Risks, Contracts, and Private-Sector Participation in Infrastructure

Rui Cunha Marques[1] and Sanford Berg[2]

Abstract: This article examines how risk is reflected in infrastructure regulatory contracts, using examples from water utilities to illustrate key points. Partnerships between public and private sectors in intensive capital network services require risks to be assigned to the contractual party that is better able to mitigate them or to bear them. After identifying risks that must be addressed in infrastructure contracts, their classification, allocation, and impact are presented along with the measures to minimize risks. Two contracts in the water sector in Portugal are analyzed. One arrangement corresponds to a public–private partnership (PPP) of the purely contractual type (concession arrangement) and the other to an institutionalized PPP (mixed company). We conclude that risk is a key issue in contracts with the private sector; an appropriate allocation of risks is a necessary condition for successful contracts. **DOI: 10.1061/(ASCE)CO.1943-7862.0000347.**

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Introduction

Infrastructure investments depend heavily upon private capital markets for financing and on private firms for managerial expertise. This paper examines the important role of risk allocation in bidding documents and contracts. Network industries are capital intensive: the success of partnerships between public and private entities requires that risks be assigned to the contractual party that is better able to mitigate or bear them. This paper uses private participation in water utilities to illustrate the importance of identifying, classifying, and assigning risks so that they can be borne and addressed by the appropriate party. Contracts that fail to address risk in a comprehensive manner raise the costs of infrastructure services (Akintoye et al. 2003a).

For several reasons, private-sector participation occurs with some frequency in the water sector worldwide [Organisation for Economic Co-Operation and Development (OECD) 2009]. Sometimes private water utilities are responsible for the operation of the whole water system (e.g., France or Spain); and in other situations, they only operate in part of the system (e.g., wastewater treatment plants, as in Delft, Holland, or in Brussels, Belgium). Both situations utilized public–private partnerships (PPPs). These arrangements are characterized by long-term duration and by underwriting substantial funding by the private sector. They are promoted as win–win agreements (Grimsey and Lewis 2004). Water and wastewater asset ownership in a few situations, such as in England and Wales, may be private, but usually the ultimate responsibility for the provision of water services belongs to the public sector (Marques 2010).

Regardless of the kind of private-sector participation, rights and responsibilities for the public and private sectors are almost always established in a written contract (Seppälä et al. 2001). These "regulatory contracts" can be a license (to the operator), a concession (or a lease contract), or the statutes of the firm and the shareholder agreement document. Contract design has a number of difficulties, with the assignment of risks being one of the most noteworthy (Crampes and Estache 1998). The imperfect allocation of risks constitutes one of the primary causes for the failures of private-sector participation (Marques and Berg 2010) or for its success when it is done adequately (Murphy 2008). Historically, there has been a perception that privatization could transfer all risks to the private sector. Political opportunism, currency shocks, and other unpredictable events have proved that this is not possible (Jin and Doloi 2008).

In addition to providing a vehicle allowing the public sector to contract for managerial expertise and acquire external funds, a key benefit associated with PPPs is the creation of mechanisms for assigning risks to the contractual party that is better able to mitigate or to bear them (see, for example, Hodge and Greve 2005; Yescombe 2007; and Delmon 2009 for analyses and discussions of the benefits and drawbacks of PPP arrangements). Efficient allocations minimize economic costs associated with such risks (Nisar 2007). Thus, substantial benefits can arise when public authorities contract with the private sector.

Although there are no definitive studies identifying the relative efficiency of private water utilities compared with the public ones (Marques 2008a), there is a consensus in the literature regarding economic savings from better risk allocations

[1]Associate Professor, Center for Management Studies, IST, Technical Univ. of Lisbon, Ave. Rovisco Pais, 1049–001 Lisbon, Portugal; formerly, Assistant Professor, Center of Urban and Regional Systems (CESUR), IST, Technical Univ. of Lisbon, Ave. Rovisco Pais, 1049-001 Lisbon, Portugal; and Visiting Scholar, Public Utilities Research Center (PURC), Univ. of Florida, P.O. Box 117142, Gainesville, FL 32611–7142 (corresponding author). E-mail: rui.marques@ist.utl.pt

[2]Distinguished Service Professor of Economics and Director of Water Studies, Public Utilities Research Center (PURC), Univ. of Florida, P.O. Box 117142, Gainesville, FL 32611-7142. E-mail: sanford.berg@cba.ufl.edu

