

Management mode and urban transit performance: A literature review

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Abstract

The aim of this paper is to carry out a literature review of the empirical studies that treat the efficiency of management modes in the urban public transport services (UPTS). It comes to analysing the scientific papers that sought to determine, based on frontier and econometric methods, the links between the choice of management mode and performance within the provision of UPT services. The question that these studies are trying to answer is: Does the delivery of UPT services by a private operator, leads to better performance than when a public or mixed operator provides these services?

Keywords: UPT Performance, Management Mode, Efficiency, Frontier Methods.

Introduction

As a result of budgetary constraints and social and environmental issues, the UPT sector, especially in Western countries, has undergone profound changes in governance and organization over the last three decades. These changes have led to the emergence of a variety of organizational models. The UPT research literature has been marked by several attempts to classify these models based on different criteria (Karlaftis, 2008). We retain the classification proposed by Karlaftis (2008) because it highlights the role played by the public and private sectors in the management and operation of the UPT. The latter distinguishes three basic organizational models: public monopoly, controlled competition and the open market (Table 1).

The public monopoly is the situation in which the public authorities directly provide all UPT services through a public company and prohibit the entry of competitor. The open market is the situation in which the services of UPT are provided by operators (either private or public) that are in competition. Market entry is free and subject to compliance with certain standards set by higher authorities. Controlled competition is achieved through the establishment of public-private partnerships (PPPs) which allow the transfer of the right to supply UPT services to a private operator without a transfer of ownership rights taking place. The model of controlled competition can be implemented in three ways: competitive tendering, concession and licensing.

Table 1: Main characteristics of each organizational model; by Karlaftis, 2008

| | Organizational models | | |
|-------------------------|------------------------------|--|---------------------------|
| | Public monopoly | Controlled Competition | Open Market |
| Ownership | Public | Public or private | Multiple players |
| Entrance in the market | No | Competition for the Market | Competition in the market |
| Regulation | Full | Multiple level regulation - partial deregulation | Deregulation |
| Management / Operations | Public | Public or private | Private |
| Subsidization | Always | In many cases | In some cases |

Among the criteria for distinguishing these organizational models, we found the management mode adopted by the public authorities. In this regard, public authorities can directly manage the UPT system or delegate it to the private sector (as is the case in most controlled competition regimes). In the case of complete deregulation (free market), the private sector has control over management and operations (Petkantchin, 2004).

Beyond this classical dichotomy (public-private management), some countries, notably in Europe, are experiencing a hybrid (or mixed) management mode that is represented by companies whose ownership is shared between the public and private sectors. Based on the assumptions made by the transaction costs theory concerning the governance structures properties, Baumstark et al. (2005) have highlighted this mode in the French context,

This variety of management modes has led researchers to question the relationship between management modes and the performance of the UPT. Therefore, the objective of this paper is to carry out a literature review on empirical studies treating this relationship. It comes to describe the scientific papers that sought to determine, based on the frontier and econometric methods, the links existing between the choice of the management mode and the performances in the framework of the provision of UPT services. The question to which these different studies attempt to answer is: does the delivery of UPT services by a private operator lead to better performance than when these services are provided by a public or mixed operator?

After focusing on the underlying theoretical framework of the impact of management mode on performance, the rest of the paper is organized as follows: The second section presents the concepts and methodologies for assessing UPT performance. The third section explains the methodology used to develop this literature review. The fourth section describes the main features of papers identified in this research. The last section presents the main results of the studies listed.

2.Management modes in UPT: A theoretical framework

There are several theories in the economic and managerial literature supporting the privatization, liberalization and delegation of UPT services to the private sector. These theories have been based on the idea that private management and operation are more effective than public management. The arguments of these theories are diverse:

First, the property rights theory (Alchian and Demsetz, 1973) which sought to demonstrate the superiority of private property over any other form. Indeed, in private (especially capitalist) companies, managers and employees can participate in the company capital and derive profit from it, and their salary is based on the financial gains of the company. Hence, they will be strongly encouraged to deploy more effort in their work and therefore the performance of private enterprise would be high. In

public enterprises, on the other hand, managers and employees do not obtain direct financial benefits in the case of improved organizational performance. Starting from the rationality of individuals, the effort of employees and managers tends to decrease and consequently the overall performance of public enterprise falls.

