ECONOMIC EFFICIENCY AND POLITICAL CAPTURE IN PUBLIC SERVICE CONTRACTS*

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We consider contracts for public transport services between a public authority and a transport operator. We build a structural endogenous switching model where the contract choice results from the combined effects of the incentivization scheme aimed at monitoring the operator's efficiency and the political agenda followed by the regulator to account for the voice of private interests. Our results support theoretical predictions as they suggest that cost-plus contracts entail a higher cost for society than fixed-price contracts but allow the public authority to leave a rent to a subset of individuals. Accounting for transfers to interest groups in welfare computations reduces the welfare gap between cost-plus and fixed-price regimes.

I. INTRODUCTION

AS IN MOST COUNTRIES OVER THE WORLD, URBAN TRANSPORTATION IN FRANCE PLAYS A CRUCIAL ROLE in the economic activity as each inhabitant is expected to travel by local mass transit 144.2 times a year on average; at the same time, it is costly for society since 68 percent of operating costs is subsidized.[1] Not surprisingly, the quality of public transport services is at the core of the local public debates. As the design of efficient regulatory mechanisms is essential for the provision of a well-defined level of service and an adequate maximization of

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1 This figure is provided to us by the Groupement des Autorités Responsables de Transport [2009]. Van Goeverden *et al.* [2006] suggest similar figures for other European countries.

society's welfare, this paper is aimed at understanding the rationale which drives the choice of regulation by elected local governments in the French urban transportation industry, its impact on operators' efficiency and its outcome in terms of welfare.

In each urban area, a local authority, which can be a municipality or a group of municipalities, monitors a single operator that provides the transport services on the urban network within a regulatory framework. In practice, two types of contracts, which notably define the payment and cost-reimbursement rules between the parties, are observed, namely cost-plus and fixed-price schemes. As it is well known, each type of regulatory rule has an impact on operating costs since it entails different levels of incentives in terms of effort in cost reduction activities, with fixed-prices providing a more powerful stimulus. As operating costs are commonly identified as the main driver of society's welfare fluctuations in the urban transportation activity, contract choice is a key issue for transport users and taxpayers.

The economic literature has often adopted a normative approach to address this question. This strand starts from the idea that the observed regulatory schemes in markets and industries are optimally designed as specified by the *new theory of regulation*, which claims that public intervention corrects market failures and regulators maximize social welfare through sophisticated programs. It builds from the fact that the presence of adverse selection and moral hazard is central in the contractual relationships between local governments and operators. This theory has reconsidered the contractual relationships between regulated utilities and regulators through the window of the theory of incentives and the principal-agent models over the last 30 years. (Loeb and Magat [1979]; Baron and Myerson [1982], Laffont and Tirole [1986]) In this setting, firms' productive capabilities and cost-reducing effort are two variables that are unknown to the regulator. Regulators submit utilities to the revelation principle in order to reduce informational asymmetries. This so-called second-best optimal solution can be implemented through a full menu of linear contracts. Empirically the question is then to explore the observed regulatory schemes through the window provided by this theory. In a pioneer paper, Wolak [1994] estimates the production function of a regulated Californian water utility and argues that the regulator uses a Baron-Myerson type of mechanism that 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]

[2] More recent contributions include Brocas, Chan and Perrigne [2006], Perrigne and Vuong [2011], and Lim and Yurukoglu [2014].

Here instead, we adopt a positive approach. First we start with the view that local authorities are unsophisticated in the sense that they cannot or are not able or willing to design a full menu and implement an optimal second-best regulatory scheme. While it is admitted that the local authorities have incomplete information on the transport operators, it is also observed that local authorities have restrained resources. In France, they have been historically blamed for their laxness in assessing operating costs, because of their lack of knowledge and experience in transportation economics and technologies, and/or because of their limited capacity in monitoring and auditing complex operating activities, which prevent them to adequately assess the effort of operators in providing appropriate and competent solutions to cost and network inefficiencies.

Assuming that information asymmetries between the regulator and the operator can be present, we then consider that the contract choice is also motivated by political agendas, which comprise the political objectives of local governments, the power and role of trade unions and the pressure of corporations that fully or partly own the local transport operators while providing other local public services like water distribution or household refuse collection. At least in France, these political aspects seem to have a critical impact.

From this consideration, following the private-interest theory of regulation initiated by Stigler [1971] and pursued by Peltzman [1976] and Becker [1983], and thanks to the richness of our dataset, we propose to explicitly 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 influence the design of 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. (Persson and Tabellini [2002]]

In other words, the authorities' choice of regulation cannot be independent from the pressure of local interest groups. For instance, a local government willing to leave significant rents to the operator's employees may thus prefer a cost-plus contract, since the latter is associated with higher operating costs; on the other hand, an operator's stakeholders looking for large returns may lobby the regulator to obtain a fixed-price arrangement which should provide higher profits. The choice of regulation has thus important consequences in terms of social costs since the incentive power of the contract directly shapes the efficiency in providing the public transport service.

In this perspective, this paper proposes to lean on a positive analysis to identify the elements -notably the welfare differentials and the political determinants- that affect the contract choice. In our model, a regulator chooses the regulatory mechanism (a fixed-price or a cost-plus contract) that maximizes an extended welfare function that entails the usual social welfare measure plus additional weights allocated to specific interest groups. Here, the interest groups are the workers and the stakeholders of the regulated firm. The regulator overstates the weight of one group or another through workers' wages or firms' profits, and this creates a distortion of the regulatory contracts toward less or more powered incentive schemes. Simultaneously, the regulatory rule affects the operator's behavior and the operating costs in one way or another.

The econometric task consists then in recovering the parameters of the contract choice and the cost function under incomplete information and testing for the relevance of the political constituents. In the course of the empirical implementation of the analysis, we address two technical issues. First, we must control for the effect of a change in welfare on the choice of regulation. As we can only observe the welfare level for a specific network under the current contract regime (fixed-price or cost-plus), we need a consistent estimate of the welfare under the alternative regulatory regime (cost-plus or fixed-price) that we construct using the parametric specification of our structural model. A second issue lies in the simultaneity between the change in welfare and the choice of regulatory contract. The choice of contract may be determined by its impact on welfare. Welfare, however, is in turn also determined by the contract choice, which implies an endogeneity between the changes in welfare and the contract choice. To address this issue, we estimate a structural endogenous switching model where the welfare expression depends on the choice of contract and vice versa.

Other positive analyses explore the rationale of observed regulations and provide explanations to the departure from fully optimal mechanisms. It is the case of the recent and empirically powerful literature that resonates with themes that are central to transaction cost economics: A seminal contribution is Bajari and Tadelis [2001], which focuses on the particular case of the private sector construction industry in the U.S. These authors 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. Simple construction projects are procured under fixed-price contracts while complex projects, which are plagued by *ex post* adaptations, are better procured under cost-plus contracts. This intuition is also behind the reply to slightly different issues such as whether a procurement contract should be awarded by using an auction or by negotiating with a potential seller (Bajari, McMillan and Tadelis [2008]), whether a firm's reputation affects the choice of contract (Banerjee and Duflo [2000]), or whether local governments should or should not privatize their services (Levin and Tadelis [2010]).

Although it is not directly related to the question of transaction costs, our paper shares common features with this aforementioned literature. Indeed, as explained earlier, addressing the issue of *ex ante* asymmetric information is not our main concern as we consider that one cannot read the regulation problem in the French public transit industry without addressing the question of political capture. Note that, while the issues raised here are largely debated in the literature, we are not aware of another attempt to propose a structural econometric analysis that is aimed at identifying the economic and political motives in the choice of regulation.

To support our framework, we propose several formal tests. First, we show that a simple structural cost function which does not account for the choice of contract is rejected against our political model. Second, we test whether the regulatory schemes currently implemented in the industry are the observable items of a more general menu of second-best contracts *a la* Laffont and Tirole. The latter arrangement assumes that local regulators are benevolent and are sophisticated enough to maximize social welfare and force operators to reveal their real technological type through a full menu of contracts. We reject this hypothesis against a simple structural cost function which does not account for the choice of contract. We extend here our 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. Our results suggest that ignoring the process of contract choice yields estimates that undervalue the importance of regulatory incentives for the operator's activity.

We also provide an empirical evaluation of a welfare measure associated with each type of contract, cost-plus or fixed-price. When the regulator suffers from asymmetric information, and in the absence of a revelation mechanism that forces the operator to reveal its real efficiency type, it is not clear whether a fixed-price contract performs better than a cost-plus contract. Indeed, even if the operator reduces its operating costs under a fixed-price regime, the subsidies paid by the regulator may be too high so that the welfare improvement due to a cost reduction may be overwhelmed by the negative impact on welfare due to an excessive rent leaving to the operator. As the profits of transport operators in France are found to have small magnitudes, we shed light on the fact that fixed-price regimes are less costly for society than cost-plus arrangements, the difference being close to three million Euros for the average network in our sample. Moreover, since the operating costs also enter the objective function of the regulator as a mean to allow transfers to a specific interest group -here the employees of the operator- higher operating costs also affect positively total welfare, as a subset of the citizens is better off. The total welfare gap between both types of contracts is therefore significantly reduced, compared to a situation where the welfare gap computation does not account for interest groups, and is close to one million Euros for the average network in our sample.