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(Haarmeyer and Moody 1998). Moreover, in regulatory contracts, the flawed assignment of risks can lead to contract renegotiation. Such situations involve bargaining between the operator and the government in a noncompetitive (and, generally, nontransparent) environment. Since there are substantial differences in information, legal skills, and technical support, the private sector tends to benefit from renegotiations. In Latin America (with a sample of 1,000 contracts), 75% of the water-concession contracts were renegotiated within an average of 1.6 years (Guasch 2004). When the private sector bears more risks (such as those related to consumption forecasts), its equity is put at risk (Glaister et al. 2000); initial competition for contracts tends to result in bids that are realistic—reflecting the bidders' knowledge of their own capabilities and awareness of external risks. In such circumstances, low-balling and other opportunistic behaviors are avoided and the winning bid is less likely to be renegotiated. However, when the assignment of risk and responsibility is poorly done, renegotiation becomes part of the strategy of "winning" bidders, damaging the public interest.

Fig. 1 illustrates the value for money created with efficient PPP arrangements when compared to the conventional model of public infrastructure procurement. PPP incentives reduce the base cost because the private sector can capture residual savings (where the public sector has reduced incentives for cost containment). In addition, the contract-inefficiency risk associated with bad management of some risks by the public sector (such as construction risk) leads to higher costs when municipalities use the traditional infrastructure contracting. Risks do not disappear under traditional procurement—they are just passed on to customers and taxpayers when they are not mitigated. Thus, even with an extra financing cost and a realistic premium risk for taking on specified risks, the bottom line of total cost is lower in PPP projects when compared to conventional projects. Therefore, the net effect of a well-designed PPP is that customers benefit; they are not saddled with excessive base costs nor is there a flawed allocation of risk-derived costs, thanks to improved procurement procedures.

This paper focuses on the contractual risks associated with PPPs in infrastructure, drawing upon examples from water utilities. After this introduction, we identify the major risks in water-utilities contracts, classify them, and estimate the probability of their occurrence and associated impacts. We also describe measures to minimize impacts. Then, we briefly examine cases of two different PPPs in Portugal: a concession contract and a contract with a mixed company. The two PPP arrangements investigated are similar to those of other countries in Europe (e.g., Spain, France, and Italy) and worldwide (e.g., South America and Africa).

Managing and Sharing the Risk

Risk Analysis

The efficiency rule for allocating risk is quite simple. The public sector (e.g., municipality) should not transfer risks that are under its control to the private partner, nor should it assume the risks that are beyond its control (Akintoye et al. 2003b). The allocation of risks to the private partner tends to increase the price of the project, so it is essential to ensure that the public benefit of such transfers outweighs any increase in financial costs associated with risk-bearing (Quiggin 2004). Fig. 2 illustrates the optimal level of risk transfer, where the relationship depends on a case-specific mix of risks.

The principle that risks should be carefully defined and assigned to the right parties ex ante is well understood, but often ignored. The Eurostat in the European Union requires that in a PPP, for the purpose of public accounts, the private sector has to support at least two of the following three risks: construction risk, demand (consumption) risk, and/or availability risk. However, in the water sector, most contracts have clauses protecting the private sector from bearing such risks, while still ensuring economic and financial equilibrium during the contract. When, for example, it is established that a decrease (or increase) of 20% in the volume of water delivered leads to contract renegotiation, the public sector bears this risk. In addition, although the private sector does not bear this risk, it now has the opportunity to renegotiate without competition, recovering the lost revenues from the lower volume sold. Furthermore, the private partner may reopen other issues to its benefit. This circumstance by itself promotes opportunistic behavior, including optimistic bidding at the public-tender stage—so the winner's curse becomes a winner's blessing (Marques and Berg 2010). Fig. 3 indicates steps of a PPP risk analysis and evaluation: (1) identification of risks, (2) classification and allocation of risks, (3) evaluation of their probability, (4) quantification of their impact, and (5) delineation of measures for risk minimization.

There is evidence that the issue of risk allocation is critical in PPP contracts for at least three major reasons (Asenova 2010):

1. Improved risk allocation reduces economic costs,
2. It provides incentives for sound management of the PPP, and
3. It reduces the need to enter a renegotiation process.

