Evaluation of Real Options Approach in Public-Private Partnerships*, Industrial and Systems Engineering Research Conference.
- Ceccato L., 2014. *Le opzioni reali per la valutazione degli investimenti. Un'applicazione al project financing*, Master Thesis, University of Venice, Master in Administration, Finance and Control.
- Colla P., et al., 2015. *Determinants of the cost of capital for privately financed hospital projects in the UK*, Health Policy 119, ScienceDirect.
- Commission of the European Communities, 2004. *Green Book on Public - Private Partnerships and Community Law on Public Contracts and Concessions*, s.l.. Available on:

<https://op.europa.eu/it/publication-detail/-/publication/94a3f02f-ab6a-47ed-b6b2-7de60830625e> [Access date: 15/09/2022]

Commission of the European Communities, 2005. *Opinion of the European Economic and Social Committee on the 'Green Paper on public-private partnerships and Community law on public contracts and concessions'*, Official Journal of the European Union, COM(2004) 327 final.

Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili, 2016. *Project Financing e partenariato pubblico privato: aspetti normativi e linee guida operative*, s.n. Available on:

[https://www.commercialistiarezzo.it/attachments/article/150/Project%20Financing%20e%20partenariato%20pubblico%20privato%20def%20\(002\).pdf](https://www.commercialistiarezzo.it/attachments/article/150/Project%20Financing%20e%20partenariato%20pubblico%20privato%20def%20(002).pdf) [Access date: 01/09/2022]

Cui C., et al, 2018. *Review of studies on the public-private partnerships (PPP) for infrastructure projects*, International Journal of Project Management 36, ScienceDirect.

Cuthbert J.R. and Cuthbert M., 2012. *Why IRR is an inadequate indicator of costs and returns in relation to PFI schemes*, Critical Perspectives on Accounting, Vol. 23, ScienceDirect.

Davis K., 2005. *Policy Forum: Financing Public Infrastructure PPPs and Infrastructure Investment*, The Australian Economic Review, Vol. 38, No. 4.

Demirel H.C., Leendertse W., Volker L. 2022. *Mechanisms for protecting returns on private investments in public infrastructure projects*, International Journal of Project Management 40, ScienceDirect.

Engel E., Fischer R. and Galetovic A., 2007. *The Basic Public Finance of Public-Private Partnerships*, Working Paper 13284, National Bureau of Economic Research.

Engel E., Fischer R. D. and Galetovic A., 2020. *When and How to Use Public-Private Partnerships in Infrastructure: Lessons From the International Experience*, NBER Working Paper No. 26766.

Esmaeeli A. N. and Heravi G., 2019. *Real Options Approach versus Conventional Approaches to Valuing Highway Projects under Uncertainty*, American Society of Civil Engineers, Technical Papers.

European Court of Auditors, 2018. *Public Private Partnerships in the EU: Widespread shortcomings and limited benefits*, Special Report 2018, n. 9, European Union

European Investment Bank, 2022. *Public-private partnerships financed by the European Investment Bank from 1990 to 2021*, European Investment Bank.

European PPP Expertise Centre, 2012. *United Kingdom – England - PPP Units and Related Institutional Framework*, EIB GraphicTeam.

- Fernandes C., Ferreira M. and Moura F., 2016. *PPPs - True Financial Costs and Hidden Returns*, Transport Reviews, Vol. 36, No. 2.
- Fontana C., Anno Accademico 2021 – 2022, *Lectures of Mathematics for Financial Risks and Derivatives*, Università di Padova, Master in Economics and Finance.
- Fourie F. C.v.N. and Burger P., 2000. *An Economic Analysis and Assessment of Public -Private Partnership (PPPs)*, South African Journal of Economics, Vol. 68, pp. 305-316
- Garcia-Bernabeu A., Mayor-Vitoria F. and Mas-Verdu F., 2015. *Project Finance Recent Applications and Future Trends: The State of the Art*, International Journal of Business and Economics, Vol. 14, No. 2.
- Geddes R. R. and Goldman J., 2022. *Institutional Economics and the Cost of Capital for Infrastructure Projects*, Journal of Economic Policy Reform, Vol. 25, No. 2.
- Gray S., et al., 2021. *The public-private partnership valuation paradox*, Accounting Research Journal, Vol. 34 No. 6.
- Grimsey D. and Lewis M. K., 2004. *Public Private Partnerships – The Worldwide Revolution in Infrastructure Provision and Project Finance*, Edward Elgar Publishing.
- Grimsey D. and Lewis M. K., 2005. *Are Public Private Partnerships value for money? Evaluating alternative approaches and comparing academic and practitioner views*, Accounting Forum 29, ScienceDirect.
- Grout P.A., 2002. *Public and Private Sector Discount Rates in Public-Private Partnerships*, CMPO Working Paper Series No. 03/059.
- Hellowell, M., et al., 2017. *Government policies to enhance access to credit for infrastructure-based PPPs: an approach to classification and appraisal*, Public Money and Management, Vol. 37, No. 2.
- Hellowell M., Vecchi V., s.d.. *Estimating the Cost of Capital for PPP contracts in Emerging Markets*, s.n..
- Hellowell M. and Vecchi V., 2018. *Assessing the Cost of Capital for PPP Contracts*, in *Public-Private Partnerships in Health*, Chapter 5.
- Hodge G.A. and Greve C., 2007. *Public-Private Partnership: An International Performance Review*, Essays on Service Delivery and Privatization, Public Administration Review.
- Hossein Darvish H., et al., 2006. *Risk Management, Public Interests and Value for Money in PPP Projects: Literature review and case studies*, The CRIOCM 2006 International Symposium on “Advancement of Construction Management and Real Estate”.
- Huanming Wang H., et al., 2019. *The moderating role of governance environment on the relationship between risk allocation and private investment in PPP markets: Evidence from developing countries*, International Journal of Project Management 37.