Note 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 address the ability of the regulator to commit not to use the information on the operator's operating costs from one regulatory period to another.[3] Here, our main objective is to identify the political determinants of the choice of regulation and its impact on short-run efficiency.

The analysis is articulated as follows: Section II describes the regulation of urban transportation in France in more details, the contracts that are implemented during our period of observation, and the assumptions that are maintained throughout the analysis. Section III presents our political model which encompasses the main features of the urban transportation industrial organization and the environment in which network operators and regulators make their decisions. Section IV then develops a formal specification of the cost function to be estimated together with the contract choice made by local governments; here we discuss the estimation method. Section V is devoted to the construction of variables and the presentation of results for the political model. In Section VI, we test our model against more traditional specifications. In particular, we focus on a hypothetical optimal regulatory environment where a regulator implements second-best contracts. Section VII proposes an evaluation of the welfare differentials between cost-plus and fixed-price contracts. Section VIII provides a summary and some concluding remarks.

[3] These issues are addressed in Gagnepain, Ivaldi and Martimort [2013].

II. THE FRENCH URBAN TRANSPORT INDUSTRY

France has a long experience of contract of public interest by which a local authority grants the transport service to a local operator under certain rules. At least since the mid twentieth century, in each urban area irrigated by a significant transport network, a local authority (i.e., a municipality, a group of municipalities or a district, whose councils are elected for six-years terms) is in charge of regulating an operator which has been selected to operate the network, i.e., to provide the transport services. Note that the 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.[4]

This framework has been recorded in a law on the organization of transport services within France enacted in 1982, which has established the principle of decentralization of these services to local authorities from the State and provided guidance and rules for their regulation. As a result, each local authority organizes its 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 decide to operate the network directly or to require the services of a transport service provider. In this latter case, a formal contract sets the terms of reference that the operator must comply as well as the payment and/or cost-reimbursement rules between the authority (the principal) and the operator (the agent).

Note that, in most urban areas, operating costs are twice as high as commercial revenues on average. Budgets are rarely balanced without subsidies.[5] Our objective is to take into account these features of the urban transport industry and to perform a welfare analysis of the observed regulatory schemes within a principal-agent setting, which requires a database that provides information both on the performance and the organization of the French urban transport industry. Such a database has been created in the early 1980s from the results of an

[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 percent), TRANSDEV (semi-public, 19 percent), CONNEX (private, 25 percent). In addition there are a small private group, AGIR, and a few firms under local government control.

[5] 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 directly 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. We return on these points below.

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 a unique tool for comparing the observed regulatory schemes (or contracts) across each other and over time. To implement our econometric analysis, we consider the regulatory scheme adopted in each urban area during a year as a realization of the same regulatory contract, i.e., as an occurrence of the same statistical model. The working panel data set covers 49 different urban transport networks over the period 1987-2001. We have selected all urban areas of more than 100,000 inhabitants. Note that the sample does not include the largest networks of France, i.e., Paris, Lyon and Marseilles, as they are not covered by the survey.

Although a law, enacted in 1993, has ended the automatic renewal of contracts -which was the tradition so to speak- by requiring the local authorities to use beauty contests to allocate the construction and the management of infrastructures of urban transportation, in practice however, very few networks have experienced changes of operators from one regulatory period to another. Over the period covered by our analysis, only two networks have decided to get rid of their operators to select another company.[6]

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 59.3 percent of the cases, as shown in Table I. Under fixed-price contracts, operators receive subsidies to finance the expected operating deficits; under cost-plus regulation, subsidies are paid to the firms 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 five to six years. Hence, for almost each urban area covered by our sample, we observe several

[6] As a matter of fact, the different operators mostly avoided head to head competition and generally put tenders for markets in distinct urban areas. The decision 05-D-38 of the French Conseil de la Concurrence shows that the competition authority is well-aware of this downstream collusion between potential operators. In more than sixty percent of cases, there is indeed only a single bidder. The three companies mentioned above, who own most of the urban transport operators in France, are usually committed to distinct geographical areas, which restricts the possibility of achieving a significant degree of competition in the awarding of transport operations in urban areas where the regulatory contract comes to an end. Moreover, these companies usually operate other municipal services such as water distribution or garbage collection, which makes it even harder for the regulator to punish them in case of bad performance in their provision of transport services. Hence, in this sector, *ex ante* competition is not so fierce and competitive tendering is not a relevant issue. In our framework, note that we consider a welfare function which accounts for the political weight of operators and captures, to some extent, the effect of potential horizontal collusion between operators. This indirect method of taking into account the absence of potential downstream competition allows us to approximate real-world practices while it fortunately eases the analysis.

contract periods. Pooling all of them, we gather 140 contracts. For the same network, the regulatory scheme may switch from cost-plus to fixed-price or from fixed-price to cost-plus between two contract periods. We indeed count twenty changes of regulatory regimes, seventeen of them being switches from cost-plus to fixed-price regimes. These changes may occur either during the term of a local authority which decides for a shift in the regulatory framework, or after the election of a new local government. We observe twenty-two changes of local governments.

Table I also sheds light on several interesting features of the regulatory practices in the industry. First, right-wing governments use fixed-price contracts more intensively than cost-plus contracts while left-wing authorities seem to be torn between both arrangements. Likewise, the identity of the operator has potentially a significant influence on the contract choice; on the one hand, public operators are associated with fixed-price contracts more often; on the other hand, Transdev and Keolis, two of the municipal corporations operating almost 50 percent of the networks in France, are regulated under fixed-price regimes in a majority of cases while their competitors, namely Agir and Connex, go in the opposite direction. The characteristics of the network seem to have an influence as well: Larger networks are usually associated to fixed-price regimes, which is not the case of the smaller ones. To establish that these features are relevant, we run a simple logit model where the probability to observe a fixed-price regime depends on a set of covariates, which are the size of the network, a dummy variable that takes value 1 if the local government is right-wing and 0 otherwise, a dummy variable that takes value 1 if the operator is public and 0 otherwise, the share of drivers in the total operating labor force, and three dummy variables that take value 1 if the operator belongs to the corporation Connex (Keolis and Transdev resp.) and 0 otherwise.[7] Many parameters are significant at least at the 5 percent level, suggesting that a simple political model for the choice of contract fits the data reasonably well. Later we show that these political elements play a significant role in a model where the regulator chooses the type of contract in order to favor specific interest groups through excessive rents.

[7] This logit probability to observe a fixed-price regime is fitted on a set of 140 contracts and yields the following equation (standard errors are provided in parenthesis):

$$\begin{aligned}\Pr\left(\textit{Fixed - price}\right) = &-\underset{(1.84)}{3.58} + \underset{(0.41)}{0.85}\,\textit{Right} - \underset{(0.50)}{0.40}\,\textit{Public} + \underset{(0.38)}{0.80}\,\textit{Size} + \underset{(1.96)}{2.19}\,\textit{Drive} - \underset{(0.63)}{0.72}\,\textit{Connex}\\ &- \underset{(0.60)}{0.25}\,\textit{Keolis} + \underset{(0.77)}{2.19}\,\textit{Transdev}\end{aligned}$$

As few networks change contract between 1987 and 2001, a fixed-effect logit estimation would entail a considerable loss of observations and was finally discarded. (For a description of this methodology, see Cameron and Trivedi, 2005, for instance.)

Transportation services are organized by local governments who are elected for short periods of six years. Leaving rents to specific interest groups allows these governments to obtain social peace and maximize their chances of reelection. 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. The 2005 report of the Cour des Comptes (i.e., court of auditors) on the French urban transport industry emphasizes that wage agreements are often discussed locally by governments and unions; hence, in some networks, wages reach higher levels than those determined by the national collective labor agreements. At the same time, in other networks, transport companies may minimize costs aggressively, and are therefore more interested in fixed-price than cost-plus contracts: This is the case of Transdev, Keolis and Connex. Interestingly, these three companies have been condemned in 2005 by the French Competition Authority (decision 05-D-38) for collusive agreements during the period 1996-1998.

Beyond the fact that the regulator may be politically motivated or not, there is the issue of its capacity of expertise and whether or not it is sophisticated. As French local authorities exercise their regulatory powers on transportation policy since the 1982 law only, and as they have limited financial resources, they probably did not have time to build significant audit capacities. A good audit system needs effort, time and money. French experts on urban transport point the laxness of local authorities in assessing operating costs, mainly because of a lack of knowledge of the technology.[8] 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 skills), the 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 the agent (operator) to provide appropriate and efficient solutions. It is then straightforward to assume the presence of moral hazard as well.

[8] 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.' See Domenach [1987]. A more recent report on the weak capabilities of expertise of the local governments and the lack of *ex ante* competition in the industry is proposed by the French court of auditors (Cour des Comptes) in its 2005 report; for more details see http://www.ladocumentationfrancaise.fr/var/storage/rapports-publics/054000270/0000.pdf.

