Scuola di Dottorato

Ph.D in Production Systmes & Industrial Design- Cycle XXVI

Dissertation

Risks in Project Finance Initiatives: Current Trends and Future Directions

Giulio Mangano

Tutor   **Coordinator**
Alberto De Marco   Luca Settineri

December 2013

Ringraziamenti

Questa tesi è dedicata ai miei genitori. Sono stati loro a sostenermi quando ho deciso di iniziare il Dottorato, esperienza che mi ha consentito di accrescere le mie conoscenze, di capire fino in fondo cosa significa imparare, e di incontrare moltissime persone interessanti, alcune delle quali sono oggi cari amici. Un grazie pieno di amore.

Grazie al mio tutor, Alberto De Marco, ha creduto in me un po' di anni fa e mi ha trasmesso, conoscenza da un lato e metodo dall'altro. Posso ritenermi completamente soddisfatto di questi anni di Dottorato, rifarei tutto dall'inizio.

E infine grazie a Marianna, per tutto, perché ci sei, per nostro modo di condividere, per avermi accompagnato sempre, averti nella mia vita mi dà gioia, sicurezza, energia, tranquillità.

Index

Executive Summary

This thesis is an analysis of Public Private Partnership (PPP). PPP refers to the provision of public assets and service through the participation of the government, the private sector and the consumers. The term covers a variety of transactions where the private sector operates for an extended period a service traditionally managed by public institutions. There are various reasons as to why governments might undertake PPPs. The quality of the services can be improved with the same amount of money, a better allocation of risk associated with the project that is carried out, and the public balance sheets are relieved. Nowadays because of the worldwide financial crisis, public budgets have been significantly cut. At the same time there for a country there is a strong need of infrastructure to be more competitive in the global market competition and to ensure adequate services, such as education and healthcare to its citizens. Furthermore privates are often more expert in developing the infrastructure and in managing it. This, brings to better delivered services to final users and to an increased Value for Money (VFM). In this context PPPs contracts can be a suitable solution to develop investments without bearing upon public budget.

The purpose of this thesis is to analyze the main risks involved in a PPP initiative and to understand how they affect its capital structure. To this aim, different datasets have been analyzed in order to trace consistent and coherent lessons. After that, this thesis aims at proposing PPP models for innovative project in the Smart City context, based on the assumption that innovative financial schemes can fit innovative projects. In particular several PPPs for Smart City projects have been analyzed and a Project Finance contract for the replacement of traffic light lamps has been proposed so that the applicability of the financial tool in new fields of application have been tested. The UK government has introduced project finance (PF) in 1992 and since then it has become a major source of investment in supporting huge capital project development. PF is based on the collection of funds to finance a capital investment

project in which a Special Purpose Vehicle (SPV)- that is a an economic entity created for the purpose of developing the capital project and operating the associated service- is responsible for the specific deal. However the success of a PF initiative is strictly related to a careful analysis of all the risks associated with the project. As a matter of fact, many risks could occur during the life of the project and they can significantly affect its outcomes. For this reason, based on an analysis of the current literature, a first step of the study refers to a deep classification of risks related to the PF arena.

Risks have been categorized in sources and associated to their indicators. For each indicator, several parameters have been identified. The main sources of risk are Country, Financial, Market and Construction. Risks heavily affect the capital structure of a PF initiative that is more complex compared with the scheme of a traditional financial scheme such as public finance that is based exclusively on public funds, or corporate finance that exploits private capitals. After the risk overview some financial considerations have been carried out. At this point several empirical analyses have been carried out in order to identify the different risk sources influencing the capital structure of a PF project.

First a dataset of worldwide toll road has been analyzed. Toll roads fit very well with the contractual scheme of PF. The private concessionaire that constructs the infrastructure collects revenues generated by users, and the infrastructure by itself represents a solid collateral. The analysis highlights that inflation rate, the investment size, the construction duration, the financial strength of the Special Purpose Vehicle and the number of partners has a significant influence with the share of the equity into the total investment. This study might help the purpose of providing better opportunities for sponsors to improve the equity profitability and for lending agencies to better handle with risks associated with the debt supply.

The analysis has been then focused on the British market, which is one of the most important ones and wherein the Project Finance is actually developed and the legislative context is well defined. Based on

the idea that the Unitary Charge (UC) periodically corresponded by the public authority (and in turn the capital structure) is associated with the project risk profile, the study investigates risks that might have significant impacts on the UC of a PF hospital project. Healthcare is a very promising and dynamic field of application for PF. As a matter of fact public budgets are limited and the demand of healthcare services is more and more growing. At the same time most of the hospitals were constructed about 40 years ago and high is the need for refurbishment and maintenance actions. Results show that the political environment, the hospital capacity in terms of number of available beds , the construction duration, and the concession period have a significant relationships with the unitary charge paid to the private concessionaire. The study demonstrates that it is possible to achieve a higher level of Value for Money (VFM) in PF hospital projects within a good economic and political environment in order to stimulate competition and, in turn, to decrease public expenditure. Furthermore, small hospitals that need shorter construction efforts and granted for longer periods are likely to be better exploited, therefore they have to bear a lower construction risk and, consecutively, a lower UC. The proposed analysis represents a first attempt to support both public authorities and private concessionaires in the risk allocation decision and in the associated determination of the UC.

In Italy the PF market has rapidly grown, in light of the need for the public sector to find a feasible way to construct or renovate infrastructures in a context of scarce public finance. Based on past projects developed in Italy an empirical analysis has been carried out in order to identify the main aspects that can impact on the success of a PF initiative. As a matter of fact, evidence has shown that not all the projects appear to fit for PF, and often a project fails to go further out of the early contract procurement phases. This means that not all the projects are designed to meet the characteristics of a successful PF contract. Therefore, there is the need to understand what are the key factors affecting the construction of a PF initiative. The study shows that large-sized projects developed in wealthy conditions in terms of

political and economic stability and levels of GDP, have good chances to be constructed, especially whenever the time is given to parties to negotiate the contract provision. The analysis provides with a hint for policy makers to learn that PF is a valuable system to be used in stable and developed environments for large projects with little time pressure.

PF mechanism was launched in Italy in 1999 and after ten years the Italian market is the second largest one in Europe in terms of both number and value of investments, especially in the healthcare sector. However, financially freestanding privately-funded PF hospitals are rare and the capital structure of most projects requires a considerable share of public funding. The most proper amount of money invested by the public authority should cover the non-self-financing (and therefore the riskier ones) of the investment costs, but it often happens that the level of public contribution exceeds this limit.

Based on the assumption that the level of public funding is closely related to the project risk profile the analysis has explored the risk factors that are likely to influence the percentage of public funding in PF hospital projects in Italy.

The results of the analysis highlight that the financial strength of the SPV, the number of services that are granted to the private partners, the level of borrowing of the public authority, and the duration of the concession period appear to be significant factors of the public fraction of financing required to deliver the project. In principle, it is appraised that initial public aid was largely used as a way to reduce the private sector's risk and in turn to attract the necessary private finance for undertaking investments in hospital facilities. These results originate some important considerations about the relevance of risks in the development of a PF initiative and about the definition of its capital structure. Every single source of risk that has been identified through a deep analysis of literature has been measured via several parameters- shows significant effects on the capital structure. This results suggest that all the risks affect the capital structure of a PF and therefore all of them need to be taken into

account. Therefore, it is very important to perform a detailed risk analysis in order to make the investment more efficient from a financial point of view. PF better fits in stable politic and economic environments, but at the same time it is largely adopted in emerging countries with large demand of new infrastructures and high level of risk (in terms of level of transparency, corruptions, currency exchange). This can bring to higher costs, but PF remains the most suitable way to develop huge and expensive infrastructures. From a financial perspective a robust SPV is likely to better deal with the project with a positive impact on the capital structure. The market risk is associated with the number of customers that exploit the facility and the number of services that privates manage. If the demand of services is not enough to generate sustainable profits, the public party could reimburse an additional fee, in order to cover for this risk. The project risk is mainly related to the complexity of the project in terms of the number of partners in the SPV and the investment size. The results show that huge investments are riskier and both unitary charge corresponded by the public sector and the public initial financing need to get increased. At the same time in the light of this higher level of risk, the equity apportion is expected to decrease.

The last part of the thesis is associated to the future and potential scenarios associated to PF and more in general to PPP scheme. In fact the aim is to propose PPP models in the smart city (SC) arena, a promising field of innovation and investments. Nowadays the offering of new kind of services and processes has more and more to be open, sustainable, accessible and efficient. SC appears to be as a new paradigm to carry out innovation that marks a shift between traditional way of completing technology-push processes and the new approach based on the user's needs. The innovation path associated with the SC topic requires a lot of investments that cannot be financed just through public resources. Furthermore, public authorities are nowadays called to invest in SC projects even in a period of global financial crisis and public financial resources are no more available to support these kinds of

initiatives. Furthermore, traditional models are often inadequate in the light of the intangibility associated with smart initiatives and their high risk profile. Therefore, in this political and economic scenario, the PPP seems to be a solution for the development of smart projects and the design of PPP models should become an integral part of the SC agendas. As demonstrated in the development of traditional infrastructure, the active involvement of privates could allow to manage more efficiently the project, and to offer an increased quality of service and to generate positive externalities for citizens. Nowadays citizens require not only and higher and higher quality provided by Public Authorities but new kinds of services too. These services are often associated with innovation, and they require high levels of expertise that often public institutions do not have. For this reason the main domains of application in the smart city context several PPP contracts have been analyzed and for each one a case study is proposed, in order to evaluate both strengths and weaknesses. In particular, the attention has been focused not only on Project Finance, but also on Revenue Sharing (RS) and Social Impact Bonds (SIB).

The analysis shows that PF is more applicable in case of projects with tangible assets, and the main strength of this scheme is the clear separation between the cash flows of the SPV and the cash flows of the investors. On the contrary, PF is more expensive in terms of contractual and transactional costs. These aspects related to PF have fostered to develop a proposal model for the application of this financial scheme in the Municipality of Torino. In particular the project is based on the replacement of the traditional lamps of the traffic lights with new ones exploiting the innovative LED technology that is supposed to guarantee savings in terms of energy consumption and maintenance cost. The whole cost of the initiative is lower than 10 Million € and its capital structure is based on the results of the previous analysis. In particular, the share of debt and equity that has been set coaches on the analysis of the main risks associated with the project. In particular the Country Risk does not seem to be relevant,

since Italy can be considered a developed country. The Financial Risk mainly refers to financial the solidity of the SPV and the inflation rate. The private partner can be considered robust from a financial perspective and the inflation is not expected to increase, at least in the short and medium term because of the global crisis. The market risk refers to the services that are committed to the privates, and to the duration of the concession period. In the proposed model the maintenance task is supposed to be carried by the privates and the contract lasts for 10 years. Based on these evaluations, the equity/debt ratio has been set at a level equal to 20/80, which is the most efficient one and represents the classical capital structure for a PF project. The periodical fee has been set considering that a concession period equal to ten years so that to make the unitary charge sustainable for the granting authority. At the same time the project does not appear to be complex too be managed, in the sense that once the new lamp are replaced the operational activities can immediately start. The low investment size makes the project more easily feasible and less risky especially considering that it is one of the first tests for PF in new fields of application, and this has a positive impact on the amount of the unitary charge. This proposal represents an attempt to apply the PF to small and medium sized projects without a strong physical collateral and a significant component of innovation. Different stakeholders have been involved so that to obtain a situation as realistic as possible. The Politecnico the Torino has been the advisor and the coordinators among the different parties. The results have been generated in two different scenarios. The project has proved to be bankable and profitable if the Public Authority corresponds a fee that includes both the availability of the lamps and the maintenance costs for ten years. On the contrary the project is only bankable and profits are not guaranteed if the fee paid by the public is only associated with the availability. The findings has validated the applicability of PF even in case of projects without assets systems as collateral and with small-medium investments size. RS is commonly defined as a contract obligation for the retailers to pay a royalty on their sales to their suppliers. In the SC context, its meaning can be extended to the savings: partners share the savings generated by the project. RS fits

when sharing revenues or savings associated with the project allows the alignment of the objectives of all the stakeholders, maximizing the overall profit, even if the single profit of each actor is not maximized. However RS needs a complete and detailed assessment of all costs of administration and of the entire lifecycle of the initiative. Furthermore the contract has to be clearly written so that disputes among parts are avoided. For example it is crucial to define when the supplier acquires the right of obtaining his payments associated with the savings generated by the project. SIB is based on the commitment of the public authority to pay a fee to privates only if certain levels of improvements associated with the project are achieved. SIB appears to be suitable when public institutions aim at preventing social crisis involving an identifiable group of people. The main weakness is the difficulty of quantifying the results of the initiative that are usually social rather than economic. After the identification of the domains of a SC and the overview of several PPP contract forms for each domain the most suitable PPP schemes has been identified. In this way some first general guidelines for the policy maker are provided in order to foster the development of SC initiative even in a period of financial public shortage. Project Finance, and more in general the PPP, can be the engine of an efficient exploitation of the potentiality offered by the SC. Furthermore, the implementation of smart solutions generates positive externalities for citizens and for their daily life, and stimulates innovation that is more and more one of the main factors of success for a modern country.

1. Introduction

Public infrastructure can be defined as facilities which are necessary for the functioning of the economy and society. Broadly speaking, public infrastructure can be divided into:

- "economic" infrastructures, such as transportation facilities and utility networks (for water, sewage, electricity, *etc.*), *i.e.* infrastructure considered essential for day-to-day economic activity;
- "social" infrastructures such as schools, hospitals, libraries, prisons, *etc.*, *i.e.* infrastructure considered essential for the structure of society.

A distinction can also be made between 'hard' infrastructure, whether economic or social, primarily involving provision of buildings or other tangible facilities, and 'soft' infrastructure, involving the provision of services, either for economic infrastructure (*e.g.* street cleaning), or for social infrastructure (*e.g.* education and training, social services). In this case the tangible aspects associated with the initiative are dominant.

There is probably universal agreement that Governments have to play a crucial role in the provision of public infrastructure, on the grounds that:

- the private sector cannot take account of "externalities" and therefore public-sector intervention is required;
- without such intervention infrastructure which has to be freely available to all ('public goods') will not be built, especially where this involves networks, such as roads, or services, such as street lighting;
- competitive provision of infrastructure may not be efficient, and a monopoly provision requires some form of public control;
- even where competition is possible, the public sector should still provide 'merit goods';

- infrastructure requires a high initial investment on which only a very long-term return can be expected. It may be difficult to raise private capital for this investment without some public-sector support.

The use of private capital to fund economic infrastructure is more and more increasing. It was generally during the 19th and 20th centuries that States took over responsibility, mainly from religious or private charity, for the provision of much social infrastructure (e.g. for schools and hospitals). Indeed it may be said that private provision of a large proportion of public infrastructure was the historical norm until recently, but the definition of 'necessary' public infrastructure has clearly widened over the last couple of centuries. And Public-Private Partnership (PPP) may therefore be considered a modern way of facilitating private provision to help meet an increased demand for public infrastructure. Thus, private-sector participation in realizing public works is often referred to as PPPs.

The term 'public–private partnership' has borne in the United States, initially relating to join public- and private-sector funding for educational programs, and then in the 1950s to refer to similar funding for utilities, but it has come into wider use in the 1960s to refer to public–private joint ventures for urban renewal. In the international-development field the term is used when referring to joint government, aid agency and private-sector initiatives to combat diseases such as AIDS and malaria, introduce improvements in farming methods, or promote economic development generally. Most of these can be described as "policy-based" or "program-based" PPPs.

PPPs as defined here have the following key elements:

- a long-term contract (a "PPP contract") between a public-sector party and a private sector party;
- the design, construction, financing, and operation of public infrastructure (the "facility") by the private-sector party;
- with payments over the life of the PPP contract to the private-sector party for the use of the facility, made either by the public-sector party or by the general public as users of the facility;

- with the facility remaining in public-sector ownership, or reverting to public-sector ownership at the end of the PPP contract.

In some cases, a PPP contract may involve major upgrading of existing infrastructure rather than a "Greenfield" construction. Moreover, private-sector provisions of soft infrastructure, which involves no significant investments in fixed assets (and hence no need for private-sector financing), fall into the category of 'outsourcing' rather than PPPs, although obviously the boundary is not precise, as soft services are often associated with hard infrastructure. Nor is a PPP a simple joint-venture investment between the public and private sectors, unless this is also linked to a PPP contract. The public-sector party to a PPP contract may be a central government department, a state or regional government, a local (municipal) authority, a public agency or any other entity which is public-sector controlled. The private-sector party is normally a special-purpose company, created by private-sector investors specifically to undertake the PPP contract. It should be noted that the relationship between these two parties is not a partnership in the legal sense, but is contractual, being based on the terms of the PPP contract.

These partnerships are based on a concession agreement related to the realization of an infrastructure, the services of which are purchased by the general public. The private party receives the operating revenue and on this basis, together with a possible public contribution it will be able to repay the initial investment. The essence of PPP arrangements is that the public sector does not buy the asset,, but there is a purchasing stream of services under specified terms and conditions, and this element is crucial for the viability of the contract. Typical examples of these type of projects are toll roads, cell phone networks, or water plants. The most common acronyms associated with different kinds of arrangements are:

- BOT (Build Operate Transfer): the public party delegates planning and realization of the project to the private partner, together with operating management of the facility for a given period of

time. During this period the private party collects all the revenues generated by the operation, but it is not the owner. The facility will then transferred to the public authority at the end of the concession period.

- BOOT (Build Own Operate Transfer): this scheme differs from BOT in the sense that the private party owns the works.

- BOO (Build, Operate, Own): in this case the private party owns the works and the ownership is not transferred at the end of the concession period.

- BTO (Build, Transfer Operate): private entities design, finance and build the project. They transfer legal titles to the host government after the project facilities passes its completion tests. Private parties then lease the project facility back from Public Authority and the right to collect revenues during the term of the lease.

- BBO (Buy, Build, Operate): a private firm buys an existing facility from the public party and modernizes or expands it and operates it as a regulated profit-making public-use facility. This model is likely to be popular in the future because of the many existing public facilities that require repair or expansion.

- LDO (Lease, Develop, Operate): a private firm leases an existing publicly owned facility and then it expands, develops and operates the facility for a fixed term, even the public part still holds the legal title.

1.1 The history of PPP

One of the first of PPP in the history can be considered the agreement set up in 1299 between the English crown and the Frescobaldi family for the development of the Devon silver mines. In 18th and 19th centuries groups of local magnates in Great Britain formed turnpike trusts which borrowed money from private investor. The debt was repaid by charging a toll. Similarly in the late 19th century Brooklyn bridge in New York was built with private sector capital. These kinds of PPP assumed the

form of the "Concession", meaning that the "user pays". In this model privates are allowed to charge the general public service fees for using the facility (*e.g.* bridges, roads, tunnels), so that to make a sustainable profit. More recently the Trans- Alaska Pipeline System has been built between 1969 and 1977 with PPP trough an agreement among the world's largest oil companies. From a historical perspective PPP came into use in sectors with basically these two characteristics: a captive market, created by means of long terms contracts at preset prices signed by financially solid buyers, and a low level of technological risk in the construction phases. The country that first have launched a systematic program of these arrangements has been the UK where these forms of PPPs have known as Project Finance (PF) Initiatives. Since the project has no operating history, lenders require that the project will be placed into service and once operations begin, the project will constitute an economically viable undertaking. In particular technical and economical requirements have to be satisfied. As a matter of fact independent engineers and consultants are involved in the preliminary phases. In the 1980s and 1990s PF followed two different trends. The first one was the export this financial tool to developing countries: entrepreneurs offered PF to public authorities as a convenient way to get a decent level of infrastructures. The second trend emerged in the industrialized countries that actually already tested PF and began to adopt it for the realization of projects with less market risk coverage (toll road, parking lots), and for projects in which the public administration participates in promoting works for the public goods and sustains the initiatives with an amount of grants. PF has expanded from $ 73.5 billion in 2003 to nearly $132 billion in 2006. The Americas, Central Asia/Asia Pacific, and in particular Europe absorb the majority of loans; Africa accounts for a total of around 18% of total financing. In these years the energy and power sector absorbs nearly 50% of all loans granted, flowed by industrial (such as transportation and infrastructure) with around 25% of the total, and telecom and media with just over 6.5%. In Europe there are some countries wherein PF is almost nonexistent (Denmark, Lithuania, Malta, an Slovakia) and other nations like UK, Italy, Spain and France that account for the largest

portion of the total. Another key observation is about the different levels of dissemination of PPP in the world. While in Europe, and Asia PPPs account for more than 25% of total loans, in the Americas this percentage is just above 14% percent. Generally the decrease in developed countries has been balanced by a growth in emerging economies. However, the most important markets for investors are still the oldest ones in the light of a higher transparency. Based on recent data (2011) the main fields of application are the education (23 projects equal to 6% of total value), services, and transport (12 initiatives, equal to 58% of total investments). A reduction both in terms of number and value of PPP initiative from 25-30 MLD € in 2005-2008 to 17-18 MKLD €. Particular relevance can be shown by the high speed railway between Tours and Bordeaux in France (investment equal to about 5.4 MLD €). Concession period lasts on average 22-25 years, with a significant recent reduction. As a matter of fact in 2010 50% of the projects had a concession period higher than 25 years. Although many commenters considers PPPs to be a new version of privatization, PPPs are not privatization because governments retain the ultimate responsibility of the service that is provided (Grimsey and Lewis, 2005).

1.2 Awarding Process

The European Community has set four different awarding procedures that the Italian legislation has defined in the "Codice degli Appalti"

- Open Procedure: every company is allowed to present a bid . It is forbidden to modify the terms of contract during the tender, to negotiate with participants or to carry out with them a dialogue, during the awarding process and after the submission of the bids. . The award is based both on lowest price or on most economically advantageous tender;

- Restricted Procedure: based on pre-qualification criteria, the number of participants has to be at least equal to 5. It is forbidden to modify the terms of contract during the tender, to negotiate with participants or to carry out with them a dialogue. Negotiation is not allowed after the

submission of the bids. . The award is based both on lowest price or on most economically advantageous tender

- Negotiate Procedure: based on prequalification criteria, the number of participants has to be at least equal to 3. Negotiation along the tendering process is allowed, in order to reduce the number of participants, and it is allowed until the end of the contract. The award is based both on lowest price or on most economically advantageous tender;

- Competitive dialogue: based on prequalification criteria, the number of participants has to be at least equal to 3. It is possible to dialogue with the participants about all the aspects of the project. Once the dialogue is finished the final bids can be requested. After the final bid is submitted the only negotiation that is allowed aims at clarifying a bid. No significant changes are admitted. The award is based on the most economically advantageous tender.

1.3 Project Finance

Project finance (PF) is the raising of funds to finance an economically separable capital investment project in which a specific economic entity – the Special Purpose Vehicle (SPV) – that is created by the sponsors to provide funds (both equity and debt), looks basically to the cash flows generated from the project as the source that covers their loans. The SPV refers to a legal entity that is formally responsible for a specific PF deal. SPV coincides with the project itself, in the sense that that entire cash flow related to the project has to be entirely attributed to the company. At the same time the company has to be protected against any possible external interference that might jeopardize the economic, financial or legal management of the project in any way. With PF Public Authority is called to be not merely a customer, but it has to become a project manager. This requires the acquisition of a deep knowledge about the capability to evaluate ex-ante the efficiency and the benefit of the financial instruments, structure the process, and to negotiate the best solutions with privates. Thus, PF is a modern financial technique for specific projects used to finance investments and realize infrastructures through private

capital. These initiatives, generally cannot be fully financed by promoter subjects because of the elevate risk and the investment size. Hence they are shared by different companies, there is the banks' contribution and sometimes a part of public funding too. In a PF initiative is evaluated under an objective profile, meaning that the analysis of profitability of a single project together with its expected cash flows is carried out.

PF is fundamentally coached on these features:

- The debtor is a project company that is financially and legally independent from the sponsors.

- The risks associated with the project have to be considered separately with the risk related to the companies already in operation.

- The risk sharing has to be developed aiming at the assignment of risks to the parties best able to control and manage them.

- Cash flows generated by the project have to cover payments from operating costs and debt.

Usually there are many stakeholders involved in a PF initiative. The equilibrium and the coordination among them is reached through a negotiation and a robust coordination of all the activities and responsibilities. We can identify mainly eight different stakeholders:

- Sponsors: they identify the business idea, decide the feasibility and promote the initiative realization through a project financing, without taking on direct responsibility for the project. So they provide for identifying the necessary opera that responds to a specific need, they evaluate the costs and the funding possibility thanks to project financing adoption, and they characterize a financial-juridical structure for project fulfillment. It is very important to emphasize that the banks pay particular attention to project promoters, especially with regard to their professional manage ability and capital capacity to cope with any rights of recourse. The success of a project financing depends on many factors, but it cannot be ignored the constant

and coordinated support of the promoters. In this sense, banks' attention to the curriculum of the promoters will be the first real important starting point.

- <u>SPV</u>: project financing operations are carried out in most cases by setting up a project company autonomous, separating the project activities from those of promoters, that creates legal and economic-financial isolation characteristics of a specific transaction. The company formed by the promoters is the one who is entrusted with the implementation of the project. Beyond the operational role which it assumes in the project, the Special Purpose Vehicle is almost always the company that is configured as direct debtor in the operation of project financing. The project company is the vehicle through which they are channeled financial resources contributed by financiers in the form of venture capital and by lenders in the form of debt capital, so as to allow the implementation of the initiative through the payment of operating expenses, repayment of debt and return on equity. Normally, the S.P.V. is a company constituted ad hoc by the project promoters but may also take different forms. The choice of the legal form and the manner in which the S.P.V. may, however, not be free. Constraints to the sponsors can come from both the project characteristics rather than the laws in respect of public works. In fact, it is not uncommon that legislation requires the establishment of an ad hoc company to undertake an initiative, or that the allocation of public concessions is subject to the provision of certain types of companies.