- Hwang H. and Kim H., 2021. *Demand risk transfer and government's cost efficiency: Focusing on Korean waste treatment PPP cases*, Waste Management 137, ScienceDirect.
- Kokkaew N. and Tongthong T., 2021. *Computational Framework for the Determination of Duration and Revenue Sharing Rates in PPP Concession Renewal: A Monte Carlo and Risk Premium Approach*, Engineering Journal, Vol. 25, No. 7.
- Lee H., 2011. *A Real Option Approach to Valuating Infrastructure Investments*, Master Thesis, KDI School of Public Policy and Management of Sejong, South Korea, Master of Public Policy.
- Leigland J., 2018. *Public-Private Partnerships in Developing Countries: The Emerging Evidence-based Critique*, The World Bank Research Observer, Vol. 33, No. 1.
- Li J. and Zou P. X.W., 2012. *Risk identification and assessment in PPP infrastructure projects using fuzzy analytical hierarchy process and life-cycle methodology*, Australasian Journal of Construction Economics and Building, Vol. 8, No. 1.
- Makovšek D. and Moszoro M., 2018. *Risk pricing inefficiency in public-private partnerships*, Transport Reviews, Vol. 38, No. 3.
- Martins J., Marques R. C. and Oliveira Cruz C., 2014. *Maximizing the value for money of PPP arrangements through flexibility: An application to airports*, Journal of Air Transport Management, Vol. 39.
- Maryouri L., 2013. PPP International Conference, *A comparative analysis of PPP financing mechanisms for infrastructure projects*, Body of Knowledge Public Private Partnership, Preston, UK 18-20 March 2013.
- Mirchandani D., Rivera Jacobo A., 2022. *The Public-Private Partnership Law Review: USA*, The Law Review, White & Case LLP. Available on: <<https://thelawreviews.co.uk/title/the-public-private-partnership-law-review/usa>> [Access date: 10/10/2022]
- Moretto M., Anno Accademico 2021-2022, *Lectures of "Analysis of Investments Projects"*, Università degli Studi di Padova, Master in Economics and Finance.
- Mu R., de Jong M. and ten Heuvelhof E., 2010. *A Typology of Strategic Behaviour in PPPs for Expressways: Lessons from China and Implications for Europe*, EJTIR 10(1), March 2010.
- Ndonye H. N., Anyika E. and Gongera G., 2014. *Evaluation of Public Private Partnership Strategies on Concession Performance: Case of Rift Valley Railways Concession, Kenya*, European Journal of Business and Management, Vol.6, No.39.
- O Ong'olo D., 2006. *Public Private Partnership (PPP), Practice and Regulatory Policy in Kenya*, Spellman & Walker Co. Ltd, Institute of Economic Affairs (IEA, Kenya).
- Pezzuto A., 2020. *Partenariato pubblico privato, finanza di progetto e project bond*. Available on: <<https://www.tidona.com/partenariato-pubblico-privato-finanza-di-progetto-e-project-bond/>> [Access date: 01/09/2022]