Second, the agency theory (Jensen & Meckling, 1976) assumes that the managers (agents) seek to maximize their own interests rather than the interests of their organizations and / or shareholders (principals). Therefore, the main agent problem is ubiquitous both in private and public enterprises. According to this theory, the high-performance of private companies is due to the fact that the agency problem is reduced in the latter thanks to the many means of control and motivation available to shareholders to encourage managers to maximize profitability and improve performance.

Third, the public choice theory (Buchanan, 1968, Niskanen, 1971, Tullock, 1976) explains the inefficiency of public organizations at the fact that politicians work in favor of their own interests rather than the general interest. As well as prestige and power, and, as a result, they impose on public enterprises targets that attract more electorates but are at odds with efficiency.

The arguments above, which advocate the use of private firms to provide UPT services, have been contradicted by the transaction costs theory (Williamson, 1976). Thus, when ownership and management are public, infrastructures and services are owned and managed respectively by a single entity, which relatively simplifies interactions and therefore reduces transaction costs. When it comes to delegated management to a private enterprise, public authorities faces the information asymmetry problems and the complexity of renegotiating contracts, which leads to higher transaction costs.

Given the above discussion, there is no clear consensus in the theoretical literature that private management outperforms public management. The comparison between management modes is essentially an empirical question.

3. UPT Performance: Efficiency concept and Measurement Methodologies

The evaluation of the UPT performance is commonly carried out from three different perspectives. The first perspective is based on the user's perception and satisfaction, or aspects of service, such as reliability, frequency, fares, comfort, cleanliness, etc, are noted by users through surveys satisfaction. The second perspective consists to measure the objectives achievement expected by the community in which PT is served. In this sense, the objectives of the community are mainly social and environmental nature such as mobility of aged and disabled people, accessibility of precarious people to employment, reduction of air pollution, reduction of the congestion ... etc. The third perspective is about measuring the productivity and primarily the efficiency UPT operators.

The dominance of the "efficiency" perspective relative to other perspectives in empirical research dealing with the UPT performance is justified by the development of an objective and transparent framework for measuring this aspect of performance when the other perspectives are characterized by subjectivity (De Borger et al, 2002). Moreover, in a comparative perspective between public and private operators, researchers argue that efficiency is a relevant criterion because it is an objective sought by both private and public operators, whereas the comparison on the basis of financial indicators May give biased results in favor of private operators. This is due to the fact that the main objective of private operators is to maximize profit while public operators follow a maximizing social welfare policy.

3.1 Efficiency

On the basis of Farrell's research in 1957, the efficiency measurement and the frontiers estimation have developed explosively in recent decades. The review of the literature shows several forms of efficiency. The three most commonly used are technical efficiency, allocative efficiency and scale efficiency.

First, technical efficiency reflects the operator's ability to obtain the maximum output (products or outcomes) from a given input quantity (production factors). An operator is said to be technically efficient when it is on the production frontier possibilities. That is, with a given quantity of inputs, it obtains the highest level of outputs

Second, allocative efficiency reflects the operator's ability to use inputs in optimal proportions, in terms of their respective prices. It is allocatively efficient if it is able to use the inputs in exact proportions, taking into account their cost in the market, which make it possible to minimize the total cost of production. The combination of technical and allocative efficiency makes it possible to measure the overall economic efficiency.

Finally, the scale efficiency indicates the optimal size of an organization. It refers to a possible divergence between actual and ideal production size. The ideal configuration coincides with the long run competitive equilibrium, where production is characterized by constant returns to scale. A producer is scale efficient if its choice of inputs and outputs is situated on a constant return to scale frontier; it is scale inefficient otherwise (De Borger et al., 2002).