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 its true productive ability level. This mechanism can be decentralized through a menu of linear contracts that avoids excessive rent leavings. Given that we have already noticed that regulators lack from a serious capacity of expertise, it is fair to assume that they are unsophisticated in the sense that they are not willing/able to implement complex regulatory tools. Hence, observed contracts are not built on the revelation principle, and cost-plus and fixed-price schemes are equally proposed to operators without paying any attention to their productive ability level. In other words, current regulatory schemes are not optimal in this sense. [9]

III. A MODEL OF POLITICAL REGULATION

We consider a random utility maximizing regulator which chooses a regulatory contract *r* among a set Ω of available types, namely $\Omega = \{FP, CP\}$, where *FP* and *CP* stands for fixed-price and cost-plus regimes, respectively. The random utility function of the regulator is defined as

$$(1) \qquad \tilde{u}^r = u^r + \omega^r ,$$

where u^r is the mean utility level of the regulator associated with contract type *r* and ω^r is an error term.

McFadden [1981] shows that the maximization of the random utility $\tilde{u}^r$ over the choice set Ω generates a probabilistic choice system, which is conditional on the characteristics of choice alternatives and individuals, through the following mapping:

[9] Four additional remarks can be made. First, private information on demand is not a relevant issue in our industry. Local governments are well informed about the transportation needs of citizens. The number of trips performed over a certain period is easily observed, and the regulator has a very precise idea of how the socio-demographic characteristics of an urban area fluctuate over time. Given the level of demand, the regulator sets the service capacity provided by the operator. Second, we do not address the issue of determining what should be the optimal rate-of-return on capital. The rolling stock is owned by the local government for a vast majority of networks. In this case, the regulator is responsible for renewing the vehicles, as well as guaranteeing a certain level of capital quality. Third, we rule out the possibility of risk sharing in the contractual relationships between the operators and the regulators since the provision of transport services does not entail unpredictable cost fluctuations for the operators. Uncertainty on costs and demand is potentially relevant in small networks but, as suggested above, we focus only on large networks, i.e., those above 100,000 inhabitants. Finally, the question of the consequence of awarding contracts through auctions versus negotiations is not relevant in our industry. Since there is very limited competition ex ante, and since the same operator usually remains in place, we mainly observe (re)negotiations between contracting parties.

(2) $$\Pr\left(r\,|\Omega\right)=\Pr\left(\tilde{u}^{r}\geq\tilde{u}^{r'},\,r\neq r',\left(r,r'\right)\in\Omega^{2}\right).$$

We thus make the following assumption:

Assumption 1: The distribution of fixed-price and cost-plus regimes in the French urban transport industry is generated by the random utility maximization program of local regulators.

In other words, the solution of the maximization programme of the regulator translates into the choice probabilities of a fixed-price or a cost-plus contract. A key issue is that, when choosing a contract inside the set of alternatives, the regulator anticipates the cost reducing activity (or effort) of the operator: The incentive property of the contract shapes the cost reducing effort of the firm, which in turns affects the objective function of the regulator. To write a contract choice probability, we need to identify the ingredients of the random utility function of the regulator which first requires determining how the operator reacts to the incentives supported by the specific regulatory contract it faces.

III(i). *The operator's programme*

To produce a volume of service Y defined by the regulator, the operator requires a certain combination of variable and fixed inputs. Let w be the price of variable inputs, namely labor and materials. Let K be the stock of capital which is fixed in the short-run. We assume here that the capital, which mainly comprises the rolling stock, is chosen by the regulator.

The actual operating cost C often differs from the minimum operating cost because the operator in charge of the provision of the service is not fully efficient. The degree of inefficiency of the operator is based on two items. First, the innate productive inability prevents the operators from reaching the required output level Y at the minimum cost, which results in upward distorted costs. Now, operators can undertake cost-reducing activities to counterbalance these inabilities. As already discussed, they can engage in a research and development process, or they can 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 labor conflicts. Whatever these cost-reducing activities may be, we refer to them as effort.[10]

Let θ and e be the productive inability and effort levels of each firm, respectively. These two variables are unobservable to the principal and the econometrician. Each operator faces a cost function which provides the locus of minimum operating costs, conditional on the levels of capital, productive inability and effort, specifically:

$$C(Y, w, K, e, \theta | \gamma), \tag{3}$$

where γ is a vector of parameters to be estimated. Note that, while the inability parameter θ is exogenous, the cost-reducing effort e is a choice variable for each firm, and therefore depends on the type of contract it faces.

To account for the regulatory pressure impinging on the operators' incentives to reduce costs through the cost function (3), we derive the equilibrium level of effort and plug it back into the conditional cost function.

Two regulatory contracts are observed in practice, namely fixed-price and cost-plus. Under a fixed-price contract, the operator is a residual claimant of productivity 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 an effort level e to reduce his operating cost C, the cost reduction activity inducing 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^{FP} that maximizes the profit:

$$U^{FP} = t^{FP} + R(y) - C(Y, w, K, e, \theta | \gamma) - \psi(e), \tag{4}$$

where $R(y)$ denotes revenue and y measures transport demand.[11] The operator determines the optimal effort level e^{FP} that maximizes its profit given in Equation (4). The first order condition is:

[10] The operator focuses on cost-reducing effort only and is not responsible for improving the quality of the service. Quality entails various dimensions such as the size of the network, the number and size of lines, the number of stops, the frequency of the service, and the age of the rolling stock which are indeed observable and regulated by contract.

[11] 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

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

which implies that the optimal effort level e^{FP} balances marginal cost reduction and the marginal disutility of effort. Note that $e^{FP} \equiv e^{FP}\left(Y, w, K, \theta \middle| \bar{\gamma}\right)$, where $\bar{\gamma}$ is a vector of parameters to be estimated comprising the vector γ and the parameters of the cost-of-effort function.

As transport demand is inelastic in the short run, which is a well-established result in transport economics as reported by Oum *et al*. [1992], as the pricing rules are relatively similar in all networks and as prices of transport services are capped on the basis of an inflation-adjusted rate imposed by the French government, the pricing strategy of urban transport networks is therefore disconnected from the cost-reducing incentives that are under the scrutiny of the local authorities. Consequently, operators are not here concerned by the question of the choice of the optimal price of transport services and, hence, the levels of transport demand. In accordance with this situation, we later introduce a specification of the cost function that allows the incentive-pricing dichotomy principle to hold. (Laffont and Tirole [1993]) In other words, we assume that the pricing structure is independent of the nature of regulatory incentives impinging on the activity of the firm. This assumption, which allows separating the incentive and pricing problems, eases the exposition, and portrays a relevant sketch of the industry. In other words, for a given network, the type of contract impacts costs but not demand.

Under a cost-plus contract, the public authority receives commercial revenue $R(y)$, and provides 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 its effort. For this reason, this contract is a low powered incentive scheme, as firms under this regime have no incentives to produce efficiently. The firm's utility level is such that

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

In this case, the optimal effort level is assumed to be equal to zero. Note that considering $e^{CP} = 0$ under cost-plus regimes provides a normalization that we adopt for ease of exposition

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*.

and tractability. There is no loss of generality because what matters in our analysis is the difference $e^{FP} - e^{CP}$.

Plugging these effort levels into the conditional cost function allows us to write the following proposition:

Proposition 1. The structure of the operator's cost function is conditional on the regulatory environment and is written as $C^r\left(Y, w, K, e^r, \theta \middle| \bar{\gamma}\right)$, $r \in \left(FP, CP\right)$.

In other words, two different cost structures, which depend on the observed regulatory regime, will be considered.

III(ii). *The objective function of the regulator*

Now, to complete the regulator's programme as introduced above, we need to define its random utility function, which includes the structural cost function of the operator as defined in Proposition 1 and also additional ingredients that we now identify. Following Laffont and Tirole [1993] for instance, the regulator, when choosing a contract, should care for a social welfare measure in the form of

$$W^r\left(e^r, \theta\right) = S(y) - R(y) - (1+\lambda)\left(U^r + \psi\left(e^r\right) - R(y) + C^r\left(Y, w, K, e^r, \theta \middle| \bar{\gamma}\right)\right), \tag{7}$$

for $r \in \left(FP, CP\right)$ where $S(y)$ is the gross surplus of the consumers and λ is the local cost of public funds. Thus, a given usage of network y guarantees a net surplus $S(y) - R(y)$ to consumers but also costs $(1+\lambda)t$, $t \in \left(t^{FP}, t^{CP}\right)$ to the society.