- <u>Financiers</u>: banks are the main character of each project financing operation. This is due to the close link that exists in every iteration of this type of industrial choices and bankability of the project. Banks in the project financing are not an exogenous that is called into question at a later time and that does not affect substantially the actual transaction. On the contrary, they come into play since its early life stages. The role of banks takes many forms: from the role of advisor, or a person who provides advisory services to the sponsor, to set up a project financing

operation, the role of arranger, or who signs a pro quota share of the debt of the project, or finally the role of the agent, that is the role of who takes charge of managing the relationship between the borrower and other lenders during the entire life of the loan.

- <u>Public Administration</u>: it can have an important role in the development of project financing operations: the government for first but in general all the public authorities that can promote a project or affect the context of convenience for operators. The public authority is obviously the main subject in the operations of project financing applied to the field of public works. It is the only entity who having the ownership can be transferred to the project company functions and rights necessary to implement and manage the work under the classical form of build and operate concession. Every time a public entity wants to achieve an investment in infrastructure, it may decide (for opportunity or need) to finance the project with recourse to private capital. This can occur if the nature of the works and the feedback of economic policy on investment allow the final product sales on the market and therefore a satisfactory economic return for banks and shareholders. The only possibility to sell a service on the market and collect a fee is not enough. It takes certainty of programs by the government, a system of clear rules, administrative procedures consistent with the timing of the production process and, very often, a system of incentives. In this spirit, what the public authority must always have clear, in addition to its own targets, is the fact that each project can be an economic opportunity for individuals but at the same time a competition with all the other investment options available on the market has to be performed. Hence the need for the government to delve into the market reality and enter into the logic of bargaining has to come up. This is to avoid both the presence of unjustified profits at the expense of users and taxpayers. If public body is interested in the development of a particular initiative, with the assistance of a financial advisor, it verifies the technical and economic feasibility, technological characteristics, environmental impacts, the

commercial structure, the opportunity of applying a rate acceptable from the market and able to ensure satisfactory profitability, the mechanisms of change in these rates, the level and modalities of a possible public support, the main terms of the concession. However, public authorities, may affect in many other ways on project financing operation. They can affect a project initiative in three main ways:

- o By changing the regulatory framework;

- o Facilitating the bureaucratic-administrative aspects related to the project;

- o Providing guarantees to support the project and / or public entities involved in it, for facilitating the availability of financial resources.

The alteration of the system of property ownership and the freedom of capital movement are some examples of changes of the legal framework of a country that influence, sometimes profoundly, the outcome of a project. Second, the existence of long bureaucratic-administrative procedures can heavily affect the outcomes of a project. Ensuring a rapid and predictable performance of these procedures is a variable that should be under the control by public authorities, national and local. But there are still many other ways to influence a project. For example, the country government can promote a project with the instrument of the tax incentive, which can help to reduce the cost of the project company as a function of the investments made or jobs created. However, because of the lack of financial resources, facilitation of such activities-financing may also result in the simple granting of rights or assets that can guarantee to the project company the appropriate economic and financial equilibrium.

- Consultants: during the identification and structuring of the project, promoters and their financial advisors have to resort to the assistance of independent experts to verify all elements relating to the project: these consultants have very different skills one from each other. They are financial advisors, legal, fiscal, technical and insurance experts. The contribution of these

professionals is necessary for the in-depth analysis of data project and the correct definition of the whole structure. The cost of external consultants are initially borne by the promoters, who will transfer them only later, as the other costs of the design phase, to the project company. Usually all the legal and technological aspects have to be analyzed very carefully right from the initial stages of the project, because they are also the ones that most affect the financial performance of the investment. Financial advisors have the primary role of verify the feasibility and the ability to fund the project. Then, they carry out economic and financial analysis and prepare detailed documents which form the framework of the whole initiative. Legal consultants support the project with activity aimed at drawing up contracts that will form the basis for the regulation of relations between the various actors involved in the initiative. Advisor can play a role of mediator between the parties involved in order to find a solution that satisfies the parties involved in order to protect the goodness of the project structure. Tax consultants, due to the complexity of the operation, are necessary for better understanding of the project from the tax point of view and thus minimize the tax burden associated with it. Technical consultants have the task of ascertaining, from the point of view of construction technique and/or management, that the design activities have been carried out in a proper way so as to give comfort to lenders on the technical success of the project and its feasibility.

- Contractors: they are entrusted by the Special Purpose Vehicle, if it does not carry out the works for the physical realization of the project. These subjects often coincide with sponsors, and these are in fact companies whose core business is precisely the course of construction, which participate in the S.P.V. with the aim to carry out works for the realization of the planned operas without assuming directly the financing of construction activity

- Off-Takers: the financial viability of a project depends on its ability to generate sufficient cash flows to repay the debt capital and the payment of interest on the loan. In this context, it is

crucial to make an estimate of the levels of demand for finished products or services, and in turn revenues, that the project will generate, even considering the possibility of entering into an agreement with a single entity with which it is willing to take on the risk of the demand volume.

- O&M contractors: once the work is completed maintenance and economic management have to be arranged. The importance of this task is evident if we consider that the production of cash flow depends on the proper running of a infrastructure. As part of the operations directed to the realization of public infrastructure, the number of people who must pay their own activities in order to correctly manage the work can also be very high. In such cases there is a clear need to find a system for coordinate the activities of all service providers in order to maintain both a high quality standard of performance and to have a clear vision of the relationships and responsibilities of each operator. In this way it is possible to quickly identify, in the case of malfunctions, the responsible subjects so that to solve the specific problem.

Following the legal and finance documents on which a PF initiative is built:

- Finance documents: they are all the documents related to the credit agreement drawn up by the lenders' lawyers.

- Security documents: they are associated with the technical/legal requirements where the asset is located.

- Project documents: they are the project company's operational contracts.

- The equity contribution agreement: the sponsors commit to contributing equity into the SPV that ensures that the debt-to-equity ratio is respected.

- The inter-creditor agreement: it regulates the relationships among the lenders who participate in the deal.

- The hedging agreement: this is a contract in which the parties assume a not determined risk in its maximum amount.

Then the term "Financial Close" refers to the moment when conditions precedent for initial utilization of the loan are met. The precedent conditions are listed below:

- Copy of corporate documents of the borrower and other entities that are fundamental for the project.

- Copy of the corporate resolutions that are mandatory to authorize the borrower and the "key" parties to execute the finance documents.

- Copy of the finance, security, and the project documents.

- Projects reports , usually from the technical advisor and the insurance advisor.

- The first set of financial documents requested from the borrower .

- Documentary evidence that the sponsors have injected the initial equity requested in the credit agreement.

- Copy of the administrative permits required to build the plant.

- Legal opinions given by lenders' lawyers.

The contractual management is crucial in PF. As a matter of fact, the critical role of contracts in explaining the performance of a firm is widely recognized. Many different kinds of contract need to be set up. For instance off-take contracts assure a market for future project's output, raw material contracts are crucial for the supply of raw materials without which production cannot take place, construction contracts define the relationships with contractors, and financial contracts are associated to the collection of debt and outside equity. All the operations related to building the plant have to subjected to contractual obligations taken on by a third part with solid reputation and financial status. The construction contract is usually signed in advance by the constructor and the project company, which needs time to allow lenders to analyze its contents and finalize the financing. Technical consultants are called to approve every issue pertinent to the execution of the contract. Once the construction is complete the operational phase begins. The Operational and Management (O&M) agreement is a

service supply contract by which the operator is commissioned by the project company to handle plants operations and maintenance. The outsourcing of these activities allows to predetermine costs, establish *a priori* the quality and the quantity of purchased service, replace the supplier if performance is not satisfactory, and eliminate structural costs.

The financial aspects that have to be taken into account are:

- Net present value analysis in order to understand if the sponsors are able to pay back the raised funds.

- Capital structure choice for the maximization of the project value. Key aspects are the amount of debt that the project can support, the number of debt class, and the influence of leverage.

- Dividend policy choice for the determination of the level of free cash flow of the project that can be assigned as dividend.

- Negotiation of debt contracts that allow the realization of the project.

- Fundraising carried out financial advisors.

- Agency theory associated with conflicts of interests between managers, equity providers, and lenders.

- Contingent claims analysis exploiting derivative instruments to manage price, interest, and currency risk.

- Resolving financial distress through the renegotiation of project's debt contracts if it the sponsors become unable to pay back their debts.

The main benefits of PF are the more efficient risk sharing, the extended debt capacity, the mitigation of underinvestment risk, the enhancement of company's financial flexibility, the lower overall cost of funds, the release of free cash flow, and the reduction of legal and regulatory costs. The Public Authority proceeds with a project if the social benefits that are expected to derive from the project exceed the social cost. Social benefits includes:

- Infrastructures (roads, airports) for which the cost is repaid out of project cash flows.

- Education and training of local workforce.

- Public facilities (school, hospital, fire stations) financed by project sponsors.

- The establishment or the expansion of industrial base.

PF appears to be very attractive to sponsors of large projects–those with a capital cost of $ 1 billion or more. The larger the project, the riskier is for a single firm to finance it on its own balance sheet. Moreover large projects often involve complex contractual relationships among the various parties, international flows of goods and the financing of these projects requires expert financial and legal assistance. On the contrary, the main disadvantages of PF are the structural contractual complexity, the indirect credit support in the sense that credits are provided through contractual commitment instead of a direct promise, and high transaction costs. PF represents an alternative to conventional finance unless it will achieve a lower after-tax cost of capital compared with traditional financing. Figure 1 shows that small projects in terms of investment size are more attractive for PF. This is due to the fact that these initiative are less risky in terms of financial exposure.

Size Distribution of Projects by Year, 1996–2006[a]

Size Range	1996	1997	1998	1999	2000	1996–2000	2001	2002	2003	2004	2005	2001–2005	2006[a]	Total[b]
<$100 million	32	36	49	59	115	291	40	70	111	165	141	527	61	879
$100 million–$250 million	47	55	65	59	96	322	36	33	56	91	86	302	43	667
$250 million–$500 million	35	39	49	68	71	262	38	34	35	56	63	226	19	507
$500 million–$1 billion	20	39	33	31	39	162	29	21	30	42	30	152	13	327
≥$1 billion	21	35	30	41	36	163	27	12	25	24	28	116	21	300
Total Number	155	204	226	258	357	1200	170	170	257	378	348	1323	157	2680
Percentage costing $1 billion or more	13.55%	17.16%	13.27%	15.89%	10.08%	13.58%	15.88%	7.06%	9.73%	6.35%	8.05%	8.77%	13.38%	11.19%

[a]Through the first half of 2006.
[b]Total projects from 1996 through the first half of 1996.
Source: Copyright Thomson Project Finance International.

Figure 1.1 Distribution of Projects by year, 1996-2006

2. RISKS in Project Financing

A successful PF initiative is based on a careful analysis of all the risks the project will bear during its economic life. Such risks can arise either during the construction phase, when the project is not yet able to generate cash or during the operating phase. In PF risk management is crucial to achieve the success of the initiative, since it allows to minimize the volatility of inbound and outbound cash flows. In PF risk is crucial since it is responsible for unexpected changes in the ability of the project to repay costs, debt service, and dividends to shareholders. If a risk is improperly allocated, the resultant transaction costs may include, among others:

- the extra costs for clients of a higher contingency (or premium) included in the bid price from contractors;

- the extra costs for clients of more resources for monitoring the risk management (RM) work;

- the extra costs for clients and/or contractors of recovering lower quality work (i.e., the materialized or deteriorated risk) for a given price;

- the extra costs for contractors of increasing safeguards (both ex ante and ex post) against any opportunistic exploitation of one's own RM service;

- the extra costs for contractors of the resources dedicated to lodging claims related to the misallocated risk;

- the extra costs for both parties of dealing with the disputes or litigation related to the misallocated risk.

Once the risks were assessed, countermeasures to these risks were sought. Each counter measure envisaged depended on the nature, type and magnitude of the risk. The key was to ensure that no risk was "reasonably" left unidentified, especially the risks with significant impacts. During the

negotiations, risk issues were discussed where iterative computations were carried out in financial modeling.

The criterion used to identify risk is chronological, in the sense that for the main phases of the project (typically pre-completion and post-competion) the risks are mapped. These phases have very distinct risk profiles and impact the future outcome of the initiative in question in different ways.

- Pre-completion Phase involves the project facilities and it is characterized by industrial risks that have to be carefully assessed, since they emerge at the outset of the project.

  o Activity Planning Risk: it involves delineating the timing and resources for various activities that are linked in the process. Delays in completing one activity can have major repercussions of subsequent activities. Grid analysis techniques (e.g. Critical Path Method) make possible to map out the timing of the project activities.

  o Technological Risk arises in project involving innovative technologies that have not been adequately consolidated in the past. This risk can even fail the project from a technical stand point.

  o Construction Risk or Completion Risk pertains to non-completion or delayed completion, completion with cost overruns or cost inefficiencies. In a PF initiative is the contractor or even the sponsors themselves who must assume this risk.

- Post-completion Phase involves the supply of output, the performance of the plant as compared to project standard and the sale of the service of product. Its risks can cause the reduction of cash flows generated by the project during its economic life. Supply risks arise when the SPV is not able to obtain the needed production input for production; the effects are that the plant often works below capacity, margins shrink, and supplemental costs. The risks associated with performance come up when the plant works, but technically underperforms causing lower

efficiency and in turn costs overrun. The demand risk is related to sale of product in the sense that revenues generated by the SPV is less than anticipated.

Many risks common to both phases pertain to key macroeconomic and financial variables such as Interest Rate Risk, Exchange Rate Risk, Derivatives Contracts, Forward Contracts, Futures, Options, Inflation, Political, Legal and Country Risk.

Different kinds of risk are characterized in a project:

- Completion: it is the risk that a project might not be completed. It has a monetary and a technical aspect. The monetary element is the risk that a higher-than-anticipated rate of inflation, shortage of critical supplies, unexpected delays, or and underestimation of construction costs might cause an increase in the expenditure that makes the project no more profitable. On the other hand in spite of all the expert assurance, the project may prove to be technically infeasible and it could require such large expenditure that it would become uneconomic to complete.

- Technological: it is the risk that the technology does not work according to specifications or it becomes prematurely obsolete.

- Raw material and supply: it is the risk that raw material, natural resources, and other factors that are necessary for successful operation may be deplete or no more available during the life of the project.

- Economic: this risk is associated with the demand for the project's products or services will not be sufficient to generate enough revenues to cover the costs.

- Financial: it is the risk that rising interests on floating-rate debt jeopardize the debt service

- Currency: this risk is faced when the project's cash flow are denominated in different currency. In such cases, a change in the exchange rate between the currencies involved will affect the availability of cash flow.

- Political: it represents the risk that politics could interfere with the development or with the operations of the project (*e.g.* new taxes or restrictions).

- Environmental: it is the risk that the effects of the environment cause delay and originate costly re-design.

- Legislative: a wrong or unsuitable legislative context can inhibit the success of a PF initiative

Managing risk is a challenging task due to the uncertainty related to forecasted cash flows and a scrupulous risk analysis is desirable, because of the role it plays in determining the capital structure of a project (Jin 2010). Table 1 reports a novel classification of risk sources, indicators, and measurable parameters that are reported to affect PF projects. The risks are categorized into different areas of origin, namely: Country, Financial, Market, and Construction. These categories are identified with reference to the above seminal literature works: the country and financial risks match the political or state-rooted risk; market risks represent the revenue areas of risks; the construction risk is intended to cover the project construction and operations risks. A further explanation of the table is given in the following sections.

Risk Sources	Indicators	Parameters
Country	Investment Environment	Country Index
		Government Effectiveness
		Regulatory Quality
		Employment rate
Financial	Cost of Equity Capital	Average Beta of partners
		Solidity of SPV
	Inflation	Inflation Rate
	Interest rate fluctuation	Interest Rate Swap
	Tax regime	Tax Rate
	Financial Resources	Private Credits
	Exchange	Currency Rate
Market	Revenue Generation	Catchment Population
		Number of Services
		Concession Period
Construction	Project Scope	Investment Size
		Number of Partners in SPV
		Construction Duration

Table 2.1. Sources, Indicators, and Parameters of risk

2.1 Country Risk

The country risk concerns the credibility and the political condition of the host country (Kumaraswamy and Zhang, 2001). Political and economic sources of risk come from the context of political events, government policies, and economic instability that could influence the profitability of a project and prevent capital from being committed to support investments (Sachs et.al. 2007). Doff (2008) defines this kind of risk as detriment due to potential changes in general business conditions such as market environment, and as loss due to change in competitive environment. This risk is here described by the Investment Environment that expresses the political and economic stability. This kind of risk is especially important in project finance lenders located in developing countries. These nations have

legal structures that are not well defined, most have politically unstable governments and there is usually little experience of private investment in strategic sectors. The indicator Investment Environment is related to the ability of drawing investments, which depends upon the access to politics, level of competition, fiscal terms, and domination of narrow interests that could hinder the efficiency of the project (Arditi et al., 2010). The Investment Environment is measured by five parameters. The alphanumerical "Country Index" provided by COFACE (2008) indicates that a high ranking shows off steady political and economic environment, good payment records, and very weak default probability. Government Effectiveness and Regulatory Quality are computed by World Bank (2011) and they are ranked on a scale from -2.5 to 2.5. The first one captures the perceptions that investors have of the country with regard to the quality of public services, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The second one is recorded to indicate the perception of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. The Employment Rate represent from 16 to 64 years old percent population employed in a specific area (Bloomberg, 2009).

2.2 Financial Risk

Financial risk is driven by cost of capital, inflation and currency (Schaufelberger and Wipadapisut, 2003). According to Xenidis and Angelides (2004) financial risk has direct impact on the cash flow of the business plan in a way that endangers project viability or limits profitability. One of the most important drivers of financial risk in construction projects is the capital interest rate (Ling and Lim, 2007). Financial risk relates to the extent to which capital is easily obtained at an acceptable cost (Schaufelberger and Wipadapisut 2003). From a business perspective, it is the risk of financial loss due

to changes in the competitive environment, or the extent to which the organization could timely adapt to external changes (Doff, 2008). In designing the financial structure of a PF initiative the cost of equity is specifically taken into consideration to address the cost of capital financial risk. The cost of equity capital is measured by the proxy parameter "Average Beta of Partner", which is referred to as the correlated risk between the SPV and the associated market. The expected RRE can be estimated using the capital asset pricing model (CAPM); according to CAPM, the expected return is a function of a firm's equity Beta (Tofallis, 2008). A high Beta stands for elevated risk, which, in turn, determines a highly expected interest rate on the equity capital brought into the project. The Beta figures considered are provided by the Financial Times (2009). On the contrary, the Solidity of SPV reflects the financial strength of the concessionaire: the more the solidity, the more the probability that the SPV can bring more equity and attract more debt capital at a lower cost. Solidity of SPV is expressed as the annual revenue generated by the main partner of the consortium at the time the project was awarded, as recorded by Deloitte (2009). Inflation also plays a major role in affecting revenue and costs. Inflation arises when the cost dynamic is subject to a sudden acceleration that cannot be transferred to a corresponding increase in revenues. Both industrial and financial costs and revenues are impacted by inflation risk. Typically, the equity sources of financing reduce as an effect of inflation-increased cash flow generation, and vice-versa. Inflation, here, is measured by the "Inflation Rate" (IR), referred to as the annual percent variation of market prices, as reported by Inflation Data (2011). Posautz (2012) underlines the importance of taxes in a PF project, since taxes have an influence on costs and profit. The fluctuation of interests affects the feasibility, construction and operations of a projects (Ling and Lim, 2007). This indicator is recorded via the Interest Rate Swap (IRS). The IRS is an agreement between two parties to exchange a series of interest payments without exchanging the underlying debt. One party pays a fixed rate, while the other party pays the floating amount of interest. This kind of financial instrument provides a hedge against interest rate risk (Bicksler and Chen, 1986). The tax

regime is measured by the Tax Rate (TR) parameter, referred to as the percent fiscal charge on profit. The Private Credit (PC) parameter, provided by World Bank (2011), gives a measure of the financial resources made available to the private sector. The values recorded are expressed as annual percentage of the Gross Domestic Product (GDP). In order to obtain the real amount of financing provided to the private sector, the indicator is multiplied by the annual GDP. The exchange risk emerges when financial flows from the project are stated in a different currency that the one of the SPV. This often occurs in international projects where costs and revenues are computed in different currencies. Advisors of SPVs try to state as many flows as possible in the home currency avoiding the use of foreign currency. This risk is here measured as the currency rate between the dollar and the local currency.

2.3 Market Risk

Market risk is related to the revenue fluctuation imposed on a project and it consists of a demand risk and a price risk. The demand risk is the uncertainty regarding the demand for the service provided by the completed project. The price risk is inherent with the fees that can be charged for the service; usually, fees are agreed upon the concession contract. The revenue risk lies in the project's market demand and concerns its ability of generating enough income to repay the debt incurred and to assure fair equity profitability. In our model we measure the capability to generate revenues with three parameters, namely Catchment population, Number of services granted, and Concession period. The Catchment Population represents the potential demand for the services associated with the project. The parameter Number Of Services has been selected to have an idea about the SPV's revenue stream. It is referred to as the number of granted services (e.g. maintenance, laundry, catering, etc). The concession period parameter reports the duration of the concession period during which the SPV collects revenues

and runs operations. It is measured in years from the end of the construction. A longer concession period provides the SPV with a better opportunity to make the project profitable (Shen et al. 2002).

2.4 Construction Risk

Construction risk is inherent with construction schedule delay and cost overrun. Typically, the scale and complexity of the 'Project scope' of work is a useful indicator of potential time delay and cost overrun: a large-sized project is likely to be complex to manage by reason of, for example, communication and coordination problems, and, in turn, likely subject to schedule delay and cost overruns (Santoso et al. 2003). The Project Size parameter measures the dimension of the investment expressed in monetary terms and it associated with the complexity of the projects that is going to be carried out. On the one hand, the investment affects the ability of collect fund and on the other hand reflect the opportunity to gain from potential organizational and physical economies of scale. The number of partners is used to quantify the composition of the SPV. A fragmentation of the SPV composition can bring better risk sharing; however, this might also increase the possibility of contractual and management problem occurring (Trujillo et al. 1997). Risk is also driven by Construction Duration, evaluated in number of years. It can be assumed that long construction duration is an inherent significant characteristic of complex projects (Hoffman et al, 2007).

There are three basic strategies the SPV can implement to mitigate the impact of a risk.

- Retain the risk. A firm can retain a risk because it considers risk allocation to third parties too expensive or the cost of insurance policies excessive compared to the effects determined by that risks

- Transfer the risk by allocating it to one of the key counterparties. This strategy is completed through an extensive work performed by legal advisors and lenders and it is based on the idea that each actor will be the cost of risk it is best able to control and manage.

- Transfer the risk to professional agents whose core business is risk management. This decision is associated with those risks so remote or difficult to address and insurers can buy them from the SPV against a payment of an insurance premium.

2.5 FINANCIAL ISSUES

A financing plan for a project includes requires careful analysis of potential sources of funds in relation to the project's year-to-year funds requirements, available cash flow, and availability of credits. The development of a financial plan begins with the estimation of the total external funds that equal the costs associated with the basic completion plus the interests paid on debt, the initial investment, and the cash for salaries and other operating expenses. The main goals of a financing plan are:

- Ensuring the necessary funds to complete the project;

- Providing the funds at the lowest realizable cost;

- Minimizing the project sponsors' credit exposure to the project;

- Setting a dividend policy that maximizes the rate of return;

- Maximizing the value of the tax benefits;

- Achieving the most beneficial regulatory treatment.

In the evaluation a project that involves capital assets, the analysis of the future cash flows appears to be very important, in order to identify initiatives with positive Net Present Values (NPV). The different steps of this process are:

- Estimate the expected future cash flows;

- Assess the risk and determine a reasonable rate of return (cost of capital);

- Compute the net present value;

- Determine the cost of the project and compare it to what the project is worth.

According to this method, an investment characterized by a sequence of cash flows unknown can be accepted on the basis of the NPV. In the estimation of NPV each cash flow can be weighted by a coefficient ($0<\lambda<1$) that represents the evaluator's aversion to risk. In this process the value of rate of return taken into account is crucial. The required rate of return can be thought of as an opportunity cost. As a matter of fact, investors require a rate of return at least as great as the percentage return they could earn in the most nearly comparable investment. Typically the cost of capital that is used is the weighted average cost of capital (WACC) that is the average cost of the components of any financing package (debt and equity) that allows the project to be undertaken. It can be expressed as:

$$\text{WACC} = (1 - \theta)r_e + \theta(1 - \tau)r_d$$

where r_e is the return on equity and r_d the return on debt and τ is the marginal income tax rate on the project's income. This rate can be used for the computation of the NPV in order to understand if the project is financially sustainable. In fact the economic viability of a project depends on the adequacy of the cash flows generated as compared to the outbound cash flows. In this sense projecting the cash flows is crucial in determining the economic viability of a project. The calculation of outbound cash flows is related to the costs that include direct costs (engineering, labor, and materials) and indirect costs (such as financing charges and guarantees). From an operational standpoint, to come up with the estimate of the future cash flow we have to define a precise set of variables.

