Contract Choice, Incentives, and Political Capture in the Public Sector[±]

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Abstract: We consider a framework of contractual interactions between public transport authorities and transport operators. We estimate simultaneously the contract choice by the authorities and the effect of regulation on the cost-reducing activity of the operators. We test whether the current regulatory schemes are the observable items of a complex menu of contracts, as proposed by Laffont and Tirole. We suggest that the generation process of the data we have in hand is better explained by a regulatory framework where an unsophisticated regulator is politically motivated. We show how these political preferences shape the contract choice and we shed light on how operating costs are affected. On average, operators' costs are 12.1% lower under fixed-plus regimes, compared to the cost-plus cases.

[±] Both authors are members of the Centre for Economic Policy Research (CEPR). The authors wish to thank the Centre d'Etude et de Recherche sur le Transport Urbain (CERTU, Lyon, France) for providing the data. They are grateful to Emile Quinet, Xulia González, Jordi Jaumandreu, Olivier Armantier, Philippe Marcoul, David Rahman, Gerard Llobet, Guillermo Caruana, Luis Aguiar as well as seminar participants at CEMFI, ESMT, Iowa State, Loughborough, Valencia, Grenoble, the 4th Annual Conference on Railroad Industry Structure, Competition and Investment in Madrid, 2006, the 8th CEPR conference on Applied IO, Tarragona, 2007, EARIE 2007 at Valencia, and JEI 2008 at Reus, for insightful discussions. Gagnepain thanks Universidad Carlos III de Madrid, as well as Ministerio de Educación y Ciencia (SEJ2004-00670 and SEJ2007-66268), and Fundación BBVA.

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1. Introduction

This paper investigates the determinants of contract choice and operating cost regulation under asymmetric information in the case of the French urban transport industry. In each city of significant size, the urban transport service is regulated by an authority and is provided by a single operator. The two parties are tied together by a regulatory mechanism that is, in practice, either a fixed-price or a cost-plus contract. The regulator does not observe the technological efficiency or the cost reduction activity of the operator.

We argue that contract choice is motivated by political considerations, which may entail the political attitude of local governments, as well as the pressure of the municipal service corporations that own the transport operators, or the characteristics of the networks in which the transport service is implemented. At the same time, the incentive properties of the regulatory contract determine the cost reduction of the operator as well as the welfare cost supported by the society.

This article contributes to two significant issues related to firms' regulation. First, it investigates whether political considerations are important in terms of understanding the effects and the cause of regulation. Following the private-interest theory of regulation initiated by Stigler (1971) and pursued by Peltzman (1976) and Becker (1983), we test whether the political process and the competition among differently organized interest groups drive regulatory decisions. Thus we assume that regulatory decisions are not entrusted to a benevolent government, but are rather endogenously determined outcomes in terms of the actions of a set of agents.

Interest groups may pursue their own self-interest through the market in which they operate and through the political regulatory process that establishes the rules for their behavior. Regulated firms might be willing to intervene in their own regulation in order to create or to protect their private interests. Local governments may care about being or staying in power, and therefore choose regulatory contracts in order to obtain consensus in their constituency, which would improve their re-election prospects (see Persson and Tabellini, 2002). The regulatory interaction between local governments and transport operators shapes the choice of the regulatory contract, and determines the economic outcome of the activity.

Regulatory endogeneity is an important issue to account for, since neglecting it may lead to inconsistent and biased estimates of the effects of economic policy. For instance, Duso and Röller (2001) shed light on these issues in the case of governments' decisions to deregulate markets. Regulation is thus an endogenous outcome of a complex political process.

A second potential contribution of this article is methodological, and is related to the on-going debate between the positive and normative analysis of regulation. The private-interest theory of regulation approach, which is advocated in this paper, contrasts with the new theory of regulation, where public intervention corrects market failures and maximizes social welfare. In this latter perspective, economists have been reconsidering the contractual relationships between regulated utilities and regulators through the window of the theory of incentives and the principal-agent model for 30 years.[1] In this framework, utilities' productive capabilities and cost-reducing effort are two variables that are unknown to the regulator. Regulators submit the utility to the revelation principle in order to extract some information and reduce informational asymmetries. Such so-called second-best optimal solution can be implemented through a complex menu of linear contracts.

While there is a general consensus on how optimal regulation should be dealt with from a theoretical point of view, the empirical literature seems to be divided between positive and normative analysis. On the one hand, many empirical studies have assumed that the actual regulatory regimes are optimally designed as specified by the new theory of regulation. In a pioneer paper, Wolak (1994) estimates the production function of a regulated Californian water utility. He argues that the regulator uses a Baron-Myerson type of mechanism and achieves a second-best welfare level. Wunsch (1994) calibrates menus of linear contracts as proposed by Laffont and Tirole for the regulation of mass transit firms in Europe. Gasmi, Laffont and Sharkey (1997) also consider a regulatory environment *a la* Laffont-Tirole to estimate operating costs in local exchange telecommunications networks.[2]

On the other hand, other studies have explicitly argued that actual regulatory mechanisms do not use such optimal mechanisms. For instance, Bajari and Tadelis (2001) focus on the particular case of the private sector construction industry. They observe that the vast majority of contracts are variants of cost-plus and fixed-price regimes and suggest that the main motivation of the regulator is to find an appropriate trade-off between ex ante incentives and avoiding ex post transaction costs due to costly renegotiation. Their results resonate with themes that are central to transaction cost economics.

A second objective of this paper is therefore to test whether regulatory schemes currently implemented in the French urban transport industry are optimal, i.e. whether they are the observable items of a more general menu of second-best contracts. We reject this hypothesis, and suggest that the generation process of the data we have in hand is better explained by the political aspects of regulation.

In our model, the regulator chooses the regulatory mechanism that maximizes his utility over the period of his mandate. The utility entails the usual social welfare measure plus some additional weight given to some specific interest groups. Here, the interest groups are the workers and the stakeholders of the regulated firm. The regulator may be willing to overstate the weight of workers' wages and firms' profits in the social welfare function, and this may create a distortion of the regulatory contracts toward less or more powered incentive schemes. Moreover, the regulatory rule affects the operator's behavior and the operating costs in one way or another. The econometric task consists in recovering the parameters of a model of contract choice and cost regulation, and testing for the relevance of the political capture hypothesis.

[1] The new theory of regulation dates back to the seminal works of Loeb and Magat (1979), Baron and Myerson (1982), and Laffont and Tirole (1986).
[2] More recent contributions include Brocas, Chan and Perrigne (2006) and Perrigne and Vuong (2007).

We extend here the line of research initiated in Gagnepain and Ivaldi (2002). In this initial project, we assumed that the choice of regulation was exogenous and we restricted our attention to the construction of the cost function. We show here that accounting for the contract choice turns out to be adequate and fruitful, since it improves the quality of our estimates. With a non-nested test, we provide evidence on how our new model improves upon the previous one in a significant manner. In particular, we suggest that ignoring the process of contract choice yields cost estimates that underestimate the importance of regulatory incentives for the operator's activity.

We must warn the reader that the dynamic aspects of regulation are wiped out in our framework. In particular, we do not focus on the electoral game that may affect the regulatory decisions made by the local government. Likewise, we do not discuss the ability of the regulator to commit not to use the information on the operator's costs from one regulatory period to another. These issues are discussed in Gagnepain, Ivaldi and Martimort (2008). Here, our aim is to show that accounting for the choice of regulation is already important in a simpler static framework.

The organization of the paper is as follows: Section 2 describes the regulation of urban transportation in France in more details. Section 3 presents the contracts that are implemented during our period of observation. Section 4 discusses the assumptions that are maintained throughout the paper. Section 5 presents our political model which encompasses the main features of urban transportation and the environment in which network operators and regulators make their decisions. Section 6 then presents a formal specification of the cost function to be estimated together with the contract choice made by local governments, as well as the discussion of the estimation method. Section 7 is devoted to the construction of the variables and the presentation of the results for the political model. Section 8 then focuses on a hypothetical optimal regulatory environment where a regulator implements second-best contracts. We test this model against our hypothesis of political regulation. Section 9 provides a summary and some concluding remarks.

2. The French urban transport industry

As in most countries, urban transportation in France is a regulated activity. Local transport networks cover each urban area of significant size; a local authority (a city, a group of cities or a district, whose regulatory council is elected on a basis of 6 years) regulates each network whereas a single operator provides the service. Regulatory rules prevent the presence of several suppliers of transport services on the same urban network. A distinguishing feature of France compared to most other OECD countries is that a majority of local operators are private and are owned by three large companies, two of them being private while the third one is semi-public.[34]

[3] For an overview of the regulation of urban transit systems in the different countries of the European Union, in the United States and Japan, see IDEI (1999).

