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This article shows that the social benefits can be annihilated by a bad negotiation or a regulation failure resulting in an over-tariffication. The example of the toll highway Dakar/Diamniadio in Senegal is revealing. This article gives an analysis as well as an economic and financial evaluation showing that the State had additional margins in tariffs negotiation.

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I. Introduction

Within the context of the liberalisation of its economy, which started in 1985, Senegal engaged in the 2000s in new projects under the regime of public/private partnerships (PPP). Prior to that, the liberalisation process led to the privatisation of Sonatel (National Company of Telecommunications) in 1996 and of Senelec (National Company of Electricity) in 1998. However, as shown by the latest work of Casadella, Liu, and Uznidis (2005), the result of the liberalisation is diminished in developing countries, and this failure is attributed to the lack of institutional capacities. This situation corroborates the acknowledgement of complexification in terms of governance requested by the PPP. This is illustrated by Rowe (2006) and Giauque (2009), who point out the lack of interest from, and even competence of, political authorities in solving problems related to urging private partners to be more transparent and, thereby, ensure more effective coordination. This article highlights this situation through focusing on analysis of service tariffication in the context of the Public/Private Partnerships that the State of Senegal agreed on in 2009 with Eiffage/Senegal for both the construction and the exploitation of a highway between Dakar and Diamniadio (approximately 35 km, or 22 miles). The first section shows a normative approach of the PPP tariff regulation and a summary of the different PPP formulas and their characteristics. The choice of the formula is very important because it determines the level of tariff within the duration of concessions. In our case, even if the concession seems to be a Design Build and Operate (DBO) type, as we explain in 3.1., the formula declared is Build Operate and Transfer (BOT), where the operator is responsible for investments, building, and exploitation up to the term of the concession. The interest in this kind of formula lies in the fact that Senegal will appropriate an important highway after the duration of the concession, which is thirty years. The second section conducts of an optimality analysis of that highway tariffication through a financial evaluation using updating mechanisms based on a simplified method of forecasting inflation and the size of the car fleet over the thirty years of that concession.

II. Theoretical bases and methodology

Private participation raises first the issue of private interests' management in public services works and companies. In fact, the private partner invests money in expectation of an incentive compensation. Besides, according to Francois Leveque (2004), the expected gain from money invested is the principal determinant in the investment decision. However, the optimality of private participation is measured through its social benefits in relation to State direct intervention. Consequently, users deserve a quality service at the best price. Such are the interests, widely antagonistic, that the regulator must reconcile.

2.1. Public/Private Partnership and normative approach of tariff regulation

The tariff level is the main source of social distortions, especially in poor countries where regulators lack experience and are not independent enough from the political power. Laffont (1996) considers that, in a regime characterised by corruption risk and a lack of qualification, the best way for the regulator to reduce the impact of asymmetric information is to resort to a strict tariff control. Demsetz (1968) wrote that regulation is not necessary if the selection mechanism of the private partner is well organised. According to Williamson (1979), whatever precautions are taken in an *ex ante* concession attribution, there is an *ex post* moral hazard that requires independent regulation. Nevertheless, the regulator must be prepared to have attributes of accuracy, transparency, and impartiality. He must be equipped enough to get the right information about the operators 'costs so as to arrive at a fair tariffication that is matched with

precise incentives in terms of profitability and productivity (Vergès, 2002). To combine optimality and incentives, the regulator must target a cost that is the closest to the marginal while taking into account the dimensions of uncertainty in addition to incomplete and asymmetric information. The regulator's objective is to maximise the social surplus, from which the cost of the public funds (T) necessary to the company budget balance must be subtracted. We assume that these public funds integrate the regulation costs (C_r) that are not taken into account in Laffont's models:

$T = C_r + S_b$, (S_b) being the money transferred to the operator.