Now, we depart from this initial definition in order to account for the political motivation of the regulator. As a politician incentivized by the possibility of being elected or re-elected, the regulator, i.e., the local government, accounts for the interests of social groups. Here, these groups are the stakeholders and the employees of the firm in charge of providing the transport service. The local government is assumed to care for the rents left to stakeholders and workers who dwell in its constituency since they constitute a transfer to a subset of voters. More precisely, we assume that, if its constituency was only composed of stakeholders, the regulator would care for the profit of the firm more than a regulator only motivated by the welfare as defined in Equation (7), and would therefore be more likely to implement high incentive schemes in order to cut operating costs. This intuition follows the insight proposed in Laffont [1996] and Aubert and Laffont [2004].[12] Here, the regulator is also willing to provide the employees of the operator with a surplus in the form of above-market wages, as suggested by Pint [1991] and Roemer and Silvestre [1992]. In this case, the regulator cares for the total wages received by the workers more than a regulator only motivated by maximizing the welfare function as defined in Equation (7), and is more likely to implement a low powered incentive scheme, which eases the pressure on operating costs, allowing for the payment of higher wages.

If $(\alpha,\beta)\in\Re^2$ are the weights associated with the profit and wage levels, then the extended social welfare objective function of a politically motivated regulator is written as follows:[13]

(8) $$V^r\left(e^r,\theta\right)=W^r\left(e^r,\theta\right)+\alpha U^r+\beta C^r\left(Y,w,K,e^r,\theta\,\middle|\,\overline{\gamma}\right),\ r\in\left(FP,CP\right).$$

A positive (negative) α or β implies that the regulator cares for (disfavors, respectively) the holders of profits and wages. Considering the costs $C^r(.)$ instead of the wage bill after the weight β in Equation (8) is convenient for our exposition given that $W^r\left(e^r,\theta\right)$ also depends on $C^r(.)$. Since the wage bill is a share of total costs $C^r(.)$, β can be interpreted as a parameter which measures simultaneously the wage share in total cost and the rent left to the employees of the operator.[14]

Rewriting Equation (8) as

(9) $$\begin{aligned}V^r\left(e^r,\theta\right)=S\left(y\right)+\lambda R\left(y\right)-\left(1+\lambda\right)\psi\left(e^r\right)+\\ \left(\alpha-1-\lambda\right)U^r+\left(\beta-1-\lambda\right)C^r\left(Y,w,K,e^r,\theta\,\middle|\,\overline{\gamma}\right),\ r\in\left(FP,CP\right)\end{aligned}$$

[12] They suggest that 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 might prefer to propose a fixed-price contract to a private firm in order to capture part of its rent.

[13] Consumers do not constitute a relevant interest group in our model for the reasons discussed above: The pricing strategy of an urban transport network is disconnected from the cost-reducing incentives; hence the type of contract impacts costs but not demand. Moreover, the quality of the service is under the responsibility of the regulator, not the operator, and is again disconnected from the choice of contract. Hence, contrary to a deregulated environment such as the airline industry where transport operators' decisions do affect consumers, consumers' surplus here is the same under both types of regulatory regimes.

[14] The wage bill usually represents on average 50 to 60 percent of total operating costs in the urban transport industry.

helps to shed light on the regulator's arbitrage between the social cost $1+\lambda$ of providing public transit services and his concerns α and β for the stakeholders and the workers. Increasing the rent U^r of the operator or the operating cost C^r can be used as a device to favor interest groups, but it also inflicts a cost on society which is proportional to the shadow cost of public funds $1+\lambda$. To have a meaningful trade-off between the dual objectives of satisfying the regulator's concerns and minimizing the social costs of profit and wages, we assume that $\alpha \leq 1+\lambda$, and $\beta \leq 1+\lambda$, so that, overall, one extra euro left to the firm is socially costly. Note that these restrictions are not imposed in the course of the estimation; instead, they are *ex post* checked for.

As the regulator suffers from asymmetric information, it cannot observe the inability term 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 $\left[\underline{\theta}, \bar{\theta}\right]$, where $\underline{\theta}$ (resp. $\bar{\theta}$) denotes the most productive (unproductive resp.) operator. Hence, the expected value of the welfare expressed in Equation (9) is denoted as

(10) $$u^r = \underset{\theta}{E} V\left(e^r, \theta\right).$$

This completes the definition of the random utility function $\tilde{u}^r$ of the regulator defined by Equation (1).

Summing up, the regulator chooses a contract type – fixed-price or cost-plus – that maximizes the random utility $\tilde{u}^r$. Having observations on the choice of contracts allows us to estimate the choice probability that is conditional on the cost technology $C^r(.)$ and the weights α and β. In what follows, we show how the distribution of fixed-price and cost-plus regimes in the industry is the key element to identify the parameters of the welfare function.

IV. THE ECONOMETRIC SPECIFICATION

We turn now to the econometric specification of our political regulation framework. On the operator side, we choose a functional form for the cost function defined in Proposition 1 and derive the expression of the structural cost to be estimated. On the regulator side, we write the probability to choose a contract type conditional on the operator's costs and the other components entering Equation (10). We finally assemble the likelihood for a single observation, that is to say, the joint realization of the operating cost level of an operator and the choice of a type of contract by the regulator.

IV(i). *The cost function*

We assume a Cobb-Douglas specification for the cost function mainly because of its tractability. Here we are not so much concerned by the predictability of the estimated model, which would require more flexible functional forms. We instead focus on the identification of the determinants of contracts and social welfare, and in this perspective, a first order approximation as provided by the Cobb-Douglas is sufficient to support our analysis. (Florens, Ivaldi and Larribeau [1996]) The cost function is then specified as:

$$C = \gamma_0 w_l^{\gamma_l} w_m^{\gamma_m} Y^{\gamma_Y} K^{\gamma_K} \exp\left[(\theta - e)\right], \tag{11}$$

where w_l and w_m denote the price of labor and material respectively.

This specification is intuitive. The observed cost C deviates from the cost frontier defined by $\gamma_0\, w_l^{\gamma_l} w_m^{\gamma_m} Y^{\gamma_Y} K^{\gamma_K}$ by a factor $\exp\left[(\theta - e)\right]$, which increases with the inability level that the effort provided by the operator attempts to counterbalance. We impose homogeneity of degree one in input prices, i.e., $\gamma_l + \gamma_m = 1$. The inability θ is characterized by a density function $f(\theta)$ defined over the interval $\left[\underline{\theta}, \bar{\theta}\right]$. Now the cost of effort is provided by the following convex function

$$\psi(e) = \exp(\mu e) - 1, \quad \mu > 0, \tag{12}$$

with $\psi(0) = 0$, $\psi'(e) > 0$, and $\psi''(e) > 0$ and where μ is a parameter to be estimated.

Using the specifications for the operating cost in Equation (11) and the cost of effort defined by Equation (12), we can solve the first order condition provided by Equation (5) to express the effort level under a fixed-price regulation as:

$$e^{FP} = \frac{1}{1+\mu}\left(\gamma_0 + \gamma_l \ln w_l + \gamma_m \ln w_m + \gamma_Y \ln Y + \gamma_k \ln K + \theta - \ln \mu\right). \tag{13}$$

This effort level increases with θ, i.e., a more inefficient operator optimally exerts more effort than a less inefficient operator. Moreover, it decreases when it is more costly, i.e., when the cost-reducing technology parameter μ is larger.

Recalling that $e^{CP}=0$ and substituting back e^{FP} and e^{CP} into (11) allows us to obtain the final forms for the cost functions $C^{FP}(.)$ and $C^{CP}(.)$ to be estimated as:

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

and

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

where $\nu=\mu/(1+\mu)$, $c_0=\gamma_0+(1/(1+\mu))(\ln\mu-\gamma_0)$, and $\gamma_i'=\nu\,\gamma_i$ with $i\in\{l,m,k,Y\}$.

Note that Equation (15) corresponds to the expression of the Cobb-Douglas cost function which is usually estimated, i.e., when moral hazard in the form of the presence of an effort activity is not taken into account. Note also that, as $\lim_{\mu\to+\infty}\gamma_i'=\gamma_i$ for any *i*, the cost level under fixed-price (14) converges to the cost level under cost-plus (15). This implies that, if the effort activity in the industry is significant but the model does not account for its impact, the estimates of the cost elasticities might be biased.

For a network *i* at period *t*, the cost function to be estimated can be rewritten as:

(16) $$\begin{aligned}\ln C_{it}=\xi_{it}^{FP}&\left(c_0+\gamma_l'\ln w_{l,it}+\gamma_m'\ln w_{m,it}+\gamma_k'\ln K_{it}+\gamma_Y'\ln Y_{it}+\nu\theta_i\right)+\\ \xi_i^{CP}&\left(\ln\gamma_0+\gamma_l\ln w_{l,it}+\gamma_m\ln w_{m,it}+\gamma_k\ln K_{it}+\gamma_Y\ln Y_{it}+\theta_i\right)+\varepsilon_{it}\end{aligned}$$

where ξ_{it}^{FP} takes the value 1 if the regulatory regime is a fixed-price, and 0 otherwise, while ξ_{it}^{CP} takes value 1 if the regulatory regime is a cost-plus and 0 otherwise, and where the error term ε_{it} accounts for potential measurement errors and is distributed according to a normal density function with mean 0 and variance σ_c^2.