Moreover, an inappropriate or excess transfer of risk to the private sector might reduce the number of bidders and foster the opportunism of the remaining tenderers (Zitron 2006). However,

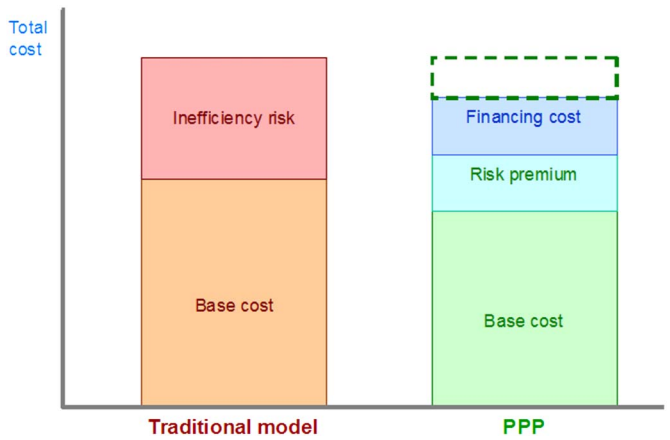

Fig. 1. Advantages of PPP model

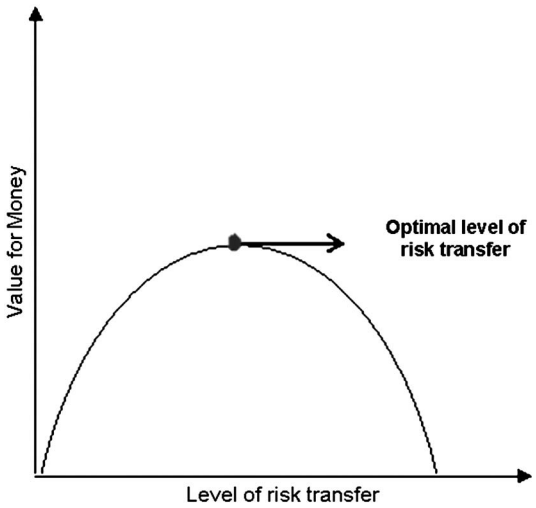

Fig. 2. Optimal level of risk transfer

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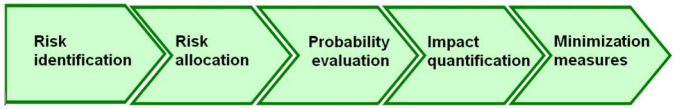

Fig. 3. Steps in risk analysis and evaluation

despite the negative connotation, risk is not necessarily harmful. Since it reflects the underlying uncertainty of developing and operating projects, risk presents both threats and opportunities (Froud 2003).

Identification of Risks

Risk is the effect of uncertainty on objectives (ISO 2009). From the standpoint of project management, risk relates to an uncertain event that, if it occurs, may have an impact on at least one project outcome (Project Management Institute 2008). Risk can be quantified as the probability of a particular event occurring multiplied by its corresponding impact level. Because of the centrality of risk identification and assessment, it is crucial that those preparing the contract identify and allocate risks before the public-tender stage. A risk matrix with contractual clauses addressing each risk should be provided to the bidders at the start of the process (Marques and Berg 2010). The bidding documents should limit ex ante situations that may lead to ex post opportunism. Inappropriate assumptions in aggressive bidding strategies include excessively optimistic population growth estimates and unrealistic forecasts of consumption per customer. Such behavior can lead less well-equipped firms to win bids, which harms the public sector because a bidder with realistic assumptions loses, and the winner will seek to renegotiate the contract when the assumptions prove false. The public sector is doubly harmed because the "wrong" bid might have been initially selected and renegotiation becomes unavoidable.

Renegotiation should be restricted to outcomes determined by developments that the private sector does not control and is not able to predict or mitigate (e.g., unilateral policy changes by the municipality or national government). For example, the public sector should normally be in a better position to extrapolate consumption forecasts (consumption/demand risk) from historical trends. Although revenues can be linked to rate design, customer growth, and consumption per customer growth, the private bidder has little incentive to incorporate such information in ways that will reduce the probability of its winning the bid (Vining and Boardman 2008a). Also, such renegotiation could be avoided if the duration of the PPP was variable or if the PPP was awarded on the basis of revenues obtained by the private operator (Engel et al. 2001). A municipality can also behave opportunistically to maximize the up-front rents or minimize initial tariffs. In addition, public officials would find it politically difficult to forecast that the resident population is likely to decrease in the future. So, upwardly biased predictions are likely to be acceptable unless another agency (like a sector regulator) has the ability to confront municipalities and/or the authority to disallow unrealistic assumptions.

Classification of Risks

There are different classifications of risks, depending on the authors and on the semantics employed. For example, Grimsey and Lewis (2002, 2004) consider at least nine risks for infrastructure projects: technical, construction, operating, revenue, financial, force majeure, regulatory/political, environmental, and project default risks. In their taxonomy, they categorize risks into global and elemental. The former includes the risks associated with the project agreement, including political, legal, commercial, and environmental risks; and the latter includes risks with the project per se, encompassing the construction, operation, finance, and revenue-generation risks. Note, however, that strictly speaking, these are not risks per se, but risk categories or risk sources, since risk as referred to (Project Management Institute 2008) is an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective (e.g., cost, time, quality). Thus, construction risk is a category rather than an event. Nevertheless, as most of the literature refers to it (and to the remaining), with this remark we retain the terminology.