In 1982, a law on the organization of transport within France was promulgated whose main objectives are to decentralize urban transportation and to provide a guide for regulation. As a result, each local authority organizes her urban transportation system by setting the route structure, the level of capacity and quality of service, the fare level and structure, the conditions for subsidizing the service, the level of investment and the nature of ownership. It may operate the network directly or it may concede service to an operator. In this case, a formal contract defines the regulatory rules that the operator must support as well as the payment and cost-reimbursement rule between the principal and the agent.[5]

In most urban areas, operating costs are twice as high as commercial revenues on average. Budgets are rarely balanced without subsidies. One reason is that operators face universal service obligations. Prices are maintained at a low level in order to ensure affordable access to all consumers of public transportation. Moreover, special fares are provided to special groups like pensioners and students. The subsidies come from the State budget, the budget of the local authority, and a special tax paid by any local firm (having more than nine workers). They are not necessarily paid to the operator. In addition to the price distortions causing deficits, informational asymmetries that affect the cost side and lead to inefficiencies make it more difficult to resume these deficits. This is discussed in more details in what follows.

Performing a welfare analysis of regulatory schemes in a one-authority-one-operator setting requires a database that encompasses both the performance and the organization of the French urban transport industry. The basic idea is to consider each system in an urban area during a year as a realization of a regulatory contract. Such a database has been created in the early 1980s. It assembles the results of an annual survey conducted by the Centre d'Etude et de Recherche du Transport Urbain (CERTU, Lyon) with the support of the Groupement des Autorités Responsables du Transport (GART, Paris), a nationwide trade organization that gathers most of the local authorities in charge of a urban transport network. This rich source is probably unique in France as a tool of comparing regulatory systems to each other and over time. For our study, we have selected all urban areas of more than 100,000

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[4] These companies, with their respective type of ownership and market share (in terms of number of networks operated) are in 2002: KEOLIS (private, 30%), TRANSDEV (semi-public, 19%), CONNEX (private, 25%). In addition there are a small private group, AGIR, and a few firms under local government control.

[5] In principle, since 1993, beauty contests are lawfully required to allocate the building and management of new infrastructures of urban transportation and the automatic renewal of contracts came to an end. In practice, however, very few networks change operators from one regulatory period to another. From 1987 to 2001, which is our period of observation, only two networks changed operators. Documentary investigation sheds light on the fact that awarding transport operations through tenders does not necessarily guarantee ex ante competition since local transport authorities usually receive an offer from one single candidate, namely the operator already in place. The three groups who own most of the urban transport operators in France are usually committed to specific geographical areas, which restricts the possibility of implementing a significant competition to award transport operations in urban areas where regulatory contract come to an end. Moreover, these groups usually operate other municipal services such as water distribution or garbage collection, which makes it even harder for the regulator to punish the operator in case of bad performance.

inhabitants for a purpose of homogeneity. However, the sample does not include the largest networks of France, i.e., Paris, Lyon and Marseilles, as they are not covered by the survey. The result is that the panel data set covers 49 different urban transport networks over the period 1987-2001.

3. Regulatory contracts

Two types of regulatory contracts are implemented in the French urban transport industry, namely cost-plus and fixed-price schemes. Over our period of observation, fixed-price contracts are employed in 55.5% of the cases, a suggested in Table 1. Under fixed-price contracts, operators receive subsidies to finance the expected operating deficits; under cost-plus regulation, subsidies are paid to local authorities to finance ex-post deficits. Hence, fixed-price regimes are very high powered incentive schemes, while cost-plus regimes do not provide any incentives for cost reduction.

On average, contracts are signed for a period of 5 to 6 years, which allows us to observe in most cases several regulatory arrangements for the same network. In total, we observe 136 different contracts. In 94 cases we observe the contract from its starting point. In the same network, the regulatory scheme may switch from cost-plus to fixed-price or from fixed-price to cost-plus between two regulatory periods. We thus observe 20 changes of regulatory regimes, most of them (i.e., 17) being switches from cost-plus to fixed-price regimes. These changes occur because the same local governments may be willing to change regulatory rules, or because a new government is elected and changes the established rules. Note however that the arrival of a new government does not imply an early renegotiation of the contract before its term. New governments are committed to the contracts signed by the former authority. We detect 22 changes of local governments and only 2 changes of operators in our database.

We argue in this article that the contract choice is related to the characteristics of the local governments and the operators. A first look at the data sheds light on interesting features of the industry. Table 1 suggests that regulators of different political colors, operators of different juridical nature, or the different corporations who owns the operators may have some preferences for one type of contract or another. These regulatory features constitute the core of our analysis on the contract choice by local government. We propose to construct a structural cost regulation model where the contract choice by local authorities is explicitly taken into account, and we test whether the characteristics of the operator and the regulator, as well as the characteristics of the transport network are good candidate to explain this choice. We explain now carefully how we construct the empirical tests that will be implemented with our data.

4. Delineating the scope of the study

The organization of the urban transportation industry in France motivates the following tests.

Test 1: The network operator has private information about his technology and his cost-reducing effort is unobserved by the authority.

Since French local authorities exercise their new powers on transportation policy since the 1982 law only, and since they usually face serious financial difficulties, they probably have limited auditing capacities. A good audit system needs effort, time and money. French experts on urban transport blame local authorities for their laxness in assessing operating costs, mainly because of a lack of knowledge of the technology.[6] The number of buses required for a specific network, the costs incurred on each route, the fuel consumption of buses (which is highly dependent on driver skill), driver behavior toward customers, the effect of traffic congestion on costs, are all issues for which operators have much more data and better understanding than their principals. This suggests the presence of adverse selection. Given the technical complexity of these issues, it should be even harder for the local authority to assess the effort of her agent (operator) to provide appropriate and efficient solutions. It is then straightforward to assume the presence of moral hazard. Informational asymmetries play a crucial role in the setting of contractual arrangements and the design of financial objectives.

We propose to assess this assumption in the course of the estimation. This can be done by testing a structural operating cost function that accounts for adverse selection and moral hazard against a more standard cost function that does not account for these items. We turn now to the second assumption.

Test 2: Regulatory schemes and operators' efficiency levels are independent.

According to the new theory of regulation, when contractual relationships are characterized by informational asymmetries, a welfare-maximizing regulator applies the revelation principle for providing the operator with incentives to reveal the true efficiency level. This mechanism can be decentralized through a menu of linear contracts and avoids excessive rent leavings. Each operator facing such a menu chooses the contract that corresponds to his own efficiency level. In this context, the most efficient firm chooses the highest-powered incentive scheme, i.e., a fixed-price contract while the most inefficient firm chooses the lowest-powered incentive scheme, i.e., a cost-plus contract.

[6] In 1987, French urban transport expert O. Domenach says that "the regulator is incapable of determining the number of buses which is necessary to run the network. The same comment can be made regarding the fuel consumption of each bus. The regulators are generally composed of general practitioners instead of transport professionals. Hence, the (re)negotiation of contracts between regulators and operators is not fair". See Domenach (1987).

Between these two extremes are incentive schemes chosen by firms with intermediate efficiency levels.

Does this framework apply to the French urban transport industry? If it did, fixed-price and cost-plus contracts would be extreme cases of a menu and would be chosen by the most efficient and the most inefficient firms, respectively. Since current rules apply to any companies (even the ones with intermediate efficiency levels) and since the real world cannot be confined to fully efficient or inefficient firms, one must conclude *a priori* that observed contracts do not include any revelation principle, and cost-plus and fixed-price schemes are equally proposed to operators without paying any attention to their efficiency level. In other words, current regulatory schemes are not optimal in this sense.

Therefore, it is realistic to assume that regulatory schemes are not driven by the intrinsic characteristics and efficiency levels of large service companies and of network operators. As already noticed, assumption 2 implies that current regulatory regimes are not optimal; i.e., local governments are not maximizing social welfare.

Again, this assumption can be translated into a test. We consider a hypothetical scenario where French local regulators propose optimal second-best contracts to transport operators. Such scenario implies that the observed fixed-price and cost-plus contracts entail in fact complex cost reimbursements arrangements that are not observed by the econometrician. From this scenario, a cost function, which determines a direct relationship between a cost objective and the real inefficiency level of the operator, is derived and estimated. This cost function is then tested against a simpler cost structure that does not account for the choice of regulation.

Test 3: The choice of regulation is better explained by political factors.

We argue that the contract choice currently implemented in the French transport industry does not respond to social welfare maximizing concerns. Instead, we suggest that it is better explained by the private-interest theory of regulation. The economic agents (the local government, the operators itself or the group the regulator belongs to) who participate in the production of the transportation services have preferences on the type of contracts to be used, and may therefore try to interfere in the design of contracts in order to pursue their own interests.

As already suggested, a first look at the data in Table 1 sheds light on interesting features of the industry. First, right-wing governments seem to have a preference for fixed-price contracts, as these contracts are implemented in 64% of the local networks controlled by them. If the local government is left-wing, this number goes down to 54%. Likewise, the identity of the operator seems to have a significant influence on the contract choice: Public operators use fixed-price contracts in 67% of the cases; Transdev and Keolis, two of the municipal corporations operating almost 50% of the networks in France have a strong preference for fixed-price contracts (87 and 65% of the networks resp.). Their competitor, namely Agir and Connex prefer cost-plus regimes (54.6% and 56.5% of the networks resp.)