Finally, the inability index θ_i is assumed to be independent of time as it is intrinsic to each network and can be changed only in the very long run, if the network adopts drastic investment, which is outside the time horizon of our analysis. It is assumed to be distributed as a Beta density with scale parameters ρ_1 and ρ_2, so that it is conveniently defined as a percentage since the Beta density is defined over the interval $[0,1]$. In this case, the level of effort is also normalized over the unit interval since $(\theta-e)$ must be non-negative. Note that, since we assume that cost-plus and fixed-price schemes are equally proposed to operators without paying any attention to their productive ability level, $F(\theta|CP)=F(\theta|FP)$.

IV(ii). *The contract choice*

We derive now the probability to choose among different types of contract. The random utility-maximizing contract is defined by Equation (2), that is to say, by the choice probability

$$\text{(17)} \qquad \Pr\left(r|\Omega\right)=\Pr\left(u^{r}+\omega^{r}\geq u^{r'}+\omega^{r'},\, r\neq r',\, (r,r')\in\Omega^{2}\right).$$

Assuming a logistic distribution, $\Pr\left(r|\Omega\right)$ is rewritten as

$$\text{(18)} \qquad \Pr(r)=\Pr\left(r|\Omega\right)=\frac{\exp\left(u^{r}\right)}{\exp\left(u^{r}\right)+\exp\left(u^{r'}\right)}=\frac{1}{1+\exp\left(u^{r'}-u^{r}\right)}.$$

Since, as we explained earlier, demand is not affected by the type of contract, the consumer gross surplus $S(y)$ and the revenue computed at the shadow cost of the public funds $\lambda R(y)$ take the same values under both regulatory contracts. Therefore the term $S(y)+\lambda R(y)$ disappears from the probability (18).

Hence, for a network *i* at period *t*, the criteria to be evaluated for selecting the utility-maximizing contract is:

$$\text{(19)} \qquad \begin{aligned} u_{it}^{r'}-u_{it}^{r} &= -(1+\lambda_{it})\left[\psi\left(e_{it}^{r'}\right)-\psi\left(e_{it}^{r}\right)\right]+\left(\alpha_{it}-1-\lambda_{it}\right)\left[\underset{\theta}{E}U_{it}^{r'}-\underset{\theta}{E}U_{it}^{r}\right] \\ &+\left(\beta_{it}-1-\lambda_{it}\right)\left[\underset{\theta}{E}C^{r'}\left(Y_{it},w_{it},K_{it},e_{it}^{r'},\theta\left|\bar{\gamma}\right.\right)-\underset{\theta}{E}C^{r}\left(Y_{it},w_{it},K_{it},e_{it}^{r},\theta\left|\bar{\gamma}\right.\right)\right]. \end{aligned}$$

If a type *r* contract is implemented in network *i* at period *t*, we compute the effort level e_{it}^{r}, the disutility of effort $\psi\left(e_{it}^{r}\right)$, the cost $E_{\theta}C_{it}^{r}$ and the profit $E_{\theta}U_{it}^{r}$, using their parametric expressions given above. Then, using our structural model, we are able to also evaluate the effort level $e_{it}^{r'}$, the cost of effort $\psi\left(e_{it}^{r'}\right)$, the total cost $E_{\theta}C_{it}^{r'}$, and the profit $E_{\theta}U_{it}^{r'}$ that would have be obtained if the alternative contract r' had been chosen.

As we expect the preference parameters of the regulator to vary across networks and over time, we suppose that $\alpha_{it}=\alpha\left(P_{it},A_{it},N_{it}\right)$ and $\beta_{it}=\beta\left(P_{it},A_{it},N_{it}\right)$, i.e., that these political parameters are linear functions of the regulator's attributes P_{it}, but also depend on the characteristics A_{it} of the operator and N_{it} of the network. For the cost of public funds λ_{it}, we assume that it is exclusively relayed to the characteristics of the regulator, as we expect the tax distortion to depend only on the actions of the local government in each urban network. Thus, we write $\lambda_{it} = \lambda(P_{it})$.

IV(iii). *The likelihood function*

The joint likelihood of a data point (i,t) defined by a cost level and a choice of type of contract is

(20) $$L(C_{it}, r) = L\left(C_{it} \middle| Y_{it}, K_{it}, w_{it}, \theta_i, \xi_{it}^{FP}, \xi_{it}^{CP}, \bar{\gamma}, \rho_1, \rho_2, \sigma_\varepsilon\right) \Pr_{it}(FP)^{\xi_{it}^{FP}} \Pr_{it}(CP)^{\xi_{it}^{CP}},$$

where $\xi_{it}^{FP} = 1 - \xi_{it}^{CP} = 1$ if $r = FP$ and $\xi_{it}^{FP} = 1 - \xi_{it}^{CP} = 0$ if $r = CP$.

Note that this likelihood function cannot be computed as the variable θ_i is unobservable. Only the unconditional likelihood can be computed as:

(21) $$L_{it} = \int_0^1 L(C_{it}, r)\, \theta_i^{\rho_1 - 1} (1 - \theta_i)^{\rho_2 - 1} \frac{\Gamma(\rho_1 + \rho_2)}{\Gamma(\rho_1)\Gamma(\rho_2)}\, d\theta_i,$$

where $\Gamma(.)$ is the Gamma function. Assuming that observations are independent, then the log-likelihood function over the sample is just the sum of all individual log-likelihood functions defined by Equation (21). Note that the fixed effects are captured here by means of the inability parameter θ -which is random- and the set of explanatory variables characterizing each network and affecting the preference parameters of the regulator and the cost of public fund.

Summing up, our econometric model allows the type of contract to impact the level of welfare while differences in welfare rationalize the choice of contract. In other words, it addresses the potential problem of endogeneity that could affect the relation between the change in welfare and the contract choice. As it is based on a theoretical model of utility and welfare maximizing agents, it can be understood as a structural endogenous switching model where the expression of welfare depends on the choice of contract and vice versa.

V. EMPIRICAL ANALYSIS

Before presenting the estimation results which are obtained by maximizing the likelihood defined above, we comment the construction of variables that enter the model. In particular, we list the characteristics of the industry that allow us to identify and measure the private concerns of local governments.

V(i). *Data and Variables*

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

Estimating the Cobb-Douglas cost function requires information 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, is measured by the size of the rolling stock, which is 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. The features of the contracts entail the type of contract itself, a measure of cost, a measure 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 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 owns 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 percent of the assets 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 comprise the local transport tax, and the political ideology 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 II, 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 ideology of the local government are published by the national newspaper Le Figaro. Over the period of observation, local governments 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 I suggests that 52.6 percent of local governments in our database are right-wing.

Identification in our model is mostly based on our knowledge of the economic objectives, such as a target for the level of supply, which pertain to each contract and need to be fulfilled by transport operators. A potential drawback of our data is that we do not have information about the details of the contractual clauses and constraints (e.g., complexity of the project, technical provisions, ex post enforcement and penalties), which are potentially good candidates to explain the contract choice, as suggested recently by Moszoro and Spiller [2012], and Beuve, Moszoro, and Saussier [2014]. We acknowledge that a significant progress could be achieved on this front in future research with richer data.

Finally, note that one contract in one network should in principle correspond to a unique observation in our empirical model, i.e., all the contract items should remain constant over the—say—five years of a contract length. The real data may slightly depart from this assumption. In practice, the dataset shows that, over a single contract period, many items can be affected by small changes. This may, for instance, be the case of the operator's supply measured by the number of seat-kilometers available (i.e., the size of the urban transport network) which, in turn, forces the costs and subsidy levels to change as well. These changes are assumed to be generated by independent and identically distributed exogenous shocks that could affect the activity of the operator over the contract length. Changes in traffic conditions, temporary changes in network configuration, road constructions which cut a service route over a certain period, or strikes are all such examples. The economic responses to these unpredictable shocks are anticipated in the contract, which is why they are assumed to pertain to the same contract. Instead of calculating a simple average value of each item over the contractual period when changes are present, we choose to treat each contract-year as a separate observation, so that the number of degrees of freedom of our study is increased. The identification of our asymmetric information model requires being able to identify through a cost system the technology of the industry and the inability θ_i, which is firm specific and constant over time. We improve significantly our estimation if the transport operators are observed several times, i.e., if we exploit the panel structure of our data. Based on these assumptions, the number of observations (735) is much larger than the number of contracts (140).

V(ii). *Results*

We turn now to the empirical results of our methodology which aims at estimating simultaneously the contract choice by local governments and the structural cost function of the operators. Table III displays the estimates of four alternative models. In each model, we test different sets of the explanatory variables that are used as proxies for the local cost of public funds λ, the regulator's concern for operating costs β, and its 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 allowing us to measure the concerns for costs β and 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 a value of one if the local government is left-wing. Finally, Model IV just differs from Model III as we drop the size of the network and we add three dummy variables to identify the corporation (Connex, Keolis, Agir, or Transdev) which the operator belongs to.[15]

Ideally, each parameter λ, β, and α should also depend on a constant term. As shown in Equation (19), the probability of the contract choice $\Pr(r|\Omega)$ is based on the differences $\beta-1-\lambda$ and $\alpha-1-\lambda$, making it difficult to identify simultaneously a constant for λ and one for β on the one hand, and a constant for λ and one for 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 and we normalize the constant terms for λ and α to zero.