- The timing of the investment: specify the start and the end dates, the duration of the concession and the construction periods.

- Initial investment cost: it includes not only the construction cost, but also the costs of purchasing the land where the facility will be build, the owner's and the development costs.

- The Value Added Tax (VAT) dynamics: it is the rate associated with the direct investment that has to be determined

- Public Grants: they represent a key source of financing in PF. The payment of the grants can be made contingent on milestones or at the end of the construction phase after plant testing.

- Analysis of sales revenues and purchasing costs:

- Analysis of operating costs during the operating life of the project:

- Fluctuations in working capital:

- Taxes: one of the key variables that must be studied is the depreciation of the plant that influences the amount of taxes that are paid. At the same time, depending on the type of the project there are different kinds of taxes that have to be considered such as carbon tax, property tax etc.

- Macroeconomic variables: these variables are typically the expected trend in the interest rate, estimates of the national inflation rate and forecast of specific sector indices that impact costs and revenues.

A project can be also evaluated trough the Internal Rate of Return (IRR) that is the rate that equals zero the NPV. In other words we have:

$$\sum_{t=0}^{M} \frac{OCF_t}{(1 + IRR_{project})^t} = \sum_{t=M}^{n} \frac{OCF_t}{(1 + IRR_{project})^t}$$

The term on the left is the sum of the present value of negative cash flows from time 0 (project starts) to M (end of the construction phase). The term on the right indicates the present value of prositive cash flows generated by the project from M to n (the last year of project's life).

The quantification of the operating cash flows is crucial for defining the optimal mix of debt and equity. Operating cash flow during the operating life represents cash available for the debt service, while the financial structure and the assumptions regarding loan repayment define the cash requirement. During the construction phase the operating cash flow is negative. This results in a financial requirement to be covered with both share capital from sponsors bank loan. On the contrary, during post construction phase, operating cash flow becomes positive and has to be able to support the debt service and the reimbursement on capital invested by sponsors. In the establishment of the debt/equity ratio modelers verify the break-even point for indebtedness and once this point is exceeded the initiative no longer has the credentials of economic viability. The viability depends on the risk the lenders perceive too. Banks are called on to study the economic convenience comparing the main aspects of the project with similar initiatives. In order to pay debts and dividends operating cash flows have to be used, but their amount is unknown until the project works. This issue is solved through a process of trial and error. Basically the variables that determine the operating cash flow are taken into account, along with project risks and associated coverage. After the definition of the debt requirement a capital structure is then computed and the it is verified the sustainability of the solution.

The world capital market have become more integrated over the past two decades. And new financial instruments have increased the array of financing alternatives available to a project. The public authority can decide if it can afford to finance the project with its own debt or if a different approach is preferable. There are a lot of different sources of financing.

- Equity: the equity perspective is based on benefits that are expected from the operation of the project and that are commensurate with project risks. A project cannot pay dividends before operations commerce, and lenders restrict the payments of dividends until at least a part of debt has been repaid.

- Long-term debt: for most project financings, commercial banks and institutional lenders constitute the initial phase of the financing plan. Several factors impact on the breadth of the long-term debt:

  o Profitability of the project: lenders will not provide funds for a project unless the expected rate of return will be sufficient to cover the debt service.

  o Project leverage: lenders require that project sponsors commit sufficient equity to make the project creditworthy.

  o Lenders' assessment of project risks: the risk evaluation brings lenders to set the rate of interests before to finance the project

  o Credit standing of the project entity: this is very important since it influence the amount of funds the project will be able to raise from all categories of lenders

  o Interest rate on project debt: it has to be high enough to fully compensate the lenders for default and illiquidity risk

  o Liquidity of project debt securities: the lack of reduces the attractiveness and implies a higher interest rate.

- Fixed-rate debt market: life insurance companies have been the principal source of fixed rate loans.

- International capital market: it is the market that works outside the capital market of the world.

- Supplier credit: it is used to finance the purchase of equipment that will not be part of the permanent structure, but it is necessary during the construction.

- Government assistance: a project may be eligible to receive some form of government support even in the form of export credits or loan guarantees.

- World Bank Loans: it includes three institutions that play a role in international project finance, namely International Bank for Reconstruction and Development (IBRD) that supports economic development, rather than commercial development, International Finance Corporation (IFC) that stimulates growth in developing countries by promoting private investment, and Multilateral Investment Guarantee Agency (MIGA) that ensures capital investments in developing countries against political risks.

Professional practice and previous research have found evidence that DSCR is a suitable indicator for establishing the debt leverage and in turn for determining the corresponding equity participation into the initial investment (Bakatian et al., 2003). In order to evaluate the financial sustainability and feasibility of a project and of its capital structure, cover ratio indicators are used. One of the most important is the Debt Service Coverage Ratio (DSCR) (Potluri and Rajan, 2010), that expresses the relationship between operating cash flows and the debt service including the interests.

$$DSCR = \frac{OCF_t}{K_t + I_t}$$
where:

OCF= operating cash flow for year t;

K = payment on the principal in year t;

I = interest payment in year t;

For any year of operation, this ratio tells if the financial resources generated by the project (numerator) are able to cover the debt service (denominator). From a theoretical point of view the lowest DSCR can

be 1, but a sequence of 1 would not be sustainable, because in this situation the dividends would fall to 0. The minimum DSCR must be greater than the one to meet the debt capacity. But, the lending agencies actually ask for a higher value, according to the expected operating cash flow and anticipated risk of the project. Thus, since the concessionaire takes an important commitment to the project and a broad scope of risk, it appears that DSCR is set at high levels not only whenever a high debt risk is anticipated, but also whenever several potential risk factors are associated to the equity portion of investment (Zhang 2005b). Another important ratio is the Loan Life Cover Ratio (LLCR) that is the quotient of the sum of the operating cash flow discounted to the moment of valuation (s) and the last scheduled year of debt repayment ($s + n$), and the outstanding debt (O) at the time of the valuation.

$$\text{LLCR} = \frac{\sum_{t=s}^{s+n} \frac{\text{OCF}_t}{(1+i)^t} + \text{DR}}{O_t}$$

LLCR is the relationship between to discounted terms. This is obvious for the numerator and the denominator is computed as the discounted debt that has yet to be paid by the borrower to the entire remainder of the loan itself.

$$O_s = \sum_{t=s}^{s+n} \frac{\text{DS}_t}{(1+i_{\text{loan}})^t}$$

DS is the installment due at time t and i is the interest rate on loan applied by lender. As such, an LLCR greater than 1 can be interpreted as a surplus of cash free available.

One important step of the analysis is to verify the project's robustness in the face of negative scenarios. In particular these tests generate various scenarios, each of which show project's performance when a

series of parameters change. On the other hand it is possible to use simulation techniques applied to a set of variables, in order to create a probability distribution of output variables that are considered critical. The logic behind sensitivity analysis is to verify the project's degree of resistance to adverse changes in the factors that determine cash flows. In the context of the simulation approach it can be argued that when the debt cannot be serviced by the project's cash flow, default occurs. In fact, thought project scenarios are unknown and potentially infinite in number and size, they can be simulated so as to be consistent with the risk view of the bank that is financing the structured deal. By projecting the cash flows for the SPV, it is then possible to dynamically test if and when a default situation could arise during the life of the project. Creating a scenario for the modeling of cash flows, in PF deals is based on the definition of a reliable risk model and of key project variables, on the estimation of the input variables and respective value distribution, and on modeling the project's cash flow, calculating input and valuing results. The first part of this process is to identify the risks and to classify them. The valuation models can be either qualitative or quantitative and they always require subjective judgments by experts, since each project and its conditions of execution are unique and historical data are usually statistically not sufficient. Then all the project variables that are the key drivers of the project's performance/cash flows are selected. After identifying the key variables the range of admissible values and their frequency distribution must be estimated and defined. The estimation of input variables and the correlation among them is a critical issues for outsiders as for bank lenders. A PF team typically builds a worksheet to evaluate project cash flows and in the base case and then applies deterministic, what-if scenario, sensitivity analysis. Furthermore by developing a stochastic model of future cash flows it can be possible to determine how frequently the project may reach a situation that can be defined as a default. At this point it becomes necessary to estimate the loss given default (LGD) or, equivalently the recovery rate for the banks financing the projects. In this context Public Warranties are a tool that can be used by Governments to incentivize privates (banks, capital markets, equity funds) to

finance PPP initiatives. Warranties can reduce financial costs, can release the initial public contribution, or exploit other financial sources like obligations. Public authorities can ensure the payment of debt to financiers if private partners are insolvent, or they can ensure a minimum level of revenues. The use of public warranties is very delicate, because they alter the allocation of risks (with an impact of Value for Money), and because moral-hazard could raise up. This is due to the fact that a warranty is likely to reduce the incentive to a good performance for private partners.

Services offered for PF initiatives by financial intermediaries fall into two categories. Advisory services includes studies for the definition of risks, of time schedule, etc. Typically they include all the analysis to make a preliminary evaluation of the financial feasibility and to assume how the funding can be obtained. The aim is to develop an information memorandum that can be proposed to potential lenders. These services are usually provided by consulting firms, engineering firms or individual professionals. Financing services concern lending activities. Since this kind of services require huge availability of capital, the role played by financial institutions (in particular commercial banks) is crucial.

In developing countries multilateral financial organizations play a very important role in PF. As a matter of fact their institutional mandate allows taking on financial commitment even in countries with high political risk, and the promote financing in the private sector and private investment in infrastructure. Among them the most important, at least in terms of political weight and financial volume is World Bank Group. It was founded in 1944 to finance postwar reconstruction in Europe. Nowadays its aim is to reduce poverty in the world and to promote sustainable growth in less developed economies.

A host government that is willing to attract foreign capital should create a favorable environment and offer investment incentives like tax "holiday" that exempts the projects entity for a specified number of

years., grant of land free, assurances as to the availability of raw materials or repatriate profits from the project for a specified number of years, and supply of items of infrastructure at no cost. In emerging markets there is an enormous needs for infrastructure investments and projects have been typically developed using public finds supplemented by World Bank and other multilateral agency loans and private sector involvement is increasing in many area of public infrastructures. Transportation projects seem particularly well-suited to private participation. For instance, toll roads and bridges, airports and rail systems can generate enough revenue from users' fees to attract private capital. Furthermore these kind of projects pay new taxes which would not be the case if they were entirely publicly funded. Under the right circumstances PF offers a number of advantages that can be achieved only after a careful analysis. The organization of the project, its legal structure and its financial plan must reflect the nature of the project, identifiable projects risks, the project's expected profitability, the creditworthiness of the various participants, the requirements for supplemental credit support and the availability of project-related tax benefits. PF allocates risks among the parties who are in the best position to bear them. Thus, for instance engineering firm can bear the construction risk and suppliers can deal with supply risk. Given the complex decisions associated with the financing of a project, the sponsor(s) needs to determine at the outset whether PF is the most cost effective method. This analysis is strictly related to the Value for Money principles that are based on the idea that the highest value of money is achievable when you get the best at the lowest price. The number of opportunities to reap the benefits of PF is likely to increase in many different fields of applications, such as power projects, regional industrial facilities, and infrastructure projects

3. Project Finance Initiatives: toll road analysis

PF delivery system allows to limit public spending on governments' budgets and facilitate private financing of desirable public facility projects (Algarni et al., 2007). In particular pay toll road projects have been accounting for an important share of the investment among all types of PF arrangements in the past two decades in both, developed and developing, countries (Medda and Carbonaro 2007). Under a PF scheme, the funding required to meet the capital expenditure necessary to construct or renovate an infrastructure is provided in the forms of both equity and debt sources. Even though the capital structure varies, equity financing typically covers from 10 to 30% of total project costs, while debt financing is obtained for the remaining 70 to 90% (Finnerty, 2007). lending institutions provide the debt portion of funding under the terms of nonrecourse financing in a way that lenders have no recourse for repayment of their loans against the shareholders, but only through the SPV's segregated cash flows and assets (Zhang 2005a).

Moreover, some PF highway projects may also include the financial support from host governments at one or more stages of the project, usually under the form of either funding aid fiscal subsidies for operations, off-take agreements or a combination of them.

The debt to equity ratio for financing the capital structure of a PF project varies according to the risk profiles borne by the contract parties. To obtain an attractive rate of return on equity (RRE) through a minimized equity investment and associated risk, equity holders usually seek to maximize the debt leverage as much as the project cash flow can justify.

On the contrary, lending institutions tend to require a large equity commitment in the SPV to reduce the risk of a heavy debt service burden on the project cash streams (Walker 1995) and avoid investors from being in a position of easily walking away from the project (Nevitt and Fabozzi 2000). Lenders calculate debt service coverage ratios (DSCR) as a supporting method to establish the project's debt

capacity and, as a result, to determine the matching equity contribution to the capital investment. Usually, high DSCRs are requested by lending institutions to bear high project risks; this requires a high level of equity level, which brings subsequent reduced profitability.

Therefore, it is of great interest to both, shareholders and lenders, to achieve the capital structure that maximizes the RRE with a tolerable debt level (Dias and Ioannou 1995). Several studies have been proposed to investigate the risk, in association with an optimized capital structure of a PF infrastructure project. In particular antecedent authors propose models to identify risks inherent with PF contracts and provide linkages between risk sources and the capital structure. A first course of study explores the effects of risk on project profitability. With this regard, Zhang (2005a) builds a theoretical methodology to optimize the capital structure and evaluate the project financial viability when the project is subject to construction risk, bankruptcy risk, and other various economic uncertainties. So that an optimal capital structure is determined to safeguard the diverse interests of both, equity investors and debt lenders. Similarly, based on the notion that the equity amount to be injected to the facility varies according to risk, Ng et al. (2010) explore the risks faced by private partners in a concession-based road project. Furthermore they illustrate a Monte Carlo simulation model, where the revenue is the uncertain parameter considered under the influence of inflation, traffic flow and operational cost risks to determine the equity level and associated RRE.

A second pertinent stream of research is dedicated to identifying risks inherent with project financing. Three studies, addressing this subject, are acknowledged to be seminal antecedents of our risk model, namely: the proposal, by Zayed and Chang (2002), of a consistent procedure for assessing PF project risk through the definition of a risk index and project ranking methodology based on actual performance of eight main risk areas, i.e., political, financial, revenue, promoting, procurement, development, construction, and operations risks; the analysis, by Schaufelberger and Wipadapisut (2003), on transportation and power-generation projects that identifies political, financial, construction,

operational, and market risks, and states that the risks reported to be most significant in financing strategy selection are the political, financial, and market risks; and Xenidis and Angelides' (2005) comprehensive list of state-rooted, concessionaire-rooted, and market-rooted financial risks with classification based on the stage at which they occur and the sources of their origin.

However, even though equity risk is affirmed to be central in the definition of the optimal capital structure and risk taxonomies are provided, very little previous work is reported with focus on the empirical assessment of the risk factors that might affect the equity portion of funding.

Nevertheless, little work has explored the empirical effects and other macro risk factors that might have a relationship with the equity level of PF projects. With the purpose of overcoming this research gap a statistical analysis on the capital structures of a set of recent PF toll road contracts is provided to study some relevant risk factors that might have significant relationships with the equity participation in project funding.

3.1 Identification of Risk Sources and Hypothesis

Based on the proposed risk model shown in Table 2.1, Table 3.1 summarizes the independent variables that are supposed to have a significant impact on the capital structure of a PF toll road initiative. The figures reported down into the columns are, respectively, the minimum, mean, and maximum value, the low, median and upper quartile, and the standard deviation.

	Acronym	Min	Mean	Max	Low quartile	Median quartile	Upper quartile	Standard deviation
Dependent variable								
Equity Share [%]		13	29	45	20	27	40	10
Independent variables								
Country index	CI	1.15	1.24	1.40	1.15	1.2	1.35	0.08
Government effectiveness	GE	-0.16	0.94	1.99	0.16	1.18	1.54	0.72
Regulatory quality	RQ	-0.33	0.86	1.65	-0.13	1.23	1.46	0.75
Average Beta of partners	BETA_PART	0.33	0.77	1.81	0.56	0.73	0.96	0.33
Inflation rate	IR	0.014	0.041	0.094	0.028	0.035	0.054	0.02
Currency exchange rate	CR	0.0012	0.416	1.15	0.018	0.0338	1	0.46
Population in the area [mil]	POP	0.07	13.98	76.00	2.73	5.00	20.57	19.28
Investment [mil $]	INV	13.20	516.04	22,214.20	153.90	412.69	436.10	519.50
Construction duration [years]	CDUR	1.00	2.93	6.00	2.00	3.00	3.00	1.34
Concession period [years]	CPER	12.00	32.09	99.00	24.25	30.00	33.00	16.93
Number of partners in SPV	PART	1	3	6	2	3	3	1.18
Average size of partners [mil $]	PART_SIZE	0.01	3.77	9.80	1.41	3.54	5.09	2.81

Table 3.1. Summary of the exploratory analysis on the dataset of PF toll road projects

The sample is composed of 31 pay toll road projects. The projects, selected from various geographical areas around the world and equally in both, developed and developing, countries, are characterized as having an approximate $500 million average investment and equity share, ranging from 13 to 45 percent of the total investment, with the most frequent value around 29%. This progression goes beyond the expected typical values, ranging between 20% and 30% (Tiong 1995); thus, we have urged a close scrutiny of the factors that might motivate its variability. Based on the mentioned research and theory about the risk profile of PF projects, a model composed of twelve independent variables that are suggested to have influence on the capital structure of PF projects and, in particular, on the level of equity is proposed. Specifically, it is assumed that the equity portion of the capital structure of a PF project is not only determined so as to optimize the profitability of the projected cash flow, but it is also a function of the risk profile and, in turn, the main risk factors, uncovered so far, might affect its optimal level. Indeed, the equity share is affected by risk as far as debt lenders are likely to carefully

scrutinize the risk involved with one project for determining the debt to equity ratio. On the one hand, it is assumed that Country index, Government effectiveness, Regulatory quality, Average beta of partners, Currency exchange rate, Construction duration, and Number of partner in SPV shall have a positive influence on the equity share. In particular, Country index is expected to show off a positive influence in the sense that, under a stable political and economic environment of the host country, with lower country index, the likelihood that a project will be called to a halt is reduced and the risk that the SPV's cash flow would be jeopardized is lessened. Consequently, lending institutions are willing to lend more money to a firm if the debt repayment capacity is high, resulting in a reduced need for equity by the borrowing firm.

On the contrary, higher country indices could lead to reluctance in funding projects with high debt leverages. Similarly, the Government effectiveness and the Regulatory quality parameters are supposed to have a positive impact on the equity share; in fact, high values stand for reliable and stable countries, where private investors are encouraged to invest.

Also, a high Average Beta of partners, as a proxy measure of a high SPV risk, is likely to require a high level of equity, because lending agencies might be unwilling to provide bulk debt service in such situations.

The Currency exchange rate is also expected to have positive impact on the equity level; in the sense that, if the local currency appreciates, revenues converted into US dollars arise, so that private investors are willing to put more funds into the project investment.

Construction duration, as a proxy indication of the project complexity and inherent risk of delay, rework and cost overruns, is likely to be the reason that prevents lending agencies from providing large debt leverage, thus giving SPV participants no choice but to raise higher equity share into the total project investment (Logan 2003).

Finally, the higher the Number of partners in the SPV, the higher is the expected capability to raise the equity portion of financing.

In contrast, Inflation rate, Population within the area, Investment, Concession period, and Average size of partners might disclose a negative impact on the equity share of the investment. In fact, higher the Inflation rate, more the debt capacity and lower the equity level. This fact is due to two simultaneous effects directed to increase the DSCR, namely: increased revenue and reduced interest as a derivative macroeconomic consequence of inflation.

Furthermore, a large Population within the area would give high chances of revenue, which in turn, would allow the SPV to easily obtain bulk debt packages with a low level of equity. Similarly, a large-sized investment might be an indicator of the project complexity and inherent risk, so that the equity portion of funding is likely to get lower.

Also, a long Concession period should justify the maximization of long-term debt through fixed rate financing structuring, which, in turn, relies on a lower share of equity investment (Tiong and Alum 1997).

Finally, a large Average size of partners should provide adequate assurance that high debt leverage will be reimbursed and that minimum equity contribution should be required.

With the purpose of challenging the proposed risk model and associated hypotheses, the following section illustrates the linear regression model used for the empirical examination of the twelve theoretically relevant predictors on the Equity share, taken as the response parameter.

3.2 Regression Analysis

After checking the normality of records, the presence of multicollinearity among the independent variables is explored. the same sign is between the independent and response variable variations. The predictive variables have to be linearly independent: it can happen in multiple regression that the

independent variables are correlated and the risk is of amplifying the variance measurement of the regression coefficients (Tabachnick and Fidell, 2001). Perfect multicollinearity is a very rare event, but some collinearity is very common. The variance inflation factor (VIF) is used to measure such level of collinearity of a variable versus the others. It is termed as $1/(1-R^2)$, where R^2 is the coefficient of determination of one predictor on all the other predictors; it represents the proportion of the variance in the independent variable that is associated with the other independent variables in the model. If VIF equals 1, there is no multicollinearity; if it ranges from 1 to 4, predictors may be moderately correlated and if VIF is greater than 4, the regression coefficients are poorly estimated (O'Brien 2007).

	CI	GE	RQ	BETA_PART	IR	CR	POP	INV	CDUR	CPER	PART	PART_SIZE
VIF	**15.463**	**30.72**	**18.497**	2.68	3.192	4.1	2.39	2.791	1.64	1.783	2.532	2.773

Table 3.2: Multicollinearity in the complete model

Results (Table 3.2) prove that multicollinearity exists in the model because CI, GE, and RQ have a very high VIF. Therefore, multicollinearity is avoided by removing these predictors from the model (Table 3.3).

	BETA_PART	IR	CR	POP	INV	CDUR	CPER	PART	PART_SIZE
VIF	1.792	1.667	2.488	1.549	2.41	1.431	1.509	1.705	1.757

Table 3.3. Proof that the model has no multicollinearity among predictors

After the exploration of multicollinearity, the regression analysis is performed. Table 3.4 presents the results of the regression analysis, where the columns report the estimate of the regression coefficient, the standard error of the coefficient estimate, the value of t statistic and the p value with the associated level of significance, respectively.

	Acronym	Estimate	Std. Error	t-value	p-value	
Average Beta of Partners	BETA_PART	-0.01125	0.04697	-0.24	0.814	
Inflation Rate	IR	-1.5652	0.7360	-2.13	0.049	*
Currency Exchange Rate	CR	0.03447	0.03847	0.90	0.384	
Population within the area	POP	-0.0005564	0.000680	-0.82	0.425	
Investment	INV	-0.0001156	0.000033	-3.42	0.004	**
Construction Duration	CDUR	0.041676	0.009622	4.33	0.001	**
Concession Period	CPER	-0.0005236	0.000745	-0.70	0.492	
Number of Partners in SPV	PART	0.04278	0.01244	3.44	0.030	*
Average Size of Partners	PART_SIZE	-0.15284	0.005160	-2.96	0.009	**
Multiple R-Squared		79.60				
Adjusted R-Square		68.10				
Constant		0.23815				
Significance notation		0 ***	0.001**	0.01*		

Table 3.4. Results of the regression analysis

The regression analysis shows that IR, INV, CDUR, PART and PART_SIZE are significant factors, influencing the equity portion of financing of a PF project. On the contrary, BETA_PART, CR, POP, and CPER are proven to not have significant influence on the capital structure.

The high R-squared value suggests that the regression line is a good fitting curve of real data points and that a large percentage of the variability is accounted for in the statistical model. In addition, the high-adjusted R-Square, which is not notably lower than the R-Square, confirms that the proposed model includes all the explanatory variables and the variation on the response variable is fully measured. Five out of the nine aforementioned independent variables show statistical relevance to the debt-to-equity ratio.

3.3 Discussions

Some of the relevant drivers confirm expected inherent relationships with the equity fraction of capital investment. For instance, an increased project complexity, by some means, indicated by the number of partners and by the length of the construction period, drives a large amount of equity funds. In fact, the

higher the number of partners involved in a project, the higher the capacity to raise equity financing. In addition, the positive impact of the construction length underlines that construction risk is an important component: a long construction period implies a high risk of cost overrun and delay, thus making lending agencies reluctant to highly leverage the debt portion of funding.

Similarly, the relationship between the size of the project and the equity allocation is clarified: a large-sized investment imposes a heavy burden on project promoters to contribute with their equity in total amount, but smaller in percent share. The positive impacts on the equity share of the average size of partners is based on the idea that the higher the solidity of a company, the easier for that company to raise the equity contribution.

Also, the inflation rate confirms the negative effect on the equity share of a PF project, because of its ability to increase cash flow revenue.

Finally, results show that the 'Concession Period', 'Population within the Area', 'Currency exchange rate', and 'Average Beta of Partner' variables do not pose significant influence, if any, on the equity share. Finally, results show that the 'Concession Period', 'Population within the Area', 'Currency exchange rate', and 'Average Beta of Partner' variables do not pose significant influence, if any, on the equity share. The analysis reveals that the inherent characteristics of both, the project and SPV, are significant factors of the fraction of equity funds required to implement a PF contract, while external factors linked, for instance, to the host country and financial environment, are likely to have lower influence. In particular, the size and complexity of the project, as well as the composition and financial solidity of the partners involved in the SPV, prove to be determinants of the equity share. To be more precise, the size of the investment and the solidity of the SPV prove to have a negative impact on the level of equity, while the complexity of a project and the composition of the consortium carry a higher share of equity.