The regulator's *Objective function* is:

$$W = S(q) - C(q) - \lambda T = S(q) - C(q) - \lambda(C_r + S_b) \qquad (1)$$

where $S(q)$ is the consumers' surplus, $C(q)$ is the cost of production and $(T = C_r + S_b)$ are the engaged public funds. The operator's benefit is: $\Pi = P(q)q - C(q) - \varphi(e) + S_b$, where (e) is the effort of reduction of the costs (private information of the company) and $\phi(e)$ is the monetary equivalent of the uselessness of the operator's efforts to reduce the costs.

Laffont and Martimort (2002) established that it is possible to determine the optimal tariff so that the applied price verifies the Lerner–Ramsey–Boiteux rule:

$$\frac{P(q) - C}{P(q)} = \frac{\lambda}{1 + \lambda} \frac{1}{\varepsilon_i} \qquad (2)$$

(where ε_i is the price-elasticity of the demand).

Laffont and Martimort underline that (λ) is not Lagrange's endogenous multiplier (which is the marginal utility of money transfers) but is the cost of public funds basically justified by the tax system imperfections.[1] It is, therefore, an arbitration model between internal profitability and budgetary compensation. This model is of particular interest when taking into account issues of adverse selection and moral hazard. The moral hazard is removed by the presumed observability of the operator's costs, but the adverse selection remains.

Finally, we can admit that the main sectors must be under the supervision of an independent regulator. Moreover, since Ramsey–Boiteux's repartition can be executed, the regulator's global programme is then *ex ante* to obtain from the operator that he maximises his efficiency and to limit his informational income (or the benefit from the asymmetry of information).

2.2. Methodology

Tariff regulation is based on theoretical formulas, depending on the type of PPP used. The BOT and DBO formulas are the main concessions usually adopted in these types of infrastructures. Chart 1 summarises the two PPP formulas and their characteristics. It will help us qualify and analyse the type of partnership chosen by the public authority within the context of the Dakar/Diamniadio highway in Senegal. Afterwards, we are going to test the hypothesis that the absence of an appropriate mechanism of tariff regulation led to an over-tariffication of this highway, thereby reducing the incentive character of the contract and leading to a loss of global surplus (for more illustrations, refer to Beuve, 2013 and Guash et al. 2006, 2007, 2008).

[1] Jullien and Rochet (2005) underline that it is about a fundamental measure in Laffont's and Tirole's (1993) approach. They quote Hausman and Poterba (1987) who assessed it in the case of the United States ($\lambda = 0,3$).

Chart I: Summary of the main PPP formulas

Contractual formula	Characteristics	Operator's remuneration
Build Operate and Transfer (BOT)	Conception, funding, implementation and management by the operator at his own risks for a given period, at the end of which the State takes over ownership of the work.	Public authority or invoicing
Design Build Operate (DBO)	Conception, achievement and management by the operator at his own risks for a given period, at the end of which the State takes over ownership of the work.	Public authority or invoicing

Sources: Marty, Trosa, and Voisin (2006), Savas (1998), and Cahiers Industries (2004).

In a DBO contract, the period and the tariffs are less high, seeing that public funds are almost entirely used for the achievement of the work. The same pattern is observed with the Dakar/Diamniadio highway, for which we are going to check the hypothesis of an over-tariffication for the planned period (30 years). BOT is the formula chosen by the public authority. The difference between DBO and BOT is that, for the latter, the private partner is responsible for all the funds required for the project. The essential aspect for both formulas is that the highway will belong to Senegal at the end of the term of the concession.

We will compare the updated financial participation of the private partner with his updated revenues over a period of 30 years. To achieve this, we will index the traffic evolution on the growth of car fleets over a period of 30 years. As for predictable tariffs' revisions, we are going to correlate them with an average estimation of the inflation over a period of 30 years. The inflation forecast can be based on simple patterns that regress the growth of the consumer price index with respect to its past values. These patterns incorporate other indicators (IND): raw materials prices, financial indicators (exchange, monetary aggregates, etc.) as well as indicators of real economy, such as the use of production capacities, unemployment, and the average hourly wage (Cecchetti, Chu, and Steindel, 2000).

$$\Delta IPC_i = \alpha + \sum_{t-i}^{4} \beta \Delta IPC_{t-i} + \delta IND_{t-i} + \varepsilon \qquad (3)$$

The use of patterns requires quarterly data. Cecchetti, Chu, and Steindel (2000) used it in the United States with data from the first quarter of 1975 to the end of 1984 to derive inflation forecasts for the eight quarters of the period 1985–1986. Therefore, it is a constraining mechanism that is difficult to implement in Senegal over a period of 30 years. Consequently, we will be satisfied with a simplified correlation to derive a global average evolution of inflation and car fleets for 25 to 30 years (refer to Box1).