Second, rents may be abandoned to the operators in the forms of excessive subsidies, which may entail high wages to the workers, or excessive profits for the operators. The urban transport industry is an activity where the volume of service supplied increases over time. Operating costs are expected to increase proportionally (or less than proportionally if economies of scale are found to be significant). Once having corrected for the increase of input prices over time, it appears that the average subsidies (per unit of supply, i.e., per seat-kilometer) paid to the operators increase in a significant share of networks: This is the case in a majority of the networks of the database over the period of observation. Figure 1 illustrates this pattern for a sample of 10 urban areas.

Transportation services are organized by local governments who are elected for short periods of six years. Leaving rents to specific interest groups may allow these governments to obtain social peace and maximize their chances of reelection. Note that operators have a strong bargaining power: Transport unions are very powerful in France, and the regulator (not the operator) is responsible for the social cost of potential strikes. Moreover, as already explained, the municipal corporations who own the transport operator may also be in charge of other municipal services.

Rent leavings and contract choice are directly connected. We propose to estimate a structural function that accounts for the contract choice by a regulator who cares about both social welfare and private concerns. Private concerns translate into excessive workers' wages and operators' profits. We evaluate the weights given to these private concerns in the regulator's objective function, and we show how they depend on several regulatory ingredients. These ingredients are the characteristics of the regulators and the operators, or the characteristics of the urban network where the service is provided. In a second step, we test our model against a simple cost structure that does not account for the contract choice, in the same fashion as in test 2.

Both test 2 and 3 allow us to shed light on which type of regulation (optimal second-best regulation versus political regulation) is more appropriate to our data. We turn now to the construction of our political regulation framework.

5. The economic model

We present in this section our model of political regulation. We describe first how the operator reacts to a given regulatory contract. The operator exerts a cost-reducing effort level that is conditional on the incentive power of the contract it faces. Once we identify this effort level, we plug it back into the primal cost function in order to derive the final cost structure to be estimated. Second, we write the regulator's objective function that includes both social and private concerns. The regulator will choose the regulatory scheme that provides him with the highest utility level.

5.1 Program of the operator

We describe first the technology associated with the transportation activity in order to determine the primal operating cost function. It is primal in the sense that it is conditional on the cost-reducing activity of the operator. To express the effort level, we need to explain in a second step how it depends on the incentives impinging on the activity of the firm.

The primal cost function

To produce a volume of service Y_i, the operator *i* requires quantities of labor *l* and materials *m*. Denote as w_l and w_m, the price of labor and materials, respectively. Also denote by *C* the observed operating cost of each firm.

The actual operating cost may differ from the minimum operating cost. Inefficiency may prevent operators from reaching the required output level *Y* at the minimum cost, and this may result in upward distorted costs. Firms can also undertake cost-reducing activities to counterbalance their inefficiency. As already discussed, they can engage in process research and development, managers may spend time and effort in improving the location of inputs within the network. They can as well attempt to find cheaper suppliers, bargain better procurement contracts, subcontract non-essential activities, monitor employees, solve potential conflicts, etc. Whatever these cost-reducing activities may be, we will refer to them as effort. Denote by θ and *e* the inefficiency and effort levels of each firm, respectively. Note that these two variables are unobservable. Finally, as the stock of capital K is determined by the regulator, our cost function is determined in the short-run, and is conditional on the stock of capital. Each operator faces a cost function, conditional on capital, inefficiency and effort, of the form:

$$C(Y, w, K, e, \theta | \gamma), \qquad (1)$$

where γ is a vector of parameters to be estimated. Note that, while inefficiency θ is exogenous, cost-reducing effort *e* is a choice variable for firm *i*, and will therefore depend on the type of contract it faces.

We describe now the operator's effort decisions. Before entering into the analysis, it is worth reminding that the pricing structure itself is independent of the nature of regulatory incentives impinging on the activity of the firm.[7] Thus, to determine effort, we do not need to care about the pricing strategy of the regulators.

[7] The way we incorporate the technical inefficiency and effort parameters allows the incentive-pricing dichotomy principle to hold (Laffont and Tirole, 1993). This means that the same pricing formula applies whether we assume strong or weak competitive pressures.

Incentives and cost reduction

We account now for the regulatory incentives impinging on the operators' incentives to reduce costs through the cost function (1) that is conditional on inefficiency θ and the effort level e. Deriving the equilibrium level of effort and plugging it back into the conditional cost function allows us to derive a structural cost function that can be estimated. The aim of this approach is twofold. First, we can test whether the different transport operators are involved in different cost reduction activities, depending on which contract they face. Second, accounting for these changes in incentives through the cost structure enables us to reduce the source of misspecification, and avoid biases in the estimation of the technological parameters.

Two regulatory contracts are observed in practice, namely fixed-price and cost-plus. With the fixed-price contract, the operator is residual claimant for effort. It obtains an ex-ante subsidy t^{FP} equal to the expected balanced budget, which is the difference between expected costs and expected revenue. This contract is a very high-powered incentive scheme as the operator is now responsible for insufficient revenues and cost overruns. The operator can exert effort e to reduce his operating cost C. The cost reduction activity induces an internal cost $\psi(e)$. Taking into consideration the operating cost reduction and the internal cost of effort, the operator sets the optimal effort level e that maximizes the profit:

$$U = t^{FP} + R(y) - C(Y, w, K, e, \theta | \gamma) - \psi(e), \tag{2}$$

where $R(y) = p(y)y$ denotes revenue and y measures transport demand.[8] Moreover, θ and e are two unobservable (by the regulator and the econometrician) variables to be evaluated. Each operator determines the optimal effort level e that maximizes his profit in (2). The first order condition is:

$$-\frac{\partial C(.)}{\partial e} = \psi'(e), \tag{3}$$

which implies that the optimal effort level e^{FP} equalizes marginal cost reduction and the marginal disutility of effort.

With the cost-plus contract, the public authority receives the commercial revenue $R(y)$, and receives an ex-post subsidy t^{CP} that reimburses the firm's total ex-post operational costs C. Hence, the firm is not residual claimant for effort. For this reason, this contract is a very low powered incentive

[8] Note that transportation networks are industries where capacity (or supply) Y is adjusted to demand levels y. As demand fluctuates during the day, the regulator determines the minimum capacity level that covers all quantities of service demanded at any moment of the day. As capacity cannot adjust instantaneously to demand levels, the minimum capacity level is always higher than demand. Hence, commercial revenues are determined by y, while costs are determine by Y.

scheme, as firms under this regime have no incentives to produce efficiently. The firm's utility level can be defined as

$$U = -\psi(e). \tag{4}$$

In this case, the optimal effort level is 0.

Note that considering that $e^{CP} = 0$ under cost-plus regimes is a simple normalization that we adopt for ease of exposition and tractability. We could as well assume these operators provide the minimum effort level that guarantees to some extent the renewal of the transport concession from one period to another. To be able to derive and identify two different closed forms for the cost function (1), we need to normalize $e^{CP} = 0$, and let e^{FP} be determined by Condition (3). This assumption is justifiable, given that what matters in our analysis is the difference $e^{FP} - e^{CP}$. Note that we do not force e^{FP} to be positive when estimating it.

Given these two effort levels, we can rewrite the primal cost expression in (1) as

$$C^r\left(Y, K, w, e^r, \theta \middle| \gamma\right), \quad r = \{FP, CP\}. \tag{5}$$

where *r* denotes the type of regulatory regime, which can be either *FP* or *CP*. Equation (5) entails two different cost structures that are conditional on the observed regulatory regime.

5.2 Utility of the regulator

We express now the utility function of the regulator. We consider an unsophisticated regulator facing a situation of imperfect information. It is unsophisticated in the sense that, although it is aware of the existence of asymmetric information, it is not able to implement a revelation mechanism through a complex menu of contracts. The regulator cannot observe the individual θ_i but has some beliefs on the distribution of θ represented by the cumulative distribution $F(\theta)$ with density $f(\theta)$ over the interval $\left[\underline{\theta}, \overline{\theta}\right]$.[9]

The regulator cares for social welfare when it is in power (the possibility of being elected provides such incentives). It has moreover additional concerns for the profit of the operator and/or the wage of the operator's workers.

[9] Laffont (1996) and Aubert and Laffont (2004) consider simultaneously the inefficiency of local political systems and the informational incompleteness of regulators in a theoretical setting where a second-best regulatory scheme is implemented by a sophisticated regulator. They suggest that, under incomplete information, the political inefficiencies of a majority system may affect the cost reimbursement rules and the incentives of the regulatory schemes. For instance, a right-wing regulator may prefer to propose a fixed-price contract to a private firm in order to capture part of its rent. Likewise, a left-wing government is more entitled to give higher wages to the workers of the firm.