In other terms, investors of large-sized projects are likely to resort to other financial sources, such as public funds, for transferring out portions of risk; similarly, financially strong consortiums of partners are likely to be capable of borrowing more debt funds and, in turn, be required for raising a lower level of equity. On the contrary, complex projects with typical long construction duration and numerous investing partners will likely require more equity financing.

Finally, inflation is the only exogenous financial variable that is probable to influence the level of equity, as it is possible that a high inflation rate is a factor of an increased debt capacity due to its contribution to cash flow generation.

Both practical and theoretical implications arise from these results. The implication for investors and lending agencies is the potential undertaking of changes in the way the PF capital structure is arranged. In fact, the presented regression model might serve as a predictive reference study in refining decision criteria for determining debt leverage in PF toll road projects. The results may provide some hints to lending agencies for improving the currently used DSCR-based method to determine the equity leverage. In particular, lenders might determine the project risk score through the evaluation of the above proxy variables.

Additionally, results might be considered as a clue for project promoters to better understand what kind of financial contract clauses and business environment might facilitate high debt leverages. For instance, they might take advantage of establishing consortiums composed of just a few solid partners, bidding for middle-sized projects, which are likely to be less complex.

In other terms, investors of large-sized projects are likely to resort to other financial sources, such as public funds, for transferring out portions of risk; similarly, financially strong consortiums of partners are likely to be capable of borrowing more debt funds and, in turn, be required for raising a lower level of equity. On the contrary, complex projects with typical long construction duration and numerous investing partners will likely require more equity financing.

Finally, inflation is the only exogenous financial variable that is probable to influence the level of equity, as it is possible that a high inflation rate is a factor of an increased debt capacity due to its contribution to cash flow generation.

Both practical and theoretical implications arise from these results.

The implication for investors and lending agencies is the potential undertaking of changes in the way the PF capital structure is arranged. In fact, the presented regression model might serve as a predictive reference study in refining decision criteria for determining debt leverage in PF toll road projects. The results may provide some hints to lending agencies for improving the currently used DSCR-based method to determine the equity leverage. In particular, lenders might determine the project risk score through the evaluation of the above proxy variables.

Additionally, results might be considered as a clue for project promoters to better understand what kind of financial contract clauses and business environment might facilitate high debt leverages. For instance, they might take advantage of establishing consortiums composed of just a few solid partners, bidding for middle-sized projects, which are likely to be less complex.

4. Privately Financed Healthcare Project: the UK case study

Her Majesty's Treasury (2000) defines a PPP as a contractual and financing arrangement typified by joint working between the public and private sectors. Under this general notion, PPP includes many types of outsourcing and joint ventures. When PPP projects were launched in the UK under the schemes of the Private Finance Initiative (PFI), the British government appeared to view them primarily as a way of getting infrastructure costs off the public balance sheet, alleviating spending on governments' budget, seeking capital from external financiers and keeping infrastructure investment levels up, and avoiding the constraints imposed on the public sector (Bing et al., 2005; Algarni et al., 2007). There is an open debate on the advantages of PPP and estimation of the benefits obtained by its usage. With this regard, a key driver in the choice of the delivery system of a constructed facility is the evaluation of the Value for Money (VFM). VFM is an expression of the economy, efficiency and effectiveness of service received by a public entity. According to HM Treasury (2007), VFM is the optimum combination of lifecycle costs and quality of good or service to meet the users' requirement. The VFM driver is of great importance for the granting authority when selecting a PPP/PFI delivery system. VFM, in this context, can be thought of as the best price for a given quantity and standard of output measured in terms of relative financial benefit (Grimsey and Lewis, 2005). Generally, the risk transfer should be one of the major factors considered in PPP when assessing the VFM (Clifton and Duffield, 2006).

In privately financed projects, the evaluation of the VFM is largely affected by the level of public risk transfer to the private sector (Andersen, 2000) and it is often stated that a significant contribution to VFM is the transfer of appropriate project risks to private sector party (Andon, 2012). A project usually consists of dealing with several potential risks, which can be borne by either one or both private and

public parties. The value is gained by both parties identifying and investigating specific risks prior to setting the cost for the project (Clifton and Duffield, 2006).

When the private party accepts the responsibility for a large share of risk, the case could be reflected in the payment by the public granting authority of a monthly or annual Unitary Charge (UC), which is determined based on estimated risks and projected capital, financing, and operating costs (Financial Services Authorities, 2004). The UC is the income paid by the public authority to compensate the private sponsors for both the capital investment made to develop the constructed facility and the operations and maintenance expenses incurred during the concession period for the provision of facilities management and ancillary services (Hellowell and Pollock, 2009). Therefore, the UC can be considered as an indication of the amount of risk paid by the public party to the SPV for taking the project risks, and as an associated important cash flow component to determine the expected rate of return of a PFI investment.

The UC form of compensation of an investment applies to a variety of PPP social facility projects. In particular, it is largely used in PFI of hospital projects worldwide.

There is another open debate in the literature around the VFM that can be obtained by the public sector in healthcare projects and the opportunity of using PPP/PFI for the delivery of hospital projects still stands unclear (Pollock et al., 2002). In particular, there is a high need to refine methodologies for determining the appropriate amount of UC associated with the project risks borne by the public authority, in order to gain an understanding of the value that can be obtained. , the exploration on the relationship between the level of risks and the UC amount in PF hospital projects is still unexplored and questions arise among scholars and practitioners regarding how to balance the appropriate level of UC in relation to the risks borne by the parties involved.

With the purpose of overcoming that research gap and addressing the question, this paper aims to understand the risks in healthcare PPP/PFI projects that could influence the determination of the UC for

the delivery of contracted services in order to improve the VFM that can be obtained. Based on the assumption that the capital structure, and, consequently the UC amount, is inherently associated with the project risk profile and allocation between the contract parties (Amatucci and Facci, 2006), the analysis explores the main risk factors that might have significant relationships with the UC of a PFI hospital project. The exploration is addressed to public authorities and private sponsors to help refine the process of determining the appropriate level of UC associated with the risk factors allocated to the parties.

4.1 Identification of Risk Sources and hypothesis

The concept of PPP/PFI is founded on the cardinal principle that risk should be taken by the party who can best manage it. In order to formulate an appropriate risk response plan, not only risks must be identified, but also their impacts must be assessed (Iyer and Sagheer, 2010).

In a PFI project, the structuring of the financial scheme is a complex process where several agreements are formed to ensure the basic financial flows and the profitability of the investment for every part involved (Xenidis and Angelis, 2005). Very few studies investigate the role of the UC in a PPP/PFI and how risk factors affect in its amount paid by the public party for the delivery of the contracted services, even Holmes et al. (2006) state that the healthcare sector improves the quality of services by implementing privately financed initiatives. Also, Akintoye and Chinyio (2005) show that the usage of PPP in the healthcare field is increasing in the UK market in terms of number, capital value, and size of projects, and the main aim is to achieve a better risk management.

Based on the proposed risk model and dataset of PPPs hospital projects, Table 4.1 summarizes the independent parameters that are supposed to have an influence on the amount of Unitary Charge. The columns report respectively the lower quartile, the median, the upper quartile and standard deviation. In the model the ratio between the unitary charge over the total investment, which represents the expected

return for the SPV company is the response variable (UC/INV). It ranges from 0.078 and 0.2342 with median value worth approximately 0.1567. As the UC can start any time during the year and can come some components which are indexed upon the inflation rate, the first whole UC is the one of the second year of payments.

		Low quartile	Median quartile	Upper quartile	Standard deviation
Dependent variable					
Unitary Charge over Investment	UC/INV	0.1266	0.149	0.184	0.0372
Independent variables					
Government Effectiveness	GE	1.62	1.86	1.93	0.16
Regulatory Quality	RQ	1.71	1.8	1.81	0.1013
Employment Rate (%)	ER	68.9	71	73.9	0.037
Inflation Rate (%)	IR	1.357	1.547	2.12	0.5321
Interest Rate Swap (%)	IRS	4.72	4.9	5.54	0.00599
Tax Rate	TR	30	30	30	0.00781
Private Credit	PC	118.5	150.8	188.1	33.82
Concession Period	CP	30	30	30.00	2.621
Hospital Capacity (#beds)	HC	90	286	516.5	375.4
Time Interval	TI	0	29	68	44.53

Table 4.1. Summary of exploratory analysis for the dataset of hospital PF projects

The definition of Government Effectiveness and Regulatory Quality suggests a positive correlation with the UC. As a matter of fact, if governments and local authorities are inclined to outsource services to the private sector and have a high level of credibility, the UC is likely to increase, due to the higher risk that is assumed by the private party. At the same time a vibrant and favorable environment is likely to increment the level of competition among companies with a negative effect on the level of the UC. Therefore, it is difficult to anticipate which one of these two elements of political and economic risk prevails on the UC. If the employment rate is high, consumers tend to spend more money and it will be easier for companies to get profits from their investments. A high employment rate represents good,

stable and non-risky economy. Thus the higher the ER, the lower the UC, thanks to a lower level of risk borne by the private sponsors. IRS is a financial instrument that provides a hedge against interest rate risk (Bicksler and Chen, 1986). It is assumed that a higher interest rate would tend to increase the cost of capital and, consequently, reduce the DSCR so that the UC is also expected to increase. In the dataset, the IRS is picked on the date of the project's financial closure with value associated to the length of the concession period (Econonmagic, 2011): for example a 25-year IRS is selected for a project having a 25-year long concession period. For any project with concession period longer than 30 years, a 30-year IRS has been recorded.. The tax regime is here measured by the Tax Rate (TR) parameter, referred to as the percent fiscal charge on profit. If the TR increases, the net cash flow reduces and so does the DSCR. As a consequence, to compensate for such decrease and keep the DSCR up to the target level, the UC needs to be increased. In the dataset, TR is provided by the Institute for Fiscal Studies of the HM Treasury (2011). The Private Credit is a proxy of the financial resources that are available for the private sector. As far as the availability of private credit increases, a SPV will have higher chances to get higher debt and the mechanism will drive interest rate down. In turn, the UC will also decrease. The Concession Period is the length of the contract expressed in years during which the SPV operates and maintains the service on the behalf of the public party before handing it back. Projects with a short Concession Period could result in a high tariff regime so that the risk burden due to short concession period may be transferred to the final users (Khanzadi, et al., 2011). Typically, a longer CP provides better opportunities for generating income; however, granting an excessively lengthy concession may result in government loss, and the impact of risk uncertainties on the estimation of various economic variables can be heavier (Shen et al., 2002). Therefore, the length of the CP, from occupancy to transfer, is usually determined to assure attractiveness and protect the interest of both the public owner and concessionaire (Shen and Wu, 2005). Focusing on the healthcare environment, technology has rapidly progressed in the last decades and the trend is anticipated by PPP

projects. This implies that hospital activities can change even drastically over the lifecycle of a PPP initiative (Hensher and Edwards, 1999). Consequently, especially for technologically uncertain medical services, a longer concession period, which implies more difficult forecast, is expected to have a reduced UC, since the amount of money that a public authority would be willing to pay decreases as far as its own risk increases. Sharrer and McQuaid (2010) note that in the European context PPP projects sizing between €10 to 15 million make sense. In the healthcare sector, some further aspects should be taken into account. First, large-sized hospitals take advantage of greater economies of scale; however, small-sized hospitals require a lower investment if a flexible and potentially expandable facility is designed. Here the project size is measured via the hospital capacity (HC) that is the number of beds available in the hospital. A negative correlation is expected with the UC: the overhead cost will in fact be allocated over a greater number of buildings/services. Given this reduced costs, the same DSCR can be obtained by reducing the UC value. Long construction duration is an inherent significant characteristic of a complex project (Hoffman et al., 2007). The parameter associated to the project complexity indicator is the Time Interval (TI), which is calculated as the difference of number of months between the date of the financial closure and the start date of the first UC payment. The longer the TI, the riskier the project and the greater the UC amount.

4.2 Regression Analysis

The first test carried out on the dataset is associated to the multicollinearity in order to check if the predictive variables are independent.

	GE	RQ	ER	IR	IRS	TR	PC	CP	HC	TI
VIF	**30.15**	5.1	1.2	**7.2**	4.5	4.4	**28.8**	1.9	1.6	2.2

Table 4.2. Multicollinearity analysis of the complete model

Results (Table 4.2) prove that multicollinearity exists in the model because INFL, PC, and GE have a very high VIF. Therefore, multicollinearity is avoided by removing these predictors from the model (Table 4.3).

	RQ	ER	IRS	TR	CP	HC	TI
VIF	2.4	1.1	2.3	2.3	1.7	1.6	1.7

Table 4.3. Multicollinearity analysis of the complete model

A first statistical analysis on the dependent variable shows a non-normality of records. Therefore, a logarithmic transformation has been applied on UC/INV data, which leads to a normal distribution. Figure 2 shows that the values are all included within the normal distribution curve line. Since the parameters of the dataset have different order of magnitude and thus results cannot be compared, the interpretation of results could be awkward. In order to overcome this issue, a regression is carried out on standardized variables (Carroll Rovezzi and Carroll, 2002). To this end, for each variable the mean and the standard deviation are calculated, and each observation is normalized using Equation 2.

$$z = \frac{x - \mu}{\sigma}$$

Equation 2

where x is the value to be standardized;

μ is the mean of the population;

and σ is the standard deviation of the population.

The results of the regression analysis are provided in Table 4.4, where the columns report the estimate of the regression coefficient, the standard error of the estimate, the value of T statistic and the p-value.

Variable	Acronym	Estimate	Std. Error	t-value	p-value	
Regulatory Quality	RQ	-0.4888	0.08010	-6.10	**0.0001**	***
Employment Rate	ER	-0.1911	0.05279	-3.62	**0.0010**	**
Interest Swap rate	IRS	-0.0600	0.07910	-0.76	0.4520	
Tax Rate	TR	0.0673	0.07280	0.89	0.3770	
Concession Period	CP	-0.1952	0.06689	-2.92	**0.0060**	*
Hospital Capacity	HC	0.1354	0.06399	2.12	**0.0400**	*
Time Interval	TI	0.7024	0.06690	10.50	**0.0001**	**

R-Squared	86.9%				
R-Squared (Adj)	84.7%				
Constant	-0.0548				
Significance notation		0***	0.001**	0.01*	

Table 4.4. Results of regression analysis.

Results reveal that RQ, ER, CP, HC, and TI are significant factors of the UC amount.

4.3 Discussions

Regulatory Quality highlights the perception of how the government favors outsourced services to the private sector and, therefore, it shows a negative relationship as expected: when public authorities create a favorable environment towards private companies, the level of risk taken by the private party reduces and, as a consequence, the UC amount charged in return for borne risk may be lower. In the same way, ER has a negative influence on the Unitary Charge over Investment Ratio. High levels of ER indicates that, for favorable general economic conditions, there are less risks for investors and, in turn, lower levels of UC. The Concession Period shows a negative influence on the UC: shorter CPs can give fewer opportunities to make profit and therefore the UC needs to be greater in order to make

the investment more attractive. A positive correlation emerges with the dimension of the project, in terms of number of beds available in the hospital: this means that economies of scale are inconsistent, but, on the contrary, large hospitals are considered riskier because of reduced flexibility and higher probability of not being capable of exploiting the whole care capacity.

The complexity of the project, measured by difference of number of months between the date of financial close and the start of the first unitary charge payment, is also a significant factor. As expected in the anticipated risk model, the longer this period the higher the complexity of the project and the higher the UC requested in light of greater risk borne by the SPV.

Some of the relevant drivers confirm expected inherent relationships. First, a favorable economic and political environment tends to reduce the amount of UC because of more competitive market forcing companies to bid lower UC payments, and less risk borne by private sponsors with subsequent lower UC.

Second, the Concession Period appears to have a negative effect on the UC: a longer concession period is likely to reduce the amount of UC, which is anyhow paid for a longer period of time.

The model addresses some practical implications consistent with the interpretation of the empirical results. Finally, the positive relationship with the construction complexity, by some means indicated by the numbers of months between the day of the financial close and the first payment, and the number of beds available in the hospitals, suggests that the public expenditure is lower in small hospitals that are inherently characterized by a shorter construction period. These kinds of projects rely on two aspects: on the one hand, facilities with small capacity are likely to have better utilization rate than large-sized hospitals; on the other hand, small facilities have shorter construction periods and likely reduced construction risk.

All types of risk sources that have been identified in the model are designated to have an influence on the Unitary Charge over Total Investment ratio.

The proposed methodology might help the purpose of better understanding the main factors affecting the UC periodically corresponded by public authorities to private SPVs for operating a social facility. Since the UC is an important component of the project's VFM, this model assists in understanding the ideal characteristics of service-performing hospital PPPs. As a matter of fact, in assessing and delivering VFM, it is important to consider the optimum allocation of risks between the parties, and in particular the amount of risk charged to the private sponsors (HM, 2006). The proposed methodology could support both public authorities and private concessionaires in the risk allocation decision and in the associated determination of the UC.

5. Project Finance in Italy

The Ranking provided by the World Economic Forum 2008-2009 shows that Italy occupies the 54th place in the infrastructure sector, and with specific reference to the quality of the infrastructure it is on the 73th place. This situation has not seemed to change and indeed there is a progressive gap between Italy and the other European countries that negatively affects the efficiency of the transportation system and more in general the competitiveness of the country. The infrastructure stem does not stem, at least recently, from a lack of resources. As a matter of fact from 2005 to 2008 169 billion were spent in Italy for civil works, slightly less than France and Germany (179 and 189 billion respectively). The point is that in Italy most of investments are carried out in maintenance rather than in new works. Only 46% of investments in civil works are associated with new constructions; in Germany and in France this percentage is equal to 60% and 67.5% (Le Politiche per le Infrastrutture di Interesse Nazionale, Rapporto 2009). This lack of infrastructure reflects on the attractiveness of foreign investments, higher cost of energy, of transport and more in generally it affects the quality of life. In the last decades Italy has faced a decline in public investment expenditure because of the financial effort to comply the parameters imposed by Maastricht Treaty and to achieve the goal of getting an early stage in the Economy Monetary Union (CNEL, 2002). This particular situation was further aggravated by the now pathological problem of the enormous financial burden of Italian public debt which has created a heavy burden on available resources, going to impact directly on the ability to activate the large public investment programs needed to modernize and improve the infrastructure.

For these reasons, Italy has rapidly grown in the use of PF to deliver various type of construction projects with limited public finance, and it is currently one of the largest PF market within the European Union (Finlombarda, 2009). At the beginning the Italian market had had to face a strong cultural opposition of banks and financial institutions that were usually inclined to consider just the

patrimonial amount of a financial subject, rather than the financial and the economics aspects of the project *per se*. The first PF initiative in Italy dates 1999 when through the law number 144 of May 1999 l'Unità Tecnica-Finanza di Progetto (Project Finance Technical Department) has been launched in order to promote this financial scheme. Basically, PF was introduced in Italy because of the urgent need of the public sector to find a sustainable way to construct or renovate infrastructures, in the light of the obsolescence of the existing ones, the need to adapt them to new technologies and the lower and lower available public resources (Barretta and Ruggero, 2008). From 2003 to 2009 1,950 PF initiatives have been promoted for a total amount of 26,695 billion (Ance, 2009).

In Italy the first complete discipline on PF operations has been settled by the Law 415, November 1998, and in the following years some adjustments have been implemented so that to simplifying the procedures and to foster the submission of proposals by privates. The law number 340 November 2000 considers PF for the development of transport infrastructures of public interest. The law number 443 December 2001 enlarges the field of application of PF to every public infrastructure that is strategic. The law 190 August 2002 has streamlined the procedure in case of so-called huge works for all the issues associated with paper procedures, authorizations and implementation. The law 160, August 2002 has cancelled the limits of the duration and of the price of the concession, and has allowed the privates to submit proposals In our country the law mandates for the granting authority to prepare a feasibility study and then manage the bidding process, where bidders propose a tender package composed of basic design drawings, draft contract, and bankable business plan. The bid selection is usually based on a combination of multiple factors such as quality of design, construction cost, user fees, and contract conditions. The awarder is then demanded to enter into negotiation with the conceding agency to sign up the PF contract agreement. The "Decreto Legislativo Aprile the 12th 2006, number 163" and the "Decreto Legislativo August the 18th 2000" regulate PPP. Basically the main forms of PPP are: work concession, services concession, financial lease, availability contract and sponsoring. In Italy the limit

imposed on public spending and the shortage of public financing to carry out necessary investments have called for the recourse to PF to build, expand or upgrade a variety of infrastructure and service facility. However, not all projects appear to be fit for PF, so that the need to understand which are the key elements to allow an *ex-ante* evaluation and assist the process of deciding whether a facility should be built under the PF form of contract or not. As a matter of fact Italy lacks of institutional body that supports and stimulates PF. General guidelines for ex-ante, in progress and ex-post evaluation are not available, and a structured methodology for the assessment of VFM does not exist so far. The Italian market is not mature enough to welcome this kind of approach even if governments have tried to introduce some reforms in legislation. What still misses is the availability of tools such as standard contract guidelines and reliable measures for cost effectiveness appraisal. Moreover, there are not incentives for greater competition and structured bodies to evaluate and sustain PFI projects. This is due to the fact that public administrations have not recognized the importance of a rigorous measurement system and of an efficient allocation of risk among the involved parties.

Italy is experiencing a slowdown in the growth of PPP projects because the financial crisis has led the private sector to borrowing difficulties and to weakening of the private sector's propensity for risk, as part of the general trend of the Italian PFI market, as shown in Figure 5.1 (Finlombarda, 2009).
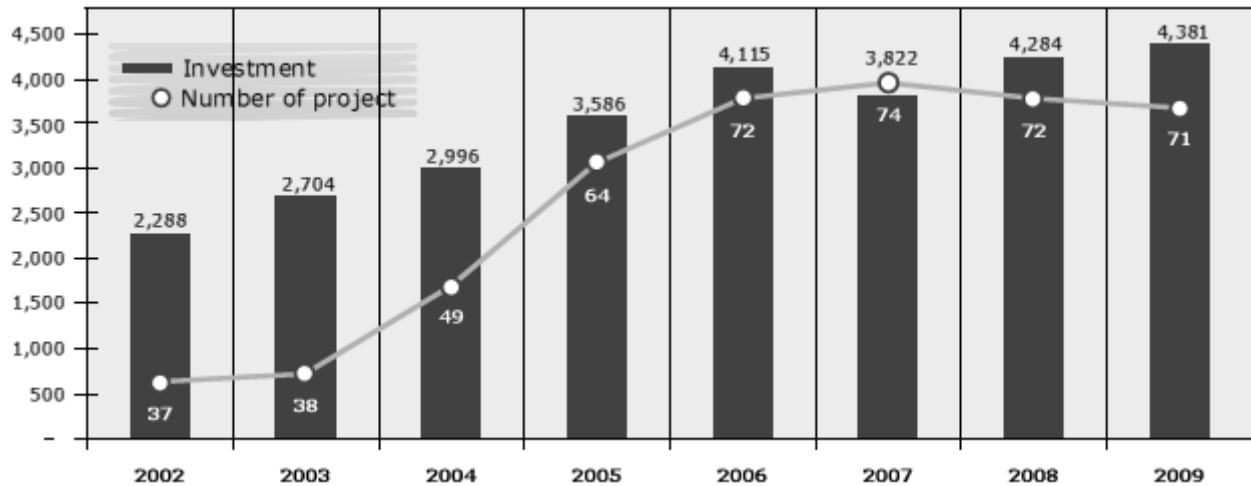
Figure 5.1. Trend in PFI Investments in Italy

Other critical issues are related to the long duration of procurement procedures, the difficulty in evaluating the proposers' documentation, the troubled coordination among participants, and, in turn, the financial plan for the project. All these issues result in projects failures in the sense that the initiative fails to go further of the early contract procurements phase. It appears that not all projects are designed to meet the characteristics of a successful PF contract. In other words, the project are often initiated, but the development process is not carried out up to the construction phase. The first part of the analysis therefore focuses on the investigation of the significant factors that might influence the capability of the project to be successfully developed. The research is conducted through the following steps. First, we gathered data from the database published by the Italian national observatory of public-private partnership (http://www.infopieffe.it), integrated with information obtained through direct inquires from local governmental agencies. The dataset records information related to a few key aspects of the 382 PF projects awarded in Italy from January 1st, 2004 to December 31st, 2009, with regard to size, duration, and location of the project. All projects total approximately 6.4 billion euro with average investment size around 17 million euro each. Approximately 28 percent of the awarded projects included in the dataset are not reported to be constructed or under construction at the date of

observation (December 2010). Then, we conducted an exploratory analysis and under the assumption that whether construction is put into effect is the binary response variable, we completed a logistic regression analysis to understand which are the factors that might influence the probability of a PF project to enter into the construction phase. The analysis was carried out after performing both classification of the observations in ordinal clusters and stratified sampling. On the one hand, logistic regression analysis is used for prediction of the probability of occurrence of an event making use of several predictors that may be either numerical or categorical (McCullagh and Nelder, 1989). On the other, stratified sampling is used to examine the empirical behaviour of a population. It is performed by taking random samples of strata of a data population and aggregating the resulting responses to produce estimates to the entire population (Mamay and Strauss, 1991).

5. 1 Exploratory analysis

Table 5.1 decomposes the sample PF Italian projects by type of service facility. For each category, the number of awarded projects, the associated size of investment, and the success ratio (constructed over number of projects ratio) are recorded.