- Ping Ho S. and Liu L. Y., 2002. *An option pricing-based model for evaluating the financial viability of privatized infrastructure projects*, Construction Management and Economics, Vol. 20, No. 2.
- Quiggin J., 2005. *Public–Private Partnerships: Options for Improved Risk Allocation*, Policy Forum: Financing Public Infrastructure, The Australian Economic Review, Vol. 38, No. 4.
- Rakić B. and Rađenović T., 2014. *Real Options Methodology in Public – Private Partnership Project Valuation*, Economic Annals, Vol. 59, No. 200.
- Rybnicek R., Plakolm J. and Baumgartner L., 2020. *Risks in Public–Private Partnerships: A Systematic Literature Review of Risk Factors, Their Impact and Risk Mitigation Strategies*, Public Performance & Management Review, Vol. 43, No. 5.
- Santandrea, M., et al., 2017. *Concentration risk and internal rate of return: Evidence from the infrastructure equity market*, International Journal of Project Management, Vol. 35, No. 3.
- Sarmiento M. J. and Renneboog, L. D. R., 2014. *Anatomy of Public-Private Partnerships: Their Creation, Financing, and Renegotiations*, CentER Discussion Paper; Vol. 2014-017.
- Sarmiento J. M. and Oliviera M., 2018. *Use and limits in project finance of the capital asset pricing model: overview of highway projects*, EJTIR, Vol. 18, No. 4.
- Shrestha A., et al., 2017. *Efficient risk transfer in PPP wastewater treatment projects*, Utilities Policy 48, ScienceDirect.
- Spackman M., 2002. *Public–private partnerships: lessons from the British approach*, Economic Systems Vol. 26.
- Vandoros N. and Pantouvakis J.-P., 2006. *Using real options in evaluating PPP/PFI projects*, Sustainability and Value Through Construction Procurement, 2006, Salford, UK.
- Vecchi V, et al., 2013. *Does the private sector receive an excessive return from investments in health care infrastructure projects? Evidence from the UK*, Health Policy (2013), ScienceDirect.
- Vecchi V. and Casalini F., 2018. *Principles of Capital Budgeting for the Assessment of PPP Projects in Public-Private Partnerships in Health*, Chapter 4.
- Vining A.R. and Boardman A. E., 2008. *Public-Private Partnerships – Eight Rules for Governments*, Public Works Management & Policy, Vol. 13 N. 2.
- Wang H., et al., 2018. *Public–private partnership in Public Administration discipline: a literature review*, Taylor & Francis Group, Public Management Review, Vol. 20, No. 2.
- Winch G. M., Onishi M. and Schmidt S., 2012. *Taking Stock of PPP and PFI around the World*, Summary of Research Report 126, The Association of Chartered Certified Accountants, ACCA, London.

Ye S. and Tiong R. K. L., 2000. *Government support and risk-return trade-off in China's BOT power projects*, Engineering, Construction and Architectural Management Vol. 7.

Zapata C.A. and Mejía C.A., 2017. *Estimation of guarantees in toll road projects: an application with real options analysis*, Conference Paper.

Sitography

- <https://www.eib.org/epec/>
- <https://www.consob.it/web/investor-education/le-crisi-finanziarie>
- <https://www.realoptions.org/>
- <https://pppknowledgelab.org/>
- <https://ppi.worldbank.org/en/ppi>
- <https://ppp.worldbank.org/public-private-partnership/>
- <https://ppp-certification.com/>
- <https://news.mit.edu/>

Appendix

Some examples of the calculation done in Excel

Net Present Value with DCF methods for the Base Case, so discount rate of 13,09%.
The table continues until the 30th year but due to the large number of years, the whole table is not possible to be reported in a Word sheet.

	0	1	2	3	4	5	6
Flusso di Cassa	\$ -294.753	\$ 40.168	\$ 40.966	\$ 41.779	\$ 42.609	\$ 43.455	\$ 44.318
Valore di Attualizzazione	1,000	1,131	1,279	1,446	1,635	1,849	2,091
Flussi di Cassa Attualizzati	\$ -294.753	\$ 35.520	\$ 32.034	\$ 28.890	\$ 26.055	\$ 23.497	\$ 21.191
Totale senza Investimento	\$ 336.680						
NPV	\$ 41.926						

Decisional Tree Calculation for the Base Case (13,09%) with Strike Price at \$235.473.