Consider first the estimates of our structural cost function, which are presented in the first part of Table III.[16] All parameters are significant at the one percent level and have the expected magnitude. Note that the parameters are in general relatively stable across each model. The two density parameters ρ_1 and ρ_2 of the Beta distribution are both greater than one, suggesting that the distribution of the inability θ is normally shaped. As $\rho_2 \geq \rho_1$, the mode of the distribution is lower than 0.5.

An important parameter in our cost function is μ, the disutility of effort parameter. Recall that, as μ increases, the parameters γ' in Equation (14) converge to the γs in Equation (15), suggesting that the incentive effects generated by the regulatory environment

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[15] Other specifications of the model have been tested as well. However, we dropped them since, in the course of the estimation, the combination of variables ended up in multicollinearity, which created identification problems, and finally, impeded the convergence of the maximum likelihood programs.

[16] The variable capital has been dropped from the regressions because the correlation between output and capital is too high, causing multicollinearity problems.

are less relevant at the moment of estimating the technology. On the contrary, as μ decreases, 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. Our estimated μ is clearly positive and significant.

Consider now the estimates of the contract choice, which are presented in the second part of Table III. 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 (9). Most 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. Note that this latter result is not necessarily in contrast with the predictions of Bajari and Tadelis [2001] which suggest that complex project are more likely to be regulated under cost-plus arrangements; indeed, whether larger networks entail more complex tasks remains to be proved. As suggested above, additional data on the contractual features, clauses and constraints would be very useful to answer this question.

Being a member of Connex, Keolis or Transdev has a significant impact on α and β. However, the global impact of each of these municipal corporations on the contract choice is not completely clear. Moreover, the effect of the share of drivers is not always significant, which suggests that its impact is potentially ambiguous. On the one hand, the share of engineers (one minus the share of drivers) 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. We expect the principal to be more willing to use cost-plus contracts if the ability of the operator to control its operating costs is higher. On the other hand, fixed-price contracts are preferred upon cost-plus regimes in an environment where moral hazard is potentially important. (Kawasaki and McMillan [1987]) Moral hazard becomes particularly relevant in a firm where drivers represent a large share of the working force since, in this case, the training of employees and the bargaining process with the unions become a key issue. When significant, our results suggest that a higher share of drivers implies a preference for fixed-price regimes, which is a potential signal that the moral hazard effect is stronger in this case.

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 ideology of the local government is considered: The cost of public funds is significantly higher if the principal is a left-wing type of government.

To determine which one of the four models provides the highest goodness-of-fit, we use a test proposed by Vuong [1989] as the four models are not nested. We test each model against each other. The null hypothesis is that two models are equally distant 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. The results of the test are presented in Table IV. When the Vuong statistic is less than two in absolute value, the test does not favor one model above the other. Positive values of the test greater than two favor one of the specifications presented in row 1 to row 4 (Model *i*). Negative values lower than minus two favor one of the specifications presented in column 1 to column 4 (Model *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. In the sequel, we perform inferences based on the results of Model II.

Evaluating the concerns for profit and wages. Having these estimates in hands, we are able to derive the estimated parameters $\hat{\alpha}_{it}$ and $\hat{\beta}_{it}$ for each network at each period. In order to test the meaningfulness of 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 V 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.[17]

Marginal effects. The results suggest that the political variables affect significantly the contract choice. The question is now to provide evidence on the magnitude of these effects. To do so, we measure how the probability to choose a fixed-price contract increases (*i*) if a government switches from left-wing to right-wing, (*ii*) if an operator switches from private to public, and (*iii*) if the size of the network increases by one kilometer.[18] These measures can be obtained through the logit specification in Equation (18).

The results are presented in Table VI, using the estimates from Model I (the only one where the choice of contract depends on whether the regulator is right-wing) and from Model II. 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 an increase of the probability from 0.47 to 0.84. The same probability increases by from 0.48 to 0.60 if the operator is public instead of private. Finally, increasing the transport network by ten kilometers increases the same probability by 0.2.

VI. SPECIFICATION TESTS

While the results show that the data do not reject our structural switching model, it remains to test whether it provides a higher approximation of the data generating process than alternative models. More precisely, we are interested in testing whether our positive approach of the choice of contract based on political interests is more realistic in a statistical sense than a normative approach based on second-best optimal contracts exclusively driven by the treatment of informational asymmetries. However, it is also useful to check our model against more traditional models. We propose to perform the following list of tests.

[17] From our results, such a 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 when we discuss our second-best analysis.

[18] We have also computed marginal effects for the other explanatory variables, namely *DRIVE*, *CONNEX*, *KEOLIS*, and *TRANSDEV*. Since these estimated effects are not significant, they are not shown here.

i) The structural cost model (SC). This model that we view as a benchmark consists in the cost functions defined by Equation (16). Here operators exert an effort level that is conditional on the type of regulatory contract they face, but the contract choice by the regulator is considered as exogenous. It corresponds to the approach considered in Gagnepain and Ivaldi [2002].

ii) The political regulation model (PR): This is the political model developed and estimated previously. To perform the test, we consider the results of Model II in Table III.

iii) The optimal second-best regulation model (SB): The structural cost function accounts for the choice of regulation, which obeys to the optimal second-best rules described in an Appendix to this text.

iv) The simple cost model (CD): This is the basic Cobb-Douglas cost function with no effort and productive inability terms.

v) The frontier cost model (FR-DUM): This is a cost frontier model based on a Cobb-Douglas cost function, which includes a productive inability parameter. Its structure is independent from the level of effort exerted by the operator; however, it includes a dummy variable which indicates whether the observed contract is fixed-price or cost-plus. Since the latter is endogenous, we run a reduced form estimation procedure as suggested by Wooldridge [2001].[19]

Table VII presents the whole set of results of the SB model; see the appendix for more details. Table VIII presents the estimation results of the five specifications. Most of the estimated parameters of the models (SC), (CD), and (FR-DUM) are significant at the 1 percent level. Note that the input prices and the output parameters are quite stable from one scenario to another. However, the disutility of effort μ, and the density parameters ρ_1 and ρ_2 may change from one specification to another. Biased estimates of μ, ρ_1 and ρ_2 may lead to erroneous interpretations regarding the importance of cost reducing incentives in the industry and the distribution of θ. For instance, note that the cost of effort parameter μ is higher in the SC specification compared to the PR one. If the true data generating process is as described in PR, SC would underestimate the importance of the cost reducing incentives in the industry since $\mu/1+\mu$ tends toward one if μ increases, and the cost structure (14) gets

[19] The empirical strategy consists in two steps; first, we specify a logit equation explaining the choice of fixed-price contracts; we then construct the predicted probabilities of choice using our estimates. The second step consists in using these predicted values in a 2SLS-IV procedure in order to identify the impact of fixed-price contracts on firms' operating costs.

closer in this case to the one described in (15). It is therefore important to figure out which specification fits data best.

Using a likelihood ratio statistic for nested specifications, we now compare the different models. Note that SC is our benchmark model; When SC is tested against PR or SB, the former is the constrained model while the later is the unconstrained model. However, when SC is tested against CD, The former is the unconstrained specification while the later is the constrained one. A positive likelihood ratio statistic indicated at the bottom of Table VIII indicates that the unconstrained model is preferred upon the constrained one, while a negative statistic suggests the opposite.

Scenario CD is rejected against scenario SC. It is interesting to note that scenario CD 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, as it is the case in our PR model. 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.

A final test of PR against FR-DUM allows us to shed light on whether the fixed-price/cost-plus cost differential obtained from our structural model could be appraised with a simple dummy. Our estimation results for the FR-DUM model suggest that the predicted dummy has no significant effect on firms' costs. Thus, a reduced form estimation procedure would have produced very different results from the ones of our structural model. We reject FR-DUM against PR, which illustrates that the FR-DUM model fails to account for the fact that, when the local authorities choose a contract, they internalize the impact of such a choice on social cost and the rents that are received by the interest groups.

Together, these results suggest that only a richer specification which accounts for the simultaneous interaction between the choice of contract and society's welfare allows evaluating properly the cost differentials between fixed-price and cost-plus contracts. 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 a model where the regulator is unsophisticated and where the political aspects of regulation are explicitly taken into account.

VII. WELFARE DIFFERENTIALS

Our political framework allows us to assess the welfare differentials between the fixed-price and the cost-plus contracts and discuss how these differentials are distributed between interest groups and taxpayers.

