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Contract choice, incentives, and political capture in public transport services[±]

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Abstract:

We consider a framework of contractual interactions between urban transport authorities and transport operators. We estimate simultaneously the choice of contract by the authorities and the effect of regulation on the cost reducing activity of the operators. We test whether regulatory schemes currently implemented in the industry are the observable items of a more general menu of second best contracts. We suggest that the generation process of the data we have in hand is better explained by the political aspects of regulation. Moreover, the cost reducing effort of the operators is greater under fixed-price regimes, compared to the cost-plus case.

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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 French 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 contract 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. In 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 Pelzman (1976) and Becker (1983), we test whether the political process and the competition among differently organized interest groups drive regulatory decisions in the French urban transport industry. 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 consistuency, which would improve their re-election prospects (see Persson and Tabellini, 2002). Thus, electoral competition considerations shape their objective function and thus the chosen regulatory policy. The regulatory interaction between local governments and transport operators lead to the regulatory contract choice, which influences the economic outcome of the activity.[1]

[1] Laffont (1996) and Aubert and Laffont (2004) consider simultaneously the inefficiency of local political systems and the informational incompleteness of regulators. They suggest that, under incomplete information,

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 described above contrasts with the new theory of regulation where public intervention corrects market failures and maximizes social welfare. Industrial economists focusing on aspects of firms' regulation by public authorities 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 more than 20 years. 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). In this framework, utilities' productive capabilities and cost reducing effort are two variables that are unknown to the regulator. According to the theory, regulators may 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 in principle implemented through an optimal menu of linear contracts.

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-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) focuses 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-

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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.

[2] More recent contributions include Brocas, Chan and Perrigne (2006) and Perrigne and Vuong (2007).

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 its utility over the period of its mandate. Its 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 thus 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 the relevance of the political capture hypothesis.

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 in the paper that accounting for the choice of contracts turns out to be adequate and fruitful, since it improve the quality of our estimates. With a non-nested test, we show how our new model improves upon the previous one in a significant manner. We suggest in particular that ignoring the process of contract choice yields estimates that underestimate the effects of regulation on the activity of the regulated operator.

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. We leave room for further potential improvements in a more complex dynamic context in future research.

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 of the political model. Section 8 focuses then 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.[3][4]

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 its own 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

[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).

[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.

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.

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, as showed in Table 1. 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. Two main reasons potentially explain this phenomenon: First, owning the rolling stock is an increasingly common practice for the transport operators, which alleviates the local governments' budgets on one hand, but also makes it more difficult for these governments to get rid of an inefficient operator and contract a new one.[5] Second, 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. Finally, 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.

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

[5] Note that local authorities own the rolling stock and the infrastructure in a majority of networks in our database. In this case, they are therefore responsible for the costs due to their renewal.

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 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 in our database.

The choice of contract is potentially related to some specific 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 choice of contracts by local government. We propose to construct a structural cost regulation model where the choice of contracts 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 its technology and its 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. 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 its 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 its 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. 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 contract 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 choice of contracts 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 choice of contract: 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 55% of the networks of our database over our 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 choice of contracts 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 choice of contract, 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. This entails describing 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. We suggest that private concerns distort regulatory schemes towards cost-plus or fixed-price regimes. 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 effort cost reducing activity of the operator. To express this 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:

$$C(Y, w, K, e, \theta | \gamma), \tag{1}$$

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.[6] Thus, to determine effort, we do not need to care about the pricing strategy of the regulators.

[6] 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

This section focuses on the construction of the structural cost function. We propose to account 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 its 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.[7] 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 its profit in (2). The first order condition is:

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

[7] 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.

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 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 Program of the regulator

In this section, we focus on the program of the regulator. Our aim is twofold: First, we need to express the welfare function of the regulator that is required to estimate the choice of contract. This entails determining carefully the different items that enter the welfare function and that can be measured with our data. Second, we suggest that the introduction of private concerns in the objectives of the regulator distort the regulatory mechanisms toward cost-plus or fixed-price regimes.

We consider an unsophisticated regulator in 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 reveal the inefficiency of the operator by introducing a revelation mechanism in its regulatory framework. The regulator cannot observe the individual θ_i but it has at least some beliefs on the distribution of θ represented by the cumulative distribution $F(\theta)$ with density $f(\theta)$ over the interval $\left[\underline{\theta},\overline{\theta}\right]$.

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.

If the constituency of the regulator is composed of stakeholders, it may care for the profit of the firm. Or, as suggested by Laffont (1996), the regulator may be willing to capture the profit of the operator if the latter is a public entity. Both cases motivate situations where the regulator implements very high incentive schemes to increase the profit of the operator.