3.2 Measurement efficiency Methodologies

In terms of methodology, researchers have recently used frontier methods, which are classified into two groups: Parametric and Non-parametric approaches. Frontier methods have been treated in detail by (Bauer, 1990, Chaffai, 1997, Murillo-Zamorano, 2004, Coelli et al, 2005) to which the reader may refer. We will therefore present Frontier methods with less technical details (see Table 2)

The Non-parametric approaches are generally deterministic and not impose particular functional form for the production frontier and are suitable for multi-inputs and multi-outputs of the study area. They estimate the efficiency scores of firms using linear and mathematical programming techniques. The most used version of this approach is the DEA (Data Envelopment Analysis) method.

Originally initiated by Farrell (1975) and developed by Charnes, Cooper and Rhodes (1978), Banker (1984) and Banker et al. (1986), the DEA method consists of evaluating the relative efficiency of all organizations, called Decision Making Unit-DMU, which are similar in terms of inputs and outputs. The technique allows to determine all the organizations located on the frontier (having an efficiency score equal to 1) to serve as a reference, from the point of view of the best practice, the inefficient organizations (having a score less than 1).

Table 2: Mathematical formulations of Frontier methods

| | Parametric Approaches | |
|--|---|---|
| | Parametric Deterministic Frontier (PDF) | Parametric Stochastic Frontier (PSF) |
| Representative model | $Y = f(x, \beta)$ - where $u \geq 0$ $f(x, \beta)$: a production function u : technical inefficiency | $Y = f(x, \beta) + (v - u)$ where $u \geq 0$; $-\infty \leq v \leq +\infty$ u : Positive component representing technical inefficiency - v : is the difference due to hazards (external factors) that influence the efficiency of the company and that are not directly under its control. |
| Farrell's efficiency measure | $\frac{y}{f(x,\beta)}$ where β is an unbiased estimator of β | $\frac{y}{f(x,\beta)+v}$ where β is an unbiased estimator of β |
| methods of estimating the unknown parameters | -The Linen programming (Aigner and Chu (1968)) -Maximum likelihood (Afriat, 1992) - Corrected Least Square (Richmond, 1974) | - Corrected Least Square - Maximum Likelihood With specification of the error terms distributions u and v |
| Nonparametric Deterministic Approach (DEA Method) | | |
| | CCR model | BBC Model |
| Linear Program - Oriented input | Min $\theta, \lambda \theta$, Under constraints: - $Y + \lambda \geq \theta$, $\theta - X \lambda \geq \theta$, $\Lambda \geq 0$. | Min $\theta, \lambda \theta$, Under constraints: - $Y + \lambda \geq \theta$, $\theta - X \lambda \geq \theta$, $N1 \lambda = 1$ |
| λ is a vector (N, 1) of constants called multipliers - X and Y respectively represent inputs outputs matrices - and θ is a scalar that represents the technical efficiency score of the ith - decision unit ($\theta \leq 0$) - $N1 \lambda = 1$ is a convexity constraint: -N1 is a unitary vector (N, 1). | | |

Table 3: Estimation models of the relationship between environmental variables and efficiency

| Models | In One-Step | In Two-Steps |
|---|--|---|
| Non Parametric Approaches (Data Envelopment Analysis) (DEA) | Integer directly environment variables in DEA models (Banker & Morey Model (1986)) | DEA + Statistics Tests (Brockett & Golany (1996); Sueyoshi T, Aoki S (2001)) |
| | | DEA + regression model (Several authors have adopted it). |
| Parametric Deterministic Frontier (PDF) | Either case 1: Consider the environment variables (EVs) as factors of production / cost, thus, they must be integrated directly within the frontier functions as explanatory variables (Good et al (1993) for the PDF. Or Case 2: Consider the VEs as inefficiencies factors thus, they must be included in the inefficiency term u as an explanatory variables (Battese & Coelli (1995) Model for PSF; Deprins and Simar (1989) Model for the FDF). | PDF+ Regression model (Several authors have adopted it) |
| Parametric Stochastic Frontier (PSF) | | PSF + Regression models (Several authors have adopted it) |

The two basic models of the DEA method and the most used in the literature are; The CCR model (developed by Charnes, Cooper, Rhodes, 1978) which assumes that returns to scale are constant. The BCC model (developed by Banker, Charnes and Cooper, 1984) which assumes that returns to scale are variable. In addition, a DEA (CCR or BCC) model can be oriented towards inputs or outputs. In an input-oriented approach, the DEA model minimizes inputs for a given level of outputs. In an output-oriented approach, the DEA model maximizes outputs for a given level of inputs. Following the notation of Coelli (1996), the linear program of each model is presented in Table 2.