If his constituency is composed of stakeholders, the regulator may care for the profit of the firm, and may therefore implement high incentive schemes in order to cut operating costs. The local government may also be willing to give the employees of the operator a worker surplus in the form of above market wages for two main reasons (Pint, 1991, and Roemer and Silvestre, 1992). First, both local government and operator are assumed to respond to pressures from workers' unions. Second, the local government can as well be politically motivated and might consider that wages paid to the workers who reside in the constituency constitute a transfer to a subset of voters. In this case, the regulator may implement very low powered incentive schemes in order to justify important operating costs, which allows the payment of excessive wages.

We write the regulator's utility as follows:

$$V(e,\theta) = W(y,Y,e,\theta) + \alpha U + \beta C(Y,e,\theta), \tag{6}$$

where $W(y,Y,e,\theta)$ is the usual welfare measure and the pair $(\alpha,\beta) \in \Re$ denotes the regulator's concern for profit U and operating costs $C(.)$ respectively. A positive parameter denotes a significant concern for profit or wage. A negative parameter entails a specific level of distaste for profit or wage. Note that since the wage bill is just a share of total costs $C(.)$, the wage surplus is denoted as $\beta C(.)$, where β captures at the same time the wage share in total cost and the taste of the regulator for the wage surplus. Welfare is measured as

$$W = S(y) - R(y) - (1+\lambda)(U + \psi(e) - R(y) + C(Y,e,\theta)), \tag{7}$$

where $S(y)$ is the gross surplus of the consumers, and λ is the local cost of public funds. We rewrite the utility as

$$V(e,\theta) = S(y) + \lambda R(y) - (1+\lambda)\psi(e) + (\alpha - 1 - \lambda)U + (\beta - 1 - \lambda)C(Y,e,\theta). \tag{8}$$

Thus, the regulator is divided between his concern α (β resp.) for profit (wage resp.) and the social cost $1+\lambda$ of profit (wage resp). Increasing β decreases the effort *e*. Likewise, increasing α increases the effort *e*. We expect the concern for profit and wage not to be greater than the cost of profit and wage for society, i.e., the local government prefers to minimize the profit and costs of the operator: $\alpha \leq 1+\lambda$, and $\beta \leq 1+\lambda$. Note that this restriction is not imposed in the course of the estimation; instead, it is verified ex post.

We use the utility function of the regulator as the main building block to write the probability to choose a cost-plus or a fixed-price contract. Since we observe the contract choice and we have information on several characteristics of the regulators and the operators, we are capable of identifying the ingredients of the model. Our empirical model will serve as a test of the regulator's objective function presented in this section. A badly defined objective function will be rejected by our data at the moment of the estimation process. Assessing the magnitude and the significance of the regulator's concerns for costs and profit will allow us to test as well for the relevance of our political model.

6. The econometric specification

We turn now to the econometric specification of our political regulation framework. We evaluate the likelihood of a data point, which is an operating cost level conditional on a specific contract chosen by the regulator. On the operator side, we need to assume a specific functional form for the cost function in (5) and the disutility of effort $\psi(e)$. Hence, we can derive the structural cost expression to be estimated. On the regulator side, it is necessary to express the concerns α and β in (8) as functions of variables that account for the characteristics of the organization of the service.

The cost function

We assume a Cobb-Douglas specification for the cost function presented in (1). This specification retains the main properties desirable for a cost function, while remaining tractable. Alternative more flexible specifications, such as the translog function, lead to cumbersome computations of the first order conditions when effort is unobservable. The cost function is then specified as:

$$C = \gamma_0 w_l^{\gamma_l} w_m^{\gamma_m} Y^{\gamma_Y} K^{\gamma_K} exp[(\theta - e)]. \tag{9}$$

We impose homogeneity of degree one in input prices, i.e., $\gamma_l + \gamma_m = 1$. The inefficiency θ is characterized by a density function $f(\theta)$ defined over an interval $[\theta_L, \theta_U]$, where θ_L (resp. θ_U) denotes the most efficient (inefficient resp.) operator. Second, the effort e is defined as follows. Define the following convex cost of effort function, with $\psi(0) = 0$, $\psi'(e) > 0$, and $\psi''(e) > 0$:

$$\psi(e) = \exp(\mu e) - 1, \quad \mu > 0, \tag{10}$$

where μ is a parameter to be estimated. Using the functional forms of operating costs (1), the cost of effort (10), and the first order condition for effort (3), we can express the effort level under a fixed-price regulation. The first-order condition that determines the effort level e^{FP} can now be written as

$$C(.) = \mu \exp(\mu e) \tag{11}$$

Substituting (9) in (11), we can solve for e^{FP} as

$$e^{FP} = \frac{1}{1+\mu}\left(\gamma_0 + \gamma_l \ln w_l + \gamma_m \ln w_m + \gamma_Y \ln Y + \gamma_k \ln K + \theta - \ln \mu\right), \tag{12}$$

while $e^{CP} = 0$. The effort level of a firm increases with θ, i.e., a more inefficient operator optimally exerts more effort than a less inefficient operator, $\partial^2 C / \partial\theta \partial e < 0$. Moreover, operators provide less effort when effort is more costly, i.e., when the cost-reducing technology parameter μ is larger. Substituting back e^{FP} and e^{CP} into (9) allows us to obtain the final forms to be estimated $C^{FP}(.)$ and $C^{CP}(.)$. We obtain:

$$\ln C^{FP} = c_0 + \gamma_l' \ln w_l + \gamma_m' \ln w_m + \gamma_k' \ln K + \gamma_Y' \ln Y + \nu\theta, \tag{13}$$

and

$$\ln C^{CP} = \ln \gamma_0 + \gamma_l \ln w_l + \gamma_m \ln w_m + \gamma_k \ln K + \gamma_Y \ln Y + \theta, \tag{14}$$

where $\nu = \mu / 1+\mu$, $c_0 = \gamma_0 + (1/1+\mu)(\ln\mu - \gamma_0)$, and $\gamma' = \nu\gamma$. It is interesting to note that $\lim_{\mu \to +\infty} \gamma' = \gamma$, suggesting that, as the cost of effort μ grows, the effort level falls, and expression (13) converges to (14). This implies that, if the effort activity in the industry is significant, and if effort is not properly identified, the estimates of the cost elasticities are biased. The cost function to be estimated is then:

$$\begin{aligned} \ln C = \xi^{FP}&\left(c_0 + \gamma_l' \ln w_l + \gamma_m' \ln w_m + \gamma_k' \ln K + \gamma_Y' \ln Y + \nu\theta\right) + \\ \xi^{CP}&\left(\ln \gamma_0 + \gamma_l \ln w_l + \gamma_m \ln w_m + \gamma_k \ln K + \gamma_Y \ln Y + \theta\right), \end{aligned} \tag{15}$$

where ξ^{FP} takes value 1 if the regulatory regime is a fixed-price, and 0 otherwise, while ξ^{CP} takes value 1 if the regulatory regime is a cost-plus and 0 otherwise.

For a network *i* at period *t*, the stochastic cost function can be stated from Equation (15) as

$$C_{it} = C^r\left(Y_{it}, K_{it}, w_{it}, \theta_i, \xi_{it} | \gamma\right) + \varepsilon_{it}, \tag{16}$$

where an error term ε_{it} is added to account for potential measurement errors. It is assumed to have a normal density function with mean 0 and variance σ_c^2. Moreover, the efficiency index θ has a beta density with scale parameters τ and φ. The inefficiency parameter is thus conveniently defined as a percentage. This is readily obtained since the beta density is defined over the interval $[0, 1]$. In this case, the level of effort is also defined over the unit interval since $(\theta - e)$ must be non-negative.

Contract choice

We write now the probability to choose a fixed-price or a cost-plus contract. In the course of the estimation, the regulator's concerns for profit and wages (α and β resp.) and the cost of public funds λ are allowed to vary across networks and across time. Hence, the regulator's utility can be expressed as

$$V_{it}(.) = S(y_{it}) + \lambda_{it} R(y_{it}) - (1+\lambda_{it})\psi(e_{it}) + (\alpha_{it} - 1 - \lambda_{it})U_{it} + (\beta_{it} - 1 - \lambda_{it})C(Y_{it}, e_{it}, \theta_i). \quad (17)$$

We expect these concerns to depend on several explanatory variables which account for the characteristics of the regulator, the operator, and the network where the service is provided. Thus, we write:

$$\alpha_{it} = \alpha(P_{it}, A_{it}, N_{it}),$$

$$\beta_{it} = \beta(P_{it}, A_{it}, N_{it}),$$

where P_{it}, A_{it}, and N_{it} are vectors that gather information on the characteristics of the regulator (Principal), the operator (Agent), and the transportation network, respectively. They will be discussed in more details in the next section. We proceed in a similar fashion with the cost of public funds λ_{it}:

$$\lambda_{it} = \lambda(P_{it}).$$

Note that we account solely on the features of the regulator in this case, as we expect the tax distortion to depend only on the actions of the local government in each urban network.

