Contract Efficiency in Public Transport Services

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Abstract

The objective in this chapter is to present a literature review on the relationship between the productive efficiency (the cost) of a transport operator and the incentive power of the regulatory contract that defines the cost reimbursement rules of the transportation activity. The economic analysis discussed here is usually based on the estimation of a cost function or a cost frontier which usually incorporates an inefficiency variable. We suggest that the literature usually agrees on the fact that contracts with higher incentives lead to larger cost reductions. However we also shed light on the fact that to identify a causal effect of a type of contract on cost efficiency is a tricky task as efficiency and the choice of the type of contract are usually jointly determined, which causes problems of endogeneity. We list a series of frameworks which attempt to deal with this issue.

Keywords

Regulation, contracts, costs, production, efficiency, effort, incentives, public transport, endogeneity, contract choice, selection effect, stochastic frontier, Data envelopment Analysis.

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1. Introduction

When a production technology is characterized by increasing returns to scale, the regulator in charge of the organization of the service prefers to keep the monopoly status of the firm in charge of the operation. The key issue is then to design the *best* regulatory contract that guarantees that the activity of the firm coincides with the objectives of the regulator. In particular, the question of the incentive power of the contract in terms of the reduction of the operating costs is a particularly important issue given that it is the society as a whole that will bear the costs associated with the provision of the service.

This chapter focuses more specifically on the urban transport industry, which is usually seen as a universal service in developed countries, and where operating costs are much higher than commercial revenues and therefore require that the regulator pays the operator a socially costly subsidy. Controlling operating costs is therefore an important issue for the regulator who ideally aims at selecting the most efficient firm to provide the service. Our objective in this chapter is to present a literature review on the relationship between the productive efficiency (the cost) of a transport operator and the incentive power of the regulatory contract that defines the cost reimbursement rules of the transportation activity. The economic analysis discussed here is usually based on the estimation of a cost function or a cost frontier which usually incorporates an inefficiency variable. We suggest that the literature usually agrees on the fact that contracts with higher incentives lead to larger cost reductions. However we also shed light on the fact that to identify a causal effect of a type of contract on cost efficiency is a tricky task as efficiency and the choice of the type of contract are usually jointly determined, which causes problems of endogeneity.

We present in Section 2 a set of estimation techniques based on reduced forms that do most of the time assume that contracts are exogenous. Then, in Section 3, we focus instead on more structural approaches that do explicitly represent in the structure of the estimated cost function the source of the potential endogeneity problem. These techniques are based on a tradition initiated by Leibenstein (1966) which considers that any cost expenditure should be affected by a global inefficiency index that depends on the firm's technical ability but also on the will of the managers and workers involved in the production process. On the one hand, a low powered incentive environment due to a lack of productivity of working agents induces the inefficiency, while appropriate incentives can lead to significant operating cost reductions. On the other hand, since the emergence of the new theory of regulation, economists admit that, in industries where a producer is regulated by an authority, the principal-agent relationship is at the core of the question of assessing the performance of a firm. (See Loeb and Magat, 1979, Baron and Myerson 1982 and Laffont and Tirole, 1986). The incentive models provide a relevant framework for the analysis of operating cost in public transport activities. In addition, because such models are able to elicit the structural relationship between the observable variables and the inefficiency term, they directly provide a way to deal with the endogeneity of the inefficiency term, i.e., with the stumbling block of the econometrics of frontiers. Hence, technical inefficiency and effort are two unobservable parameters, which characterize the incentives faced by a firm to reduce costs and define the source of global inefficiency.

2. Reduced forms

The efficiency of a firm is typically measured from a production or a cost function as both are a dual representation of the same technology. Cost expressions have been more popular given that the public transport industry usually considers that output levels are set by transport authorities. The researcher may be interested in the direct relationship between the operator's cost and several explanatory variables or may attempt to estimate an efficiency index that is incorporated directly in the cost structure. We present in this section the different types of functional form used by the researchers and we shed light on how the contract effect is accounted for. We present a first set of cases where contracts are assumed to be exogenous. Then, we discuss several papers that relax this hypothesis and attempt to explain in a simple way how the choice of contract can be identified.