The local government may also be willing to give the employees of the operator a worker surplus in the form of above market wages. As suggested by Pint (1991) and Roemer and Silvestre (1992), the local government and the operator are assumed to respond to pressures from workers' unions. The local government can also 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. These potential settings entail situations where the regulator implements very low powered incentive schemes in order to justify important operating costs, which allows the payment of excessive wages.

Hence, the regulator's utility is given by the following expression:

$$V(e,\theta)=S(y)-R(y)-(1+\lambda)(U+\psi(e)-R(y)+C(Y,e,\theta))+\alpha U+\beta C(Y,e,\theta), \qquad (6)$$

where $(\alpha,\beta)\in\Re$ denote the concern attached to the profit U of the firm and the wage bill 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 as well as the taste of the regulator for the wage surplus.

The utility function (6) can be re-written as

$$V(e,\theta)=S(y)+\lambda R(y)-(1+\lambda)\psi(e)+(\alpha-1-\lambda)U+(\beta-1-\lambda)C(Y,e,\theta). \qquad (7)$$

Thus, the regulator is divided between its concern α (β resp.) for profit (wage resp.) and the social cost $1+\lambda$ of profit (wage resp.). 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.

The regulator determines the operator's optimal effort level that maximizes the expected utility $E_\theta V(e,\theta)$. Differentiating $\underset{\theta}{E} V(e,\theta)$ with respect to *e* yields the following condition:

$$\psi'(e) = -(1-\beta/1+\lambda)\underset{\theta}{E} C_e(.,e) - (1-\alpha/1+\lambda)\underset{\theta}{E} U'(.,e). \tag{8}$$

Hence, increasing β decreases the effort *e*. Likewise, increasing α increases the effort *e*. The implemented contract tends toward a cost-plus regime when β increases toward $1+\lambda$ and α decreases down to 0. Moreover, the contract tends toward a fixed-price contract when β is close to 0 and α tends toward $1+\lambda$.

Our empirical model will serve as a test of the simple theoretical predictions presented in this section. First, our econometric specification of contract choice is based on the objective function of the regulator specified in (7). A badly defined objective function will be rejected by our data at the moment of the estimation process. Second, Our theoretical prediction says that, since we observe only cost-plus or fixed-price contract in practice, the taste α for profit as well as the test β for wages should be closely related to the cost of public funds λ. Again, this can be tested with our empirical 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 (7) 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

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

while $e^{CP} = 0$. As suggested by the new theory of regulation, 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

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

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 focus now on the regulator's objective function. In the course of the estimation, the regulator's concerns for profit and wages (α and β resp.), as well as the cost of public funds

λ, are allowed to vary across networks and across time. Hence, the regulator's utility can be expressed as

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

Second, we expect these concerns to depend on several explanatory variables which account for the characteristics of the regulator itself, the characteristics of the operator, and those of 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* with the highest 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 choice a contract 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[8]

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

or

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

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 consumers' net 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

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

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

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

consequences of its 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 choice of contract.

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 derived from the estimation of the likelihood in (24). We discuss first the construction of the variables that are necessary for the identification of our framework. In particular, we focus on the features of the industry which allow us to evaluate the private concerns of the local governments. The results are exposed in a second step.

7.1. Data and Variables

Different types of variables are needed 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 that capture the characteristics of organizations that pressure regulators. Second, institutional variables that 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 choice of contract 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. From Table 2, drivers represent on average 70.7% of the 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. Note from Table 2 that less than 39% of operators are public in our database. 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

Estimation results are displayed in Tables 3-6. 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 specified in Equation (21), the probability of the choice of contract $P(r|\Omega)$ 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 asymmetric information cost function, which are presented in the first part of Table 4. 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 similar to a Normal one. As $\varphi \geq \tau$, the mode of the distribution is lower than 0.5.

An important parameter in our asymmetric information cost function is μ, the disutility of effort parameter. The reader should remember that, as μ increases, the set of parameters β' in Equation (13) converges to the set β, 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 4. 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 expect from the first order condition on effort (8) that the observation of a fixed-price contract (cost-plus contract resp.) entails $\alpha \geq \beta$ ($\alpha \leq \beta$ resp.), i.e., the concern for the profit of the operator is stronger than the concern for wages. 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. Thus, right-wing authorities, who are perceived as less conservative than left-wing authorities, are more likely to favor high incentive powered 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. This result goes in line with the intuition provided by Laffont (1996): When the operator is a public firm, it is owned by the political majority who induces effort levels which are higher than optimal and which create higher profits. Thus local governments may be tempted to capture the profits of the operator if the latter is public. If the operator is private, it is regulated under cost-plus regimes so that the authority reduces rent leavings. The size of the network does not seem to affect significantly the interest for cost, while it affects positively the interest for profit. Thus, there is a preference for fixed-price regimes in bigger networks. This suggests that more experienced operators are more willing to face regulatory regimes that imply financial uncertainty.