Parametric approaches assume that the Frontier can be represented by a particular functional form. They are an econometric answer and use statistical estimation techniques. In addition, parametric approaches can themselves be grouped into two broad categories: Parametric Deterministic Frontier (PDF) or Parametric Stochastic Frontier (PSF)

In the case of a deterministic Frontier, all gaps to the frontier are considered to be technical inefficiency caused solely by factors which are under the control of the enterprise (or DMU). For example, mismanagement, poor technological choices or incompetent staff, etc. In addition, the model does not take into account also the observation or output measurement errors. And in response to this shortfall, Aigner, Lovell and Schmidt (1977), Battese and Corra (1977) and Meeusen and van denBroeck (1977) simultaneously developed the model of stochastic frontier Analysis (SFA). This takes into account, in addition to technical inefficiency, another random term that encompasses any errors in the observation or output measurement.

3.3 Efficiency and environmental factors

The efficiency of the operators in UPT can be influenced by several external factors that are not under the control of the managers, contrary to the inputs and outputs that are supposed to be under their control. These external factors called environment variables are for example; Management Modes, public regulation, competition, contractual arrangements, subsidy schemes ... etc. The environmental variable studied in this literature review is the variable representing "management modes".

Generally, there are two models in the literature to describe the relationship between environmental variables and operators efficiency (Table 3). The first called one-step model consists of integrating, directly, these variables into the adopted frontier model. The second "two-stage" model consists of calculating the efficiency or inefficiency scores (based on the approach taken) in the first stage and applying statistical tests or regression models in the second step according to research aims.

4. Literature Review Methodology

The literature on the relationship between management modes and UPT performance has been abundant since the 1970s. J Perry et al. (1988) have published a literature review on the researches treating, through regression methods, the relationship between organizational forms and UPT performance. They conclude that ownership and management have no effect on UPT performance.

The aim of this literature review is to analyze and present papers treating the efficiency of UPT management modes, based on frontier methods. These studies seek to compare the efficiency of private and public operators or to study the impact of

management mode on the operator's efficiency. This literature review is devoted solely to papers published in specialized scientific journals (from electronic sources).

Our references are largely derived from previous literature reviewing the UPT performance and its determinants, notably those of De Borger et al (2002), Sami Jarbaoui et al (2012) and Cinzia Daraio et al (2015). To find these papers and others, a search was carried out on the databases, ScienceDirect, SpringLink, Scopus, JSTORE ... etc, using expressions like "public-private ownership and efficiency" or "ownership structure and performance" Efficiency frontier ", " Parametric Frontier ", " Non-Parametric Frontier "and" technical efficiency ", " Transit efficiency ", " urban public transport performance ", " transit performance ", " determinants of urban transport performance "...

After the research, we collected 26 papers, 4 of which are theoretical and 2 are inaccessible. In the end, we identified 20 papers from the empirical literature whose main characteristics (context, type of data collected, methodology used, and main variables used...) are presented in the following section.

5) Management Modes and Efficiency: General Considerations

Among the 20 papers, 12 explicitly compare the efficiency of management modes while the others study the effect of the "management mode" variable, among other variables, on the UPT efficiency. The most studied forms of efficiency in these papers are technical efficiency, (in) efficiency-cost, scale efficiency.