In another study, Ng and Loosemore (2007) categorize risks into two major groups: project and general risks. Project risks comprise the events concerning the microenvironment associated with each project, and general risks are external to the PPP project itself. Li et al. (2005) propose a classification of risk into three categories: macro-, meso-, and microlevel risks. Macrolevel risks are externally generated and therefore not related to the project, whereas mesolevel risks are endogenous to the project. Finally, the microlevel risks comprise the risks borne in the procurement process; these are associated with stakeholder relationships and the differences between private and public perspectives. One way to systematically and comprehensively address the categorization of risk is through the risk breakdown structure (RBS), which consists of listing the categories and subcategories within which risks may arise for a typical project; the process allows the interested parties in a risk identification exercise to identify the many sources that project risk can bring about (Project Management Institute 2009).

Here, we suggest another categorization, dividing risks into production, commercial, and contextual risks. We think that this classification of risks is more consistent with practice while being quite intuitive: major protagonists are associated with each category. Some of these risks are associated with the bidding-process stage and others with the project-implementation stage. Although risks related to the production process are almost always best borne by the private sector, the commercial and contextual ones are mixed. However, they are often borne by the public sector, so risk mitigation by the private partner is not optimal. Fig. 4 presents a classification of the most typical risks. The importance of each risk depends on the project and contextual environment under consideration (Ng and Loosemore 2007). Nevertheless, consumption (demand) and unilateral policy-change risks tend to be the most problematic ones in PPP infrastructure projects. The realization of negative outcomes associated with these risks often leads to contract renegotiation.

Allocation of Risks

The allocation of each type of risk should be assigned between the private and public sectors to promote economic cost minimization. Some types of costs could even be transferred directly to the customers, such as those related to new legislation (e.g., a new tax), avoiding the contract renegotiation and the associated opportunistic behavior (Williamson 1979). The allocation of risks depends on the particular project and on different contextual issues, such as the technical expertise available to the procuring authority, law and judicial precedents, the macroeconomic context, and others (Ke et al. 2010). As noted, risk should be allocated where it can be better managed; contractual partners should not maximize risk transfer at any price (Nisar 2007). The principle that Fig. 5 supports is that whenever the public party controls an event leading to a negative outcome, the public partner should bear the risk (e.g., those associated with unilateral changes in environmental rules or political regimes).

However, some risks affecting PPPs are generally always transferred to the private sector. For example, the allocation of risk of

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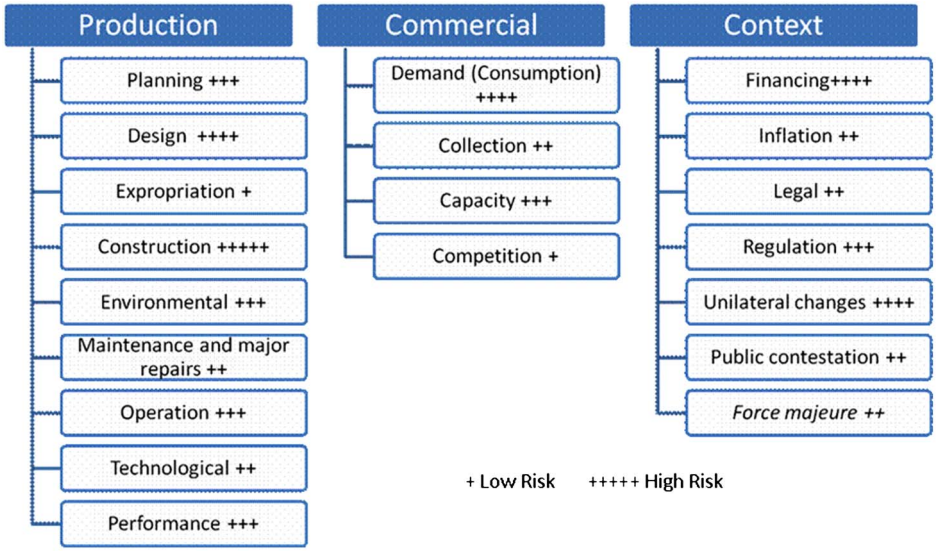