The regulator selects the type of contract *r* that maximizes his utility $\overline{V}_{it}^{r}$. Since the utilities are not known to the econometrician with certainty, they are treated as random variables. The choice probability of contract *r* is equal to the probability that the utility of alternative *r*, $\overline{V}_{it}^{r}$, is greater than or equal to the utility of the other alternative r' in the choice set $\Omega = \{FP, CP\}$. This can be written as follows:

$$P(r|\Omega) = \Pr\left(\overline{V}_{it}^{r} \geq \overline{V}_{it}^{r'}, \quad r, r' \in \{FP, CP\}\right). \quad (18)$$

We can express the random utility of an alternative as the sum of observable and unobservable components of the total utilities:

$$\overline{V}_{it}^{r} = \underset{\theta}{E} V_{it}^{r} + \omega_{it}^{r}, \quad (19)$$

where V_{it}^{r} is the utility expressed in (17), and ω_{it}^{r} is an error term. Hence, a contract choice implies a utility level that is conditional on the features of the contract itself (a specific effort level, and therefore a given quantity of cost, profit, and disutility of effort), as well as the characteristics of the regulator, the operator, and the network. As we observe these characteristics and the contract choice, we are able to identify our political parameters α_{it}, β_{it}, and λ_{it}.

Expression (18) is now rewritten as[10]

$$P(r|\Omega) = \Pr\left(EV_{it}^{r} + \omega_{it}^{r} \geq EV_{it}^{r'} + \omega_{it}^{r'}, \quad r, r' \in \{FP, CP\}\right), \tag{20}$$

or

$$\begin{aligned} P(r|\Omega) &= \Pr\left(\omega_{it} = \omega_{it}^{r'} - \omega_{it}^{r} \leq EV_{it}^{r} - EV_{it}^{r'}, \quad r, r' \in \{FP, CP\}\right) \\ &= \Pr\left(\omega_{it} \leq (\beta - 1 - \lambda)\left[EC^{r}(., e_{it}^{r}) - EC^{r'}(., e_{it}^{r'})\right] + (\alpha - 1 - \lambda)EU_{it}^{r} - (1+\lambda)\psi(e_{it}^{r})\right), \end{aligned} \tag{21}$$

assuming that $r = FP$, and $r' = CP$.

As specified in a previous footnote, the pricing structure of the service is independent from the incentive rules set by the regulatory contract. Moreover, we consider a setting where the elasticity of demand is very small which seems a reasonable assumption in the case of transportation (see Oum et al., 1992). Hence, we assume that the consumer gross surplus $S(y_{it})$ and the revenue computed at the shadow cost of the public funds $\lambda R(y_{it})$ are the same under both regulatory contracts. The term $S(y) + \lambda R(y)$ therefore disappears from our probability (21), and we do not need to care about the demand side of regulation.

Assuming a logistic distribution for ω_{it}, $P(r|\Omega)$ can be rewritten as

$$P_{it}(r|\Omega) = \frac{e^{EV_{it}^{r}}}{e^{EV_{it}^{r}} + e^{EV_{it}^{r'}}}. \tag{22}$$

The likelihood function

The likelihood of a cost data point conditional to θ_i, given the choice of one particular type of contract, is

$$L_{it}(\theta_i) = P_{it}(r|\Omega)^{\eta_{it}^{r}} P_{it}(r'|\Omega)^{\eta_{it}^{r'}} L\left(C_{it}^{r} | Y_{it}, K_{it}, w_{it}, \theta_i, \xi_{it}, \gamma, \sigma_c, \tau, \varphi\right), \tag{23}$$

where η_{it}^{r} ($\eta_{it}^{r'}$ resp.) is an indicator parameter that takes value 1 if the observed contract at date *t* is of type *r* (r' resp.), and 0 otherwise. Estimating the likelihood in (23) entails estimating simultaneously the cost structure defined in (16) and the contract choice probability specified in (22). Note that the cost function enters explicitly in the contract choice probability: When choosing a regulatory scheme, the regulator is aware of the consequences of his decision on the operating costs. Hence, our political regulation framework accounts for the interaction between the realization of costs and the political variables that influence the contract choice.

[10] We get rid of the sub index θ to simplify the exposition.

Note that, since the variable θ_i is unobservable, only the unconditional likelihood can be computed, i.e.,

$$L_{it} = \int_0^1 L_{it}(x_i) x_i^{\nu-1} (1 - x_i)^{\gamma-1} \frac{\Gamma(\nu+\gamma)}{\Gamma(\nu)\Gamma(\mu)} dx_i \, , \tag{24}$$

where $\Gamma(.)$ is the gamma function. Assuming that observations are independent, then the log-likelihood function for our sample is just the sum of all individual log-likelihood functions obtained from Equation (24).

7. Empirical results

We present now the empirical results of our political model which are obtained from the estimation of the likelihood in (24). We comment first the construction of the variables. In particular, we discuss the features of the industry that allow us to evaluate the private concerns of the local governments.

7.1. Data and Variables

Different types of variables are required in order to identify our model: The cost equation calls for contextual variables that capture elements of the economic environment. On the contract choice side, two sets of observations are required: First, interest group variables which capture the characteristics of the organizations that pressure the regulators; second, institutional variables which reflect differences across urban networks in terms of political attitudes and structures. Summary statistics are given in Table 2.

Estimating the Cobb-Douglas cost function requires measures on the level of operating costs, the quantity of output, capital, and the input prices. Total costs C are defined as the sum of labor and material costs. Output Y is measured by the number of seat-kilometers, i.e., the number of seats available in all components of rolling stock times the total number of kilometers traveled on all routes. In other words, this measure accounts for the length of the network, the frequency of the service and the size of the fleet. Note that this is also a measure of the quality of service. Capital K, which plays the role of a fixed input in our short-run cost function, measures the size of the rolling stock, which is denoted as the total number of seats available. Since the authority owns the capital, the operators do not incur capital costs. The average wage rate w_l is obtained by dividing total labor costs by the annual number of employees. The price of materials w_m has been constructed as the average fuel price for France (published by OECD).

Estimating the contract choice requires observations on the features of the contracts, as well as observations on the characteristics of the actors involved in the organization and the production of the service. Observing the features of the contracts entails observing the type of contract itself, a level of cost, a level of profit (and therefore a level of commercial revenue), and a quantity of disutility of effort (and therefore a level of effort). The commercial revenue is obtained as the total revenue obtained from transport tickets sales. The other variables are known already.

The characteristics of the regulator, the operator, and the network where the service is provided are measured by the following variables: The local transport tax, the share of drivers in the total labor force, the size of the network, whether the local regulator is left-wing or right-wing, whether the operator is private or public, and the identity of the municipal corporation that owns the operator.

Interest groups variables include the share of drivers, the size of the network, whether the operator is private or public, and the identity of the municipal corporation that own the operator. We thus assume that some firms are more likely to succeed in promoting their private interests than others due to inherent advantages of larger stakes, size, and jurisdictional mobility. The total labor force entails the bus drivers as well as engineers who are responsible for the improvement of the operator's productivity. The share of drivers is simply obtained by dividing the number of drivers in each network by the total labor force. The size of the network is measured as the total length of the transport network in kilometers. Note that this variable is also a proxy for the size of the operator. We construct a dummy variable that takes value one if the operator is public (in the sense that at least 50% of the capital of the firm is in the hands of the state or the local government), and zero otherwise. Finally, the four important municipal corporations who potentially own the local operator are Keolis, Transdev, Agir, and Connex. We construct a dummy variable for each one of these corporations.

Institutional variables entail the local transport tax, and the political color of the local regulator. The local transport tax is paid by any local firm with more than 9 employees. We divide it by the number of seats-kilometers supplied to have a measure of the level of tax per unit of output. From Table 2, it is close to 2.2 cents. Finally we construct a dummy variable that takes value one if the local government is right-wing. Data on the political color of the local government are published by the national newspaper Le Figaro. Over the period of observation, local government may belong to one of the five main political groups, which are, Extreme right, right, center right, left, and extreme left. Note that the local government is made of members of municipal councils, who are elected by direct universal suffrage for a renewable six-year term. The mayor is elected by the municipal council. Table 2 suggests that 52.6% of local governments in our database are right-wing.

7.2. Results

We turn now to the estimation results of our structural methodology, which considers simultaneously the contract choice by local governments and the structural cost function. Table 3 displays the estimates of four alternative models. In each model, we test different sets of explanatory variables, which are used as proxies for the local cost of public funds λ, the regulator's concern for operating costs β, and the concern for operating profits α.

The four models are specified as follows: In Model I and II, the local cost of public funds is a function of the local transport tax per unit of output produced. Whether the local government is right-wing or not, whether the operator is a public entity or not, the share of drivers in the total labor force, and the size of the network are explanatory variables for the concern for costs β and the concern for profit α. Model III is similar to the previous ones with the exception that the local cost of public funds is a dummy variable that takes value one if the local government is left-wing. Finally, Model IV is similar to Model III with the exception that the size of the network is dropped, and we add three dummy variables that account for the identity of the municipal corporation (Connex, Keolis, Agir, or Transdev) the operator belongs to.