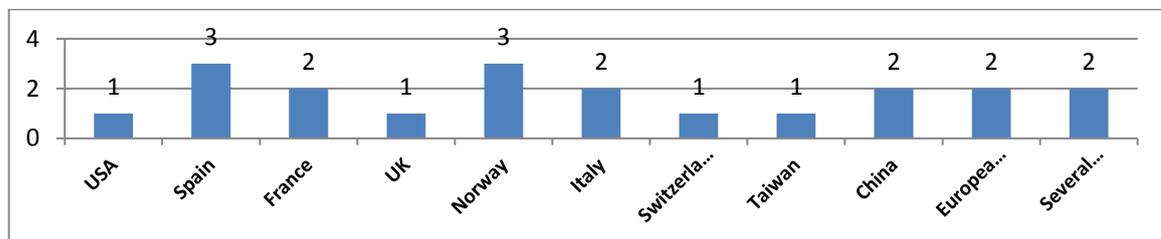


Figure 1. Number of papers by country studied

The debate on the merit of the private sector in the management of the UPT has given rise to several empirical studies exploring different contexts (Figure 1). According to the papers examined, we observe that the European context is the most studied. This is due to the fact that Europe has undergone revolutionary reforms in terms of regulation of the UPT sector. However, other countries have recently been interested in research into the efficiency of urban public transport. For example, Chang and Kao (1992) have applied their study in the Taiwanese context. Huanming Wang et al (2015) exploited data on the Chinese bus sector. Finally, other researchers like Pina & Torres (2006), Priyanka Jain et al (2008) have adopted an international comparative perspective.

5.1 Urban public transport modes

The urban public transport sector is a rather heterogeneous mix of firms, with different ownership structures; which provide services to passengers using a variety of transport modes (buses, trams, subways, etc.). In almost all countries, urban bus transport is the backbone of this sector and a vital mode for urban mobility. It's the most studied mode on the UPT performance researches. Thus, in our sample of papers, we find that 17 studies deal with of urban bus transport. Two deals with the urban railway system and another analysis all modes of public transport (Autobus-Tram-Metro).

5.2 Efficiency Measurement Approaches

Figure 2 shows the classification of papers according to the approach adopted and the technique used to measure the efficiency of urban public transport. We notice the dominance of the non-parametric DEA method. However, some studies have adopted parametric approaches, especially the SFA "Stochastic Frontier Analysis" method. Moreover, we observe the absence of studies that have adopted a mixed approach (use of DEA and SFA methods).

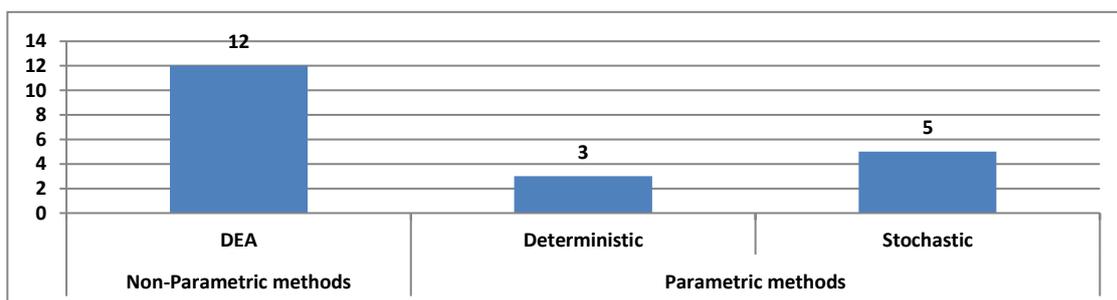


Figure 2. Number of Publications by Adopted frontier Method

5-3) Estimation models of the relationship between management mode and efficiency