2.1. Contract choice is exogenous

French data on urban transportation have been very popular in the economic analysis as there is quite a long tradition on collecting data on the activity of both transport operators and local regulator in each urban area of significant size. A local authority (i.e., a municipality, a group of municipalities or a district, whose councils are elected for six-year terms) is in charge of regulating an operator which has been selected to operate the network, i.e., to provide the transport services. This framework has been recorded in a law on the organization of transport services within France enacted in 1982, which established the principle of the 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 with as well as the payment and/or cost-reimbursement rules between the authority (the principal) and the operator (the agent). Gagnepain (1998) focuses on a panel data set covers 49 different urban transport networks over the period 1987-2001. Two types of regulatory contracts are implemented, namely cost-plus and fixed-price schemes. 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. The identification strategy of the paper is built upon a reduced-form model which provides insights into the effects of certain variables without requiring a complete modelling of the environment that characterizes the production activity. More in particular, a reduced Translog cost function is used to support the estimation of operating costs. A variable, which characterizes the type of regulatory scheme in operation, is introduced to study the effect of the latter on costs. The results indicate that firms regulated by fixed-price contracts have an average cost of 2.05% lower than firms regulated by cost-of-service schemes, hence suggesting that a transport company has an incentive to reduce costs depending on the type of contract that the local authority offers.

Kerstens (1996) uses the same type of data but works on a smaller sample (114 observations). This study also differs from the previous one as it is based on a two-step estimation procedure: First, the author estimates a production frontiers for the transport operators using Data Envelopment Analysis (Farrell, 1957). In a second step, the determinants indexes of the performance of French urban transit companies are investigated with a Tobit model. The empirical results show that higher efficiency measures are observed more often with fixed-price contracts. Roy and Yvrande-Billon (2007) and Gautier and Yvrande-Billon (2013) use the same type of data but focus instead on a stochastic cost frontier (Aigner et al., 1977 and Meeusen and van Den Broeck, 1977) where some of the deviations from the frontier are attributed to inefficiency, as suggested by Battese and Coelli (1995). Their results suggest that operators under cost-plus contracts exhibit a higher level of technical inefficiency than operators under fixed-price agreements.

Vigren (2016) investigates how common contract types and contract design factors in the Swedish public transport system affect cost efficiency. There are three different types of contract, which entail significant incentives, as in a fixed-price regime: On the one hand, a gross-cost contract without incentives implies that the operator receives a fixed payment based on the supply objectives set by the regulator; in this case, the operator bears only the production “risk”, i.e., it is responsible for potential cost-overruns and it obtains a positive profit if the ex-post cost is below the expected cost defined ex-ante. On the other hand, the net-cost contract implies that the operator bears both industrial and commercial “risk”. In other words, the operator is also incentivized to increase commercial revenue and hence influence the service to a much higher degree in the form of improving service quality and punctuality. Finally, a last - not so frequent – type of contract could be viewed as a mix of the two previous contracts and is called the gross-cost contract with incentives. In this case, the operator still bears the production “risk”, and is levied some revenue “risk”. However, in the latter case, the incentives are lower than in a net-cost contract; the idea is to base some of the operator's payment on a performance measure in order to get the operator to improve some aspects of the service. The estimation procedure considers again the same stochastic cost frontier as in Battese and Coelli (1995). The inefficiency index depends on several explanatory variables, namely, the population density of a contracting area, the ownership of the transport operator, a measure of the contracting term in numbers of years, and a dummy variable indicating whether the regulatory contract in place entails any incentive payment. An important assumption is that, since transport concessions are awarded through competitive tenders, more incentives in the form of a net-cost contract in place of a gross-cost contract without incentives may entail a higher “risk” for the operator. The later may therefore require a risk premium in its bid in the form of a higher subsidy. Hence, incentives may lead to two opposite effects: The usual cost-reduction effect, which is the one on which most of the empirical literature focuses, and a cost-increase effect due to a risk premium, as emphasised here. More incentives could therefore lead to higher costs if the risk premium effect is large enough. The estimated results on the effect of the choice of contract are not significantly different from 0, which probably illustrates the fact that the ex-ante risk premium impact emphasized by the author is not the unique effect to be expected in this case. The ex post effect, which guarantees that incentive contracts make the transport operator residual claimant for cost overruns and force the manager of the firm to provide a higher effort level to reduce costs, should be present as well. Since both ex ante and ex post effects go in opposite directions, it is not unreasonable that the estimation results show non-significant effect of the type of contract overall.