Fig. 4. Classification and importance of major risks

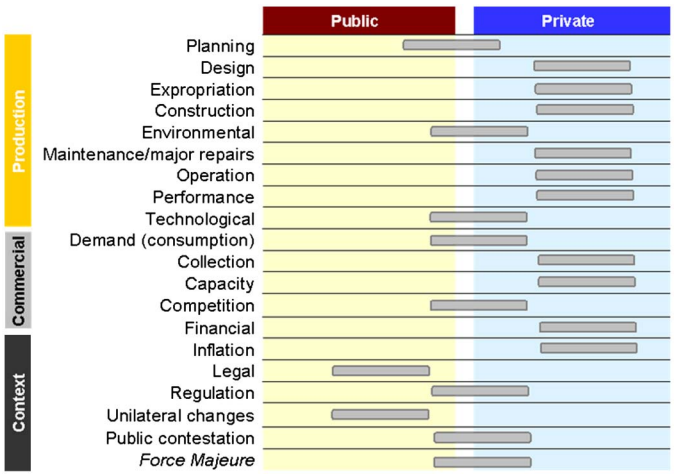

Fig. 5. Allocation of major risks

construction to the private sector reduces cost overruns and project delays that often characterize public works (Flyberg et al. 2002). In the United Kingdom, a study of the National Audit Office concludes that PPP projects were on time and on budget 76% and 78% of the time, respectively, as compared to conventional procurement projects, where the corresponding percentages are 30% and 27%, respectively (National Audit Office 2003). Moreover, payment to the private sector (by the government or the customer) only occurs when the assets are in operation, thereby incentivizing contractors to complete construction on time and within budget (Reeves 2003). Also, the demand/consumption risk described previously should be transferred to the private sector a priori or wherever possible. Nevertheless, there should be some caution when the volume of revenues depends on a large customer or a particular customer segment. Furthermore, some government policies can change the patterns of consumption, affecting the private partner's cash flows. This situation can be particularly serious in transportation projects (e.g., a parallel bridge is built or a new railway is subsidized that competes with a highway) but is unlikely in the water sector.

Other important risks such as design, operation, maintenance and major repairs, performance, or financial risks should be borne by the private sector, while others (e.g., regulation risk) depend on the particular circumstances. Indeed, the dilemma for the public authority is what to do about risks that neither party can control, such as force majeure (Lissauer and Robinson 2001). Loosemore et al. (2006) recommend that risks should only be transferred to or retained by the entity possessing five qualities:

1. *Awareness:* is fully aware of the risks it is taking;
2. *Mitigation and diversification opportunities:* provides evidence of having the capacity to manage the risk effectively and efficiently (because it has opportunities to mitigate and diversify risk, thus reducing risk);
3. *Technical skills and resources:* has the capability and resources to assess and evaluate risk;
4. *Risk tolerance:* possesses an appetite to take the risk; and
5. *Compensation for risk:* has the opportunity to charge the appropriate premium for taking risk.

On the other hand, it is unrealistic to formally transfer risks providing compensatory (higher) risk premiums when there is a high probability that risks will end up being borne by customers or the public partner (Ng and Loosemore 2007). Fig. 5 presents an illustrative risk allocation for a particular water project under a PPP arrangement. Note, however, that often the allocation of risks stems from asymmetries in bargaining power; the private partner has a corporate culture that draws on past experiences, whereas the public partner develops bidding materials once every couple of decades. In addition, the equity investor must meet the requirements of the debt holders for the project, incentivizing opportunistic behavior. In Portugal, some risks initially retained by the private party typically end up being borne by the public sector even before the contract is signed (between the awarding procedure and the financial close and the final negotiation of clauses). Similarly, ambiguities in the initial contract tend to be resolved in favor of the private partner. For these reasons, a risk matrix should be developed and published at the start of the initial public tender (Marques and Berg 2010) or at least risk allocation should be given some weight as an award criterion.

Probability and Impact Quantification

During contract preparation, each type of risk should be described, establishing and enumerating the different causes that may lead to its occurrence (Cooper et al. 2005). The probability of occurrence of each cause should be estimated and quantified as well as the

Table 1. Probability of Occurrence and Impact Level of Construction and Design Risks