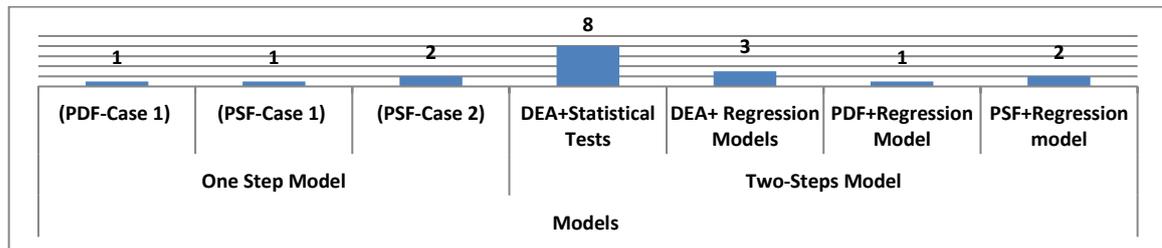


Figure 3. Estimation models of the relationship between management mode and efficiency

From the figure 3, we note that the two-steps model is the most used (13 papers) to describe the relationship between the management mode and the efficiency of the operators in UPT. 8 studies have adopted the model (DEA + Statistical tests). 6 studies adopted the model (DEA / FPD / FPS + Regression model). One-step models are rarely used (4 papers). In addition, none of the studies listed have adopted a model or the "management mode" variable is integrated in the DEA models. Thus, no study has adopted a single-step model or the variable "management mode" is included in the inefficiency term of a deterministic parametric Frontier (DPF-Case 2).

5.4 Variables and databases

De Borger et al (2002) reported in their review that an important characteristic distinguished between the identified papers is the diversity of inputs and outputs used. This diversity shows that there is no consensus on the use of well-defined inputs and outputs.

In regards to our sample of empirical studies, the most used inputs are related to capital, labor and energy. However, some authors have not used these three inputs in common. For example, Kartafllis (2009) used the capital input expressed as the total number of vehicles and the labor input expressed as the total number of employees.

In relation to output indicators, some studies used outputs oriented-supply as "vehicle-kilometers" (Kerstens, 2006, Roy and Yurande-Billon, 2007). Others preferred the use of the "place-kilometers" indicator as the most appropriate oriented-supply output (Odeck and Alkadi, 2003). Filippini and Prioni (2003) used both indicators in their empirical study.

The definition of output is indeed subject to many debates. Some authors support the use of indicators called demand-oriented output (eg the number of transported transporters or the amount of passenger-kilometers) because they are highly relevant than the so-called "supply-oriented" indicators. The main arguments in favor of the use of these outputs are cited by Berechman (1993). Thus, Fazioli et al (1993) and Huanming et al (1915) used the indicator "Number of passengers" and "Passenger-Km". Several authors, on the other hand, have used outputs that reflect both approaches (Viton, 1997, Odeck J. and O. Sunde, 2001, Garcia-Sanchez, 2008, Pina & Torres, 2006, James Odeck, G. Karlaftis, 2010, Filippini & Prioni, 2001).

Moreover, the debate on the use of oriented-demand and supply-oriented outputs gave the opportunity to propose the use of certain financial variables. These variables are more robust because they reduce the problems reflected by the use of -oriented-demand or supply-oriented output. Thus, Cowie et Asenova (1999) used "operating income" as the only output. Boitaniet al (2013) considered in their study the ratios "value added" and "total monthly sales" as outputs.

On the other hand, the nature of the data used in the literature on measuring the UPT efficiency is diversified. The review shows that the authors used two basic types of data: Panel Data (10 papers) and time series data (10 papers).

6. Key Results

This literature review presents the empirical studies that treating the relationship between management modes (public, private and mixed) and efficiency of operators in UPT. Of the 20 papers that we examined, 7 studies indicate no significant difference between management modes. The 13 studies give the advantage to private provision. None of the studies listed settle for public management.

6.1 Papers whose results favor the private management in terms of performance

Chang and Kao (1992) evaluate the efficiency of a public operator and four private operators of public bus transportation in Taipei, and find that after market liberalization in 1996, the public operator has gained technical efficiency but technical efficiency of private operators was even better.

In France, **Kerstens (1996)** analyzed the technical efficiency of 114 French operators in 1990 and notes that the private management has a positive impact, though not very strong, on efficiency. This result is confirmed by **Roy William and Anne Yurande-Billon (2007)**. The latter, by examining the effect of three management modes (public, private and mixed), deduced that private operators are more technically efficient than the public operators (public administration) and mixed companies (semi-public operators). Moreover, the mixed companies appear less efficient than public operators.