Starting from the parameter estimates obtained from our political regulation model, we can reconstruct estimates of the different welfare components specified in Equation (8) under both fixed-price and cost-plus regimes. Our simulation strategy proceeds in this way. First we select the networks that are regulated under fixed-price regimes over our period of observation, which provides 408 contract-years. We compute the welfare levels that pertain to these networks and then simulate the welfare components that would be obtained had these networks been regulated under cost-plus regimes. This allows us to keep the characteristics of networks constant and to focus on the impact of a change in regulation only. A more detailed description of our simulation is as follows:

In a first step, using the set of political regulation estimates $\Psi^{PR} = \left(\hat{\bar{\gamma}}, \hat{\rho}_1, \hat{\rho}_2, \hat{\alpha}, \hat{\beta}\right)$ and the equations (8), (13), and (14), we compute the effort level e^{FP}, the cost C^{FP}, the social cost WC^{FP}, the rent U^{FP}, and the extended social welfare level V^{FP} for the average fixed-price network. We set λ, the local cost of public funds, to be equal to 0.3. (See Footnote 18.) Moreover, we assume that the average inefficiency term θ is equal to 0.5, which is reasonable, given that the estimated density $f(\theta)$ is almost symmetric and is centered on this value.

In a second step, for the same set of networks, using the ingredients of Ψ^{PR} and Equations (8) and (15), we assume that a cost-plus regulation is implemented, i.e., $e^{CP} = 0$, and derive the associated welfare ingredients C^{CP}, WC^{CP}, and V^{CP} (U^{CP} is equal to zero) for the average network.

In a third step, we compute the welfare differential $\Delta V = V^{FP} - V^{CP}$ keeping in mind that we consider a setting where the elasticity of demand is small, i.e., the consumers' surplus is constant from one regulatory regime to another and is thus omitted in our analysis.

Table IX exhibits several remarkable results. Note first that the effort level e^{FP} for the average network is always lower than the inefficiency index θ; That this condition is satisfied while no constraint on the values of parameters was introduced in the course of the estimation can be considered as a sign that the model is well specified. A more important result is that fixed-price contracts are less costly for society compared to cost-plus regimes since they entail lower social costs, i.e., $WC^{FP} < WC^{CP}$. This outcome is due to the fact that (*i*) operating costs C^r are lower under fixed-price by 2.6 million Euros on average, and (*ii*) the profits U^{FP} currently obtained by the operators under fixed-price are low enough so that the firms do not enjoy excessive rents which are costly for society. At the end, social costs are lower under fixed-price regimes by 3.1 million Euros on average. Note that such a social cost difference is of the same magnitude as the annual transport budget of a 60,000 inhabitants urban area.

If, on top of the previous welfare components, one accounts also for the weighted profit and cost $\hat{\alpha}U^r + \hat{\beta}C^r$ that are received by the interest groups and obtains a measure of the extended social welfare V^r, it turns out that the burden beard by society under a cost plus contract is less important. Indeed, in this case, higher operating costs C^{CP} benefit to the workers supervised by the operator since they receive higher wages. The final extended welfare differential between cost-plus and fixed-price regimes shrinks down to 0.9 million Euros. Thus, taxpayers lose from a switch from a fixed-price to a cost-plus contract, but a subset of society, i.e., the workers of the firm, benefits from an additional rent.

To conclude this discussion, we may as well wonder how the optimal second-best regime (SB) described in the previous section would perform compared to cost-plus and fixed-price contracts. Moreover, given that the regulator should in principle organize a tender in order to select its transport operator, we can simulate the effect on welfare of an optimal auction (OA). Following Laffont and Tirole [1987], we know that an optimal auction, which promotes ex ante competition between several firms, reduces significantly the rent left to the operator compared to a situation where a monopoly is regulated under an optimal second-best regime. Competition for the most efficient operator amounts to a truncation of the interval $\left[\underline{\theta}, \overline{\theta}\right]$ to $\left[\underline{\theta}, \theta^*\right]$, where θ^* is the inefficiency type of the second lowest bidder. Note that the optimal auction requires the same effort level and operating cost target than the optimal second-best regime. We again consider the average fixed-price operator of our sample and simulate welfare differentials between two scenarios where this operator (*i*) is regulated under an optimal second-best regime, and (*ii*) wins the auction against a single competitor with the same technological characteristics but with an inefficiency term θ that is 5%, 10% and 25% higher.

Table IX suggests that the different regulatory scenarios can be ranked as follows: $WC^{FP} < WC^{OA} < WC^{SB} < WC^{CP}$, i.e., an optimal second-best regime entails higher social costs than a fixed-price contract, but performs better than a cost-plus contract. Second, an optimal auction allows reducing social costs by 1.2 to 1.6 million Euros, compared to an optimal second-best regime, thanks to a significant reduction of the informational rent left to the operator. Overall, the optimal auction would improve total welfare by 0.27 to 0.36 million Euros on average.

VIII. CONCLUSION

Our study contributes to the empirical literature on regulation on several fronts: First, we provide evidence that 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 who is responsible for the service. A second 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 in principle 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 has considered them intensely. In this paper, we reject this hypothesis and suggest that the generation process of the data we have in hand is better explained by a framework where information revelation is not the main concern of the regulator. We propose to draw a positive picture of the economics of regulation that relies on the observed probabilities of contract choice and the characteristics of the economic agents that participate in the regulatory process. We show that considering simultaneously the causes and the consequences of regulation helps improving the empirical results.

Although, in the course of the analysis, we implicitly impose many technical simplifications, we show through several specification tests that a simple static model that combines a probability of contract choice and a structural cost function shaped by the incentive pressure impinging on the activity of the firm already performs better that many frameworks that have proved popular in the economic literature. That said, in future research, many aspects of our model can be improved: They entail for instance the specification of the cost, effort, and welfare functions, or the absence of heterogeneity of the cost of public funds, the steadiness of the inability parameter over time, or the knowledge of its distribution. Moreover, behind the scenery, there are implicit assumptions about the competitive conduct of corporations which could be discussed further. Finally, the static context we have considered probably ignores the potential strategic use of information by the authorities, a question we address in a companion paper.

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APPENDIX: 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 is accounted for at the moment of maximizing social welfare. We present briefly this model and the first order condition on effort which is derived from the exercise.

The regulator is once again imperfectly informed on the productive inability level of the operator and has only some beliefs on the distribution of inability, 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

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

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; the optimal allocation is obtained by maximizing the expected social welfare,

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

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

$$U'(\theta) = -\psi'(e^s).$$

It 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 he announced a lower productive ability 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,

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

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 in Equation (11) and disutility of effort in Equation (12), 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}:

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

Reintroducing e^S into the primal cost structure in Equation (11), we derive the second-best cost function to be estimated:

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

The second-best effort and cost levels can be interpreted from the fixed-price levels: Assuming that the monotone hazard rate property holds, i.e., $d(F(\theta)/f(\theta))/d\theta \geq 0$, the condition on second-best effort suggests that the downward effort distortion becomes more important as θ increases. Thus, the less productive operator (given the belief of the regulator) should be provided an effort level that is close to the cost-plus effort. Likewise, the most productive 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 a proportional upward cost distortion.

Estimation results for the second-best cost function are provided in Table VII. As λ cannot be identified in the course of the estimation, we need to calibrate it. We estimate Equation (22) for different values of $\lambda \in [0.1, +\infty[$, knowing that the cost of public funds is expected 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 too much on the value of λ.

TABLE I
CHARACTERISTICS OF THE 140 REGULATORY CONTRACTS (1987-2001)

Variable Name	Frequency	Percent
Years	15	
Networks	49	
Single contract periods	140	
FP contracts		59.3
Changes in contract type	20	
Changes from *CP* to *FP*	17	
Changes of operators	2	
Changes of local authority	22	
Right-wing local authority		54.3
FP if the local authority is right wing		68.4
FP if the local authority is left wing		48.4
Public operator		38.7
FP if public operator		68.5
FP if private operator		53.5
FP if large network		68.2%
FP if small network		51.9%
Keolis		35.7
FP if Keolis		54.0
Agir		12.8
FP if Agir		38.9
Connex		22.1
FP if Connex		41.9
Transdev		25.0
FP if Transdev		91.4

Note: *CP* refers to cost-plus contracts and *FP* to fixed-price contracts. Keolis, Transdev, Connex and Agir are the companies that gather most of the local operators. 'Large network': Size bigger than the average network. 'small network': Size smaller than the average network.