Dalen and Gomez-Lobo (2003) use the same estimation technique, but work on a slightly different regulatory context: They estimate a cost frontier model for a panel of Norwegian bus companies (1987-1997). Once again, their objective is to investigate to what extent different type of regulatory contracts affect company performance. On the one hand, regional authorities may bargain individually with transport companies on the subsidy levels to be granted during the forthcoming year; this arrangement should then be assumed to be of low power in terms of its incentive properties. On the other hand, a number of regional authorities have adopted a more high-powered contract based on a yardstick benchmark which consists in comparing similar regulated firms with each other: The regulator uses the cost of comparable firms to infer a firm’s attainable cost target (Schleifer, 1985). This regulatory scheme is again similar in spirit to a fixed-price mechanism. In Norway, the regulator and the transport operator agree upon a set of criteria for calculating the costs of operating a bus-network, namely, a cost index based on a linear model that links driver, fuel, and maintenance costs to the number of bus-kilometres produced for different categories of routes. Given fares and route schedules, this index determines the level of transfers that is granted to the operator. The important point is that the same standard cost model applies to all companies within a geographical area and transfers to the operator depend upon the cost performance of a large set of companies. The authors conclude that firms regulated under the yardstick type contract exhibit less than half the cost inefficiency compared to those firms regulated under the traditional contract, but they also acknowledge that contracts choice is endogenous, which complicates the interpretation of the results.

Similar estimation techniques are used by the following authors: Piacenza (2006) analyses a seven-year (1993–1999) balanced panel of 44 Italian municipal companies managed under cost-plus or fixed-price regulatory schemes. The stochastic inefficiency effects are supposed to be linearly related to the regulatory scheme and the commercial speed of the transit companies. The results confirm the initial hypothesis of a lower inefficiency under fixed-price schemes. Karlaftis and Tsamboulas (2012) use data from 15 European transit systems between 1990 and 2000 and test whether different efficiency assessment methodologies produce similar results and whether the impact of the contractual form are robust to the methodological specifications employed. They find that net cost contracts, where the operator bears both production and consumption “risk”, involve higher efficiency indexes compared to the gross cost contract case where operators bear only production “risk”. Margari et al (2007) focus on 42 Italian transport operators observed from 1993 to 1999. Their approach is based a three-stage methodology which mixes both Data Envelopment Analysis and stochastic frontiers techniques in which they attempt to identify and separate three input-specific determinants of inefficiency, namely exogenous factors, pure managerial inefficiency and statistical noise. The so-called exogenous factors are related to the regulatory context and lie outside the managers’ control but are direct decisions of regulators and policy-makers. It is found that the implementation of high-powered incentive contracts enhances production efficiency. The authors conclude that the main source for inefficiency has to be sought in contract choice or even random events, while pure managerial skills only play a minor role. Finally, an exception to all the results presented above is Zhang et al. (2018) which estimates transport efficiency for 26 different Chinese public transport operators in 13 cities across China for the period 2008–2014. Here, contrary to previous predictions, the most powered incentive schemes do not entail the highest efficiency measures.

2.2. Contract choice is endogenous

The aforementioned studies assume that contract choice is exogenous, which is a potential drawback. As suggested for instance by Chiappori and Salanié (2003), contract endogeneity is an important issue since, in the presence of unobserved heterogeneity, the matching of transport operators to contracts is probably not independent from the unobserved heterogeneous firms' efficiency variables: If fixed-price contracts are given to efficient firms while cost-plus regimes are proposed to inefficient ones, the choice of contract is endogenous and any empirical analysis taking contracts as given will be biased. The 2.05% cost reduction emphasized in Gagnepain (1998) may not be *caused* by the implementation of fixed-price regimes but may illustrate instead a simple selection effect, i.e., fixed-price contracts are chosen more often by efficient firms. Before turning to a presentation in the next section of a more structural analysis that allows to embody the endogenous effect in the structure of the cost expression to be estimated, we discuss in what follows a few proposals that attempt to address the endogenous bias in a reduced form.