Cowie and Asinova (1999), by analyzing the deregulated market in England have come to the conclusion that public enterprises are less efficient than private firms both in technical and organizational level. In addition, they noted a high level of cost inefficiencies in the sector are due to the absence of competition and oligopolistic form that emerged from privatization.

Filippini and Prioni (2003) examine, in a Swiss context, the impact of management mode (public, private and mixed) on the cost of bus services and find that private participation enhance cost efficiency of companies ensure these services. In Spain **Gines Rus and Gustavo Nombela (1997)**, studying the impact of the privatization bus services, concluded that private operators are more cost efficient than public operators.

In an international comparative perspective, **Pina and Torres (2006)**, by comparing operators in 73 cities around the world, have concluded that private enterprises, either operating on the open market or a controlled competitive market, are more efficient than public ones. In the same perspective, **Priyanka Jain et al (2008)**, comparing 15 rail systems in the world, concluded that privatized systems show high efficiency score during the period 1992-1902 compared to systems whose proprieties are "corporatized" and public.

At the European level, **Karlaftis Matthew G. (2010)** showed, by analyzing 15 systems that regulated private operators, whatever the contract type, have a very low-cost inefficiency score compared to public operators. His results show that in the case of a net cost contract of which the operator assumes the commercial and industrial risk, the private operator has a very low cost inefficiency score 4 times than public operator. In the some context, **Boitani Andrea et al. (2013)**, by examining the panel data of 77 operators between 1996 and 1906, confirmed the hypothesis stating the superiority of private management, in terms of efficiency, compared to public management.

Elisabetta Ottoz et al 2009 state, when studying an Italian sample, that public operators are less efficient than their private rivals and the degree of cost-inefficiency increases proportionally with the size of both private and public firms.

In China and more recently, **Feifei Qin et al (2014)** compared three organizational models of urban rail transport systems namely the publicly owned-operated model, Contemporary commercialization model and Innovative privatization model. The authors concluded that the innovative privatization model (of which ownership and management are private) is the most efficient for both production and consumption at the financial and construction level. In the same context, **Huanming Wang et al (20 15)**, Comparing the bus services in 29 municipalities, have confirmed that the private management is the most efficient.

6-2) Papers whose results have conclude to no significant difference between management modes

Several authors don't find difference in terms of technical efficiency between private and public operators. Indeed, **Pina and Torres (2001)** compared the technical efficiency of the Spanish public and private operators that manage public transport and do not detect significant differences between of each others. **Garcia-Sanchez (2008)** uses a larger sample in the same context but reaches the same conclusion. In addition, **Jorgenson et al. (1997)**, using the parametric approach PFS, alleged that there is no difference between cost-inefficiencies of public and private operators. The same result was confirmed by **Odeck J. & O. Sunde (2001)** and **Odeck Alkadi J & a (2003)** using reduced sample to 47 operators and based on the non-parametric approach DEA. The authors explained this result by the absence of competition on the Norwegian market.

Similarly, **Fazioli et al (1993)** use a sample of 62 bus transport operators in the Emilia Romagna region in Italy for a period of 10 years from 1978. They do not find significant differences in efficiency between public and private operators. Finally, **Viton (1997)**, studying the efficiency of the bus system in USA, concluded that private and public operators have the same level of technical efficiency.