Strike Price	K	\$ 235.473	up	1,50	Valore Progetto con opzione al 2014	\$ 72.826										
Time			down	0,80												
Discount Rate		13,09%	risk-neutral probabilit	0,47												
Sottostante	S	\$ 41.926	Volatility of expected cash flow	20%												
	0	1	2	3	4	5	6	7	8	9	10	MAX				
									\$ 1.599.139	\$ 2.417.686	\$ 2.417.686					
								\$ 1.057.725	\$ 1.611.791							
							\$ 699.615	\$ 1.074.527	\$ 852.874	\$ 1.289.433	\$ 1.289.433					
							\$ 464.575	\$ 716.352	\$ 564.120	\$ 859.622						
							\$ 312.646	\$ 477.568	\$ 377.076	\$ 573.081	\$ 454.866	\$ 687.697				
							\$ 215.844	\$ 318.378	\$ 259.358	\$ 382.054	\$ 309.397	\$ 458.465				
							\$ 212.252	\$ 186.304	\$ 254.703	\$ 222.606	\$ 305.643	\$ 261.038				
							\$ 154.562	\$ 169.802	\$ 203.831	\$ 244.515	\$ 366.772	\$ 366.772				
							\$ 115.509	\$ 141.502	\$ 140.611	\$ 169.802	\$ 170.217	\$ 203.831	\$ 244.515			
							\$ 90.056	\$ 94.334	\$ 111.127	\$ 113.201	\$ 136.932	\$ 135.841	\$ 168.385			
							\$ 62.890	\$ 91.117	\$ 75.467	\$ 114.162	\$ 90.561	\$ 143.401	\$ 108.673			
							\$ 41.926	\$ 76.688	\$ 50.312	\$ 97.337	\$ 60.374	\$ 124.016	\$ 72.449			
								\$ 33.541	\$ 84.085	\$ 40.249	\$ 108.061	\$ 48.299	\$ 139.519			
									\$ 26.833	\$ 94.498	\$ 32.199	\$ 122.407	\$ 38.639			
										\$ 21.466	\$ 107.393	\$ 25.760	\$ 139.519			
											\$ 17.173	\$ 122.407	\$ 20.608			
												\$ 13.738	\$ 139.519			
													\$ 10.991			
														\$ 8.793		
															\$ 7.034	
																\$ 5.627
																\$ 4.502
																\$ 235.473

Black and Scholes calculation for Base Case, volatility at 20%

Year	0	1	2	3	4	5	6	7	8	9	10
Revenues	\$ -	\$ 67.241	\$ 68.585	\$ 69.957	\$ 71.357	\$ 72.784	\$ 74.240	\$ 75.725	\$ 77.239	\$ 78.784	\$ 80.360
Discount Rate	13,09%										
Valore di Attualizzazione	1,000	1,131	1,279	1,446	1,635	1,849	2,091	2,365	2,674	3,024	3,420
Rev attualizzati	\$ -	\$ 59.460	\$ 53.632	\$ 48.375	\$ 43.633	\$ 39.356	\$ 35.498	\$ 32.019	\$ 28.880	\$ 26.049	\$ 23.496
Totale	\$ 564.376	Sottostante									
Investment Costs	\$ 294.753	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Operating Costs	\$ -	\$ 295	\$ 309	\$ 325	\$ 341	\$ 358	\$ 376	\$ 395	\$ 415	\$ 435	\$ 457
Tasse	\$ 0	\$ 26.778	\$ 27.310	\$ 27.853	\$ 28.406	\$ 28.970	\$ 29.545	\$ 30.132	\$ 30.730	\$ 31.339	\$ 31.961
Discount rate	13,09%										
Valore Attualizzato	1,000	1,131	1,279	1,446	1,635	1,849	2,091	2,365	2,674	3,024	3,420
Costi attualizzati	\$ 294.753	\$ 23.940	\$ 21.598	\$ 19.485	\$ 17.578	\$ 15.859	\$ 14.307	\$ 12.908	\$ 11.645	\$ 10.506	\$ 9.478
Totale	\$ 522.450	Strike									

MATURITY	STOCK VALUE (\$0)	STRIKE PRICE (K)	TIME (T)	TEREST RATE	VOLATILITY (σ)	d ₁	N(d ₁)	N(-d ₁)	d ₂	N(d ₂)	N(-d ₂)
2024	\$ 564.376	\$ 522.450	10,00	13,09%	20%	0,85	0,803506996	0,196493004	0,56	0,287740126	0,712259874

The calculus for finding the discount rate for having the Value Added was done through the “Analisi di Simulazione” – “Ricerca Obiettivo”, finding the right rate to discount the cash flows.

Example for the Decisional Tree is the following:

	Esercizio dopo	10	anni				
Valore Aggiunto	\$	1.177.367					
NPV RO	\$	72.826					
Discount rate?		11,95%					
		0	1	2	3	4	5
Flusso di Cassa	\$	-294.753	\$ 40.168	\$ 40.966	\$ 41.779	\$ 42.609	\$ 43.455
Valore di Attualizzazione		1	1,119452387	1,25317365	1,40286823	1,57044419	1,75803749
Flussi di Cassa Attualizzati	\$	-294.753	\$ 35.881	\$ 32.689	\$ 29.781	\$ 27.132	\$ 24.718
Valore uguale a NPV RO	\$	72.826	\$ -0				