Iseki (2010) addresses in part the endogeneity issue using data on the US bus transit services between 1992 and 2000. Transit agencies in charge of the organization of the service would typically implement three types of contracted service arrangements: 13% of the agencies contracted out a portion of service, while 21% of agencies contracted out for all service, and 66% contracted out no service. As emphasized by the author, assessing the effect of regulation on operating cost with a regression that combines contracting practices in several dichotomous variables may not be appropriate. The potential endogeneity problem is addressed by applying an instrumental variables technique which consists in predicting each agency's decision making regarding contracting: Two contracting categories are predicted using a multinomial logit model in the first-stage of the two-stage regression analysis which includes a set of explanatory variables related to agencies' revenue and governance characteristics such as labour conditions in the region, regional political climate, and state legislations governing regional and local governments. The results suggest that partial and full-contracting arrangements allow agencies to reduce operating costs.

Díaz and Charles (2016) focuses on the same French urban transport industry as in the previous studies (1995-2010). Efficiency is estimated in a first stage using a Data Envelopment Analysis production frontier. In a second stage, the estimated efficiency indexes are regressed on a set of variables, including contract characteristics and a set of cities' fixed effects. The authors stress the role of unobserved heterogeneity in their analysis: If unobservable factors affect simultaneously both the efficiency and the choice of contracting types, a simple correlation analysis could be misleading. For instance, cities with geographical features that reduce the productivity of inputs might be the most interested in delegating the service to private firms or using certain type of contracts. The introduction of fixed-effects should at least solve the problem as long as the cities' unobserved characteristics are fixed over time, which may not be the case of congestion for instance. Moreover, unobserved characteristics on the operators' side could be relevant as well. Once again, fixed-price contracts are found to perform better than cost-plus contracts in terms of efficiency.

2.3. Auction versus negotiation

Before choosing a type of contract, such as fixed-price or cost-plus, a regulator must decide whether to organize a competitive tender in order to attract new firms and organize ex-ante competition, or whether to negotiate the terms of a new contract with the incumbent. Such a decision has consequences as well on the future costs of the transport operator and the price paid by the regulator. The introduction of auction procedures in many developed countries aims at introducing competition for the field. An increase in the number of bidders should encourage more aggressive bidding, i.e., lower bids. In a context of asymmetric information, it is well known from Laffont and Tirole (1987) that an optimal auction, which promotes reduces significantly the rent left to the operator compared to a situation in which a monopoly is regulated under an optimal second-best regime. In this section, we list a series of papers that attempt to provide empirical evaluation of these issues, keeping in mind that once again, regulatory arrangements are generally endogenous decisions, which complicates the analysis of the econometrician.

Amaral et al. (2013) investigate the relationship between the number of bidders and price reduction in the London bus market. They note that, even if competition among bidders leads them to reduce their bid, the winning bidder may, ex-post, renege on the initial commitments. From an empirical perspective, this implies that assessing the impact of the number of bidders on price requires controlling for potential contractual renegotiations. The authors use a database on 806 calls for tender on London bus contracts (1999-2008) and find that a higher number of bidders is associated with a lower cost of service. A key issue is the potential endogeneity of the number of bidders, as the expected value of the winning bid potentially influences the number of participating bidders or both variables may be jointly affected by a third variable, such as the value of the service for instance. In order to get rid of potential time-varying heterogeneity, the authors add in the regression the number of auctions organised during the month as well as the number of auctions already won by the winner during the previous month. The estimation results confirm a positive and significant cost-reducing effect of competition.