Table 4: Summary of empirical papers

| Reference | Research Context | Type of database | Sample Size | Estimation models of the relationship between Management modes and efficiency |
|--|--------------------------------|---------------------------|---|---|
| papers whose results favor the private management in terms of performance | | | | |
| Chang and Kao (1992) | Taiwan | PD * (1970-1988) | 5 bus operators (1 public- 4 private) | Two Steps Model : DEA + Statistical tests |
| Kerstens (1996) | France | TSD ** (1991) | 114 bus operators | |
| Cowie and Asenova (1999) | England | PD (1995-1996) | 141 bus operators | |
| Vincente Lourdes Torres & Pina (2006) | Several countries of the World | TSD (2000) | 73 City in the world | |
| Feifei Qin (2014) | China | TSD (2012) | 17 urban rail systems | |
| Gines Rus & Gustavo Nombela (1997) | Spain | TSD (1990) | 28 Bus Operators (11 public-17 private) | One-step Model : PDF (Case 1) |
| Massimo Filippini and Paola Prioni (2003) | Switzerland | PD (1991-1995) | 34 Bus Operators (4 public-8 private 22 mixed) | |
| Roy W, Yurande Billon-A (2007) | France | PD (1996-2002) | 135 Bus Operators | One-Step Model : PSF (Case 2) |
| Elisabetta Ottoz & al. (2009) | Italy | unbalanced PD (1998-2002) | 77 Operators (bus-tram-metro) | |
| Matthew G. Karlaftis (2009) | Several Europeans countries | PD (1990 -2000) | 15 Bus Systems | One-Step Model : PSF (Case 1) |
| Priyanka Jain et al (2008) | China | PD (1992-2002) | 15 urban rail systems | - |
| Boitani A, M Nicolini, Scarpa (2013) | Several Europeans countries | PD (1997-2006) | 77 Bus Operators (63, 39% public -17.39% private- 19.22% mixed) | Two-Steps Model : PSF+ regression models |
| Papers whose results have conclude to no significant difference between management modes | | | | |
| Fazioli et al. (1993) | Italy | PD (1986-1990) | 40 Bus Operators (11 public, 29 private) | Two-Steps Model : DEA + Regression model |
| Garcia-Sanchez (2009) | Spain | TSD (2008) | 24 Bus Operators | |
| Pina V, L Torres (2001) | Spain | TSD (year not noticed) | 14 Bus Operators | |
| Viton (1997) | USA | TSD (1990) | 217 Bus Operator (28 public-189 private) | Two-Steps Model : DEA + Statistical Tests |
| Odeck J. and O. Sunde (2001) | Norway | TSD (1994) | 47 Bus Operators | |
| Huanming Wang et al (2015) | China | PD (2007-2011) | 29 Municipalities | |
| Jorgensen F et al (1997) | Norway | TSD (1991) | 170 Bus Operators | Two-Steps Model : PSF + Regression model |
| Pina V, L Torres (2001) | Spain | TSD (year not noticed) | 14 Op Bus Operators | Two-Steps Model : DEA + Regression |

| | | | | |
|--|--|--|--|-------|
| | | | | model |
|--|--|--|--|-------|

* PD = Panel Data ** = TSD time series data

Conclusion

In this paper, we identified 20 empirical studies treating the relationship between management modes and UPT efficiency. Some studies have as aim to compare, explicitly, the efficiency of management Modes. Others seek to determine the effect the "management mode" variable, among other variables, on operator's efficiency. In addition, the efficiency forms that have been most studied in this work are technical efficiency, cost efficiency and scale efficiency. Methodologically, the efficiency scores are measured by frontiers methods and the relationship between the management modes and efficiency is explored through two models (see section 3). The results of these studies are divided between two opinions: Some researches find that efficiency of private management is high than public one; others find no difference between them or no significant impact of management modes on efficiency. Finally, no study favors public management in terms of efficiency.

This literature review shows that the results are always inclusive despite using frontier methods judged by some authors that offer a relevant analytical framework to assess the relative efficiency of management modes. This result in divergence is explained by the fact that most studies are unable to control the degree of competition and the nature of government regulation in the sector (De Borger, 2002). Indeed, in markets where competition is absent, the link between the management modes and efficiency could be nonexistent. This is confirmed by Fazioli et al. (1993), Jorgensen, F. Pedersen, PA, Holden, R (1997) Odeck J. & O. Sunde (2001), and Odeck Alkadi J & A (2003). Therefore, the management mode is not the most crucial factor in determining the efficiency of the UPT. Other factors appear important namely competition, the regulatory framework and the characteristics of the UPT network.

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