III. The example of over-tariffication of Dakar/Diamniadio toll highway

The relevance of independent regulation was emphasised by Williamson's (1979) study, as we mentioned in the theoretical bases (2.1). In Senegal, independent regulation exists only in the telecommunications and the energy sectors, and it does not exist in the transportation sector. That is why the public authority was responsible for the entire negotiation process of the Dakar/Diamniadio toll highway, within a ministerial regulation system. Former experiences reveal that this kind of regulation cannot cope efficiently against the asymmetry of information and corruption. Therefore, it seems that the absence of adequate regulating mechanisms has enabled the private partner to apply an over-tariffication. To demonstrate this, we proceed by determining the averages of tariffs and the evolution of the car fleets for 25 years (see Box 1

and Annex 1). Before that, we will show that the financial setting cannot involve a BOT contract, but can involve a DBO contract, which is unfamiliar among the Senegalese practices.

3.1. Survey of the highway financial setting

The global cost is approximately Franc CFA 380 billion.[2] The Senegalese government gave Franc CFA 319 billion, and the Eiffage/Senegal contribution amounted to Franc CFA 61 billion, in addition to the responsibility for construction. A 30- year contract named *BOT* was executed on July 2, 2009.

Chart II: Dakar/Diamniadio highway financing (in billions F CFA)[3]

	Motorway work	**Expropriation procedure**	**Relocation zone**	**Urban restructuring**	**Miscellaneous (studies, control, etc.)**	**Total**
Phase 1: Malick SY- Patte d'Oie/Pikine						
Senegal	82.8	18.6			5.9	107.3
Phase 2: Pikine/Diamniadio						
Senegal	37.8	37.4	5.4		5.6	86.2
WB		11.1	18.2	13.6	9.6	52.5
AFD	16.4		12.6	9.4	1.6	40
BAD	33.2					33,2
Eiffage	61					61
Total	231.2	67.1	36.2	23	22.7	380.2

Source: APIX, Senegalese Investment Promotion Agency:
(WB=World Bank, AFD= French Development Agency, BAD= African Development Bank)

This chart shows that the State of Senegal and its financial partners (government loans) provided 84% of the funding. This strong public contribution discredits the BOT designation of the contract. Eiffage/Senegal's work is, rather, centred on the conception and implementation of the infrastructure. It is, rather, a DBO-type contract (Cf chart I). The Dakar/Diamniadio portion was delivered in 2011 and the remaining part has been available from August 2013 onwards.

[2] Franc CFA (or FCFA) is Senegalese currency, shared by States of the West African Economic and Monetary Union (UEMOA).

[3] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/AR%20senega01fr.pdf
http://investinsenegal.com/IMG/pdf/insert_autoroute_financement.pdf

Box 1: Estimation of average rates of evolution of the tariffs and automobile fleet from 2012 to 2037

To determine an average inflation and evolution of car fleet over the next 30 years, we simply made a delayed correlation. Our concern is to obtain a general average of the evolution of the concerned variables over a period of 30 years. Owing to the difficulties faced with prevision of inflation for Senegal, the general average over the 34 last years has been sufficient. Thus, our main goal is to give an indication of the inflation's evolution.

Inflation

As for inflation, we then chose the simple linear model with a delayed variable:

$$Inf_t = \alpha_0 + \alpha_1 Inf_{t-1} + \varepsilon$$

We just use some data published by the ANSD (Senegalese Statistic Agency), on inflation in Senegal from 1980 to 2013. This correlation, which is 90% significant, shows a general tendency of rising inflation in Senegal. Its main limitation is its failure to deal with periods of high rises (32% in 1994) or drops (-4.1% in 1987). Inflation being too unstable over the study period, we will ultimately consider the general average over the last 34 years, approximately 4% of inflation on average (see annex 1 for details).