	Number	Min size (K€)	Mean size (K€)	Max size (K€)	Construction effective	Construction not effective	Success ratio
Sport venues	63	450	6,280	42,494	52	11	82.54%
Utility facilities	59	57	10,402	166,430	43	16	72.88%
Social buildings	72	294	54,058	840,369	52	20	72.22%
Car parks	94	167	10,088	92,503	65	29	69.15%
Burial grounds	94	272	6,235	60,305	61	33	64.89%

Table 5.1. PF projects decomposed by type of service facility

Social buildings are the largest sized types of projects, while sport venues and burial grounds are the smallest ones. However, sport venues do demonstrate the highest probability to be constructed. On the contrary, burial grounds have the lowest success ratio. This proves that from this preliminary

exploratory analysis it is not possible to directly draw clear conclusions on the relationships between the success ratio and the size of investment.

Table 5.2 is a summary illustration of the dataset: the factors that are considered to have influence on the likelihood of construction are recorded with associated distributions. The columns report, respectively, the lower, the median, the upper quartile, the standard deviation and the frequencies of each cluster. The response variable measuring whether construction is effective or not (CE/NE) is a binary variable: 1 indicates the facility is built or under construction; on the contrary, 0 means construction has not started yet.

Factor	Acronym	Lower quartile	Median	Upper quartile	Standard deviation	Class 1	Class 2	Class 3
Population	POP	522	234,969	2,743,796	585,744	176	101	105
Investment Size	SIZE	57,243	16,848,162	840,369,560	69,295,628	216	136	30
Concession Period	PER	2	26.19	60	8.40	145	211	26
Interval	INT	19	46.28	78	18.07	150	140	92
Geographical Area	AREA					164	67	151

Table 5.2. Summary of the dataset

In particular, each factor is classified into three clusters. The Population in the municipality (POP) variable is defined as the number of residents in the urban area where the project is planned to be located. This represents a proxy variable of the catching population for the services associated with the facility. It is expected that the more the POP, the higher the probability of the construction to be effective. The cluster thresholds selected for this variable are indicated by the Italian law, namely, less than 20,000, from 20,000 to 100,000, and greater than 100,000 people.

The Geographical Area (AREA) variable identifies the area of Italy wherein the project is carried out. This is intended to explore if there is a relationship between the local area and the probability of a PF

project to be constructed. AREA is a categorical variable classified according to the Eurostat parameters, specifically 1 northern, 2 central, and 3 southern Italy.

The Investment Size (SIZE) factor is a measure of the extent of the investment expressed in euro amount. This variable is expected to positively influence the response variable: the larger the SIZE, the higher the probability that the project will enter the construction phase because of a few reasons: on the one hand, a large-sized project is meant to generate high revenues with subsequent high incentive for the concessionaire to start the construction; on the other hand, one large project is a easy way of communicating and proving the government capabilities toward the electorate rather than several small ones.

The cluster boundaries are set according to the standards issued by the Italian Authority for Public Contracts, namely: investments valuing less that 5 million, from 5 to 25 million, and greater than 25 million euro.

The Concession Period (PER) variable reports the duration of the concession during which the SPV collects revenues and runs operations. It is measured in years from the construction completion date. A longer concession period usually provides the SPV with longer chances to run a profitable project, therefore the probability of success should be higher. By the Italian law, the standard concession period should be as long as 30 years, but longer durations may be agreed whenever a longer period is necessary to cover the initial investment and provide the SPV for a reasonable return. Similarly, a shorter period is negotiated if profitability is quickly assured. Therefore, the PER cluster thresholds are as follows: less than 30, 30, and more than 30 years.

The Interval (INT) variable is referred to as the number of months from the point in time the project is awarded to observation (December 2010). This parameter has been included to consider that negotiation might take long and, consequently, as a way to take into account that more recent projects have lower success probability due to the short time elapsed from awarding to observation. It is

expected that the more the INT, the greater the probability that construction is initiated. INT is classified into less than 40, from 40 to 60, and more than 60 month-long clusters.

5.3 Logistic regression analysis

The goal of a regression analysis is to test if the independent variables are significant factors and whether they have positive or negative effect on the response variable. Given the binary nature of the response variable at issue, a logistic regression was performed. The aim of a binary regression analysis is to estimate the probability of occurrence of an event, that is the probability of construction to succeed.

Based on the population consistent with the total awarded projects, we conducted a stratified sampling. Each observation is classified according to a disjoint subset of the sample space called stratum, from which the sample is drawn. In our case we used a proportionate allocation by type of service facility and observations were randomly extracted to obtain a representative sample of the population and, thus, reducing the sampling error.

Table 5.3 shows the structure of the sample used for the logistic regression.

	total	relative frequencies	observations in the sample
Burial grounds	94	24.61%	25
Social buildings	72	18.85%	19
Sport venues	63	16.49%	16
Utility facilities	59	15.45%	15
Car parks	94	24.61%	25
Total	382	1	100

Table 5.3. Stratified sample

	Coeff	SE Coef	Z	P
Cluster POP	-0.39	0.34	-1.16	0.244
Cluster SIZE	1.04	0.42	2.47	**0.014**
Cluster AREA	-0.57	0.258	-2.22	**0.026**
Cluster PER	-0.038	0.41	0.1	0.924
Cluster INT	0.78	0.3	2.6	**0.009**

G- Test	20.04
Degree of Freedom	5
P-value	0.01

Table 5.4. Results of the logistic regression analysis

Results of the regression analysis are provided in Table 5.4, where columns report the estimate of the regression coefficient, the standard error of the regression estimate, and the Z value with associated P-value. Table 4 shows the values for the G-Test, the degree of freedom and P value too. AREA, SIZE and INT are significant factors of success, which means that they influence the probability that a PF project is built. G equals 20.4 and P-value equals 0.01 ensure the reliability of the model.

5.4 Discussions

The analysis results originate some considerations on the characteristics of the Italian PF market and on the main aspects that can influence the success of the development process of a PF project. In particular, it is revealed that location, size of the investment and time elapsed since awarding are significant predictors that influence the probability of ground breaking of a awarded project.

The negative relationship between the response variable and the AREA highlights that in the wealthy North of Italy a PF project is more likely going to be constructed rather than in central and southern regions.

The significance of the SIZE variable proves that the larger PF initiatives are more likely to be constructed. This confirms the mental model based on the assumption that for large initiatives, involving a lot of actors since they move and transfer relevant amounts of money, the probability of ground breaking is high. Moreover, since the administrative efforts for either small or large projects

can be considered as equivalent, it is more convenient to focus investment on large-sized projects. In this way, local authorities can testify their political and management acts to the voters. The positive influence of INT reaffirms that a long time from awarding to construction is required to perform negotiation and administrative procedures. This proves that the one-year period from awarding of the last project to the date of observation is not long enough and this is a limitation of the dataset, because still some of the most recent projects are likely to be constructed after the date of observation. On the contrary, the catchment population and the duration of the concession do not prove to influence the likelihood of building the facility.

6. Project Finance in Italian Hospital Projects

Some of the most popular PF applications can be found in the healthcare sector. Since the enactment of the PF contracting/financing mechanism in 1999, Italy has rapidly grown in its use of project finance (PF) to develop healthcare constructed facilities. As of May 2009, after only a decade of PF application, Italy was the second largest market in terms of both number and value of investments in healthcare PF initiatives, after the U.K. and ahead of all other European countries (Amatucci et al. 2010).

However, despite promises of limited public financing demanded to support PF projects, financially freestanding privately-funded PF hospitals are rare in Italy due to the public nature of the healthcare fee reimbursement system. That is why the capital structure of most projects requires considerable share of public funding, on average equal to more than 30 percent of the initial investment. Typically, investors are responsible for the arrangement of both equity and debt finance for the percentage of the initial investment that can be recovered with a fair profit through net income generated within the operations period, while the non self-financing part is paid by the conceding government (Zhang 2005a).

In addition, uncertainty and risk related to forecasted project cash flows play an important role in determining the capital structure. Indeed, the portion of investment covered with public funding also depends on the project risk profile and the strategy of allocating risk on the private party (Jin 2010), who will commit lower finance to a PPP project in case of high risk exposure. The apportion of public governmental-granted equity to the capital structure not only reduces the total amount of private finance required, but also allows for a higher debt leverage. In fact, the reduced demanded private financing is associated with smaller risk borne by the private investor, who is in turn asked a lower level of equity liability by the committed debt lenders.

As stated above, the appropriate amount of money invested by the government should cover the non-self- financing part of the investment costs, but it often happens that the level of public funding is sized over this limit. The justification of this notion is that the level of public financing serves as a coverage of the project risk profile. For this reason, an empirical model based on identification of the most important risks and associated indicators is developed in order to study the extent to which risks might affect the level of public financing in PF healthcare facility projects.

These aspects of PF healthcare projects have been raising questions among scholars and practitioners regarding how to create balanced benchmark of public financing to mitigate the private sector's risks in a project. However, the risk factors to be taken into account for determining a fair percent share of public financing to contribute to the capital structure of hospital PF initiatives are still unexplored.

With the purpose of overcoming the research gap, we present an empirical analysis of Italian PF hospital projects addressed to answer these questions. Based on the assumption that the capital structure and, in particular, the level of public funding is inherently associated with the project risk profile and allocation between the contract parties (Amatucci et al. 2006), the analysis explores the main risk factors that might have significant relationships with the ratio of public funding to the total amount of financial resources of a PF hospital project.

6.1 State-of-the-art of hospital PF projects in Italy

In Italy, the change in healthcare service provision (e.g.: shorter hospital stays, organizational change from specialties to level of intensity of treatment), the obsolescence of healthcare public infrastructures, and, overall, the limits imposed on public spending and shortage of public financing to carry out necessary investments, have called for the recourse to private finance to build new hospitals or to upgrade existing ones without an ex-ante evaluation demonstrating that this scheme would be more advantageous than traditional public financing (Barretta and Ruggiero 2008; Amatucci et al. 2006).

As of May 2009, based on consultation of the database published by the Italian national observatory of PPP (http://www.infopieffe.it), public healthcare authorities have put out to bid 42 hospitals and 29 support facilities, such as parking lots, hotels, and production of utilities since 1999. Out of the total 71 initiatives, 47 contracts were awarded to a concessionaire, with an investment totaling 3 billion euro. Among those, only 28 are reported to be awarded hospital facilities, which are today partly into the design phase, under construction, or in operations.

The majority of hospital PF arrangements provide for the concessionaire to maintain the infrastructure and operate auxiliary activities and commercial services, while the public agency manages and operates the core clinical service with their resources. Operations and maintenance (O&M) services typically apply to equipment, built assets and utilities; auxiliary services are related to catering, laundry, cleaning, waste management, security, and IT hardware systems; commercial services might involve shops, parking lots, guest rooms, children daycare, etc. Only a few contracts require private O&M of healthcare equipment, IT software tools, medical gas systems, emergency and operation rooms, diagnosis, and other paramedical services (Finlombarda 2010). To benefit from O&M and, if applicable, paramedical services, the public agency typically pays the SPV an agreed-upon-the-contract service fee. On the contrary, the concessionaire collects fees from tenants and end users for commercial services.

As a consequence of the limited number and scope of contracted auxiliary and non-clinical services, most projects are reported not to have self-financing ability, so that public funds are necessary to cover the non self-financing portion of the initial investment. As of 2007, public sources of funds are on average 57% of the investment; hence, private financing captures the remaining 43%, which can in turn be decomposed into debt (38%) and equity (5%) capital, so that the debt to equity ratio equals about 88/12% (Amatucci et al. 2007). As of May 2009, public financing ranges from 0 to 81% of the total investment, with decreased median value equaling approximately 36%. Also, it is observed that large

projects have a higher share of public funding and a higher award rate: this fact indicates that a high level of public financing reduces the project risk exposure with resulting increased likelihood of the project to be successful and attractive for promoters and equity investors (Amatucci et al. 2007).

The research was carried out through the following steps. First, we identified the risk factors that might influence the level of public funding in PF projects. Second, we gathered data through both consultation of public databases and direct inquiries from local healthcare agencies. The dataset records information on public funding and the identified risk parameters of the PF hospital projects awarded in Italy from 1999 to May 2009. All initiatives total approximately 2.6 billion euro and the average size of projects is around 110 million euro each. Then, we conducted an exploratory data analysis and investigated the multicollinearity among the risk parameters. Finally, after assuming that the level of public financing is the response variable and the risk parameters are the independent variables, we completed a linear regression analysis to understand the relationship between the project risk profile and the capital structure.

6. 2 Identification of Risk Sources and hypothesis

Political and economic sources of risk come from the context of political events, government policies, and economic instability that could influence the profitability of a project and prevent capital from being committed to support investments (Sachs et.al. 2007). Doff (2008) defines this kind of risk as detriment due to potential changes in general business conditions such as market environment, and as loss due to change in competitive environment. Therefore, we express these risks by means of the 'Investment environment' indicator to analyze the political/economic context wherein the project is developed. The Investment environment is measured by way of three parameters, namely Location (Loc), Healthcare Infrastructure Index (HII), and Public Borrowing (Borr).

The Location identifies the geographical area of Italy in which the project is located. This variable has been selected to represent differences in legislation and policies among various regions of Italy. It is used to understand if there is a relationship between the hospital location and the share of public funding. Location is defined as a categorical variable (1 North-West, 2 North-East, 3 Center, and 4 South of Italy).

The HII reflects the quantity of healthcare facilities and services in each geographical area: the higher the index, the more the local investment in healthcare services. Therefore, it is expected that a high HII determines the conditions for reduced public sources of funds assigned to the development of hospital facilities. The index is measured and provided by Unioncamere (2009) for each region of Italy. The average national index is set equal to 100, in which a lower figure indicates fewer infrastructures in the area.

The Borrowing parameter is used to take into account the healthcare policies that might be affected by the amount of public borrowing. Borrowing is the per-capita borrowing of the local healthcare granting agency expressed in euro, as reported by Amatucci et al. (2010). It is expected that the higher the Borr, the higher the public expenditure in the healthcare sector and, in turn, the lower the commitment of public money to the development of hospital projects.

According to Xenidis and Angelides (2004) financial risk has direct impact on the cash flow of the business plan in a way that endangers project viability or limits profitability. One of the most important drivers of financial risk in construction projects is the capital interest rate (Ling and Lim, 2007). Financial risk relates to the extent to which capital is easily obtained at an acceptable cost (Schaufelberger and Wipadapisut 2003). Consequently, we describe the financial risk by means of the 'Cost of capital' indicator, which is referred to as the ability of the concessionaire to privately finance the investment with both equity and debt sources of funds. In fact, a high level of private financing is likely to limit the need for public funding.

The Cost of capital indicator is measured through two variables: the Solidity of SPV (Sol) and the Banking and Financial Service Index (BFSI). On the one hand, Sol reflects the financial strength of the concessionaire: the more the solidity, the more the probability that the SPV can bring more equity and attract more debt capital at a lower cost. Sol is expressed as the annual revenue generated by the main partner of the consortium at the time the project was awarded, as recorded by Deloitte (2009).

On the other hand, the BFSI parameter represents the availability and accessibility of the banking sector. This index measures the number of financial institutions available in the project area. It is measured and provided by Unioncamere (2009). The average national index is set at a value of 100, so that a higher figure shows a higher liquidity that banks are willing to lend more easily to SPVs.

Market risk is related to the revenue fluctuation imposed on a project and it consists of a demand risk and a price risk. The demand risk is the uncertainty regarding the demand for the service provided by the completed project. The price risk is inherent with the fees that can be charged for the service; usually, fees are agreed upon the concession contract.

The Catchment Population parameter represents the potential demand for healthcare and related services. It is defined as the population in the area where the hospital attracts patients and visitors. We measure it through a proxy variable: the population living within the area where the hospital is located, as measured by Unioncamere (2009). A larger population potentially generates a greater demand, thus giving the SPV an enhanced capability to generate profits. It is expected that the more the population, the greater the governmental public aid to fund the initial investment.

The parameter Number of Services has been chosen to have an idea of the SPV's revenue stream. It is referred to as the number of types of granted services (e.g. maintenance, laundry, catering, etc.). The more the services granted, the higher the probability of cash generation and profitability for the private concessionaire so that the share of public financing is expected to reduce.

85

The Concession Period parameter reports the duration of the concession period during which the SPV collects revenues and runs operations. It is measured in years from the end of the construction. A longer concession period provides the SPV with a better opportunity to make the project profitable (Shen et al. 2002), which can entail a lower public funding.

Construction risk is inherent with construction schedule delay and cost overrun. Typically, the scale and complexity of the Project scope of work is a useful indicator of potential time delay and cost overrun: a large-sized project is likely to be complex to manage by reason of, for example, communication and coordination problems, and, in turn, likely subject to schedule delay and cost overruns (Santoso et al. 2003). The Project Scope indicator is therefore represented by two parameters, namely: Project Size (Size) and Number of SPV's Partners' (Parts).

On the one hand, the Size parameter measures the dimension of the investment expressed in euro amount. It is expected that the larger the Size, the more burden for the project promoters to raise private funds required for the project. Size shall have a positive influence on the percentage of public funding: in fact, a project that needs more financial resources would require a greater governmental commitment to fund the initial investment.

On the other hand, the Parts parameter is used to quantify the composition of the SPV. A fragmentation of the SPV composition can bring better risk sharing; however, this might also increase the possibility of contractual and management problem occurring (Trujillo et al. 1997). Therefore, it is hard to enforce a mental model to indicate which one of these two effects prevail in the relationship between the SPV composition and the role of public financing in the capital structure.

6.3 Regression Analysis

Table 6.1 summarizes the independent parameters that are supposed to have an influence on the capital structure of PF project financing (to get access to the complete dataset, please inquiry the

corresponding author). The columns report, respectively, the lower quartile, the median, the upper quartile and the standard deviation. The 'Location' is presented apart as a categorical variable.

In the model, Public Funding (PubFun) is considered as the response variable. This is defined as the percent ratio of public funding to the total initial investment. It ranges from 0 to 81% with median value worth approximately 36%.

	Acronym	Lower quartile	Median	Upper quartile	Standard deviation
Dependent variable					
Public Funding	PubFun	0	0.3645	0.81	0.219
Indipendent variables					
Healthcare Infrastructure Index	HII	55.11	109.1	135.27	24.52
Public Borrowing [€]	Borr	19	52	167	41
SPV Solidity [€]	Sol	108,000	749,715,155	3,703,000,000	1,111,684,234
Banking&Financial Service Index	BFSI	40.95	119.11	160	36.73
Project Size [€]	Size	860,491	110,549,478	409,459,958	93,603,041
Number of Partners	Parts	1	3	10	2.4
Catchment Population	CPop	161,444	1,672,838	4,337,979	1,484,726
Number of Services	Serv	0	9	20	4.84
Concession Period [years]	Per	10	24	38	6.67
Independent categorical variable		North-West	North-East	Center	South
Location	Loc	12	6	2	4

Table 6.1 . Summary of exploratory analysis for the dataset of hospital PF projects in Italy

Again we first explored the presence of multicollinearity among the predictors through the computation of the VIF.

	Loc	HII	Borr	Sol	BFSI	CPop	Serv	Per	Size	Parts
R^2	0.884	0.961	0.464	0.511	0.978	0.584	0.578	0.494	0.573	0.411
VIF	**8.621**	**25.64**	1.866	2.045	**45.45**	2.404	2.37	1.976	2.342	1.698

Table 6.2. Multicollinearity analysis of the complete model

Table 6.2 shows that multicollinearity exists in the model because HII, BFSI and Loc have a very high VIF. Therefore, multicollinearity is avoided by removing these predictors from the model (Table 6.3).

	Borr	Sol	CPop	Serv	Per	Size	Parts
R^2	0.126	0.248	0.462	0.483	0.176	0.471	0.269
VIF	1.1442	1.3298	1.8587	1.9342	1.2136	1.8904	1.368

Table 6.3. Proof that the model has no multicollinearity among predictors

After verification that the response variable is normally distributed, we run the linear regression analysis. Results are provided in Table 6.3 where the columns report the estimate of the regression coefficient, the standard error of the coefficient estimate, the value of the t statistic, and the p-value with associated level of significance.

Variable	Acronym	Estimate	Std. Error	t-value	p-value	Significance
Public Borrowing	Borr	0.00177	0.00062	2.87000	0.00110	**
SPV Solidity	Sol	0.00000	0.00000	4.53000	0.00000	***
Catchment Population	CPop	0.00000	0.00000	0.72000	0.48400	
Number of Services	Serv	0.02087	0.00548	3.81000	0.00200	**
Concession Period	Per	0.00784	0.00341	2.30000	0.03500	*
Project Size	Size	0.00000	0.00000	3.09000	0.00700	**
Number of Partners	Parts	-0.08550	0.01207	-0.71000	0.48900	

Multiple R-Squared		86.50%				
Adjusted R-Square		80.60%				
Constant		-0.2846				
Significance notation		0 ***	0.001**	0.01*		

Table 6.4. Results of regression analysis

Results reveal that Public borrowing, SPV Solidity, Number of Services, Concession Period and Project Size are significant factors of the level of Public Funding.

6.4 Discussions

The Public Borrowing variable has positive influence on Public Funding. This is against the supposed idea that a public healthcare local system with large debt can bring less initial share of Public Funding.

The SPV Solidity shows both a perfect relationship with PubFun and the highest degree of influence indicating that a solid concessionaire is also likely to take advantage of more public financing. This goes against the assumption that a solid SPV would need a lower public contribution to the initial investment. Then, the Number of Services factor has a positive influence on Public Funding. This finding denies the literature review and mental model, in the sense that we expected that more services are able to generate more cash flow so that public funding should be lower. The Concession Period variable has a positive relationship to Public Funding. On the contrary, we would have expected that a long concession period is a factor for the SPV to generate more cash flow so that the need for initial public aid is lessened. The positive influence of the Project Size on the response variable suggests that a large-sized and complex project is likely to demand a high percentage of Public Funding. This reaffirms the principle that large projects tend to have a high contribution of public equity on the total finance (Amatucci et al. 2007). In contrast, the relationships of the other significant variables are counter-intuitive, which means that significance is assured with different sign of influence than expected from the risk model, as follows.

First, large-sized capital projects, which are typically characterized by scope complexity and high risk, are likely to need large portions of public financial resources. In other words, public funds are intended to cover those risks that the private party is not willing or capable to bear, so that the financial burden largely fall on the public balance (H.M. Treasury 2003).

Second, the positive relationship between Public Borrowing and Public Funding indicates that public financing is necessary to develop PF hospital projects even though the local public healthcare system is indebted. Basically, it is revealed that PF projects are one of the few ways to develop new infrastructure that would not be possible with traditional contracting. In fact, traditional procurement requires public financing to cover the investment totally, while PF projects call for the public party to contribute only to the non self-financing portion.

Then, it is demonstrated that more financially robust SPVs are likely to negotiate a higher share of public financing than less solid concessionaires. In particular, the financial strength of the major shareholder of the SPV is a form of incentive for the public agency to inject more public equity into the investment. A probable explanation is that a solid SPV is considered a reliable partner capable to give assurance that the project will be efficiently constructed and managed. Also, a solid concessionaire is not expected to experience financial problems on the long term, so that granting authorities are confident that public equity is efficiently spent in a long lasting and effective healthcare service for the community.

Finally, both the Number of Services and the duration of the Concession Period appear to be tools to make a PF hospital project financially viable and attractive for private investors. In fact, regardless of the model expectations that a greater number of services and a longer concession would reduce the need for public financing, we observe that public sources of financing, which are intended to reduce the risk borne by the private sector, are likely to increase if also the number of services and the duration of the concession period increase, that is to say if the private risk is greater. In particular, the concessionaire's long-term risk of potentially delayed cash flow and late payback period is covered with initial public funding. Therefore, the number and variety of non-clinical services, long concession periods and considerable public financing are ways to face high levels of risk that the private party is unable to assume. Again, it appears that there is no efficient risk sharing between the parties and the public sector still need to carry a large portion of the effort.

In summary, because private lenders and investors do not tend to participate in risky projects unless they receive a high rate of return, the duration of the concession period, the variety of granted auxiliary services, and the amount of public funding are three substantial levers that granting authorities have in periods of public funding shortage to attract the contribution of private finance into hospital investments with low/medium rates of return. This confirms that PF projects, despite being valuable

contracting mechanisms to take advantage of the private sector's efficiency in service delivery, are likely to be inefficient and expensive hospital procurement systems for public parties because of the large non self-financing portion of the investment required. However, PF reveals to be currently one of the few available mechanisms to undertake public investments in periods of limited public financial resources.

The fact that only 8 hospital facilities have been built in Italy with traditional public financing/contracting mechanism (AVCP 2010) for the same ten-year period when 28 PF hospital projects have been developed is a further confirmation of our results and interpretations. In this context, the private sector is likely to gain contractual power and advantageous conditions in PPP agreements (Amatucci et al. 2007).

The model yields practical implications consistent with the interpretation of the empirical results. This study contributes to recognize how risks are shared between the public party and the concessionaire. In fact, all types of risk sources identified in the model are designated to have influence on the percent share of public financing at various degrees, namely: the political/economic risk linked to the level of public borrowing that affects the availability of public resources to undertake the total investments, the financial risk associated with the solidity of the SPV, the construction risk because of the dimensions and complexity of the project scope, and the market risk through both the duration of the concession period and the variety of granted services. In other words, the level of initial public financing is a primary way to reduce the burden of project risks on the shoulders of the private party. In addition, the proposed model helps to unlock the value of PF and gain an understanding of the extents to which benefits can be obtained from using PF to procure hospital projects and assess whether a PPP model provides better value for money than traditional public financing and provision of healthcare facilities and services (Mehta et al. 2010). Therefore, the proposed regression model might serve as an orienting study to refine decision criteria for determining the level of public funding in PF hospital projects.