Scheffler et al. (2013) investigates the impact of the introduction of competitive tendering in German public bus transport networks. Over the period of observation (2004 to 2009), Germany's public bus transport markets remain dominated by publicly-owned companies that provide services based mainly on monopoly rights without competitive tendering. In 2009, a large majority of bus operators were fully publicly owned. European regulation (EC) No. 1370/2007, which came into force at the end of 2009 specifies that local authorities have the right to award services directly to transport companies which are under the actual control of the local authority. A direct award is also backed by EU law if the size or value of the transport service contract is small. Hence, German local authorities can generally decide on a discretionary basis as to which services they wish to open up to more competition. The methodology chosen by the authors consists in estimating a production stochastic frontier, as proposed by Battese and Coelli (1995), where the inefficiency term depends on a dummy variable that takes value 1 if the bus operator is chosen under a competitive tendering procedure. Once again, regulatory endogeneity is a potential issue here. Local authorities can generally decide on a discretionary basis as to which services they wish to open up to more competition. A local public might decide to open a route to competition if the publicly-owned incumbent is already relatively efficient, and therefore likely to succeed in the tendering process. To address this issue, the authors use as a benchmark the Federal State of Hesse where local authorities were obliged to put routes out to tender from 2002 to 2007; hence services tendered in this period in this area were not subject to regulatory discretion. Estimation results suggest that there is no significant difference on the influence of technical efficiency between competitive tendering in general and competitive tendering in the Federal State of Hesse which allows the authors to discard the issue of endogeneity. Bus companies which operate in areas where competitive tendering takes place are more efficient than others. A somehow analysis is provided by Filippini et al. (2015) but the conclusions differ: The authors focus on 630 bus lines operated by the main Swiss company, Swiss Post, in 2009 throughout the country. Following the revision of the Swiss railways act in 1996, regional public authorities were given the choice between two different contractual regimes to procure public passenger transport services, competitive tendering versus negotiation. The paper evaluates the impact of competitive tendering and performance-based negotiation using a stochastic frontier analysis. About 10% of Postbus lines have gone through a competitive tendering process between 2005 and 2015. The estimation results show that the average levels of cost efficiency are relatively high and no significant differences are observed between competitive tendering and performance-based negotiation.

Moreover, Mouwen and van Ommeren (2016) aims at assessing the impact of contract renewal and competitive tendering on operational costs. They employ a panel dataset for the period 2001–2013 on the level of concession areas in the Netherlands. Contract renewal allows several operators to bid for a new contract. More precisely, in the period under study, 61 contract were renewed and 69% of these were renewed after a process of competitive tendering of which about half were awarded to a new operator. The authors estimate a cost function which accounts for the number of contract renewals between 2001 and the period of observation. They find that contract renewal leads to a substantial reduction in operational costs: When a contract is renewed at least once, costs fall by 10%, while contracts renewed at least twice even lead to an extra costs reduction of 6%.

To conclude this section, note that the endogeneity of the decision of whether a service should be tendered or not also depends on the importance of transaction costs in the industry. Bajari et al. (2008)

suggest that auctions perform poorly when projects are complex and contractual design is incomplete. Hensher and Stanley (2008) suggest that there may be high transactions costs of re-tendering through competitive processes, causing ex post adaptation to become an important feature of the transaction. Properly structured transparent and performance-based negotiated arrangements may avoid this problem and protect the provision of service, while meeting government service objectives. Performance-based negotiation can also avoid some drawbacks of competitive tendering, such as asymmetric information, lack of trust, and hold-up problems between the incumbent and the public authority. Finally, Yvrande-Billon (2006) also suggests that problems associated with competitive tendering come from the contractual disabilities of the parties.

3. Structural models

The treatment of contract choice endogeneity in reduced forms analyses such as the ones presented in the previous section typically require a two-step (sequential) estimation procedure where the inefficiency index for each transport operator is estimated first, and is then regressed on the set of contract characteristics. We turn now to more structural models which intend to embody directly in the structure of the functional form to be estimated the incentive impact of the observed contract impinging on the activity of the transport operator.