Construction and design risks	Risk allocation		Probability of occurrence	Impact level
	Public	Private		
Increase in prices as a result of raw material price rise		X	Low	Medium
Delays in design		X	High	Medium
Quality gaps		X	Low	Medium
Uncertainty regarding geological conditions		X	Low	Low
Uncertainty regarding environmental conditions		X	Low	Medium
Difficulty in material supply		X	Medium	Low
Adequacy between infrastructure and objectives	X	X	Low	Medium

associated impacts level. A sensitivity analysis should be done for the different risks (including correlations between risks) to determine the robustness of the business case; focusing on cash flows helps identify the preferred bidder for the public tender (Grimsey and Lewis 2002). Cost implications of different risks and their corresponding allocation are central for the value for money of the infrastructure project and, consequently, for the creation of a PPP (in comparison to traditional public procurement). Table 1 presents examples of the risks affecting costs, efficient risk allocation, probability of occurrence, and the impact of such risks. The categorization depicted in the table is based on the writers' evaluations of over 20 such projects and would depend on the particular project, context, or geography. The probability and impact level are qualitatively presented on the basis of our experience; nevertheless, as noted previously, they should be estimated and quantified prior to the bidding process. These particular risks in traditional procurement are usually borne by the public sector (for example, with frequent delays and cost overruns); however, in PPP contracts, such risks tend to be allocated to the private sector (because construction is often its core business). Therefore, this allocation would only be a significant advantage of PPP contracts in comparison to traditional infrastructure contracting.

Identification of Mitigation and Minimization Measures

For each type of risk, contracting parties should develop strategies for mitigating that risk. Note that risk transfer does not eliminate the risks; it allows them to be better handled and a priori reduces their economic cost. Table 2 shows examples of minimization approaches for each type of cost. For instance, for inflation risk, minimization measures include indexing revenues to inflation, fixed price contracting, or forward contracts; such strategies reduce the probability of occurrence and potential impacts. Many of the risks are transferred to third entities by the private party through the special-purpose vehicle (SPV), which has closed contracts with contractors (construction risk), service delivery organizations (operation cost), and other providers.

The Public Management Institute identifies four response-planning techniques to address risk: risk avoidance, risk mitigation, risk acceptance, and risk transference (Project Management Institute 2009). Risk avoidance tries to eliminate the risk or to protect the project objectives from its impact. Risk mitigation seeks to reduce the probability of occurrence or impact of a risk below an acceptable threshold. Risk acceptance occurs when those designing the contract decided not to change the project to deal with a risk or

Table 2. Minimization Approaches for Each Type of Risk

Risks	Minimization approaches
Planning	Careful selection of project designers; increased detail in studies
Conception	Careful selection of project designers; realism in studies planning; auditing studies and projects; contracts with premiums and fines
Expropriation	Experienced work teams; project compatibility; fixed-price contracting
Construction	Strict management; fixed-price contracting; insurance contracting
Environmental	Sensitizing actions; supervision and research; pressure near the authorities
Maintenance/repairs	Association to specialized companies; fixed-price contracting; insurance contracting
Operation	Association to specialized companies; fixed-price contracting; insurance contracting
Performance	Systematic control; fixed-price contracting
Technological	Contracts with warranties; insurance contracting
Demand (consumption)	Sensitivity analysis; sensitizing actions; making payment easier
Collection	Sensitivity analysis; service interruption; making payment easier; customers and collection management
Capacity	Increase studies accuracy; cost–benefit analysis
Competition	Sensitivity analysis; public disclosure of indicators
Financial	Long-term financing; hedging policies; backup funding (bank accounts)
Inflation	Indexation of revenues to inflation; fixed-price contracting; forward contracts
Legal	Protected by contract
Regulation	Keep with international trend; systematic control of performance; benchmarking policies
Unilateral changes	Protected by contract
Public contestation	Sensitivity analysis; public disclosure of indicators
Force majeure	Mostly protected; insurance contracting

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they are unable to do or identify suitable responses. Finally, risk transference, as mentioned previously, corresponds to the shift of impact or threat to a third party.

Portuguese Case Study

Private-Sector Participation

The framework previously described can be applied to most nations. It is helpful to illustrate the importance of appropriate risk assessment and mitigation by considering how one country is attempting to cope with the complex issues raised by regulatory contracts. In Portugal, the responsibility for water activities belongs to municipalities. There are 300 retail water utilities, with about 70% of the water provided by 14 public wholesale companies. Municipalities can select from among a number of institutional arrangements, including the establishment of private companies by means of concession contracts, municipal companies that can include a (minority) private shareholder, semiautonomous organizations, or direct supply by the municipality. Private participation was not introduced in the sector until 1993. The enactment of legislation in that year allowed local municipal authorities to delegate water service functions to private-sector companies through concession contracts (purely contractual PPPs).