Finally, this work might also be used as a template for an investigation that could be repeated in other countries.

7. PPP in Smart City

Nowadays, cities and megacities have to solve new kinds of problems, such as difficulty in waste management, air pollution, human health, traffic congestion, deteriorating and aging infrastructures (Chourabi, et al., 2012). Moreover, in 2008 for the first time in human history, people living in cities have overcome people living in rural areas, and United Nations have forecasted that 70% of people will live in an urban setting by the year 2050. As a result, cities have assumed a key role in the urbanized world of the 21st century (Dirks and Keeling, 2009). The urgency of making a city a more sustainable and livable place calls public bodies to realize innovation and transformations at the urban scale. Furthermore, the high concentration of people could be a source of cultural, political and economic strength and cities can act as talent magnets and incubators of innovation and, in turn, as main engines of economic growth (Berthon et al., 2011).

7.1 Definition of Smart City

The need of innovation is strictly related to the challenges cities are facing. Today, there is not just a clear and unique definition of SC that is universally accepted (Chourabi et al., 2012). Its main focus seems to be on the role of ICT infrastructure, but also, as much research underlines, a SC relies on key factors such as human capital, education, environmental interest, social and relational capital for urban growth (Caragliu et al., 2009). Harrison and Donelly (2011) state that the notion of SC is not new, since it recalls the policies for urban planning and has been used since the early 2000s for the application of new systems to integrate data and operations of urban infrastructures and services as buildings, transports, public safety, water and electrical distribution. Their definition states that a SC is a city connecting physical and IT infrastructure, social and business infrastructures to leverage the collective intelligence of the city. At present, the concept of a SC seems to include fairly any form of mainly

technology-based innovation in the cities. Giffinger et al. (2007) define a SC as a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living. According to Hall (2000) a city has to monitor and integrate conditions of all of its critical infrastructures to be considered as smart. Washburn et al. (2010) provide with a complete list of domains of application: in particular these are city administration, education, healthcare, public safety, real estate, transportation, and intelligent, interconnected, and efficient utilities. Based on these analysis it can be stated that the offering of new type of services and processes, primary based on ICT, should be accessible, efficient, saving generating, open, sustainable. Therefore, SC is a new paradigm of doing innovation, able to bring together the characteristics associated with organizational change, technological, economic and social development of a modern city, and to the interaction among citizens that are involved (Gonzalez and Rossi, 2011). This new paradigm of innovation marks a shift between more traditional ways of carrying out technology-push research and development, and the new approach based on user needs and bottom-up processes from citizens to IT services.

Each city is unique from the geographical, demographic, economics, cultural, and social point of view, but all the cities are joined by common characteristics. For this reason a taxonomiy of the field of application of a Smart City has been defined. Environment, transport and energy are the most common field in the existing literature (Chourabi et al, 2012; Correia and Wustel, 2009; Caragliu et al, 2009, Dirks et al, 2009; Giffinger et al, 2007; La Greca et al, 2011). Furthermore, buildings have become a crucial area since they have proven to be the main responsible for the emissions (Steria, 2011; Washburn et al, 2010). These aspects are basically related to physical infrastructures. At the same time there are several services that the public authority has to provide with the citizens such as health, education, safety, culture, welfare, and social inclusion.

Following the proposed taxonomy:

- Mobility & Transport;

- Energy;

- Environment;

- Building;

- Living;

- Government;

- Economy & People.

Mobility and Transport

Traffic congestion highlights the issue about the mobility of people and goods ensuring higher and higher service levels and at the same time, reducing the negative externalities for citizens. Basically we can identify the City Logistics, that is the process of optimizing the delivery of good urban areas, and System mobility that refers to new methods of transport people. Both City Logistics and System Mobility are based on the information management, through the development of smart solution that can be exploited by logistics providers and citizens. In Italy the external costs associated with the mobility equal about 49MLD €. There are mostly due to greenhouse gases, air pollution, acoustic pollution, congestion and safety. The current technology can be exploited in order to achieve significant improvements. In particular, the exponential diffusion of smartphones give a lot of opportunities in terms of information flow. In fact whereas some years ago traffic data could be collected only through tangible infrastructures, now they are available through different sources. Furthermore the new technology has permitted the interoperability of different services for the mobility (parking, bike sharing, car sharing, electric charger) that have to be coordinated.

Streetline is a platform that thanks to a technological infrastructure supports the users to find free parks. The concessionaries of the parks pay to be in the list when the user is looking for a park exploiting the

app in his smartphone. As well as the retailers are stakeholders of the initiative because they can join the app and they can give parking coupon together with their products. Drivers save time to find a park, traffic and CO_2 emission are reduced and purchases increase with positive effect in terms of fiscal flows.

Energy

Many European projects aim at an efficient utilization of energy sources and the research of new ones. Smart Grids integrate electricity grids in order to monitor the consumption of the users and in turn to supply electricity in a more sustainable and economic way. This domain in the energy field is the most promising. The modernization in production, distribution and management carried out through the information sharing is based on the involvement of new actors (monitoring, sensors, ICT companies, green energy producers). Moreover the citizen has a new role in the game, in the sense that with recent technologies he can be defined as a "presumer" (producer, consumer at the same time). All these new issues require a careful analysis of the existing business models that had been developed when the role of small players was not crucial as today. Nowadays we can observe barriers because of no-technological maturity, governance, lack of expertise, cost and revenue sharing mechanisms. The main challenge is to develop new business models that allow to exploit all the benefits among the stakeholders so that to make sustainable the investments and share equally costs and revenues based on the new value chain. San Josè has launched a program to replace 62,000 street lamps with "Intelligent Streetlight" that through LEDs can save up to 60% of the energy. The WAN (Wide Area Network) allows a real time control. 3 "micro-projects" have been firstly developed in order to evaluate the effective returns and reduce the uncertainty associated to the investment. "Better Place" is a project carried out in Denmark and Israel based on the idea to the electrical vehicles as storage of electricity. As a matter of fact in Denmark 20% of energy comes from wind, but the instable weather causes

problems of fluctuation. The main barriers to the diffusion of electric vehicles are the high cost of batteries (between 6,000 and 12,000€), demand picks during some certain time slots, significant recharge times, and life-cycle of batteries. The owners of electric vehicles lease the batteries, paying an annual fee based on the driven Km. Better Place develops areas for the quick replacements of batteries (from 3 to 5 minutes). The public authority finances the company that is sustained through equity and venture capital too. This brings to a reduction of costs to maintain the car and at the same time it allows a more flexible use of the vehicle. Furthermore social costs associated with CO_2 emission are reduced, and a new market can grow with consequent opportunities of profits.

Environment

This is based on practices of water management that allows a reduction of waste, and on the monitoring of air pollution through specific tools, in order to foster public initiatives supporting the environment. Refuses are still a black box, in the sense that very little information about the management of wastes once they are collected from containers. In Italy each day 120 l per capita of water are wasted because of the water channels. 32% of water does not get the final destination. This number underline the absolute need to carry out investment on the infrastructure in order to save resources and money. The technology is mature enough so that to coach sustainable and not risky investments. Waste management is more labor intensive, even if the first phases of the chain could be improved from a technological point of view. In particular RFID for rubbish could allow the traceability in order to complete a proper reuse or disposal.

Building

This domain is based on the integration of all those systems that aim at achieving a higher efficiency. The main fields of application are the energy management in terms of hard and soft solutions that allow an optimization of the consumptions, and the domotic that refers to the instruments that can improve

the usage of the building systems such as heating, air conditioning, fire control, elevators etc. A very recent domain of application is the smart appliances based on remote control. EU legislation 2012/27 fosters each country to define a long term strategy for the refurbishment of both residential and commercial buildings. In particular, 3% of public real estate has to be refurbished each year. Furthermore all new buildings has to be "almost zero impact" by 2021, and by the end of 2014 a national plan must be defined in order to fix all the assessment criteria. All the risks associated with these kind of initiatives are low and saving are relatively easy to be forecasted. This makes the investments sustainable for privates even if some issues could be arise, in particular the reduction of energy consumption. This situation could be overcome through tax break (ex-ante), incentives associated with the positive effects (ex- post).

Living

This domain is associated with the services that the public authority is able to provide with the citizens. Basically there is the need to guarantee a more efficient healthcare, that is able to ensure treatments exploiting ICT and biomedical engineering knowledge. ICT has to foster welfare services and public safety. In the Public Safety domain horizontal platforms allow real time monitoring. The physical infrastructure (like cameras in the street) is already developed, but that is not enough, in the sense that the manpower cost required to ensure a proper monitoring is nowadays not sustainable. This activity (not value-added) can be carried out by technologies that signal dangerous situation through analytics. In this configuration, the main concern is not the technology *per se,* but the governance model between the different actors involved. As a matter of fact, privacy complains are very likely to arise. Furthermore cultural heritage needs to be appraised through the development of tourism services. Private initiative could foster tourism and culture. The Italian heritage should encourage investments and initiatives and the collaboration between public and private. The domains of application are mostly

public value driven, therefore the related initiatives need the support of the public authorities. In welfare sector the main issues are the assistance of eldest people (this cost is supposed to go up in the light of the higher average age of the population), and the administrative inefficiencies. Bolzano in north of Italy implemented a project called "Safe Living" oriented to old people. In their apartments some sensors have been installed for the monitoring of gas, water, humidity, and temperature. All the data are sent to a central platform that can identify a dangerous situation. Pay-back period is very short because initial investments are balanced by the savings associated with the reduction of the days of recovery in the hospitals. The project has increased the wellness thanks to a higher perceived safety.

Government

The exploitation of ICT can allow an easier fruition of services (e-Governement) and at the same time the participation of citizen to the administrative decisions (e-Democracy). Furthermore procurement public processes can benefit by ICT in terms of transparency and cost reduction. The initiatives in this field cannot be considered in a short period of time, but in a long horizontal perspective. Public authority can use public contract as a tool for innovation that can limit market failure and informative asymmetry. Furthermore, the challenge is to define a panel of indicator capable to measure the effect of the implemented projects.

Economy & People

It is the ability of the Public Authority to create a favorable environment for the development of companies and more in general of economic activities. In particular it is very important to sustain human capital that can (through research center, innovative start-up) finally develop the entrepreneurship of a city. With these kind of initiatives the source of income is not a physical infrastructure and this impacts the business model developed in term of risks. As a matter of fact the

savings that the project is able to generate are difficult to be computed. Therefore a possible solution is to operate to the fiscal leverage in order to stimulate these businesses.

Therefore it is important to identify proper business models for Smart City initiatives, based on the risk involved, on the cash flow generated and on the sharing of benefits, especially in a period of bad economy with limited public resources. The public involvement appears to be crucial in the sense that on the one hand has it has to avoid market failures and on the other hand the legislation could obstruct the development of new initiatives. In the light of the innovative nature of these projects the raising of capital could be difficult. For this reason new financial instruments can be used.

7.2 Sources on Financing in Smart City

The innovation path introduced by Smart Cities requires a lot of investments that cannot be financed just by public resources. Public funding is used in case of public utility and to overcome market failure, but there is the need of private investments even through institutional investors like pension funds. First of all there is the need of exploit the EU instrument in the light of 2014-2020 program. Therefore it is very important to facilitate private finance through Public-Private Partnership. Public authorities should create an environment that is business friendly in the sense that it is able to hold the private financing with economic, social and environment positive effects. Following the different European financial program that can be related to the Smart city issue.

Horizon 2020

Horizon 2020 aims at creating an European space for the research, with the involvement of private investments in those sectors that are considered as crucial for the competitiveness of Europe. The total funds of the program equals about 70-80MLD € is based on three pillars that are oriented to the collaboration between public and the private parties. Excellence Science (European Research Council,

Future and emerging technologies, research infrastructure), Industrial Leadership (ICT, nanotechnologies, risk finance, innovation for SMEs), and Social Challenges (Health and wellness, food safety, sustainable agriculture, safe and green energy, social inclusion).

COSME

COSME (Competitiveness for Small and Medium Enterprise) program has a budget equal to 2.5 MLD €. Its aims are:

- Make the access to financing for SMEs easier through the development of new financial instrument that are more suitable, based on the phases of their life-cycle;

- Create a good environment for the development of new business thanks to the development of the Enterprise Europe Network, that link more than 600 organizations in 60 different countries;

- Support the entrepreneurship in Europe in order to share good practices and expand business activities;

- Increase a sustainable competition among European companies;

- Facilitate the entrance in new markets for small companies.

Exiting small companies and young startups are the main actor that are involved in the program.

LIFE +

LIFE + is a financial instrument developed for the sustain environmental projects. The program has basically three main fields:

- LIFE + Nature and Biodiversity aims at the reinforcement of the general knowledge and awareness;

- LIFE + Environment and Governance to develop innovative methodologies, technologies and laws in the environment arena. . The goal is to implement an European politics for the environment.

- LIFE + Information and Communication for the diffusion of the awareness about environmental issues.

Structural Funds

- European Fund for Regional Development for the reduction of disequilibrium among different areas of Europe. Its priorities are:

  - Research, development and innovation;

  - Improvement of the quality of ICT

  - Economy with low carbon emissions;

  - Sustain to SMEs;

  - TLC infrastructures, transports and energy;

  - Efficient public administration;

  - Healthcare, social, and education infrastrure;

  - Urban sustainable development

- European Social Fund for supporting a European strategy for the employment and the social integration. In particular its main goals are:

  - Promotion of employment and the mobility of people;

  - Sustain social inclusion initiatives against poverty;

  - Investments on education;

  - Improvement the capabilities of the institutions and of the public administrations

Each European region can receive these contributions, based on this classification. GDP per capita lower than the 75% than the European mean (less developed regions), GDP per capita between the 75% and 90% of the European mean (transition regions), GDP per capita higher than 90% of the European mean (more developed regions). Programs are defined by the European Commission together with Central Governments and Regions.

- European Investments Bank aims at stimulating private investments. In particular there are:

  o ELENA (European Local Energy Assistance) to support local and regional authorities in the development of energy efficiency projects in order to achieve the Europe2020 target. The total budget comes from Intelligent Energy for Europe program and equals to 49 MLN €. Thanks a robust economic and technical plan the initiatives can attract private financing with leverage equal to 20.

  o JESSICA (Joint European Support for Sustainable Investment in City Area) is oriented to urban initiatives such as cultural heritage, urban infrastructures, refurbishments.

  o JEREMIE (Joint European Resources for Micro to Medium Enterprises) tries to make easier for small and medium companies the access to credit, thanks to equity share, loan, and warrantees. JEREMIE looks at the financial operators and not directly to the companies;

  o EUROPE 2020 PROJECT BOND INITIATIVE, has been launched in 2010 in order to stimulate large scale transport and energy projects. During the first phase 230MLN € have been invested for boosting the market and in turn collect fund for 4 MLD €. The action is defined as funded when there is a real contribution in order to reinforce the debt rating or unfunded is case of a recommendation credit letter to increase the credibility of the initiative.

o RSFF (Risk Sharing Finance Facility) is a mechanism that facility the access to credit for R&D projects for medium company in case of initiative about which it is difficult to raise fund.

According with the growing relevance of SCs and smart communities worldwide, in 2012 the European Commission has launched the Smart Cities and Communities European Initiative. The funding initiative proposes to pool resources to support pilot demonstrations of energy, transport and information and communication technologies in urban areas. In addition, several EU member states, as part of their declined digital agendas, are promoting and coordinating SC actions and projects.

In this context, governments and municipalities are called to invest for the development of SC initiatives in a period of economic downturn and unavailability of financial resources. Public funding is no more sufficient to sustain SC projects and traditional models for financing utility and facility projects are often inadequate because of high risk profile and intangibility of SC innovation projects. In this contest, the injection of private funding becomes necessary and PPPs appear to be suitable solutions for the implementation of SC initiatives. Therefore, the design of innovative PPP financial models must become an integral part of the planning of SC projects.

7.3 PPP Contracts for Smart City

Three are the proposed forms of PPP that are suggested for potential usage in SC projects, namely: PF, RS, and SIB. As a matter of fact, the recourse to new forms of financing for projects of public utility, as SIBs, has been advised in Italy by the "Social Innovation Agenda" launched in March 2013 by Ministry of Education, University and Research. Under the terms of a typical PF, one or more investors join a special purpose vehicle (SPV) to finance the design, the development and the operations and maintenance of a public facility for a specified concession period, at the end of which the ownership of

the project is transferred back the public granting authority. During the concession period the private partner collects revenues from operating the project in order to recover the initial investment and get a profit (Schaufelberger and Wipadasut, 2003). The success of PF is based on claims that it provides for improved service due to private sector efficiency, reduced burden on public budgets to develop new facilities and risk reduction for the contract parties (Lattemann et al., 2009). In 2011 the main fields of operation are burial grounds, sport plants, and photovoltaic systems in terms of numbers. In terms of investments the main projects are streets, hospital and waste treatment infrastructures. It is clear that so far PF has been adopted with tangible assets. Moreover evidence shows that only 40% of projects have been able to achieve the ground breaking and the operations have been carried out only for 25% of initiatives. Usually 4 years and 10 months are necessary to complete the procedure, but in case of projects with an investment size higher than 50 MLN € this period can be up to 6 years. This time is significantly lower compared with the average time needed to complete an infrastructure in Italy.

RS is proposed as a second form of PPP for SC projects. In the commerce language, RS is a contract obligation for the retailers to pay a royalty on their sales to their suppliers. In this sense, this type of contract is able to align incentives among the vertical supply chain and among the actors involved. In fact, many supply contracts in vertically separated industries include revenue-sharing agreements where the downstream firms make royalty payments to the upstream firm based on the downstream sales (Dana and Spier, 2000). Fee established in a RS contract must satisfy two proprieties: first, it should be Pareto efficient so that no other allocation can offer better payoff for every actor involved; second, this allocation should not depend on the scale by which the providers' profits are measured (He and Walrand, 2006).

In the SC context, revenue sharing can be applied in a "zero cost" form, also named savings sharing. This means that involved partners share savings, and not revenues, generated by the new applied

solution. This model is able to foster the reduction of public expenditure and, in turn, free public funding for other socially urgent projects.

Finally, a third proposed PPP mechanism is the SIB. SIB can be defined as a contract arrangement where the public commits to pay for improved outcomes of privately-delivered social services to the private sector. Based on this contract, the necessary investment is raised from socially-motivated investors. Target outcomes can be gained also in terms of cost savings for the public authority and if they are achieved, investors will receive payments from the government that repays the initial investment plus a financial return that depends on the level of improvement of the resulting outcomes (Social Finance, 2011). If no improvement is gained on the provision of the service, no profit is remunerated to the social investors. This means that the private investors, rather than the government, bear the financial risk of paying for services (Rubin, 2011).

7.3.1 PF CASE STUDY

Description

This project under analysis pertains the realization of a project of smart lighting, for a city of medium-size of about 300.000 inhabitants. Nowadays the cost of electricity is more and more growing and savings are decisive aspects not only from an environmental point of view, but especially for economic reasons because of public spending's constrains. Moreover, energy savings are easy to be measured and are able to sustain PPP initiatives for the realization of new installations. Furthermore, street lamps could become the end point of a communicational network thanks to some options as hot-spot points, electrical recharge points, cameras, monitors for variable messages. The new street lamp uses LED technology that illuminates based on the intensity that is needed. The project also includes a platform for analytics and decision-making support. Finally, the tele-control system allows the detection and

management of system failures and the application of policies for light intensity regulation. The platform is able to manage maintenance interventions and the planning of supply.

Benefits associated with the project are the efficiency of energy consumption, savings for Public Administration, and in turn the reduction of cost for ordinary maintenance. The project considers a city of medium-dimension, with about 30.000 street lamps. Right now, energy cost for a street lamp is about 150 €/year and the cost of maintenance is about 20 €/year, for a total amount of 170€/year for street lamp. After the implementation of the project, energy savings are expected to be about 45% and maintenance savings can rise until 30%, therefore the total expenditure is about 75 €/year for each street lamp.

The form of PPP proposed is a PF, with the creation of a SPV, aiming at the realization of project activities. The investment, equals about 10 million €, is financed by debt leverage of different banks, and privates invest in the equity of SPV. The public Authority, thanks to savings obtained after the intervention, pays a fee to the SPV considering operative costs, debt rate and revenues for investors. SPV is still responsible for the investment and the maintenance of lamps, eventually subcontracted to EPC and O&M contractors. Finally, extra cash flows come from additionally services offered throw street lamps.

Applicability, weaknesses, and strengths

Requiring the conferment of tangible asset on which it is possible setting real rights, PF is more applicable in the case of projects with an tangible asset, such as street lamp. The main strength of the project is a clear separation between cash flows of the SPV and cash flows of investors. Moreover PF, realizes a risk allocation between public and private parts secondly the actor that is more able to manage them. Finally, SPV is an unique center of responsibility for the realization of all the activities of the project. On the other hand, PF requires more costs for due diligence, contracting, transactional

costs, debt with higher interest rates due to the risk of the project and to the complex mechanism of engagement between public and private parts. In addition , contracts are often inadequate to the project, causing controversies and failures.

PF can be effective for funding smart city initiatives because it is supported by digital instruments of aggregation for the participation and transparency and by systems of accountability and management.

7.3.2 Our pilot

Within the Research Programme *Smart City Finance and Technology*, the Polytechnic of Turin has launched a study project, aiming at defining a contractual and financial scheme, that can be replicable, for a project of energy efficiency. In particular the study has been focused on the replacement of traditional lamps of traffic lights with new ones using LED technology. The main objective of the study has been the analysis of the applicability of Project Financing (as described in the Italian Articles 153-160 "Codice dei Contratti", ex D.Lgs. 163/2006), usually used for projects with a certain dimension with strong tangible infrastructure as collateral (such as hospitals, parking lots), even for smart projects of energy efficiency with minus dimension. The project has been launched with the acronym P^4, which stays for Pilot Pubilc Private Partnership, on January 2013 and lasted almost 6 months.

The project consists on the realization of a Public Private Partnership (PPP), in the form of Project Financing (PF) for the upgrading of the traffic light park of a metropolitan city. For this reason and since the study was realized in Turin, for the implementation of the model figures relative to the city of Turin, a metropolitan city in the north-west of Italy, have been considered. The number of lanterns that were supposed to be replaced taken into account are equal to 14.062, exactly equal to the realistic figure in Turin.

The replacement of the old traditional incandescence lanterns with more modern LED technology ones allows the development of energy efficiency and increases the lamps' reliability. Furthermore, the

application of LED technology allows savings in terms of maintenance and energy costs, Also, the forecasted reduction of CO2 emissions, is expected to be about 3.000 tons/year. Finally, LED technology can be considered mature, because it is still in use for domestic purpose and indoor/outdoor lighting. As a consequence, we considered equal to zero the time-to-market and the activities of substitution can start as soon as possible.

The project also includes the substitution of regulators with new ones, at the same time of the substitution of lanterns. Regulators have the function of regulating energy consumption. An integrated and multidisciplinary approach has been carried out for the realization of the project. In fact, a work group has been instituted, with the purpose of involving different stakeholders, and each of them represents a center of interest and appears to be very suitable for the objective of the project. The Politecnico di Torino that acts as a facilitator for the experimentation and the study of the pilot project in the city of Turin. The project is still in the initial phase and it is related to the realization of a traffic light park that is intelligent and allows savings of electricity expenditure. As a matter of fact public lighting is one of the most critical services for public authorities. This is due to the fact that it is a continuous service by definition and at the same time it is facing higher and higher costs (increases up to 40% in the last 5 years) (Echelon, 2007). Furthermore in 2012, the expenditure in public lighting in Italy has exceed 1 MLD € and even some municipalities are trying to reduce this cost, we spend on average 100% more than the other European countries (Cielo Blu, 2012). The combination of high energy efficiency technologies with sensors and network data able to monitor on real-time the system allows to overcome many criticalities. Moreover thanks to the current level of maturity of the technologies it is possible to easily measure costs and savings. The project promoted by Polytechnic of Turin, involves different actors:

- the Municipality of Turin, that is the owner of the traffic lights and allows the testing in the urban area;

- the supplier of electrical energy;

- the Italian Public lending institution Cassa Depositi e Prestiti (CDP), that participates with debt;

- the Institutional investor Equiter, that participates with equity in the project;

- the legal advisor for the activity of contracting and of institution of the SPV;

- the vendor of technology Swarco Mizard, that offers his LED technology for traffic light;

- Polytechnic of Turin, as facilitator and coordinator of the working group.

The project considers the creation of a SPV, financed by debt by CDP and with equity by Swarco, Equiter and the energy supplier. The SPV repays interest to the lender and revenues to the investors. The SPV subcontracts the design, the replacement of the lamps and the improvement of the existing technology for traffic control to Swarco, while operations and maintenance are implemented by the energy supplier that already does it. The Municipality of Turin transfers the assets (traffic lights) to the SPV and gives guaranteed to the energy provider in order to allow the allocation of a part of savings to SPV by energy provider. The SPV is responsible for the replacement of the old lamps with new ones exploiting the LED technology, and for the O & M activities. In the SPV the O&M contractor – that carries out maintenance activities – and the constructor contractor – the vendor of LED lamps – are the equity investors. Banks and lending institutes support the SPV with loans.

Main costs and revenues of the project are:

- Fixed cost of supply and substitution of the lamps;

- Cost of energy consumption;

- Savings coming from the reduction of energy consumptions thanks to LED technology;

- Saving from more durability and reliability of the new lamps;

- Revenues from Energy Efficiency Securities (TEE) that reward the realization of projects of energy efficiency;

- Cost for the use of incandescence lighting prohibited by EU.