The effect of the different municipal corporations on α and β seem to be significant. However, their impact on the choice of contracts is rather ambiguous. While our preliminary logit estimates clearly suggested that Transdev and Keolis have a preference for fixed-price regimes, this more structural approach is less conclusive.

The concentration of the engineers and maintenance workers in the firm provides a measure for the endowment of skills embodied in the firm. Engineers are generally responsible for research and development in quality control, maintenance, and efficiency. Maintenance workers are responsible for the maintenance of the rolling stock. Note that a possible alternative explanation is that the share of drivers provides a measure of the degree of moral hazard in the relationship between the regulator and the operator. A lower endowment of skills (a higher share of drivers) reduces the ability of the operator to shirk, and this may in turn increase the willingness of the regulator to support the financial loss of the activity through cost-plus contracts. Unfortunately, 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 counter intuitive and contradicts the initial intuition provided by the preliminary logit estimates.

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.

Test on the structural models

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 5. 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 choice of contract.

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 are observed. Table 6 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.[9] Ideally, from our first order condition (8), we should observe $\beta \approx 0$ and $\alpha \approx 1+\lambda$ under a fixed-price regime ($\alpha \approx 0$ and $\beta \approx 1+\lambda$ under a cost-plus regime resp.). Here, the average β is slightly higher than expected under fixed-price (α under cost-plus resp.). Note however that the results go in the right direction, i.e., a fixed-price contract implies a higher interest for profits than costs; likewise, a cost-plus contract entails a higher interest for costs than profits.

Welfare analysis

[9] 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.

We can also compute the real magnitude of the marginal impact of the political ingredients on society's welfare. We have suggested so far that our political variables affect significantly the choice of contract, 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.[10] 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 $\Delta C_{it} = \exp[-E_{\theta}(e)] - 1$. Note that we restrict our welfare analysis to operating costs since consumers' surplus is unknown to us, and these costs constitute the core of the welfare costs of transport regulation.

The results are presented in Table 7. 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 7, switching from a cost-plus regime to a fixed-price one entails a 12.14% cost reduction. Note that the average network regulated under a cost-plus regime in our database faces a 14.3 millions 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 urban transport budget of a 55,000 inhabitants urban area.

7. 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.

[10] 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.

If the contracts currently implemented in the industry are derived from optimal second best mechanisms, the fixed-price and cost-plus contracts we observe are 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, and that they entail in fact complex financial arrangements that are unobservable to us, but that can be identified through the estimation of a cost function.

Second best optimal contracts

Here, the regulator is benevolent and uses a revelation mechanism to force the operator to reveal its real type. This translates to 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. It 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

$$U = t_0 - \psi(e), \tag{25}$$

where t_0 is a net transfer paid to the firm.

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

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

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

$$U'(\theta) = -\psi'(e^s), \tag{27}$$

i.e., 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,

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

This condition on effort can be translated into a cost function that 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}:

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

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

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

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 providing 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 8. As λ cannot be identified directly 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

Now, we test whether the assumption of second best optimal contracts is more realistic than our hypothesis of political regulation. 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 choice of contract. The three frameworks are as follows:

(SC) **Structural cost**. We estimate Equation (16), which is our reference case; operators exert an effort level that is conditional on the regulatory contract they face, but the choice of contract 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 choice of contract. The choice of contract is explained by political ingredients. Model II in Table 4 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 therefore 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 choice of contract is useful, and (*ii*) which type of regulation explains the data best.

We also perform two additional tests: We first assess our structural cost function (SC) against a simple cost function with no effort and no inefficiency term, denoted as the **simple cost** (C) specification. Second, we test our structural cost function (SC) 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 9 presents the estimation results of the 5 different specifications. The estimated parameters are significant at the 1% level in most cases. Note that the inputs 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 of our test. The reader should remember that the structural cost function (SC) serves as the reference for each test.

Scenarios (C) and (FRONT) are rejected against scenario (SC), which includes an inefficiency measure and assumes that the nature of regulation affects firms' behavior. Given that scenario (C) represents the standard cost estimation approach proposed by the literature focusing on regulation in general, its rejection advocates the construction of models including these components and indicates that we have to be cautious when interpreting the results derived from other models. As in Gagnepain and Ivaldi (2002), we conclude that the cost specification should account for the ability of the operator to reduce cost, as well as 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. Likewise, 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. 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 aspects of regulation.