Car fleet

As regards the car fleet, statistics are unavailable. However, given the continuous rise of the car fleet since 1996, it was possible to use data for 1996–2012 to make a simple forecast until 2037. The correlation with a delayed variable helped in making this forecast of the Senegalese car fleet.

$$Pa_t = \beta_0 + \beta_1 Pa_{t-1} + \varepsilon'$$

Data used here are the results of 17 years' of observation (1996–2012). Their analysis with Stata software enabled us to collect the results of regression, which helped in the forecast of the car fleet value until 2037. The results of regression and the table of expected figures are in annexes (1 and 2). They enabled us to forecast an average rate of the evolution of the car fleet of 3.15% from 2012 to 2037.

3.2. Analysis of the highway tariffication

This highway is Senegal's first experience of transportation PPP. Before this highway, there was no similar project, and the transportation sector was not yet provided with an independent regulator. The main goal here is to show the high level of the tariff negotiated by the public authority, with the important revenues expected by 30 years, in comparison with the partner's financial contribution (Eiffage/Senegal). In Senegal, a discount rate of either 10% or 12% is generally used (Bah and Diop, 2015). However, the discount rate is an important tool for the negotiations with the private partner during the funding stage of the project. Taking into account the negotiation skills of the Senegalese State allows us to agree on a 10% discount rate over 30 years. Therefore, the FCFA 61 billion injected by Eiffage/Senegal allows a current value of FCFA 1,064 billion. In the case of a 12% discount rate, the FCFA 61 billion allows a current value of FCFA 1,828 billion. These amounts are to be compared with the updated average of potential revenues expected for 30 years of exploitation.

Current tariffs are as follows: FCFA 800 for two-wheeled vehicles, FCFA 1,400 for private vehicles, FCFA 2,000 for minibuses and public transportation vehicles, and FCFA 2,700 for trucks and any heavy vehicles. On average, 16% of the traffic involves public transportation vehicles (Senac SA, 2015)[4]. From field observations, approximately 60% of the traffic is made up of private vehicles, 6% consists of motorcycles, and 18% is heavy vehicles. The average

[4] Public communication by the General manager, Gerard Senac (published by LObservateur, 7/17/2013)

tariff (AT) is then: AT=(0.6x1,400) +(0.16x2,000) +(0.06x800) +(0.18x2,700) =FCFA 1,694. If a maximum TVA (Added Value Tax) rate of 18% is subtracted, the concessionaire collects an average amount of FCFA 1,390 per transaction. Statistics show an initial traffic volume of 40,000 vehicles per day, which is approximately 50,000 daily transactions from 2013. Our inflation and car fleet forecasts give respective average growths of 4% and 3% in the next 30 years (Cf. box 1).

Chart III : Calculation table of updated cash flow

	Toll rate	**Total number of transactions**
Total value over 30 years	$1{,}390 \ \frac{1-(1{,}04)^{30}}{1-1{,}04} = 77{,}958$	$50{,}000 \times 365 \ \frac{1-(1{,}03)^{30}}{1-0{,}03} = 868{,}335{,}000$
Annual average	F CFA 2,598	28,944,500 transactions
Average of revenues expected over 30 years = 28,944,500 x 2,598 x 30 = FCFA 2,256 billion		
Current value of 61 billion (10% over 30 years) = 61 billion x 17.449= FCFA 1064 billion		