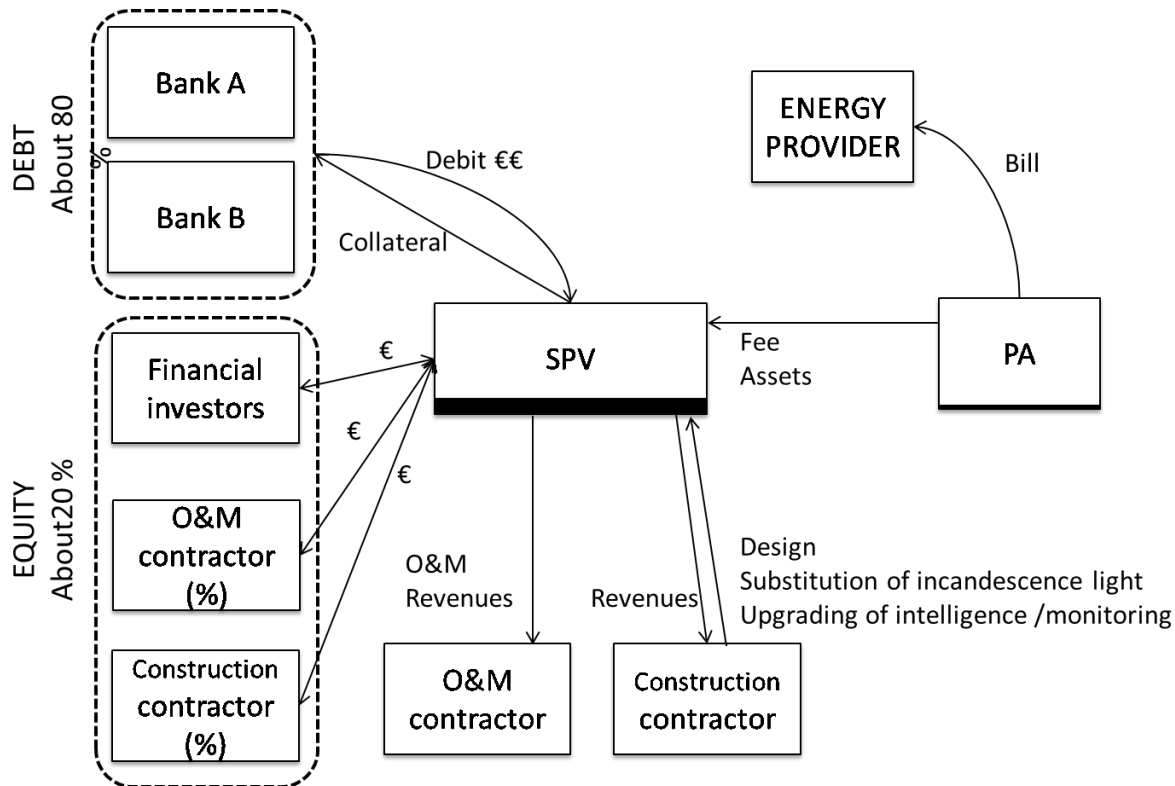The scheme of the financial model is presented in the following figure.

Figure 7.1 Contractual Scheme of PF project Pilot

The initial investment equals 9.600.00 €. This amount of money is distributed over three years and it is composed as follows:

- 5.200.000 € : Purchasing and installation of the new LED lamps;

- 2.500.000 € Installation of new regulators;

- 1.100.00€ : Design and Consulting fee;

- 790.000 €: Administrative activities;

- 31.000 € asset acquisition.

The definition of the capital structure of the project coaches on the results of the previous empirical analysis, in the sense that it has been proven that a careful analysis of the main risks can actually optimize the capital structure of a PF project. The idea is that SC projects, representing a promising field of investment, can fit the PF scheme. Therefore the main risks involved have been considered. In particular the Country Risk does not seem to be relevant, since Italy can be considered a developed country. The Financial Risk is mainly associated with the solidity of the SPV and the inflation rate. The private partner can be considered robust from a financial perspective and the inflation is not expected to increase, at least in the short and medium term because of the global crisis. The market risk refers to the services committed to the privates, and to the duration of the concession period. In the proposed model the maintenance task is supposed to be carried by the privates and the contract lasts for 10 years. Based on these evaluations, the equity/debt ratio has been set at a level equal to 20/80, that is the most efficient one and represents the classical capital structure for a PF project (Schaufelberger and Wipadapisut, 2003). With this configuration the capital structure can be considered optimized. The periodical fee has been set considering that a concession period equal to ten years so that to make the unitary charge sustainable for the granting authority. At the same time the project does not appear to be complex too be managed, in the sense that once the new lamp are replaced the operational activities can immediately start. The low investment size makes the project more easily feasible and less risky especially considering that it is one of the first tests of application of PF in new fields, and this has a positive impact on the amount of the unitary charge.

The largest part of the costs is related to the purchasing and the installation of the new LED lamps and the new regulators for the monitoring and the regulation of the energy consumption. In particular, the total cost for the *Supply and Installation of new LED lanterns* is a construction cost and incudes two

different elements. First, the cost for the supply of the new technology, which is equal to the mean cost per a LED lantern (about 335 €), multiplied for the total number of lanterns. Then, the cost of the installation (about 35 €), multiplied for the total number of lanterns. Both the mean cost of a new LED lantern and the cost for its installation have been defined with the Operations & Maintenance contractor and the Vendor involved into the study.

The voice *Design & Consulting fee* includes costs related to the realization and the coordination of both the planning and the execution of the substitution, such as costs for services of design, consulting and construction.

General & Administration expenses refer to the costs of operations and are directly related to the implementation of the lamp's substitution. In particular, they include general expenses for about 5% of the total construction cost *Supply and Installation of new LED lantern*, plus 200.000 € of due diligence and about 200.000 € of success, arranging and commitment fee.

Finally, *Asset acquisition* refers to the acquisition of the asset. A residual value of 20€/per lamp has been supposed (even if the depreciation could be considered finished) for the evaluation of a charge for the Registration tax, calculated using a rate of 11%. This has been carried out in order to formalize the transfer of the ownership of the assets.

Based on previous analysis the main risks associated with this kind of initiative are the Investment Environment wherein the project is carried out. As a matter of fact we have demonstrated that the ability of a public authority to foster the private initiative is likely to decrease the periodical fee corresponded to the private partner. The main financial risk that has been taken into account is the Inflation Rate. This parameter negatively affects the equity portion of PF projects, and since in recent periods its values have been low in Italy, the equity corresponded in the capital structure of the project has been actually set at the 20% that is the typical share for PF initiative. This decision has been confirmed in the light of Construction risk, measured by the Investment Size. On the one hand it shows

a negative influence with the equity portion of capital, and coherently a positive impact on the initial public fund. However, the requested investment for the project under study is very low compared with the traditional PF. The main parameter of market risk is the concession period that has proved to negatively influence the periodical fee corresponded by the public authority and at the same time to positively impact the level of the initial public contribution. This result has suggested to propose a concession period equal to ten year in order to avoid the initial public funding and to maintain the annual fee at a sustainable level. In the proposed model some scenarios with shorter concession periods have been generated, but the profitability of the initiative was not guaranteed.

A transitional period of 3 years with the implementation of 33% of the investment each year has been taken into account. This means that the total amount of the traffic lights which will be upgraded within the first year of the project will be 33%, 66% at the end of second year and 100% at the end of the third year. As a consequence, the annual fee paid by Public Administration (PA) will be related to the progress of replacement. At the end of the third year, an amount equal to the total annual fee set in the model will be corresponded by PA. After that, the total and constant annual fee will be paid for 10 years. At the end of the decade, PA will bear only the costs of maintenance and energy, that in the meantime have been dramatically reduced thanks to the intervention of energy efficiency.

The equity/debt ratio has been set at 20/80. The debt structure is composed by senior debt facility and VAT facility.

Table 7.1 shows the expected savings generated by the project.

	Traditional technology	LED technology	Saving (%)
Annual cost for maintenance for each lantern	17,62 €	11,15 €	36.72%
Total annual cost for maintenance	248.000 €	157.000 €	37%
Annual energy cost for each lantern	115,76 €	13,93 €	
Total annual energy cost	1.600.000 €	196.000 €	87%
Annual total cost for each lantern	133 € (about)	25 € (about)	81%
Total annual saving	108 €/lantern (about) 1.500.000 €/year		

Table 7.1 Expected Savings generated by the project

The new technology can guarantee savings equal to 81% in particular thanks to the lower energy consumption of the LED technology that reflects on a significant decreased energy cost.

The model has been evaluated in two different scenarios. In the first scenario the fee corresponded by the public party includes the availability charge – that is equal to the total amount of savings generated by the project – and the maintenance costs. The fee in the second scenario is only associated to the availability charge.

Simulations show that in the first case the project is bankable and profitable. In fact the IRRE is equal to 12.60% and the DSCR before and after the service of taxes is always higher than 1, 1.38 and 1.32 respectively. The first academic result is the applicability of Project Financing in the case of medium-small size projects of energy efficiency, where the measurement of savings obtained is easy to implement and the total amount of general expenses is relevant respect to the total amount of the investment.

The results of the study originate some considerations about the applicability of PF to innovative projects. The first academic result is the applicability of PF in the case of medium-small size projects of energy efficiency, where the measurement of savings obtained is easy to be implemented and the total amount of general expenses is relevant respect to the total amount of the investment.

PF has proved to several advantages. First, it allows a better risk allocation between the public actor and the private one, as the risk is assigned to the part which is more able to bear it. As a consequence, there is a reduction of the probability of failure of the initiative. Then, the separation between the cash flows of the project and the cash flows of its participants and the SPV as the unique center of responsibility for the execution of the projects are others benefits of the application of PF. Furthermore, on the one hand besides the actual savings that are obtained can be reinvested, and on the other hand the application of this model allows the realization of projects of energy efficiency also in the cases of a gap in the know-how of the public party. In fact, PF is based on the participation of the private sector not only from a financial perspective, but also from technological point of views such as capabilities in project management.

In the proposed model, PA pays an annual fee for a decade, but in a period of economic constraints and crisis a new investment in capital account is attractive only if an effective possibility of savings' for the Public Authority can be achieved. This is the reason why a fee equal only to a certain percentage of the total saving gained has been taken into account. Furthermore in order to increase the attractiveness of the project for the public party, the time horizon should be no longer than 6-7 years, as results from surveys and dialogues with PA involved in the study. Furthermore, all the aspects associated with risks and guarantees are crucial. In fact, PA would prefer to link the annual fee to the performance level really obtained respect to the preventive evaluation, with the introduction of performances bonds and contractual constraints. On the contrary, also the SPV would like to receive a guarantee of the punctuality of public payments. The aspect of punctuality of payments really weighs on the level of return on investment required by the investors: the more the solvency risk, the more the level of the profitability that is desired.

The model that has been proposed for the Municipality of Torino, in the light of its feasibility, could be implemented in many other cities. As a matter of fact, this scheme can actually fit with both developed

countries, wherein the PF market is mature, and developing countries that strongly need infrastructure to deal with source more efficiently.

Finally, in general the application of Project Financing requires more costs related to transactional costs, due diligence and contracting. In fact, contracts are often inadequate to the project, because the governance and relation management in a multi-stakeholders contest are more difficult. It causes greater amount of disputes increasing the risk of failure of the initiative.

This work represents a preliminary contribution to the development of PF contracts for SC initiatives. Nowadays PF is more and more appearing as a tool for the financing of public infrastructures in the light of its overtaking the financial burdens imposed by public authorities and its ability to better provide with services and infrastructures. The adoption of PF schemes in SC arena is relatively new and its suitability needs to be deeply investigated. To this end a framework for the application of PF in a SC project is here proposed. In particular the attention has been focused in the energy field that appears to be a promising domain of future applications. The study proposes the implementation of a project associated with the replacement of the traditional lamps of traffic lights with new ones exploiting LED technology. This solution is able to guarantee significant savings in terms of both operational and maintenance costs. The results of the study reveal that even PF is traditionally adopted with infrastructures with strong physical assets that work as collateral, it can be a good solution for the implementation of innovative initiatives with lower investment size and with a significant intangible component. The capital structure of the model is affected by the results of the previous analysis that have been carried out. The main potential risk have been taken into account and based on this assessment, the structure 80/20, that is the typical scheme associate with PF initiative, appears to fit also in the SC context. The simulations that have been carried out prove the bankability of the proposed model and even the profitability of the project in case of a higher fee corresponded by the public authority can be easily achieved. This important result highlights the need for public institutions to

fully exploit all the potentialities offered by PF especially in a period of bad economy and financial shortage. As a matter of fact, there is more and more demand of innovative infrastructures able to facilitate the daily life of citizens, and feasible and sustainable financial schemes are strongly required. This study can be considered a model to be adopted in the development of PF schemes for SC energy application; in particular it supports all the stakeholders in the definition of the main aspects such as the capital structure and the expected cash flows so that to anticipate potential criticalities of a project. Future research will be addressed mainly on two different directions. The first goal is the real implementation of the proposed model, and then other fields of application will be investigated such as the transport and mobility one. In this way the goodness of PF for a SC will be completely validated.

7.3.3 RS CASE STUDY

Description

New solutions offered by ICT allow the achievement of efficiency, the improvement of financial result and the release of economic resources of Public Administration. ICT and the application of a revenue sharing model between public actor and vendors, permit the realization of improvements without the inscription of new costs on the public balances. As a matter of fact, Public Administration repays his supplier, by means of a part of savings generated by the new implemented solution , for a certain period of time necessary for the payback period in addition to revenues for the vendor. So that, implementing a revenue sharing model in the form of savings sharing, it becomes possible for the Public Administration to realize a smart project at zero additional costs. After this period that is taken into account, Public Administration takes advantage from all amount of savings. IBM has presented a model in three fields of application: fiscal evasion, management of public assets and improvement of use of ICT resources for new services for citizens. The use of instruments of intelligence in these field increases the speed and the efficiency of process of detection, inspection and recovery of lost resources.

The project achieves the reduction of fiscal evasion by the improvement of cadastral folders, guaranteeing not only the recovery of lost revenues, but also extra cash in. The improvement of the management of public assets through the development of competences of urban facility management allows the assets to generate more revenues. The improvement of the use of ICT resources, such as the dematerialization of papers or the supply of new services thanks to the application of sensors in the city for example, increases savings and efficiency.

Applicability, weaknesses, and strengths

Revenue Sharing is a paradigm well applicable where all the actors of supply chain (add ref) are clearly identified and revenues are easy to be shared. Lastly, Revenue Sharing is applicable in those cases wherein sharing revenues or savings allows the alignment of the objectives of the different involved stakeholders, maximizing the overall profit, even if the single profit of each actor is not maximized.

The main advantage of Revenue Sharing is the implementation of smart projects without any additional costs on public balance. As matter of fact, the project is repaid through savings which it generates by itself.

After all, a Revenue Sharing model requires a precise and detailed assessment of all costs of administration, implementation and of the entire lifecycle of the implemented innovation , including potential costs of the future. The other main criticality is the exact definition about the moment of payment in the sense that the public institution can correspond the shared savings when the inefficiency is identified or when the saving is actually got. It is fundamental to establish when the supplier acquires the right of obtaining his payments, in the light of savings generated by his solution. Lastly, the way of engagement between public and private actors by a legal point of view remains a central question.

7.3.4 SIB CASE STUDY
Description

SIB are financial instruments not diffused in Italy yet. Even if experts have started looking at SIB, the Italian system has not regulated them so far. There are some first examples of social bonds, that are not social impact bonds. In fact with Social Bonds a little percentage of the capital collected by the emission is devolved to a social project, independently from the achievement of target output defined before. In this sense, Italian Social Bonds are not output oriented and they are not Social Impact Bonds. An important case of SIB application is in Great Britain, where there was the first case of SIB emission. It was implemented in Peterborough in 2012 aiming at the reduction of recidivism rate of offenders serving short prison sentences, less than one year. SIB were funded for an amount of about £5 million mainly by foundations and charities, but also by private individuals, through the finance intermediary Social Finance. If members of Peterborough are reconvicted less than offenders in a comparison group not subjected to SIB intervention and taken as a target, in the year following the release, the Ministry of Justice and the society have less crime and less costs of policing, court cases, prison places. If Reoffending has reduced by at least 10% for each cohort, compared with the target group, the Ministry of Justice and the Big Lottery Fund would have paid a return on investment to SIB investors.

Stakeholders involved in SIB launch were Ministry of Justice, the Big Lottery Fund, prisoners, Social Impact Partnership, Investors, Providers (St Giles Trust), Peterborough Prison (Disley et al., 2011).

Applicability, weaknesses, and strengths

SIB are applicable in contests where the Government aims to prevent social crisis with a project involving a target group of people clearly identifiable. The applicability requires adequate measurement system, that is robust, objective and comparable with target values, and sufficient revenues or savings to repay interest rates to investors. SIB application fields are reduction of recidivism, rehabilitation of disadvantage people, health, disability, assisted living.

The main strength of the application of SIB is its ability to overcome limits of innovation development for social issue, because it is strictly oriented to outputs and prevents that not successful projects with little social impact persist year by year. Moreover, with SIB application the public sector is more incentivized to invest thanks to the transfer of a part of risk to privates. Lastly, SIB allows capitalization of competences adding dynamism in the public sector, traditionally static.

On the other hand, SIB requires more costs for assessment and contracting among involved parts . Furthermore it is necessary an accurate analysis to calculate revenues for investors. Finally, the obtained outputs are not only economical but especially social.

There are other financial instruments that can be adopted in the Smart City arena:

- MiniBond: they are obligations that allow SMEs to get capital markets. In Italy, according the law 147/2012, their emission can be put into effect with the assistance of a sponsor like a bank, through a society with the balance sheet that is accredited by a third authorized company;

- Venture Philantrophy: it is based on the same model of the venture capital but it refers to the no-profit for the realization of social projects. The main actors are usually social investors, patrons, foundations, private equity funds, or social entrepreneurs. Compared to the traditional philantrophy that is based on short and small contributions, here there is a structure investment strategy. First of all the project is selected based on the its efficiency and on the opportunity to share knowledge among financers and promoters. Therefore, the contributions of financers is not merely economical, but also technological. Moreover, in this case we are in medium.long term horizon;

- Crowdfunding: this is a collective financing process through which many people can pay out to a project and therefore they are its supporters. It is based on transparency and on the active participation of a group people that share the same values and idea and they want to foster a real change. There are four different Crowdfunding platforms:

- o Reward- based: people that contribute to the project receive an award or a reward that can be tangible (e.g. the prototype of the product) or intangible (acknowledgement of a web site). 2/3 of the platforms are reward-based. The success is associated with the achievement of the target;

- o Equity- based: it works in the same way of an investment stock. A precise amount is defined and then it is split up in market share;

- o Lending- based: based on lending among privates or companies based on philanthropic objectives. The loan is then reimbursed with an interest rate that is lower than the traditional one of the traditional system;

- o Donation- based: it is just sustained by single donations.

A proper application of Crowdfunding is based on a preliminary analysis of goals, targets and times. A good communication strategy is also required. In terms of governance all the stakeholders (financers, proponents, users) are the owners of the platform. The proponent defines the characteristics of his idea and chooses the more suitable platform. Then, the target of money that is needed is set together with the horizontal period and the reward for the investors. The platform is here an intermediary, in the sense that it raises up the funds and it gives them to the proponent. The main criticism for Smart City initiatives is associated with the low awareness of citizens that implies a scarce interest for the projects. Moreover, initiatives are top-down, in the sense that the community is not actively involved. On the contrary, these kind of initiatives should be bottom-up, so that people can choose the most successful projects and they can be involved on its development.

7.4 PPP in the different Smart City Domains

Research, development and innovation are typically difficult to be financed through traditional instruments such as corporate debt. Empirical studies demonstrate that fundraising is the main constrain

for the development of innovation (Pencarelli and Menghi, 2004). The main reason is that the return of these kinds of initiatives cannot be always precisely forecasted. In particular, in a period of bad economy, the uncertainty of return is a risk that cannot be always born. One of the difficulties of raising funds is the asymmetric information. Firms are reluctant to invest because the inventor has frequently better information about the success and the nature of the innovation compared with the potential investors (Hall, 2002). Therefore the risk for investors is higher than in case of an ordinary investment and, as a consequence, the cost of the debt is greater. The issues of asymmetrical information arise with investment in intangible assets. In fact, the knowledge asset created by innovation is intangible and in part intrinsic in the human capital, while lenders and banks prefer physical assets as collaterals to secure loans. In addition, servicing debt usually requires a stable source of cash flow, which is more difficult in the case of a R&D investment (Hall, 2002). Often, innovative firms are in the beginning phase, when it is difficult realizing the risk assessment because of scarcity of data about past experiences. Furthermore, the absence of a secondary market for intangibles makes the investment an irreversible decision and increases the risk of financing (Pencarelli et al., 2004). In this sense, the marginal cost for obtaining debts for innovative firms increases (Bugamelli et al, 2011). The different forms of PPP could be a solution for financing these initiatives. They allow a more efficient risk sharing among parts, and there are not extra costs for the public institutions. However, the complexity of these financial instruments and the nature of developed projects foster the stakeholder to write down very precise contracts in order to avoid any kind of disputes that could jeopardize the output. Therefore, the development of contracts can be expensive, and the institutions have to evaluate these costs before to undertake PPP initiatives, in particular in case of projects of small size in terms of investment when the weight of assessment costs is higher.

However in this period of financing shortage, organizations are either unable or reluctant to use debt or traditional finance for innovative investments (Hall, 2002), limiting their capacity of fundraising. For

innovative firms new forms of financing that are appropriate to the characteristic of intangibility appear to be the main way to sustain innovation (Bugamelli et al, 2011). In this context it is very important for public authorities to be not merely a client, but to acquire several competencies in terms of technical, economical and financial feasibility, in order to understand the proper level of involvement of privates (ex-ante). At the same time monitoring and evaluation capabilities about the supplied services are required (ex post). In the Smart City environment this process appears to be very important but very difficult to be implemented in the light of the very innovative nature of those kind of initiatives.

After the analysis of PPP, the definition of the Smart City and its domains of application, for each domain the potential applicability of a PPP contract is described. In this way the innovation pattern associated with the SC issue is provided with the stakeholders. Table 7.2 shows the different domains of the SC and for each one the most suitable source of financing is provided.

	Buildings	Economy & People	Energy	Government	Environment	Living	Mobility & Transport
Structured Funds	X			X			
Project Finance	X	X	X				X
Crowdfunding		X					X
Horizon 2020		X	X		X		X
Project Bond					X		
Social Impact Bond						X	
Venture Philanthropy						X	

Table 7.2 Domains of Smart City and Sources of Financing

Buildings

We have already described how the technological maturity could ensure stable returns (in particular in terms of cost savings) especially in the energy efficiency area. The development of PPP in the energy issue is one of the main goals for UE , thanks to the Research and Innovation Program (the topic "Safe,

clean and efficient energy" is listed in Horizon 2020) and to the Structured Funds. Project Finance in the light of the real tangible assets seems to be very suitable with the buildings initiatives, except for domothic projects that are more difficult to be evaluated.

Economy and People

The Smart City issue is strictly related to the attention to the society and its people. Crowdfunding can support the development SMEs and mini-bond facilitate them to get loans. ICT infrastructures are nowadays a pillar in the urban development and they match with Project Finance thanks to the low level of risk. Horizon 2020 fosters the growth of urban platform, business models of which are still unclear and the involvement of private is more difficult.

Energy

Smart Grid is the main challenge of next years of the energetic urban arena. Because of the significant innovation component, business models that properly allocate benefits along the value chain does not exist so far. Public lighting is based on completely different pillars in the sense that through mature technologies, a clear evaluation of the advantages together with stable demand can exploit PF contracts. As well as, photovoltaic systems have achieved a level of maturity that allows them to access the market capital and to exploit PF mechanisms. Wind and biomass plants do not guarantee enough sustainable investment so far and their financing can be performed through Horizon 2020.

Environment

Project bonds are advisable for hydro-channel refurbishment in order to reduce wastes. Solid wastes can be managed by privates through the European finances related to Horizon 2020.

Government

Public Authorities have to be considered as "Intelligent Customer" encouraging the innovation. The government issue is under the responsibility of central governments and its main driver is the public value, that can be sustained mainly through public finance.

Living

All the initiatives related to welfare are welcome for public institutions. Venture Philanthropy and Social Impact Bonds seem the most suitable tools in this field. The healthcare can be also associated with Social Impact Bonds. Actually in an early phase European funds can be exploited to develop tests and to evaluate the real benefits that are generated by the initiative. Then thanks to a SIB mechanism the project can be replicated with less level of risk.

Mobility and Transport

Innovative projects can be sustained by Horizon 2020. In case of huge projects, Project Finance is advisable, thanks to a physical infrastructure that can be considered as a collateral and to a toll that is usually paid to use the infrastructure (road, electric network to charge cars). Other initiatives such as car-sharing, bike- sharing, car-pooling, could be based on Crowdfunding.

This analysis shows that transport and energy are the domains that better fit PPP and in particular PF, thanks to a significant infrastructural component often based on mature technologies, to a huge cost savings and the need of considerable investment. A crucial factor is associated with the minimum efficient scale issue so that joining together different projects and in turn to make transaction costs sustainable. The bundling between similar projects (maybe carried out in different cities) with a similar risk profile could overcome this burden. The financial activities could be managed by an SPV holding and the operational ones could be completed by the single SPVs. In this way through the development of a project portfolio a diversification and mitigation of risks could be get with positive repercussion on the each projects. Beside the energy and the transport areas, welfare services, human capital, protection

of cultural heritage, are raising up, in particular in Italy wherein these topics assume significant relevance. A Smart City is based on enabling infrastructures, but also on human capital that is able to improve the quality of life. For this reason the emerging of new PPP forms, such as the Crowdfunding and Social Impact Bonds could be crucial for the solidity of the finances for the public authorities and for the growth and the sustainability of the society.