Moreover, 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 choice of contracts under political regulation is not considered.

9. Conclusion.

We have discussed in this article several issues which we believe contribute to the current debate on methods of regulation.

First, we suggest that political considerations are important in terms of understanding the effects and the cause of regulation in 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, its size, its technological capability, or the identity of the municipal corporation it belongs to are all potential candidates as 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 its 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 choice of contract by local authorities in order to understand better how this regulation affects the behavior of regulated agents. Thus, the effect of regulation on the behavior of regulated firms would be underestimated if the choice of contract is 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)

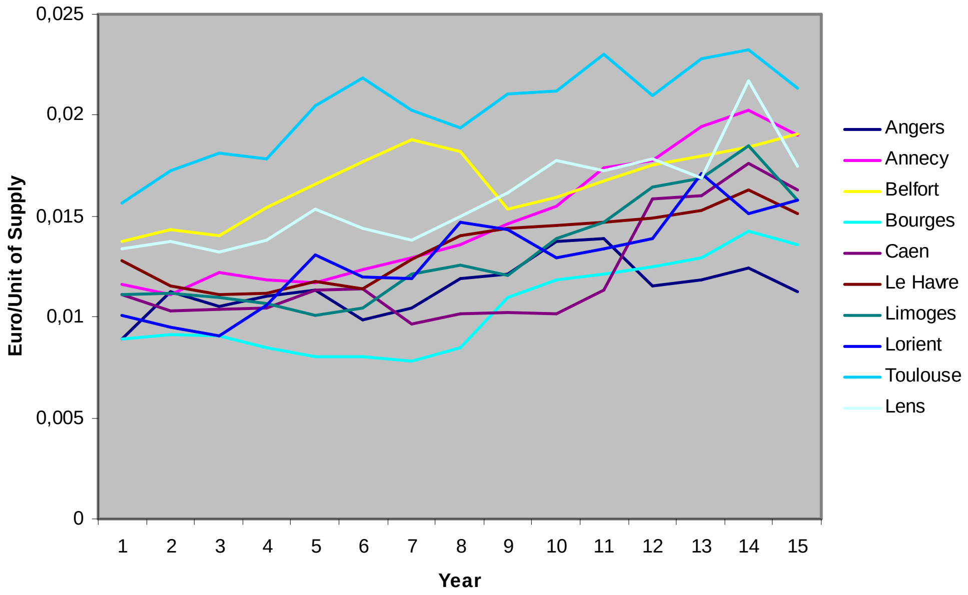

Table 2: Data description

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 4: 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 4 continued next page

Table 4 continued

Variable	Par	I	II	III	IV
DRIVE		0.02* (0.014)	0.06 (0.058)	0.02 (0.081)	-1.228*** (0.372)
LENGTH		0.00 (0.002)	0.01 (0.058)	-0.02 (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*** (0.150)	0.51** (0.208)	1.473*** (0.344)
DRIVE		0.06* (0.038)	0.22 (0.212)	0.18 (0.257)	2.296* (1.215)
LENGTH		-0.00 (0.008)	0.11*** (0.028)	0.09*** (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 5: 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 6: 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 7: 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]	-12.14	1.168

Note: Standard deviations are in parenthesis.

Estimates are computed from the results obtained in Model 1 ([1]) and Model 2 ([2]).

Table 8: 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 9: Tests of hypothesis

Variable	Par.	PR	C	FRONT	SC	SB
Cost Function						
CONSTANT	$\ln \beta_0$	-5.74***	-4.614***	-3.947***	-4.922***	-5.156***
			(0.159)	(0.151)	(0.246)	
LABOR	w_l	0.24***	0.312***	0.322***	0.323***	0.368***
			(0.033)	(0.034)	(0.035)	
OUTPUT	w_Y	1.07***	0.993***	0.985***	0.972***	0.977***
			(0.010)	(0.011)	(0.017)	
COST EFFORT	$\ln \mu$	3.83***			4.937*	2.709***
					(2.946)	
DENSITY θ 1	τ	1.28***		3.547***	3.454***	3.564***
				(0.411)	(0.544)	
DENSITY θ 2	φ	1.305***		2.378***	3.758***	3.495***
				(0.308)	(0.726)	
ERROR S.D.	σ_ε	0.05***	0.200***	0.075***	0.076***	0.013***
			(0.005)	(0.016)	(0.025)	
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.