With the opening of the market to private participation, it became necessary to supervise this activity (private operators), so the national government created a sector-specific regulator (Institute for the Regulation of Water and Waste—IRAR, which was recently replaced by the Water and Waste Services Regulatory Authority—ERSAR), whose responsibilities included providing a nonbinding opinion about the public-tender documents (and the design of the contracts), as well as playing a role in the renegotiation proposals and supervising the quality of service. In this scope, IRAR can make some judgments about the real transference of risks between the parts, although, in fact, its suggestions are scarcely respected. No other entity monitors such risks in Portugal. Concerning the quality of service, IRAR uses sunshine regulation for this purpose; that is, it collects data, compares relative performance of operators, and promotes a public discussion of those indicators (Marques 2008b). In 1998 (amended in 2006), new legislation allowed for the creation of municipal companies, including the implementation of mixed companies (institutionalized PPPs). Both types of PPPs (concessions and mixed companies) require the private partner to be chosen by public tender.

In Portugal, as of December 2009, 40 public tenders for PPPs were launched in the water sector, corresponding to more than 2.8 million inhabitants (27% of the total population). Of the 30 contracts already signed, 25 correspond to a purely contractual PPP (concession) and five to institutionalized PPPs (mixed companies). The average length of time between the tender call notice and the contract signature was about 21 months. The average number of bidders was four; at present there are five major private players in Portugal. Although private-sector participation is a relatively recent development, 60% of the PPPs have already been renegotiated. The main causes of contract failure are unsurprising. They were related to water consumption below the predicted amount, nonfulfillment of investment commitments assumed by the municipality, and unilateral changes by the municipality. All of these developments could be avoided (or reduced in impact) if risks had been managed appropriately. The Portuguese experience is similar to that of other countries, mainly those influenced by Continental (French) administrative law such as Spain, France, and Italy in Europe and African and Central and South American countries subject to its influence (e.g., Brazil and Colombia). The failures of regulatory contracts are generally because of the poor allocation of risks. Note that Portugal has even tighter rules than many other nations because there is a sector-specific regulator (IRAR) and a Court of Auditors, institutions that are not present in some other countries.

Concession Contracts

A key problem in concession regulatory contracts is that the risk is not shared adequately with the private sector. According to Portuguese law, and in line with European law, the concessionaire must bear the risk of operating the water infrastructure. If there is investment by the private sector, the construction risk should be allocated to the private operator. However, if we carefully analyze concession contracts, we would find that most should not be characterized as concession arrangements because the private sector does not bear the major risks. The clause concerning the restoration of economic and financial equilibrium transfers the most important risks to the public sector (municipality) or specifically allocates the risk to the municipality. This circumstance is shown in Table 3 for a typical water utility concession contract. Moreover, the contract signed between the private company and the municipality as a rule also allocates rights of way or eminent domain (expropriation) and force majeure (acts of God) risks to the municipality. While the former allocation is reasonable, the latter greatly reduces the risk to the company, reducing its incentives to mitigate such risks.

This clause has perverse consequences for actual risk-bearing by public and private entities. For example, the consumption risk encourages excessive optimism (and the winner's curse—which becomes a blessing upon successful renegotiation). The PPP granting authority is doubly penalized: not only does it not select the "best" bidder, but if the optimistic winner predicts a high volume of water billed (and is wrong), the granting authority has a higher probability of needing to revise the contract to achieve the financial and economic equilibrium of the PPP. Only the risks related to unilateral changes and the legal and regulatory risks should be borne by

Table 3. Risks Affecting the Financial and Economic Equilibrium of the PPP

Changes requiring restoration of financial/economic equilibrium	Risk
Change greater than 10% (up or down) of the number of customers and of the annual volume of water distributed predicted by the bidder	Consumption
Change greater than 20% (up or down) of the annual volume of wastewater collected predicted by the bidder	Consumption
Expansion or reduction of the system scope concerning the works predicted by the concessionaire	Several
Meaningful change of the rules or legislation that leads to the alteration in equipments and procedures	Legal/regulation/operation
If the concessionaire has to bear charges related to the factors that could not be predicted at the date of contract signature, such as new taxes, tariffs, or taxes determined by new legislation	Legal/regulation
Change greater than 20% of the annual average value of Euribor (6 months) when compared with the previous year	Financing

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the public sector (municipality), with the latter borne by the citizens/customers (Marques and Berg 2010).

Most of the other risks in the table should be borne by the private sector. For example, the private firm does not have incentives to predict other investments beyond the compulsory ones in the public-tender documents because their inclusion in the bid diminishes the likelihood of the concession being awarded. The best strategy for the bidder is to negotiate directly with the municipality (in a bilateral way without competition) after winning the bid. The financing risk is one that, at least in theory, should always be passed to the private sector. Note that ambiguous expressions such as "meaningful change" and "expansion or reduction of the system" without detail constitute an additional risk, increasing the likelihood of conflicts between the partners (private and public).