8. Conclusions

The need of increasing the level of both tangible and intangible infrastructure has recently run against the financial public shortage, the poor capacity of government debt and the need of an increased technical knowledge. These aspects have made the involvement of the private capital into the development of public infrastructures a necessary step. This thesis has deeply investigated the PPP with particular focus on Project Finance as a suitable solution to these issues. PF considered not only as a merely financial technique, but as a new paradigm and culture. PF represents a new logic that encompasses the involvement of new and different capabilities (private and public, central and local) that are able to sustain and guarantee the overall competitiveness. Therefore PF is not just a technical innovation, but it is a new managerial approach. In this thesis a deep analysis in the PF fields has been carried out, exploring different kinds of initiatives all over the world. In particular, based on a categorization of the main risks that are related with a PF initiative, some empirical analysis have been carried out in order to identify those risks that significantly impact the capital structure of a PF project.

The first analysis has been focused on the capital structure of toll roads, a typical infrastructure developed under the PF scheme. The size of the investment and the financial strength of the SPV have proved to have a negative impact on the level of equity. On the contrary, complex projects with long construction duration and numerous investing partners require more equity financing. The inflation rate also positively influences the level of equity because it increases the debt capacity in the light of the increased cash flow generation.

The study on the unitary charge paid by the public authority in the English market for the development of healthcare facilities has shown that a good political and economic environment can decrease public expenditure. Furthermore, small size hospitals that require less construction efforts and that are granted

for longer concession periods can be better exploited, with positive impact on the risks and in turn on a lower UC amount.

The attention has been then moved to the Italian market that has recently grown in the use of PF and it is currently one for the largest markets in the European Union. PF projects are often initiated, but the development process is not carried out up to the construction phase. Our study has shown that large-sized project, carry out in good market conditions are more likely to be completed, in particular whenever the involved parties have time to negotiate the contract provisions. The analysis of the Italian market has then investigated the healthcare sector and the public contribution for the development of new hospitals. The results has proved that the SPV solidity, the number of services that are granted to privates, the size of the investment, the concession period, and the public borrowing are significant factors of the financing required to deliver the hospital investment. The initial public support appears to be used as a way to reduce the private sector's risk and therefore to make the investment more attractive for private investors.

The analysis addresses to consider risk as an intrinsic factor affecting the capital structure of PF initiatives, and this highlights the need for exploring improved methodologies aimed at sizing the debt capacity of PF projects, in combination with the traditional financial covenants used by lending institutions. Therefore risks factors should be taken into account into future design models of PF initiative.

In particular, any source of risks that has been identified through the analysis of literature has proved to affect the capital structure of a PF initiative. A stable and favorable environment can decrease the amount of money requested in the light of the lower level of country risk. Furthermore, the SPV is crucial for the success of a PF initiative. As a matter of fact, the results have shown that the financial robustness of the SPV is a significant factor for determining the capital structure of a PF initiative. A

solid SPV reduces the risk associated with financing of a project and increases the borrowing capacity and higher public aid. The project risks are mainly associated with the number of partners in the SPV and with the size of the investment requested to carry out the project. Both this parameters show a significant impact on the capital structure, especially the investment size that can be considered as a PF leverage that reduces the equity share and increases both the public contribution and unitary charge, meaning that in case of huge investments, privates are not willing to born a big amount of risk. Also the concession period, which is a typical characteristic of a PF scheme, affects the structure of the capital of a PF initiative. This is a coherent result since the concept of PF is closely associated with the concession to privates that manage and operate the infrastructure for a certain number of years. Best results in PF can be achieved through the support of legislation that needs to be well structured and efficient.

The Italian market even largely uses PF to develop constructed facilities has not reached an adequate level of maturity. In fact, a discipline accomplishing technical aspects is still missing and the level of specialized skills in public authorities is still low. Improvements could arise from the spread of best practices in the sector and the activities of supporting and consultancy to governments and these structures could proceed to the definition of standards, increasing the margins of certainty of interpretation in a regulatory context of high complexity. The implementation of such practices would also help to reduce the costs that the individual public administration would otherwise incur to obtain the necessary skills and, in the medium term, to facilitate the dissemination of this know-how.

Based on the obtained results about the relevance of risk and the efficiency of the capital structure, the second part of the thesis focuses on the application of PF to innovative projects in particular to initiatives related to the Smart City agenda. In fact, one of the main constraints is the raising of capital, particularly in the current economic climate, wherein most of the cities are forced to cut budgets. In this

context PF can be a good instrument for levering limited public funding and at the same procuring new SC project. PF has already proved to be a solution for the development of traditional infrastructures, and basically, the idea the idea has been to apply this financial mechanism in a new field of application and testing its suitability. For this purpose several PPP initiatives have been analyzed in order to understand how PPP contracts work in innovative environment.

PF has been typically applied to large-scale projects (Esty, 2010) and it has still to prove its suitability to smaller-sized projects. The main reasons and drawbacks that have limited PF past applications are the high transaction costs for small and medium–sized projects, and the financial strength of the promoters (Bonetti et al., 2010). Therefore the usage of PF to develop SC initiatives should learn from previous experiences.

After the definition of the SC notion and the identification of its main domains and associated sub-domains, the most relevant sources of financing for SC have been analyzed, focusing of the PPP contractual schemes. Particular attention has been posed to PF, which is typically adopted to develop projects with a strong tangible component as collateral. As a matter of fact, a proper risk sharing and an efficient capital structure can make PF suitable in the SC field.

In this thesis, the PF is proposed to be applied in an energy project with a significant innovation component. In particular the purpose of the project is the replacement of the lamps of the traffic lights of the Municipality of Torino (Italy) with new ones that exploit the LED technology. This model is based on the idea that this kind of financial schemes can be adopted with innovative projects. Coherently with our study the capital structure of the project derives from a detailed analysis of the main risks involved.

In particular, the environment wherein a project is developed is a significant source of risk. As a matter of fact we have demonstrated that the ability of a public authority to foster the private initiative is likely

to decrease the periodical fee corresponded to the private partner. The main financial risk that has been taken into account is the Inflation Rate. This parameter negatively has proved to affect the equity portion of PF projects, and since in recent periods its values have been low in Italy, the equity corresponded in the capital structure of the project has been actually set at the 20% that is the typical share for PF initiative. This decision has been confirmed in the light of Construction risk, measured by the Investment Size. On the one hand the parameter shows a negative influence on the equity portion of capital, and coherently a positive impact on the initial public fund. However, the requested investment for the project under study is very low compared with the traditional PF. The main parameter of market risk is the concession period that has proved to negatively influence the periodical fee corresponded by the public authority and at the same time to positively impact the level of the initial public contribution. This result has suggested proposing a concession period equal to ten year in order to avoid the initial public funding and to maintain the annual fee at a sustainable level.

Two different scenarios have been generated: in both case the project appears to be bankable, but a certain profit is reached only if the fee corresponded by the public authority includes both the availability and the maintenance of the lamps. This analysis has allowed tracing some first general guidelines for policy makers in order to foster the development of SC initiative even in a period of financial public shortage. In particular, it demonstrates that PF can be useful in case of innovative initiatives that present a lower size of investment compared with the traditional applications, but at the same time the intangible aspects associated with innovation and technology are particularly relevant. A The proposed study proves a proper risk allocation, brings to a more effective capital structure and in turn to a better success of the project. Furthermore, PF contracts can stimulate the diffusion of smart initiatives thanks to the opportunity to relieve public budgets This aspect assumes particular relevance especially in a period of economic crisis and financial shortage. Nowadays in fact, public investment need to be efficient from a financial point of you and are expected to generate significant benefits for

people. In this context, PF can be considered one crucial leverage in the development of SC. The knowledge of privates is in fact fully exploited in order to provide more efficient services to citizens that require more and more quality. At the same time PF is able to ensure an acceptable level of profit to private investors, that are called to promote smart initiatives in the cities of the future.

References

Algarni, A., M., Arditi, D., and Polat, G. (2007). "Build-operate-transfer in infrastructure projects in the United States. *Journal of Construction Engineering and Management*", Vol. 133, No. 10, pp.728-735.

Amatucci, F. and Lecci, F. (2006). "Le operazioni di partnership finanziaria pubblico-privato in sanità: un'analisi critica." *Rapporto OASI 2006 L'aziendalizzazione della sanità in Italia*, E. Cantù, ed., SDA Bocconi Egea, Milano, pp.689-731.

Amatucci, F., Lecci, F., and Marsilio, M. (2007). "Le sperimentazioni gestionali per i servizi core: ricognizione delle esperienze e analisi di due casi." *Rapporto OASI 2007 L'aziendalizzazione della sanità in Italia*, E. Anessi Pessina and E. Cantù, eds., SDA Bocconi Egea, Milano, pp.325-370.

Amatucci, F., Favretto, F., and Vecchi, V. (2010). "Il finanziamento degli investimenti sanitari: il partenariato-pubblico privato su misura." *Rapporto OASI 2010 L'aziendalizzazione della sanità in Italia*, E. Cantù, ed., SDA Bocconi Egea, Milano, pp. 565-593.

Andersen, A. (2000). "Value for money drivers in the private finance initiative", *Arthur Andersen and Enterprise LSE*, London.

Andon, P. (2012). "Accounting-related research in PPPs/PFIs: present contributions and future opportunities", *Accounting, Auditing and Accountability Journal*, Vol. 25, No.2, pp.876-924.

Arditi, D., Isik, Z., Dilment, I, and Birgonul, T. (2010). "The role of exogenous factors in the strategic performance of construction companies", *Engineering, Construction, and Architectural Management*, Vol.17, No. 2, pp. 119-134.

AVCP Autorità di Vigilanza sui Contratti Pubblici (2010). "Consultazione estremi bandi di gara." <http://bandigara.avcp.it/AVCP-ConsultazioneBandiGara/> (Feb 1, 2011).

Bakatjan, S., Arikan, M., and Tiong, R. L. K., (2003). "Optimal capital structure model for BOT power projects in Turkey", *Journal of Construction Engineering and Management*, Vol. 129, No. 1, pp.89-97.

Barretta, A. and Ruggero, P. (2008). "Ex-ante evaluation of PFIs within the Italian healthcare sector: what is the basis for PPP?", *Health Policy*, Vol. 88, pp. 15-24.

Berthon, B., Massat, P., and Collison, S., (2011), "Building and Managing an Intelligent City" *Accenture*.

Bicksler, J. and Chen, A.H. (1986). "An economic analysis of Interest Rate Swaps", *Journal of Finance*, Vol.41, No. 3, pp. 645-655.

Bing, L., Akintoye, A., Edwards, P.J., and Hardcastle, C. (2005). "The allocation of risk in PPP/PFI construction projects in the UK*", International Journal of Project Management*, Vol. 23, No.1, pp. 25-35.

Bloomberg (2009). "Unemployment at 10% to depress consumer spending, survey shows", <http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aSqyoDA4ePbg> (Oct. 4, 2011).

Bonetti, V., Caselli, S., and Gatti, S. (2010), "Offtaking agreements and how they impact the cost funding for project finance deals: A clinical case study of the Quezon Power Ltd Co.", Review of Financial Economics, Vol. 19 No. 2, pp.60-71.

Bugamelli, M., Cannari, L., Lotti, F., and Magri, S., (2011), "Radici e possibili rimedi del gap innovativo del sistema produttivo italiano", *Banca d'Italia.*

Caragliu, A., Del Bo, C., and Nijkamp, P., (2009), "Smart Cities in Europe. Proceedings of the 3rd Central European Conference in Regional Science", *Proceeding of 3rd Central European Conference in Regional Science CERS-2009.*

Carroll Rovezzi, S. and Carroll, D. J. (2002). "Statistics Made Simple for School Leaders", Rowman&Littlefield, Lanham, ML.

Centro Studi Confindustria (2011), "Dalle Infrastrutture Crescita e Competitività", *Scarieconomici*, No. 13, pp 81-120

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J.R., Mellouli, S., Nahon, K., Pardo, T.A., and Scholl, H.J., (2012). "Understanding Smart City Initiatives: An Integrative Framework", *Proceedings of the 45th Hawaii International Conference on System Scienc*e, *Maui,* HI, pp. 2289–2297.

Clifton ,C. and Duffield, C.F. (2006). "Improved PFI/PPP service outcomes through the integration of Alliance principles", *International Journal of Project Management*, Vol.24, No.7, pp. 573-586.

Correia, L. M., & Wünstel, K. (2011). "Smart Cities Applications and Requirements". White Paper of the Experts Working Group, Net!Works European Technology Platform.

Dana, D., Kathryn J., Spier, E., (2000), "Revenue sharing and vertical control in the video rental market", *Harward Faculty.*

Deloitte (2009). "Classifiche 2009 Cresme." *Costruire*, 318, Editrice Abitare Segesta, Milano.

Dias, A. Jr. and Ioannou, P.G., (1995). "Debt capacity and optimal capital structure for privately financed infrastructure projects", *Journal of Construction Engineering and Management*, Vol.121, No. 4, pp. 404-414.

Dirks, S. and Keeling, M., (2009), "A Vision of Smarter Cities: How Cities Can Lead the Way into a Prosperous and Sustainable Future", *IBM Institute for Business Value, Executive Report 2009.*

Dirks, S., Keeling, M., & Dencik J. (2009). How smart is your city. IBM Institute for Business Value.

Disley, E., Rubin, J., Scraggs, E., Burrowes, N., and Culley, D., (2011), "Lessons learned from the planning and early implementation of the Social Impact Bond at HMP Peterborough", *RAND Europe.*

Doff, R. (2008). " Defining and measuring business risk in an economic-capital framework" *Journal of Risk Finance*, Vol. 9, No.4, pp. 317-333.

Esty, B., and Sesia, A. (2010). "An overview of Project Finance and Infrastructure Finance- 2009-Update", *Harward Business School*, Note 2010-061, June 2010.

Financial Services Authority, (2004). PPP Forum, London

Financial Time, (2009). "*Market and Data Home*". Available at: <http://markets.ft.com/ft/markets/companyResearch.asp> (May 23,2009).

Finlombarda (2010). "Osservatorio sul project finance in sanità IX edizione", *Finlombarda*, Milano.

Finnerty, J.D. (2007). *Project financing: asset-based financial engineering*, 2nd Ed., Wiley, Hoboken, New Jersey.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N. & Meijers, E. (2007). "Smart Cities: Ranking of European Medium-Sized Cities. Vienna, Austria: Centre of Regional Science (SRF)", Vienna University of Technology. <http://www.smart-cities.eu/download/smart_cities_final_report.pdf> (March, 10.2013).

González, J. A., & Rossi, A. (2011). "New trends for smart cities, Open Innovation Mechanism in Smart Cities". *European Commission within the ICT Policy Support Programme* <http://opencities.net/sites/opencities.net/files/content-files/repository/D2.2.21%20New%20trends%20for%20Smart%20Cities.pdf> Accessed 15.01.2013.

Grimsey, D. and Lewis, M.S. (2005). "Are Public Private Partnership Value for Money? Evaluating alternative approaches and comparing academic and practitioner views", *Accounting Forum*, Vol.29, No.4, pp. 345-378.

Hall, B.H., (2002), "The Financing of Research and Development", *Oxford Review of Economic Policy,* Vol. 18, No. 1, pp. 35-51.

Harrison, C. and Donnelly, I. A., (2011), "A theory of smart cities". *Proceedings of the 55th Annual Meeting of the International Society for the Systems Sciences*, The University of Hull.

He, L. and Walrand, J., (2006), "Pricing and Revenue Sharing Strategies for Internet Service Providers", *IEEE JSAC*.

Hellowell, M. and Pollock, A.M. (2009). "The private financing of NHS hospitals: politics, policy and practice", *Journal of the Institute of Economic Affairs*, Vol.9, No. 1, pp. 13-19.

Hensher, M. and Edwards, N. (1999). "Hospital provision activity, and productivity on England since the 1980s", *British Medical Journal*, Vol. 319. No. 7214, pp. 911-914.

Her Majesty's Treasury (HMT) (2000). *"Public Private Partnership The Government's approach"*, The Stationery Office, London.

H.M. Treasury (2003). *PFI: meeting the investment challenge*, London, The Stationary Office.

Her Majesty's Treasury (HMT) (2006), "Departmental Report 2006", St. Clements House, Norwich.

Her Majesty's Treasury (HMT) (2007). *"Managing Public Money"*, The Stationary Office, London.

Her Treasury (2011), Value for Money Assessment Guidance Institute for Fiscal Studies (2011). < http:77www.ifs.org.uk/fiscal/Facts/taxTables> (Dec. 2, 2011).

Hoffman, G. J., Thal Jr., A. E., Webb, T, S., and Weir, J. D., (2007). "Estimating performance time for construction projects". *Journal of Management in Engineering*, Vol. 23, No. 4, pp.193-199.

Holmes, J., Capper, G., and Hudson, G. (2006). "LIFT: 21st century healthcare centres in the United Kindom", *Journal of Facilities Management*, Vol. 4, No. 2, pp. 99-109.

Inflation data, (2011), *Current Annual Inflation Rate.* Available at: <http://www.fintrend.com/inflation/Inflation_Rate/CurrentInflation.asp> (Sept. 10, 2011).

Iyer, K.C. and Sagheer, M. (2010). "Hierarchical structuring of PPP risks using interpretative structural modeling", *Journal of Construction Engineering and Management*, Vol. 136, No.2, pp. 151-159.

Jin, X. H. (2010). Determinants of efficient risk allocation in privately financed public infrastructure project in Australia. *Journal of Construction Engineering and Management*, 136(2), pp. 138.150.

Khanzadi, M. , Nasirzadeh, F, and Alipour, M. (2012), "Integrating system dynamic fuzzy logic model to determine concession period in BOT projects", *Automation in Construction*, Vol. 22, No.3, 368-376.

Kumaraswamy, M. M., and Zhang, X. Q., (2001), "Procurement protocols for public- private partnered projects", *Journal of construction Engineering and Management*, Vol. 130, No. 5, pp. 670-679.

La Greca, P., Barbarossa, L., Ignaccolo, M., Inturri, G., and Martinico, F. (2011). "The density dilemma. A proposal for introducing smart growth principles in a sprawling settlement within Catania Metropolitan Area", *Cities*, Vol. 28, No. 6, pp. 527-535.

Lattemann, C., Stieglitz, S., and Schneider, A., (2009), "Impact of PPPs to broadband diffusion in Europe", *Transforming Government People: Process and Policy*, Vol. 3, No.4, pp. 355-374.

Ling, F. and Lim, H. L. (2007). "Foreign firms' financial and economic risk in China." *Engineering Construction and Architectural Management*, Vol. 14, No. 4, pp. 346-362.

Logan, T. M., (2003). "Optimal debt capacity for BOT projects in emerging economies", *The Journal of Structured Finance*, Vol. 9, No. 3, pp.71-79.

Mamay, C. and Strauss, T. (1991). "Effectiveness of Antithetic Samplig and Stratified Sampling in Montecarlo Chronological Production Cost Modeling", *Transaction on Power System*, Vol. 6, No.2, pp. 669-675.

McCullagh, P. and Nelder, J.A. (1989), Generalized Linear Model, Chapman and Hall.

Medda, F. and Carbonaro, G. (2007). "Public Private Partnerships in transportation: Some insights from the European experience". Available at: <http://sadapt.agroparistech.fr/ersa2007/papers/606.pdf> (2 Nov. 2 2011).

Mehta, A., Bhatia, A. and Chatterjee, A. (2010). "Improving health and education service delivery in India through public–private partnerships", *Asian Development Bank*, Mandaluyong City, Philippines.

Nevitt, P. K. and Fabozzi, F., 2000, *Project Financing*, Seventh Edition. London UK: Euromoney.

Ng, S. T., Xie, J., and Kumaraswamy, M. M., (2010). "Simulating the effect of risks on equity return for concession-based public-private partnership projects", *Engineering, Construction and Architectural Management*, Vol. 17, No. 4, pp.352-368.

O'Brien, R. M. (2007). "A caution regarding rules of thumb for variance inflation factors", *Quality&Quantity*, Vol. 41, No. 5, pp. 673-690.

Pencarelli, T., Droghini, D., Menghi, L., Patacchini, L., and Mariotti, S., (2004), "Studio/ricerca di forme di finanziamento innovative a supporto dello sviluppo di attività di ricerca e di trasferimento tecnologico", *Università degli Studi di Urbino*, Italy.

Pollock, A. M., Shaoul, J., and Vickers, N. (2002). "Private finance and value for money in NHS hospitals: a policy in search of a rationale?", *British Medical Journal*, Vol. 324, pp. 1205-1209.

Potluri, S.S., and Rajian A. T. (2010), "Merchant power plants in India: risk analysis using simulation", *International Journal of Energy Sector Management*, Vol.4, No.1, pp.87-112.

Posautz, G. (2012). "The proper taxation of Public-Private Partnership (PPP)", < http://www.wu.ac.at/steuerlehre/dwld/paper_gerald_posautz.pdf > (Jan. 4, 2012).

Rubin, J., (2011), "Evaluation of the Social Impact Bond -Lessons from planning and early implementation at HMP Peterborough", *RAND EUROPE*.

Sachs, T., Tiong, R., and Wagner, D. (2007). "Political risk quantification using fuzzy set approach", *Journal of Financial Management of Property and Construction*, Vol. 12, No. 2, pp. 107-126.

Santoso, D., Ogunlana, S., and Minato, T. (2003). "Assessment of risks in high rise building construction in Jakarta", *Engineering, Construction and Architectural Management*, Vol. 10, No. 1, pp. 43-55.

Schaufelberger, J. E. and Wipadapisut, I., (2003). "Alternate financing strategies for build-operate-transfer projects", *Journal of Construction Engineering and Management*, Vol. 129, No. 2, pp.205-213.

Shen, L. Y., Li, H., and Li, Q. M. (2002). "Alternative concession model for build-operate-transfer contract projects.", *Journal of Construction Engineering and Management*, Vol. 128, No. 4, 326-330.

Shen, L. Y. and Wu, Y. Z., (2005). "Risk concession model for build-operate-transfer contract projects", *Journal of Construction Engineering and Management*, Vol. 131, No. 2, pp. 211-220.

Scherrer, W and MCQuaid, R.W. (2010). "The role of public private partnership at the regional level of government and regional innovation policy in particular", <http://hum.ttu.ee/failid/HKAC%202011/HKAC_Scherrer.pdf> (Oct. 5, 2011).

Social Finance (2011), "A Technical Guide to Developing Social Impact Bonds", *Social Finance Ldt,* London, UK.

Steria-Smart City (2011). "Smart Cities will be enabled by Smart IT ". < http://www.steria.com/uk/fileadmin/assets/media/STE3899Smart_Cities_brochure_08_APP.PDF > (Feb. 10, 2013).

Tabachnick, B. G. and Fidell, L. S. (2001). "Using Multivariate Statistics", 3rd Ed., HarperCollins, New York.

Tiong, R. L. K., (1995). "Competitive Advantage of Equity in BOT Tender", *Journal of Construction Engineering and Management*, Vol. 121, No.3, pp.282-289.

Tiong, R. L. K. and Alum, J., (1997). "Financial commitments for BOT projects", *International Journal of Project Management*, Vol. 16, No. 2, pp.73-78.

Tofallis, C., (2008). "Investment volatility: a critique of standard Beta estimation and a simple way forward", *European Journal of Operational Research*, Vol.187, No. 3, pp.1358-1367.

Trujillo, J. A., Cohen, R., Freixas, X., and Sheehy, R. (1997*). Infrastructure financing with unbundled mechanisms, Inter-American Development Bank*, IFM-109, <http://www.iadb.org/sds/doc/1208eng.pdf> (July, 25, 2009).

Unioncamere (2009). "Atlante della competitività delle province e delle regioni.", <http://www.unioncamere.gov.it/Atlante/> (Oct. 25, 2010)

Walker, C. and Smith, A. J., (1995). "Privatized Infrastructure: The Build Operate Transfer Approach". London: Thomas Telford.

Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N. M., & Nelson, L. E. (2010). Helping CIOs Understand "Smart City" Initiatives: Defining the Smart City, Its Drivers, and the Role of the CIO. Cambridge, MA: Forrester Research, Inc. < http://public.dhe.ibm.com/partnerworld/pub/smb/smarterplanet/forr_help_cios_und_smart_city_initiatives.pdf > (May, 5, 2013).

World Bank (2011), "Wordwide Governance Indicators". <http://info.worldbank.org/governance/wgi/index.asp> (Sep. 8, 2011).

Xenidis, Y. and Angelides, J., (2005). "The financial risks in build-operate-transfer projects". *Construction Management and Economics*, Vol. 23, No. 4, pp.431-441.

Zayed, T. M. and Chang, L., (2002). "Prototype model for Build-Operate-Transfer risk assessment". *Journal of Management in Engineering*, Vol.18, No. 1, pp. 7-16.

Zhang, X., (2005a). "Financial viability analysis and capital structure optimization in privatized public infrastructure projects". *Journal of Construction Engineering and Management*, Vol.131, No.6, pp.656-668.

Zhang, X., (2005b). "Concessionaire's financial capability in developing build-operate-transfer type infrastructure projects". *Journal of Construction Engineering and Management*, Vol. 131, No. 10, pp.1054-1064.