We explain briefly how the structural cost expression is constructed, starting with Gagnepain and Ivaldi (2002a). We consider a Cobb-Douglas technology:

(1) $$Y = A \prod_{j=1}^{n} X_j^{\alpha_j} \exp[e - \theta + \varepsilon_Y],$$

with one output Y and n variable inputs X_j, where A and the α_j's are parameters describing the technology. To construct the dual cost frontier, we assume that the producer seeks to minimize the cost C of producing its desired rate of output Y under technical inefficiency. The associated allocation of inputs sets the factor demand X_j, $j = 1, \dots n$. The program of the producer is then

(2) $$\min_{X_j} \sum_{j=l}^{n} w_j X_j ,$$

under the previous technological constraint, where w_j is the price of input *j*. The excess of factor demand above its frontier prevents the producer from reaching the theoretical level of production. Such a distortion of factor demands leads to a rise of operating costs. In logarithmic form, the associated stochastic cost frontier, $C(Y, w, e, \theta)$, is given by

(3) $$lnC(Y, w, e, \theta) = \mathrm{K} + \sum_{j=1}^{n} \frac{\alpha_j}{r} lnw_j + \frac{1}{r} lnY + \frac{\theta - e}{r} + \varepsilon_C$$

where $r = \sum_{j=1}^{n} \alpha_j$ measures returns to scale, and K is a constant. Note that the term $(\theta - e)/r$ is the total cost distortion above the cost frontier. Global inefficiency is smaller when the industry enjoys large returns to scale *r*. This cost frontier expression is preliminary as the cost reducing effort *e* is endogenous and depends on regulatory schemes or the competitive environment set by the regulator. We turn now to the cost reducing activity aspect of the problem. Consider a transport operator whose profit function is

(4) $$\pi = R(Y) - C(Y, w, e, \theta) - \psi(\mathrm{e}),$$

where *R*(*Y*) denotes its revenue. Exerting effort is costly and leads to internal cost $\psi(e)$. A profit-maximizing operator determines the optimal effort level. The first order condition is given by $\psi'(e) = -C_e$, which states that the optimal effort level is chosen to equalize the marginal disutility of effort and the marginal costs savings. Let us define a specific functional form for the internal cost of effort $\psi(e) = \exp(\tau e) - 1$, where $\tau > 0$. The first order condition on the effort can then be expressed using the cost frontier and the internal cost of effort. The level of endogenous effort exerted by the operator is obtained as $e = e(\mathrm{K}, w_j, Y, \theta, \tau, \alpha)$, and is then reintroduced in the preliminary frontiers in order to derive the final structural cost frontier to be estimated:

(5) $$\ln C = \mathrm{H}_C + \xi \left[\sum_{j=1}^{n} \frac{\ln w_j}{r} + \frac{1}{r} \ln Y - \frac{\alpha_k}{r} \ln k + \frac{1}{r} \theta \right] + \varepsilon_C,$$

where H_C is a constant and $\xi = \frac{\tau}{\tau + 1/r}$. If the effort of the producer is nil, the structural cost frontier is given by the expression:

(6) $$\ln C = \mathrm{K} + \sum_{j=1}^{n} \frac{\ln w_j}{r} + \frac{1}{r}\ln Y - \frac{\alpha_k}{r}\ln k + \frac{1}{r}\theta + \varepsilon_C ,$$

Gagnepain and Ivaldi (2002b) use a database on the French urban transport services described above. The panel data set covers 59 different urban transport networks (operators) over the period 1985-1993. We stressed earlier that two types of contract are observed in practice, cost-plus and fixed-price schemes. The empirical work involves fitting the stochastic cost functions presented in Equation (5) and Equation (6) to this dataset. Under fixed-price regimes, we would estimate Equation (5), while we would estimate Equation (6) under cost-plus contract.