Ideally, each parameter λ, β, and α should also depend on a constant term. As explained in Equation (21), the probability of the contract choice $P(r|\Omega)$ computes the differences $\beta - 1 - \lambda$ and $\alpha - 1 - \lambda$, making it difficult to identify at the same time a constant for λ and β on the one hand, and λ and α on the other hand. Likewise, the interaction between β and α does not allow a simultaneous identification of two constants for these parameters. Hence, we introduce a single constant term for β.

Consider first the estimates of our structural cost function, which are presented in the first part of Table 3. All parameters are significant at the 1% level and have the expected magnitude. Note that the parameters are in general quite stable across each model. The two density parameters τ and φ are both greater than 1, suggesting that the distribution of the inefficiency θ is normally shaped. As $\varphi \geq \tau$, the mode of the distribution is lower than 0.5.

An important parameter in our cost function is μ, the disutility of effort parameter. The reader should remember that, as μ increases, the parameters β' in Equation (13) converge to the βs, suggesting that the incentive effects generated by the regulatory environment are less relevant. On the contrary, as μ reduces, the incentive effects become more important, and using the same cost functional form under both fixed-price and cost-plus environments would lead to important biases in the estimates. From our estimates, the differences in the slopes of the cost functions under fixed-price and cost-plus regimes may vary from $\gamma = \mu/1+\mu = 0.987$ to $\gamma = 0.976$.

Consider now the estimates of the contract choice, which are presented in the second part of Table 3. Again, our aim is to evaluate the local cost of public funds λ, the regulator's concern for operating costs β, and the concern for operating profits α in the regulator's objective function (6). We assume that both parameters α and β depend on explanatory variables that are specific to the regulator, the operator, or the network itself, while the local cost of public funds λ depends on variables that are regulator specific only.

In general, many parameters are significant and have the expected sign and magnitude, suggesting that our political model is potentially relevant to explain the choice of regulatory contracts in the industry. The right-wing government variable has a stronger effect on α than β, suggesting that these governments show a greater interest for profit, and therefore prefer to use fixed-price regimes. Likewise, the public operator effect is stronger on the profit side, which also implies that fixed-price contracts are preferred if the operator is public. The size of the network does not seem to affect significantly the interest for cost, while it affects positively the interest for profit. This also goes in line with the initial intuition that there is a preference for fixed-price regimes in bigger networks.

The effect of the different municipal corporations on α and β is significant. However, their impact on the contract choice is rather ambiguous.

The effect of the share of drivers in the total labor force is not always significant. When significant, it seems to go in the opposite direction, i.e., a lower endowment of skills (as proxied by a higher share of drivers) implies a preference for profits, and therefore for fixed-price regimes. This effect is rather counter intuitive.

Finally, the local transport tax paid by local firms is not a good candidate to proxy the local cost of public funds. We obtain a significant effect however if the political color of the local government is considered: The cost of public funds is significantly higher if the principal is a left-wing type of government.

We are interested in determining which one of the four models fists the data best. Since the four models are not nested, we use a test proposed by Vuong (1989). The null hypothesis is that two models are equally far from the true data generating process in terms of Kullback-Liebler distances. The alternative hypothesis is that one of the two models is closer to the true data generating process. When the Vuong statistic is less than two in absolute value, the test does not favor one model above the other. The results of the test are presented in Table 4. Note that positive values of the test favor Model *i*. Negative values favor the alternative specification *j*. The results suggest that Model I is dominated by the other three specifications. When comparing Models II, III, and IV, the test is inconclusive, suggesting that these models are equally appropriate to explain the contract choice.

Evaluating the concerns for profit and wages

Having these estimates in hands, we are able to derive the estimated $\hat{\alpha}_{it}$ and $\hat{\beta}_{it}$ for each network at each period. In order to test the predictions of our political model, we compute an average value of each parameter conditional on whether a fixed-price or a cost-plus contract is observed. Table 5 presents the results derived from Model II.

Our estimates go along with the intuition. The observation of a fixed-price (cost-plus resp.) entails $\alpha \geq \beta$ ($\alpha \leq \beta$ resp.), i.e., the regulator's relative concern for profits (costs resp.) is greater. Both parameters are statistically different from each other, as specified by a t-test. Note also that both parameters are lower than the distortion $1+\lambda$ imposed by the cost of public funds, as expected.[11]

Welfare analysis

We can also compute the real magnitude of the marginal impact of a political ingredient on society's welfare. We have suggested so far that our political variables affect significantly the contract choice, but we have not provided evidence on the importance of these effects.

We proceed in two steps. First, we evaluate the marginal effect of each political variable on the probability of choice of a fixed-price contract. In particular, we shed light on how this probability increases if (*i*) a government switches from left-wing to right-wing, if (*ii*) an operator switches from private to public, and if (*iii*) the size of the network increases by one kilometer.[12] This can be achieved through the logit specification in (22), using our estimation results. In a second step, we compute the cost reduction ΔC_{it} that can be obtained if a fixed-price regime is implemented in place of a cost-plus regime. This can be performed through our effort expression (12). The cost reduction is denoted as $\Delta C_{it} = \exp[-E_\theta(e)] - 1$.

Since we assume that the consumer surplus is the same under both regulatory contracts, we restrict our welfare analysis to operating costs. The results are presented in Table 6. They show that our political variables affect significantly the probability to choose a fixed-price contract. In particular, switching from a left-wing to a right-wing government implies a 0.461 probability increase. The same probability increases by 0.125 point if the operator is public instead of private. Finally, increasing the transport network by one kilometer increases the same probability by 0.017 point.

We can put these results in perspective by evaluating the operating cost reduction associated to the choice of a fixed-price contract in place of a cost-plus regime. As indicated in Table 6, switching from a cost-plus regime to a fixed-price one entails a 12.1% cost reduction. Note that the average network regulated under a cost-plus regime faces each year a 14.3 million Euros operating cost bill. Implementing fixed-price schemes in these networks would thus allow average costs savings of 1.8 million Euros, which is the equivalent of the annual transport budget of a 55,000 inhabitants urban area.

[11] From our results, such distortion ranges from 1 to 1.47. These estimates are reasonable in the sense that they are in the range of values obtained by others and published in the economic literature. For instance, Ballard, Shoven and Whalley (1985) provide estimates (namely, 1.17 to 1.56) of the welfare loss due to a one-percent increase in all distortionary tax rates. In the case of Canadian commodity taxes, Campbell (1975) finds that this distortion is equal to 1.24. More generally, it seems that the distortion falls in the range of 1.15 to 1.50 in countries with a developed efficient tax collection system. We will go back to these comments in the next section on second-best analysis.

[12] The marginal effects of the variables *DRIVE*, *CONNEX*, *KEOLIS*, and *TRANSDEV* are not significant, which is not a surprise, given the ambiguous estimates obtained previously with our structural model.

8. Positive versus normative analysis

We turn now to a hypothetical scenario where the regulator proposes an optimal second-best regulatory contract to the operator. We test whether this scenario fits the data better than the political model we advocate in this paper.

If the contracts currently implemented in the industry were derived from optimal second-best mechanisms, the so-called fixed-price and cost-plus contracts we observe would be the "visible part" of a more general menu of linear contracts. Since the real world cannot be confined to only very efficient or very inefficient operators, this is equivalent to assuming that these so-called fixed-price and cost-plus schemes are not the two extremes of a menu of linear contracts, but are rather complex financial arrangements that are unobservable to us, but can be identified through the estimation of a cost function.

Second-best optimal contracts

In this framework, the regulator is benevolent and uses a revelation mechanism to force the operator to reveal his real type. This translates into an incentive compatibility constraint that should be accounted for at the moment of maximizing social welfare. We present briefly this model and the first order condition on effort that is derived from the exercise.

The regulator is once again imperfectly informed on the inefficiency level of the operator. He has only some beliefs on the distribution of inefficiency, which takes the form of a distribution function $F(\theta)$ on a specific interval $\left[\underline{\theta},\bar{\theta}\right]$. We consider the accounting normalization where the regulator receives the commercial revenues $R(.)$ and pays *ex-post* operating costs $C(.)$. Hence, the utility of the operator is

$$U = t_0 - \psi(e), \qquad (25)$$

where t_0 is a net transfer paid to the firm.

A second-best contract is characterized by a second-best effort level e^s. Hence the optimal allocation is obtained by maximizing the expected social welfare ,

$$\underset{\theta}{E}W = \underset{\theta}{E}\left\{S(y) + \lambda R(y) - (1+\lambda)\left(\psi(e) + C(Y,e,\theta)\right) - \lambda U\right\}, \qquad (26)$$

with respect to *e* under two constraints: *i*) an individual rationality constraint $U \geq 0$, meaning that the operator is endowed with a utility level at least as high as he/she could get outside; *ii*) an incentive compatibility constraint written as

$$U'(\theta) = -\psi'(e^s), \qquad (27)$$

which means that, to have the incentive to tell the truth, the operator must be provided with the same gain than the one he would obtain if the announces a lower efficiency level.