In terms of current value and according to the tariffication applied, the Dakar/Diamniadio highway will yield revenues of at least FCFA 2,256 billion in 30 years, more than the current value of the FCFA 61 billion injected by the private partner, with either a 10% or a 12% discount rate. So, the capital pay-back period is less than 10 years. That period is less than 3 years for the FCFA 61 billion injected by Eiffage/Senegal. The BOT convention, in its article 21, allows the operator to conduct additional activities, such as the exclusive contract award for constructing and running gas stations on the highway. However, it is essentially an evaluation with a clear future, not taking into account potential hazards, especially country risk and traffic risk. In addition, it does not take into account traffic-jam effects, which an upheld tariff could help solve. The margin of error agreed relatively in correlation with inflation and the car fleet is 10%. However, this evaluation uses a low rate of evolution of the car fleet; the rate was 11% between 2009 and 2010 (Ansd, 2012). The low rate of evolution of the car fleet that has been agreed on (3.15%) enables consideration of a hypothetical fall of personal transportation opportunities generated by the improvement strategies of public transportation, such as the Express Train Regional (TER) being implemented between AIBD (Blaise Diagne International Airport) and Dakar. Besides, whatever the level of public control of revenues and the private exploitation costs, the tariffs and the concession period are proving to be too high for a highway financed with 84% of public funds. There are margins of tariff renegotiation and lessons for ongoing works.

IV. Conclusion

PPP enables the States to have access to modern infrastructures that they appropriate at the end of contracts. However, a question remains: do users' complaints about the quality and the tariff of services confirm the still unseen hypothetical effects of private participation? From a social perspective, liberalisation has not yet borne the expected fruits, as confirmed in the latest work of Casadella, Liu, and Uznidis (2015). The case of the Dakar/Diamniadio toll highway in Senegal reflects the problems of transparency in the PPP that are highlighted in several scientific works (Sadran, 2004; Rowe, 2006; Giauque, 2009). Transparency is an objective to reach. The same is true for the State in its ability to monitor and regulate these new forms of coordination (Giauque, 2009). In the case of Senegal, the over-tariffication hypothesis has been verified. Besides, the initial presentation of the two PPP formulas evocated, their characteristics

and the normative approach of tariff regulation lead to a general remark: a weak appropriation of the theoretical tools in the regulation mechanisms of the PPP in Senegal. As it appears in Williamson's (1979) propositions, the transportation sector needs to have an independent regulator with responsibilities from the attribution phase *ex ante* of the infrastructures' concessions to the regulation *ex post* of services. Globally, the independent regulation mechanism should help avoid potential mistakes in the PPP formula negotiation and manage correctly the asymmetry of information about the costs to keep the final tariff at the normal level.

Annex 1: Tables of delayed correlation and forecast results

Statistics on inflatio

Variables	Obs	Means	Std. Dev.	Min	Max
Inflation	34	4.183824	6.838712	-4.1	32.1
Lagged_inf	33	4.259091	6.930429	-4.1	32.1

Results of the regression on inflation

Inflation	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]	
Lagged_inf	.3073665	.1700085	1.81	0.080	-.039368	.6541011
Cons	2.737868	1.367646	2.00	0.054	-.0514653	5.527201

Statistics on the Car (Automobile) fleet (Af)

Variables	Obs	Means	Std. Dev.	Min	Max
Af	17	243426.9	74691.27	125762	374384
Lagged_af	13	235242.1	68818.09	125762	347901

Results of the regression on car (the Automobile) fleet

Af	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]	
Lagged_af	1.006597	.0508428	19.80	0.000	.8975502	1.115644
Cons	13986.95	12430.91	1.13	0.279	-12674.69	40648.59

Annex 2: Growth of car fleets: 3.15%

Year	Forseen number	Growth (%)
2012	374384	7,6
2013	390617	4,3
2014	406948	4,1
2015	423376	4
2016	439903	3,9
2017	456530	3,7
2018	473256	3,6
2019	490083	3,5
2020	507010	3,4
2021	524039	3,3
2022	541170	3,2
2023	558404	3,1
2024	575742	3,1

Year	Forseen number	Growth (%)
2025	593183	3
2026	610729	3
2027	628381	2.9
2028	646138	2.8
2029	664002	2.7
2030	681973	2.7
2031	700052	2.6
2032	718239	2.5
2033	736536	2.5
2034	754942	2.5
2035	773458	2.4
2036	792086	2.4
2037	810828	2.3

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