The estimation of the system (5)-(6) allows recovering individual inefficiency and effort indexes for each local transport operator. Table I lists the estimated technical inefficiency, effort levels and cost distortions over the frontier for the biggest networks included in the dataset. Figure 1 provides for each network, the level of the inefficiency parameter and indicates the type of contract used to regulate it. Note that three groups of networks are easily detected. The first group with the lowest levels of cost distortion gathers sixteen networks, all of which are managed under a fixed-price contract. The next twenty ones can be collected in a second group as all of them (but four networks) are regulated through a cost-plus contract. Finally the last twenty networks are assembled in a third group, almost equally shared between the two types of contract. Concerning the third group, we just conclude that technical inefficiency is so high that even a highly incentive scheme, such as a fixed-price contract, cannot cure the problem. This structural methodology has been tested successfully in other industries such as, for instance, the Norvegian bus industry (Dalen and Gomez-Lobo, 1997) or the European railroad industry (Urdanoz and Vibes, 2012).

The question of how contracts are chosen and how the information can be included in the estimation process is important and is discussed in Gagnepain and Ivaldi (2017). On the one hand, the choice of contract is 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, the authors estimate a structural endogenous switching model where the welfare expression depends on the choice of contract and vice versa. In the 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. 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 powerful incentive schemes. Simultaneously, the regulatory rule affects the operator's behavior and the operating costs in one way or another. It is shown that a simple structural cost function which does not account for the choice of contract is rejected against the political model advocated in this paper. Hence, accounting for the contract choice turns out to be adequate and fruitful, since it improves the quality of the estimates. The results suggest that ignoring the process of contract choice yields estimates that undervalue the importance of regulatory incentives for the operator's activity.

Gagnepain et al. (2013) extends this analysis into a dynamic setting. In the French urban transport industry, contracts are usually signed for 5 years periods and an extended enough database (1987-2002) allows the econometrician to observe series of contracts in the same local transport network over several periods. Interestingly, a dynamic perspective sheds light on the fact that the power of the incentives of a specific contract and the cost inefficiency type of the transport operator who chooses a specific contract are strongly related. This paper shows that very efficient firms choose series of fixed-price contract over time while very inefficient ones prefer series of cost-plus contracts. In-between, firms that are neither very efficient nor very inefficient choose a cost-plus arrangement first and switch to a fixed-price regime only if subsidies are increased.

4. Conclusion

This chapter focuses on the assessment of the impact of contractual regimes on the efficiency of public transport operators. The economic literature is almost unanimous on the fact that the incentive power of the contracts used by public authorities in charge of the organization of the service does indeed have a significant effect on the firms' costs. In particular, fixed-price contracts, which entail the highest possible incentive power, and which are very often implemented in the transport industry, are the ones that encourage operators to reduce their operating costs the most.

The issue of the measure of the magnitude of these effects remains however quite tricky to deal with since, as we have consistently pointed out in this chapter, a potential issue of selection linked to the choice of contract can create significant biases in the estimation results. The approaches used to address these biases have so far been of two types. First, in studies based on the estimation of reduced forms of cost functions, the authors choose to perform a two-step identification in which efficiency is first measured using a cost or a production frontier, and is then regressed on a set of variables that shed light on the characteristics of the productive environment. Structural studies allow integrating directly in the body of the function to estimate the structure that accounts for the contractual framework and that allows identifying the endogeneity bias.

Using incentive contracts can therefore encourage transport operators to reduce their costs. But it is also important to remember that the optimal nature of these contracts is economically guaranteed if the incentive power of each contract is adjusted to the productive efficiency of the transport operator. In other words, a fixed-price contract must be offered to a very efficient company while a cost-plus contract must be offered to a very inefficient company. Naturally, other types of contracts with intermediate incentive powers could be designed for operators characterized by average efficiency levels. The ability to design these contracts together with a good assessment of the volume of subsidies to be paid to operators (in order to avoid giving those too large rents) depends on the expertise capability of the public authorities. The role of the economist in this context is then to also encourage these authorities to equip themselves with adequate resources in order to implement the sometimes sophisticated tools proposed by economic research.