Mixed Companies

The problem of risk sharing is more serious in the case of institutional PPPs. In this type of PPP, the public sector and a private company create a third company to provide an infrastructure or a service (e.g., water utility) or an existing public company sells part of its shares to the private sector.

Generally, the public sector retains corporate control of the company, although the technical management (and operations) is normally carried out by the private company. In this model, the PPP is regulated by the statutes of the firm and by the shareholder agreement document; these establish the relationships between private and public partners. Because the public sector is involved in management, key elements like price levels and price structures, quality of service, and investments are periodically defined, and the risk is almost always transferred to the customers or, alternatively, to the taxpayers. Although the principles underlying mixed companies are sound (Marra 2007), the public sector is an active partner in the PPP, becoming an accomplice of the private operator, so it tends to accept tariff increases (Vining and Boardman 2008b). Indeed, mixed companies in general do not bear risks; risks are transferred to customers or to taxpayers. The bidding documents identify the situations that constitute the causes for restoring the financial and economic equilibrium of the mixed company. Table 4 highlights these causes for a typical case in Portugal. Moreover, the bids impose financial indicators (e.g., equity internal rate of return) that should be fulfilled each year. The tariff changes according to these values every year.

These clauses represent almost all the risky situations. However, the shareholder agreement document clarifies these circumstances by establishing the conditions in which a change in the proposed main financial indicators is recovered in the next annual tariff review. In this way, the rate of return and other indicators are always guaranteed. Note that the risks are not supported directly by the municipality and that the benefits of this arrangement belong to the municipality as well (as shareholder), although management and other fees paid directly by the mixed company accrue to the private firm and its managers. Nevertheless, customers bear the risk, and costs can drift upward, leading to the conclusion that the public interest is harmed by poor contract design in this instance (Marques and Berg 2010).

As mentioned previously, the issue of risk allocation is central to problems arising within PPP projects. Earlier studies suggest that these contracts have a high failure probability (Boardman and Vining 1989). Because the municipality is inside the mixed company, there will be political and ethical difficulties that may generate controversies due to the duty of protecting the public interest and simultaneously remaining loyal to its partner, especially because of its coresponsibility for key decisions. The time horizons of elected officials do not necessarily coincide with the long-term implications of pricing and investment decisions. Furthermore, a dispute leading to a deadlock may compel the municipality to purchase shares under the call option, which is unacceptably costly in economic terms.

Concluding Remarks

This paper discussed the problem of risk in infrastructure regulatory contracts. The first part of the paper highlighted some methodological aspects regarding a way to deal with risk in these infrastructure contracts. As scholars and practitioners note in the literature, this is a major issue that needs to be addressed if regulatory contracts are to succeed and provide value for money. We first identified the major risks associated with the private-sector participation in infrastructure contracts (and particularly of water utilities). We not only pointed out the more usual risks, but also depicted some of those more relevant in infrastructure contracts, including consumption (demand) risk. Next, we classified the risks and allocated them to the party (public or private) better able to mitigate or bear them. The probability of occurrence and the impact of different risks were then briefly described. We also referred to the mitigation measures. In the second part of the paper, we described problems with regulatory contracts in the Portuguese water sector, both concession contracts and those associated with the creation of mixed companies. These examples are not different from other countries influenced by Continental administrative law, such as France, Spain, and Italy, and African and Central and South American countries.

We conclude that the risk is generally taken into account in a flawed way: this represents one of the major reasons for contract failure, both renegotiation and/or early termination. In Portugal, the risk in the two types of PPPs (concession contracts and mixed companies) is not correctly transferred to the private sector: this tendency limits the success of contracts and consequently reduces

Table 4. Risks Affecting the Financial and Economic Equilibrium of the PPP

Changes requiring restoration of financial/economic equilibrium	Risk
Abnormal change of volumes not predicted in the economic and financial viability study of the public tender	Consumption
Significant expansion of capacity requirements not predicted in the plan of investments	Several
Meaningful change of the rules or legislation that leads to the alteration of the conditions reflected in the initial bid	Legal/regulation
Having to bear charges related to the factors that could not be predicted at the date of shareholder-agreement signature, such as new taxes, tariffs, or taxes determined by new legislation	Legal/regulation
Change greater than 30% of the annual average value of Euribor (6 months) relative to the date of the signature on the financing contract	Financing
Unilateral change initiated by the municipality, implying changes in the business case of contract	Unilateral changes
Some form of force majeure	Force majeure

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the benefits from private-sector participation in the water sector. Thus, one can argue that the major problems of water utilities are neither technical nor solved by developments in science and engineering. Rather, contract design, institutional incentives, interagency collaboration, benchmarking, and management information systems represent the high payoff areas for those seeking to improve water sector performance.

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