TABLE II
STATISTICS ON THE DATASET

Variable name	Name	Mean	Standard Deviation	Mean if *FP*	Mean if *CP*
Cost (Euros)	C	20,549,568	19,273,852	25,558,923	14,299,363
Revenue (Euros)	$R(y)$	9,608,629	10,526,903	12,064,283	6,544,695
Subsidy (Euros)	T	11,093,512	9,659,325	13,734,840	7,797,909
Production (seat-kilometers)	Y	671,315,300	537,941,510	776,698,720	539,827,720
Wages (Euros)	w_l	30,218	5,337	30,951	29,304
Price of materials (Index)	w_m	1.159	0.199	1.194	1.116
Size of the network (kilometers)	*Length*	288.3	200.1	334.4	230.8
Local tax per unit of supply (Euro)	*Tax*	0.022	0.013	0.024	0.019
% of drivers in the labor force	*Drive*	0.707	0.072	0.701	0.715

TABLE III
STRUCTURAL ESTIMATION RESULTS

Variable	Parameter	Models I	II	III	IV
Cost Function					
Constant	$\ln\gamma_0$	-5.76*** (0.071)	-5.74*** (0.08)	-5.69*** (0.079)	-5.60*** (0.127)
Wages	γ_l	0.25*** (0.010)	0.24*** (0.011)	0.22*** (0.011)	0.23*** (0.011)
Production	γ_Y	1.07*** (0.005)	1.07*** (0.006)	1.07*** (0.005)	1.06*** (0.009)
Cost of Effort	$\ln\mu$	4.41*** (0.302)	3.83*** (0.203)	3.72*** (0.246)	4.03*** (0.637)
Beta scale par 1	ρ_1	1.22*** (0.086)	1.28*** (0.095)	1.23*** (0.084)	1.25*** (0.089)
Beta scale par 2	ρ_2	1.32*** (0.093)	1.305*** (0.092)	1.32*** (0.09)	1.31*** (0.086)
Error std dev	σ_ε	0.05*** (0.004)	0.05*** (0.003)	0.05*** (0.004)	0.04*** (0.004)
Cost of public funds	λ				
Tax		0.27 (0.217)	0.51 (0.941)		
Left-wing				0.08** (0.04)	0.47*** (0.137)
Concern for costs	β				
Constant		0.41*** (0.036)	0.69*** (0.067)	0.77*** (0.119)	
Right-wing		0.54*** (0.040)			
Public			0.18*** (0.068)	0.21*** (0.083)	0.62*** (0.105)
Drive		0.02* (0.014)	0.06 (0.058)	0.02 (0.081)	-1.22*** (0.372)
Length		0.00 (0.002)	0.01 (0.058)	-0.02 (0.027)	
Connex					-0.28*** (0.055)
Keolis					-0.56 (0.844)
Transdev					-1.50*** (0.550)

Table 3 continued next page

Table 3 continued

Variable	Parameter	I	II	III	IV
Concern for profits	α				
Right-wing		1.03***			
		(0.046)			
Public			0.42***	0.51**	1.47***
			(0.150)	(0.208)	(0.344)
Drive		0.06*	0.22	0.18	2.29*
		(0.038)	(0.212)	(0.257)	(1.215)
Length		-0.00	0.11***	0.09***	
		(0.008)	(0.028)	(0.031)	
Connex					-0.19**
					(0.084)
Keolis					-1.23
					(1.928)
Transdev					-1.58*
					(0.831)
# Observations		735	735	735	735

Note: Standard errors are in parenthesis. ***significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

TABLE IV
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 V
MEAN VALUES FOR THE REGULATOR'S CONCERNS FOR PROFIT AND COSTS

	Concern for profit α	Concern for costs β	t-test
Under cost-plus contracts	0.70	0.74	3.11
	(0.206)	(0.081)	
Under fixed-price contracts	0.81	0.77	3.27
	(0.230)	(0.090)	

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

TABLE VI

MARGINAL EFFECTS ON THE PROBABILITY TO CHOOSE A FIXED-PRICE CONTRACT

	Prob. Choice Fixed-price	
Switching from left to right-wing$^{(1)}$	+0.46	(0.206)
Switching from a private to public operator$^{(2)}$	+0.12	(0.063)
Increasing the network length by 10 *km*$^{(2)}$	+0.2	(0.008)

Note: Standard deviations are in parenthesis. Estimates are computed from the results obtained in Model I (^{1}) and Model II (^{2})

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TABLE VII
SECOND-BEST ANALYSIS

Variable	Par.	Estimates					
Cost of Public Funds λ		0.1	0.3	0.5	0.7	0.9	∞
Constant	$\ln \gamma_0$	-5.15 (0.181)	-5.15 (0.031)	-5.19 (0.040)	-5.19 (0.035)	-5.50 (0.068)	-5.48 (0.072)
Wages	γ_l	0.33 (0.034)	0.36 (0.004)	0.38 (0.009)	0.36 (0.004)	0.36 (0.008)	0.40 (0.011)
Production	γ_Y	0.98 (0.012)	0.97 (0.002)	0.97 (0.002)	0.97 (0.003)	1.00 (0.005)	0.99 (0.005)
Cost of Effort	$\ln \mu$	3.33 (0.363)	2.70 (0.048)	3.27 (0.074)	2.71 (0.051)	2.43 (0.057)	2.69 (0.081)
Beta scale par 1	ρ_1	3.48 (0.359)	3.56 (0.149)	3.50 (0.176)	3.71 (0.159)	3.88 (0181)	4.02 (0.213)
Beta scale par 2	ρ_2	3.31 (0.496)	3.49 (0.107)	3.47 (0.162)	3.34 (0.113)	3.72 (0.154)	4.29 (0.210)
Error stand dev	σ_ε	0.04[†] (0.032)	0.01 (0.000)	0.01 (0.001)	0.01 (0.001)	0.01 (0.001)	0.016 (0.001)
# Observations		735					

Note: Standard errors are in parenthesis. Almost all parameters are significant at the 1 percent level: The symbol [†] means ‘not significant’.

TABLE VIII
SPECIFICATION TESTS

Variable	Parameter	SC	PR	SB	CD	FR-DUM
Cost Function						
Constant	$\ln\gamma_0$	-4.92*** (0.246)	-5.74***	-5.15***	-4.61*** (0.159)	-3.95*** (0.152)
Wages	γ_l	0.32*** (0.035)	0.24***	0.36***	0.31*** (0.033)	0.32*** (0.035)
Production	γ_Y	0.97*** (0.017)	1.07***	0.97***	0.99*** (0.010)	0.98*** (0.011)
Cost of Effort	$\ln\mu$	4.93* (2.946)	3.83***	2.70***		
FP dummy (predicted)						0.02 (0.069)
Beta scale parameter 1	ρ_1	3.45*** (0.544)	1.28***	3.56***		3.54*** (0.419)
Beta scale parameter 2	ρ_2	3.75*** (0.726)	1.30***	3.49***		2.42*** (0.341)
Error stand deviation	σ_ε	0.07*** (0.025)	0.05***	0.01***	0.20*** (0.005)	0.07*** (0.016)
Cost of public funds	λ					
Tax			0.51			
Concern for costs	β					
Constant			0.69***			
Public			0.18***			
Drive			0.06			
Length			0.01			
Concern for profits	α					
Public			0.42***			
Drive			0.22			
Length			0.11***			
Specification Test			22.7	-43.6	21.9	36.2
# Observations				735		

Note: Standard errors are in parenthesis. ***Significant at 1 percent; **Significant at 5 percent; *Significant at 10 percent. The specification test is computed using a likelihood ratio statistic. The model SC is our benchmark and is tested against the specifications PR, SB, CD or FR-DUM. When tested against PR and SB, SC is the constrained specification. When tested against CD and FR-DUM, SC is the unconstrained model. A positive test statistic entails that the unconstrained model is preferred upon the constrained one; under a negative test statistic, the opposite result is obtained.

TABLE IX
WELFARE DIFFERENTIALS FOR THE AVERAGE NETWORK

Welfare Items	Variable	Estimation
Inefficiency	θ	0.5
Effort *FP*	e^{FP}	0.13
Effort *CP*	e^{CP}	0
Effort *SB*	e^{SB}	0.09
Cost *FP*	$C^{FP}=C^{FP}\left(Y,w,K,e^{FP},\theta \middle\| \hat{\bar{\gamma}}\right)$	18
Cost *CP*	$C^{CP}=C^{CP}\left(Y,w,K,e^{CP},\theta \middle\| \hat{\bar{\gamma}}\right)$	20.6
Cost *SB*	$C^{SB}=C^{SB}\left(Y,w,K,e^{SB},\theta \middle\| \hat{\bar{\gamma}}\right)$	18.7
Rent *SB*	U^{SB}	1.3
Rent *AO*[1]	U^{AO}	0.08; 0.16; 0.4
Weighted profit + weighted cost *FP*	$\hat{\alpha}U^{FP}+\hat{\beta}C^{FP}$	13.8
Weighted profit + weighted cost *CP*	$\hat{\alpha}U^{CP}+\hat{\beta}C^{CP}$	15.9
Social cost *FP*	$WC^{FP}=(1+\lambda)\left(U^{FP}+\psi\left(e^{FP}\right)+C^{FP}\right)$	23.7
Social cost *CP*	$WC^{CP}=(1+\lambda)C^{CP}$	26.8
Social cost *SB*	$WC^{SB}=(1+\lambda)\left(U^{SB}+\psi\left(e^{SB}\right)+C^{SB}\right)$	26.1
Social cost *OA*[1]	$WC^{OA}=(1+\lambda)\left(U^{OA}+\psi\left(e^{OA}\right)+C^{OA}\right)$	24.5; 24.6; 24.9
Extended welfare differential *FP-CP*	$\Delta V=V^{FP}-V^{CP}$	0.9
Welfare differential *OA-SB*[1]	$\Delta W=W^{OA}-W^{SB}$	0.36; 0.34; 0.27

Note The unit for costs, social costs and welfare levels is the million Euros.

[1]The type θ^* of the second lowest bidder in the optimal auction is 5%, 10%, and 25% higher than θ resp.