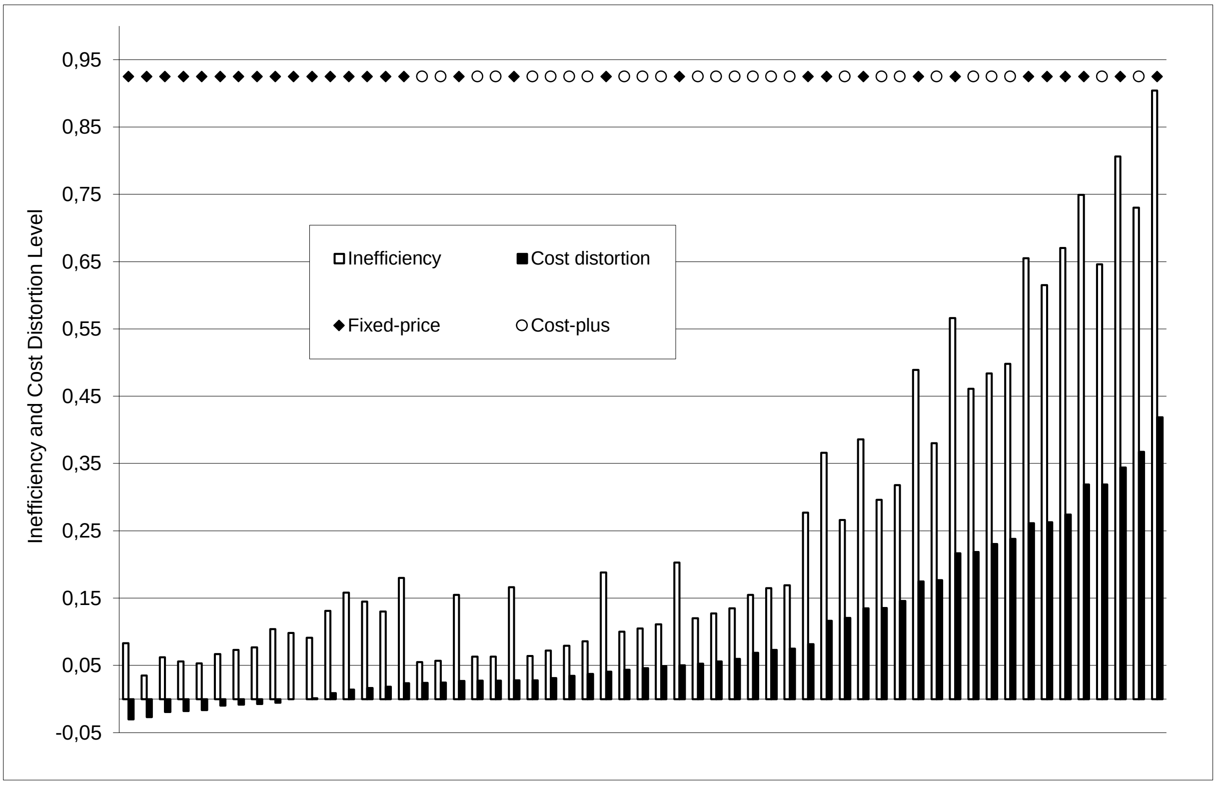
Annex

Table I: Technical inefficiency, effort level and cost distortion for some networks

Network	Technical inefficiency	Effort	Distortion
Aix	0.067	0.089	0.990
Besançon	0.318	0.000	1.153
Bordeaux	0.086	0.000	1.039
Caen	0.749	0.103	1.337
Cannes	0.646	0.000	1.337
Clermont	0.155	0.000	1.072
Dijon	0.120	0.000	1.055
Grenoble	0.083	0.114	0.986
Le Havre	0.266	0.000	1.127
Lille	0.180	0.126	1.024
Montpellier	0.131	0.110	1.009
Nantes	0.104	0.117	0.994
Nice	0.489	0.113	1.184
Nîmes	0.035	0.097	0.972
Rennes	0.484	0.000	1.243
Strasbourg	0.806	0.117	1.363
Toulon	0.064	0.000	1.029
Toulouse	0.158	0.124	1.015
Valence	0.111	0.000	1.051

Source: Gagnepain and Ivaldi (2002b)

Figure 1: Inefficiency and regulatory schemes



Note: To each network are associated three data: The inefficiency level (white bar), the cost distortion (black bar) and the type of contracts (a black diamond refers to a fixed-price contract and an empty circle indicates a cost-plus contract.

Source: Gagnepain and Ivaldi (2002b)

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