At the optimal solution, the marginal cost reduction is equal to the marginal disutility of effort from which a downward distortion is subtracted in order to limit rent leavings. In our notations,

$$\frac{\partial C(\phi(y^s), e^s, \theta)}{\partial e} = -\psi'(e^s) - \frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)}\psi''(e^s). \qquad (28)$$

This condition on effort can be translated into a cost function which can be estimated and tested against our political cost function. Using the functional forms for operating costs (9) and disutility of effort (10), we can derive an expression of the second-best effort e^S in the same manner we obtained an expression of the fixed-price effort level e^{FP}:

$$e^s = e^{FP} - \frac{1}{1+\mu}\ln\left[1+\mu\frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)}\right]. \qquad (29)$$

Hence, reintroducing e^S into the primal cost structure (9), we derive the second-best cost function to be estimated:

$$\ln C^S = \ln C^{FP} + \frac{1}{1+\mu}\ln\left[1+\mu\frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)}\right]. \qquad (30)$$

Note that the second-best effort and cost levels can be interpreted from the fixed-price levels: Assuming that the monotone hazard rate property holds, $d(F(\theta)/f(\theta))/d\theta \geq 0$, the condition on second-best effort suggests that the downward effort distortion becomes more important as θ increases. Thus, the most inefficient operator (given the belief of the regulator) should be provided an effort level that is close to the cost-plus effort. Likewise, the most efficient operator exerts an effort level that is similar to the fixed-price effort. These effort distortions are translated into the second-best cost function. A downward effort distortion entails an upward cost distortion of similar size.

Estimation results for the second-best cost function are provided in Table 7. As λ cannot be identified in the course of the estimation, we need to calibrate it. We compute several estimations for $\lambda \in [0.1, +\infty[$. As emphasized in a previous footnote, we expected the cost of public funds to be in the range $[1.15, 1.5]$ in developed countries. We extend this interval to unrealistic values in order to check for the robustness of our estimates. Note that the estimation results are quite stable and do not seem to depend to much on the value of λ.

Specification tests

Is the assumption of second-best optimal contracts more realistic than our hypothesis of political regulation? To provide an answer, we test both scenarios of contract choice (second-best optimal design versus political regulation) against an estimation procedure which accounts for the effects of regulation in a structural cost function, but do not explain the contract choice. The three frameworks are as follows:

(SC) **Structural cost**. We estimate Equation (16), which we call our benchmark; operators exert an effort level that is conditional on the regulatory contract they face, but the contract choice by the regulator is not explained. This case is similar to the one considered in Gagnepain and Ivaldi (2002).

(PR) **Political regulation**. This is our political model which has been presented in details in this paper. We estimate a structural cost function simultaneously with the contract choice. The contract choice is explained by political ingredients. Model II in Table 3 serves as our political specification.

(SB) **Optimal second-best regulation**. The structural cost function accounts for the effects of regulation and the choice of regulation. The choice of regulation obeys to the optimal second-best rules described in this section.

We perform two main nested tests: (PR) against (SC), and (SB) against (SC). The result of these tests will shed light on whether (*i*) accounting for the contract choice is useful, and (*ii*) which type of regulation explains the data best.

We perform two additional tests as well: The structural cost function (SC) is first assessed against a simple cost function with no effort and no inefficiency term, denoted as the **simple cost** (C) specification. Second, the structural cost function (SC) is tested against a **cost frontier** (FRONT), which includes an inefficiency parameter, but does not account for the effect of regulation, i.e., its structure is independent from the level of effort exerted by the operator. Performing these two tests allows us to determine whether accounting for the regulation effects in the cost structure is useful, as in Gagnepain and Ivaldi (2002).

Table 8 presents the estimation results of the 5 different specifications. The estimated parameters are significant at the 1% level in most cases. Note that the input prices and the output parameters are quite stable from one scenario to another. Significant variations can be observed however for the disutility of effort μ, and the density parameters τ and φ.

We compute a Likelihood ratio statistic for each test where the structural cost function (SC) serves as the benchmark. Scenarios (C) and (FRONT) are rejected against scenario (SC). It is interesting to note that scenario (C) is the standard cost specification used by the literature focusing on regulation; its rejection indicates that we have to be cautious when interpreting the results derived from other models. The cost specification should account for the cost-reducing effort that is contingent on the regulatory environment impinging on the activity of the firm.

Scenario (SB) is rejected against scenario (SC). Thus, assuming that the current regulation is based on optimal second-best rules, and modelling explicitly such rules when estimating the structural cost function does not improve the estimation results. Moreover, scenario (SC) is rejected against scenario (PR). This suggests that estimating together the structural cost function and the contract choice is useful if it is assumed that the current regulation obeys to private concerns. Hence, regulatory endogeneity is an important issue to account for, since neglecting it may lead to inconsistent and biased estimates of the effects of economic policy. Note for instance that the (SC) scenario overestimates the disutility of effort μ compared to the (PR) scenario. Thus, the effect of incentives on the cost reduction activity of the operator is under evaluated if the contract choice under political regulation is not considered.

Together, these results imply that the regulatory schemes currently implemented in the French urban transport industry are not optimal and are not the observable items of a more general menu of second-best contracts. On the contrary, the generation process of the data we have in hand is better explained by the political aspect of regulation.

9. Conclusion.

We believe our study contributes to the empirical literature on regulation on several fronts: First, we provide empirical evidence which illustrates that political considerations are important in terms of understanding the effects and the causes of regulation in the public sector. In the particular case of the French urban transport industry we show that regulatory decisions are not entrusted to benevolent governments, but are rather endogenously determined outcomes in terms of a set of agents who participate to the design of transport contracts. Here these agents are the local government in charge of the organization of the transportation activity, and the operator (or in a wider sense the corporation who owns the operator) who is responsible for the service. The political color of the regulator, as well as the juridical nature of the operator, his size, his technological capability, or the identity of the municipal corporation it belongs to are all potential candidates for factors that influence contract design.

A second potential contribution of this article is related to the on-going debate between the positive and normative analysis of regulation. When the relationships between a regulator and his operator are characterized by asymmetries of information, the regulator can implement an optimal regulatory scheme which enables him to reach a second-best welfare level. Although these optimal contracts are technically difficult to implement in practice, the recent empirical literature on regulation has assumed that they are systematically used. In this paper, we reject this hypothesis and suggest that the generation process of the data we have in hand is better explained by the political aspects of regulation.

Finally, we show that considering simultaneously the causes and the consequences of regulation helps improving the empirical results. We show that it is important to model the contract choice by local authorities in order to understand better how this regulation affects the behavior of regulated agents. The effect of regulation on the behavior of regulated firms would thus be underestimated if the contract choice was not properly accounted for in the estimation process.

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Table 1: Contracts

Name	Quantity	%
Period of observation	1987-2001	
Number of networks	50	
Changes of operators	2	
Changes of local governments	22	
Number of contracts	136	
FP contracts		55.5
New contracts	94	
Switch contract type	20	
Switch CP to FP	17	
Share right-wing governments		52.6
FP if right wing government		64
FP if left wing government		54.5
Share public operator		38.7
FP if public operator		67
FP if private operator		61.4
Share Keolis		32.6
FP if Keolis		65
Share Agir		16.3
FP if Agir		45.4
Share Connex		22.4
FP if Connex		43.5
Share Transdev		245
FP if Transdev		87

Note: CP denotes cost-plus contracts. FP denotes fixed-price contracts.

Figure 1: Average subsidy (in real terms)

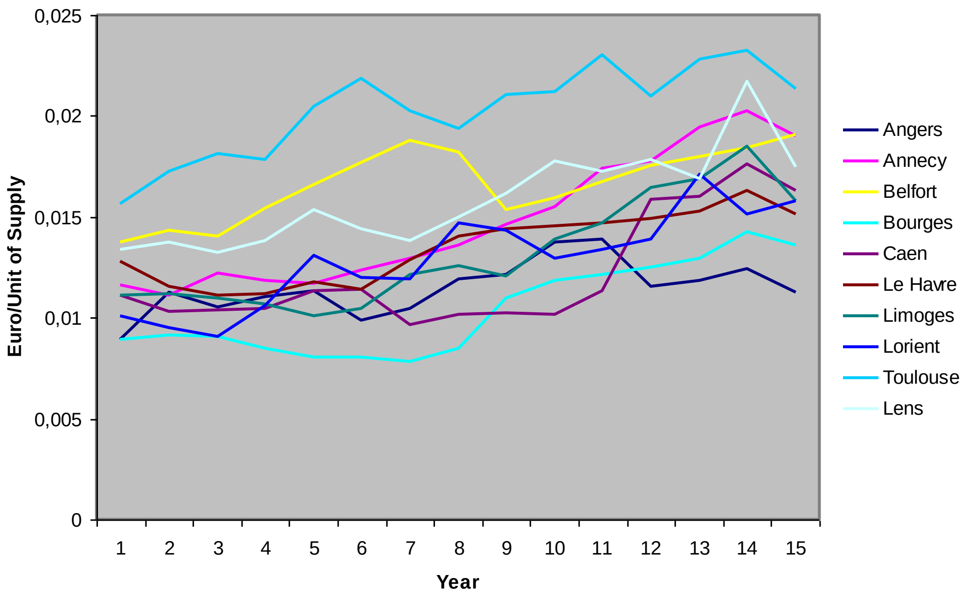

Table 2: Data description

Name	Variable	Mean	Standard Deviation
Cost (Euros)	C	20,549,568	19,273,852
Revenue (Euros)	$R(y)$	9,608,629	10,526,903
Subsidy (Euros)	t	11,093,512	9,659,325
Production (seat-kilometers)	Y	671,315,300	537,941,510
Wages (Euros)	w_l	30,218	5,337
Price of materials (Index)	w_m	1.159	0.199
Size of the Network (kil.)	*LENGHT*	288.3	200.1
Local tax per Unit Supply (Euro)	*TAX*	0.022	0.013
Share of Drivers	*DRIVE*	0.707	0.072
Share Fixed-price contracts	*FP*	0.555	
Share Right-Wing Principal	*RIGHT*	0.526	
Share Public operator	*PUBLIC*	0.387	
Share Keolis	*KEOLIS*	0.326	
Share Agir	*AGIR*	0.163	
Share Connex	*CONNEX*	0.224	
Share Transdev	*TRANSDEV*	0.245	

Table 3: Structural estimation results

Variable	Par.	I	II	III	IV
Cost Function					
CONSTANT	$\ln \beta_0$	-5.76***	-5.74***	-5.69***	-5.604***
		(0.071)	(0.08)	(0.079)	(0.127)
LABOR	w_l	0.25***	0.24***	0.22***	0.233***
		(0.010)	(0.011)	(0.011)	(0.011)
OUTPUT	w_Y	1.07***	1.07***	1.07***	1.061***
		(0.005)	(0.006)	(0.005)	(0.009)
COST EFFORT	$\ln \mu$	4.41***	3.83***	3.72***	4.032***
		(0.302)	(0.203)	(0.246)	(0.637)
DENSITY θ 1	τ	1.22***	1.28***	1.23***	1.256***
		(0.086)	(0.095)	(0.084)	(0.089)
DENSITY θ 2	φ	1.32***	1.305***	1.32***	1.310***
		(0.093)	(0.092)	(0.09)	(0.086)
ERROR S.D.	σ_ε	0.05***	0.05***	0.05***	0.048***
		(0.004)	(0.003)	(0.004)	(0.004)
Cost of public funds	λ				
TAX		0.27	0.51		
		(0.217)	(0.941)		
1-*RIGHT*				0.08**	0.470***
				(0.04)	(0.137)
Taste for costs	β				
CONSTANT		0.41***	0.69***	0.77***	
		(0.036)	(0.067)	(0.119)	
RIGHT		0.54***			
		(0.040)			
PUBLIC			0.18***	0.21***	0.622***
			(0.068)	(0.083)	(0.105)

Table 3 continued next page

Table 3 continued

Variable	Par	I	II	III	IV
DRIVE		0.02^{*}	0.06	0.02	-1.228^{***}
		(0.014)	(0.058)	(0.081)	(0.372)
LENGTH		0.00	0.01	-0.02	
		(0.002)	(0.058)	(0.027)	
CONNEX					-0.283^{***}
					(0.055)
KEOLIS					-0.561
					(0.844)
TRANSDEV					-1.504^{***}
					(0.550)
Taste for profits	α				
RIGHT		1.03^{***}			
		(0.046)			
PUBLIC			0.42^{***}	0.51^{**}	1.473^{***}
			(0.150)	(0.208)	(0.344)
DRIVE		0.06^{*}	0.22	0.18	2.296^{*}
		(0.038)	(0.212)	(0.257)	(1.215)
LENGTH		-0.00	0.11^{***}	0.09^{***}	
		(0.008)	(0.028)	(0.031)	
CONNEX					-0.194^{**}
					(0.084)
KEOLIS					-1.230
					(1.928)
TRANSDEV					-1.588^{*}
					(0.831)
# Observations		735	735	735	735

Note: Standard errors are in parenthesis.
***Significant at 1%; **Significant at 5%; *Significant at 10%.
Vuong test for non-nested hypothesis: Model IV against other models.

Table 4: Vuong tests on non-nested models

Model *j* / Model *i*	**I**	**II**	**III**	**IV**
I		-11.2	-8.03	-14.8
II	11.2		0.03	0.25
III	8.03	-0.03		-1.50
IV	14.8	-0.25	1.5	

Note: Vuong test for non-nested hypothesis: Model *i* against Model *j*. For values less than 2 (in absolute terms), the test is inconclusive. Values greater than 2 favor Model *i*. Values less than -2 favor Model *j*.

Table 5: Interest for profit and costs

	Interest for profit α	**Interest for costs** β	**t-test**
If cost-plus	0.702	0.740	3.11
	(0.206)	(0.081)	
If fixed-price	0.815	0.775	3.27
	(0.230)	(0.090)	

Note: Standard deviations are in parenthesis.
The estimates are computed from the results obtained in Model 2.

Table 6: Marginal effects on the probability to choose a fixed-price contract

	Prob. Choice Fixed-price	
RIGHT[1]	+0.461	(0.206)
PUBLIC[2]	+0.125	(0.063)
LENGHT[2]	+0.017	(0.008)
Cost reduction if Fixed-price contract (in %)[2]	-12.1	1.168

Note: Standard deviations are in parenthesis.
Estimates are computed from the results obtained in Model 1 ([1]) and Model 2 ([2]).

Table 7: Second-best analysis

Variable	**Par.**	**Estimates**					
		Cost of Public Funds λ					
		0.1	**0.3**	**0.5**	**0.7**	**0.9**	∞
CONSTANT	$\ln \beta_0$	-5.152	-5.156	-5.198	-5.193	-5.506	-5.481
		(0.181)	(0.031)	(0.040)	(0.035)	(0.068)	(0.072)
LABOR	w_l	0.334	0.368	0.380	0.369	0.362	0.406
		(0.034)	(0.004)	(0.009)	(0.004)	(0.008)	(0.011)
OUTPUT	w_Y	0.984	0.977	0.977	0.977	1.004	0.994
		(0.012)	(0.002)	(0.002)	(0.003)	(0.005)	(0.005)
COST EFFORT	$\ln \mu$	3.331	2.709	3.271	2.714	2.434	2.693
		(0.363)	(0.048)	(0.074)	(0.051)	(0.057)	(0.081)
DENSITY θ 1	τ	3.485	3.564	3.508	3.713	3.883	4.029
		(0.359)	(0.149)	(0.176)	(0.159)	(0181)	(0.213)
DENSITY θ 2	φ	3.310	3.495	3.476	3.347	3.726	4.297
		(0.496)	(0.107)	(0.162)	(0.113)	(0.154)	(0.210)
ERROR S.D.	σ_ε	0.039†	0.013	0.013	0.013	0.014	0.016
		(0.032)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
# Observations		735					

Note: Standard errors are in parenthesis.
All parameters are significant at the 1% level, except †not significant.

Table 8: Tests of hypothesis

Variable	Par.	PR	C	FRONT	SC	SB
Cost Function						
CONSTANT	$\ln \beta_0$	-5.74***	-4.614*** (0.159)	-3.947*** (0.151)	-4.922*** (0.246)	-5.156***
LABOR	w_l	0.24***	0.312*** (0.033)	0.322*** (0.034)	0.323*** (0.035)	0.368***
OUTPUT	w_Y	1.07***	0.993*** (0.010)	0.985*** (0.011)	0.972*** (0.017)	0.977***
COST EFFORT	$\ln \mu$	3.83***			4.937* (2.946)	2.709***
DENSITY θ 1	τ	1.28***		3.547*** (0.411)	3.454*** (0.544)	3.564***
DENSITY θ 2	φ	1.305***		2.378*** (0.308)	3.758*** (0.726)	3.495***
ERROR S.D.	σ_ε	0.05***	0.200*** (0.005)	0.075*** (0.016)	0.076*** (0.025)	0.013***
Cost of public funds	λ					
TAX		0.51				
Taste for costs	β					
CONSTANT		0.69***				
PUBLIC		0.18***				
DRIVE		0.06				
LENGHT		0.01				
Taste for profits	α					
PUBLIC		0.42***				
DRIVE		0.22				
LENGHT		0.11***				
Specification Test		22.7	21.9	55.5		-43.6
# Observations		735	735	735	735	735

Note: Standard errors are in parenthesis.
***Significant at 1%; **Significant at 5%; *Significant at 10%.
Specification test: Likelihood ratio test. Model VIII against other models.