"Cost-Efficiency Analysis of a Regulated Public Service: the case of Regional Bus Services in Italy."

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Abstract

This paper represents an application of the so-called *evaluative* or *performance-approach* to the analysis of a regulated sector as public transport. The aim of this work is to provide more information to the debate on the privatization programmes. A translog cost function for a five-year panel is estimated and measures of economies of scale and density are derived. Indeed, from the derived cost-efficiency frontier evidence for scale inefficiency and overall cost inefficiency can be noted for 40 regional bus companies in Emilia Romagna. The estimation results allow for a discussion of inefficiency in terms of sub-optimal scale and density. Overall cost inefficiency is estimated by means of a frontier cost function. The findings emphasize strong evidence for merger policies because of too little size of actual operators and non significant difference in cost-efficiency between public and private enterprises operating in a strongly regulated sector.

This work was made during my permanence in Zurich, to the Institut fur Empirische Wirtschaftsforschung, where Dr. M.Filippini provided invaluable detailed observations. To carry our this work I utilized the general econometric package LIMDEP written by W.H.Greene (see appendix 2)

1. Introduction

In many countries, the public service sector is currently experiencing a downswing and programs of privatization are seriously advocated, if not implemented. At the same time, public enterprises which escape privatization are given much looser regimes of financial and economic regulation with emphasis on profitability, cost efficiency and competition.

These policy developments are founded on a mixed set of arguments, ranging from pure "laissez-faire" ideology to considerations of economic performance. Even if the economists could say something on the former argument, they have much to say on the latter. In particular, tehy can first define what is meant by the performances of an enterprise. Then, they can turn to the two following questions: to what extent are current privatization policies based on or ispired by actual measures of performances, and if they are not, should they do so?

Obviously, the purpose of this paper is not to tackle all these issue. My purpose is to apply a method of measuring cost-efficiency performances in a regulated sector and to advocate its adoption when deciding about forms of privatization and deregulation.

Efficiency is related to the way resources are used to pursue a pre-specified objective. Now, what are the objectives that are assigned to public enterprises or sector regulation? These objectives can be summarized under four different headings: allocative efficiency, equity, financial balance and macroeconomics. So, we cannot analise the efficiency of an enterprise operating in a strongly regulated sector by mean of profit-oriented indicators.

Among the various indicators utilized, comparisons based on minimum cost are usually utilized to study the efficiency of different operators in regulated sectors (Pestieau, Tulkens, 1990). Such comparisons are made through the estimation of an ad hoc cost-function including a dummy variable accounting for public and private property.

The perspective of multi-objective approach to the analysis of regulated sectors is strictly related to the analysis of the sources of market failure that has been justified public intervention (Vining, Weimer, 1990).

Such a policy approach has become more entrenched as governments have become not only regulators, but, also, financiers and owners of quite a few local transport companies.

The italian growth and development has been accompanied by a widespread public intervention. In particular, because of the importance of transport service to promote social and economic development and because of its peculiarities of network-based service, the specific sector regulation had been characterized by the istitution of a particular public right on the sector as a whole, called "Riserva Pubblica". It's not defining a public monopoly *per se*, but allows private and public firms to operate with a regional monopoly licence given by local authority.

Like franchising instruments, local authorities have hence granted exclusive operating rights, within their own area of jurisdiction, to different companies.

Consequently, such an authority can designs fares, routes and schedules for every franchising-operator. Such a regulation emphasizes the problems of licensing policy: indeed, the distribution of concessions implicity performs itself into particular sector structure and network attributions to every firms.

The problem of supply fragmentation is such that nearly all of the extraurban transport sectors present a considerable number of small private companies, without any operative coordination, through limitated network and levels of activities. Seem to be no cost-efficiency consideration when new concession are distributed.

The relevance of such a sector can be emphasized by some figures. On the 1989, the inter-local transport sector registered 959 companies (90 public and 869 private) with 54826 employees. The supply disaggregation is evident if we note that 448 companies have less than five employees and only 54 companies exceed the dimension of 100 employees; again, 529 companies own less than 5 bus and only 55 have more than 100 bus. Usually, public companies are bigger than Private one, indeed, only 3 Public Companies (only 3,33% of the total pubblic companies) offered less than 100.000 Autobus-Km. and 345 Private Companies (39,7% on the total private companies) are in such a cluster; on the contrary, 14 Public Companies (15,55% of the total) supplied over 100.000.000 Autobus-Km-year, but only 7 Private Companies did so.

Such a service was utilized by 1.100.756.400 passengers. 65.977 seats offered and 1.084.782.300 autobus-km. were registered by annual Transport Minister's report. The overall cost to provide such a service amount to 7.800 bilion £.

If we consider the balance-sheet of the italian bus companies we can note that the medium value of the ratio between Costs and Direct Revenue is about 4 and, furthermore, to emphasize the economic relevance of such a regulated service we can estimate the ratio between direct expenses and italian citizen amounting on 145.142 £. The effect of a strong regulation emerge at once if we compare the cost per passenger, nearly 3.747 £. on 1990, with the allowed revenue per passenger, nearly 935 £. on the same year.

Nowadays, a radical reform of public intervention (and licensing policy) is claimed, not only to redefine public-private relations, but also to improve efficiency of such an important network-based service. The need to improve knowledge about the economic aspects of italian bus transport sector is evident, and the cost structure analysis represents one of the most important step to improve efficiency of the provision of such a service.

In the economic literature, the importance of the economies of scale as a determinant of industry structure and behaviour has long been recognized. In recent years, there has been much progress in the measurement of scale economies, because of advances both in applied economics and in econometric theory. Hence, the estimation of scale economies plays an important role in the design of public policy pertaining to regulated industries.

Several studies have advocated partial or total deregulation of different utility industries, arguing that effective (or potential) competition may be both feasible and desiderable. The ultimate success of this policies will depend upon the number of (potential) firms that can efficiently compete (for) in a given market, which depends upon both the size of the market and the extent of scale economies.

The bus sector constitute an industry in which there is a spatial dimension of output. This adds another dimension to the output-efficiency relationship. In this study we consider the peculiarities of network relevance in the efficient provision of such a service; therefore economies of density will be estimated.

Recent econometric works have highlighted the importance of such a distinction between scale economies and density economies, everywhere an output is provided by network (Caves, Christensen, Tretheway, 1984; Windle, 1988; Filippini, Maggi, 1992) and at the beginning of section 2 some further aspects will be discussed.

One of the most often employed methods of measurings economies of scale takes advantages of the availability of cost data and the duality between cost and production representation of technology. Indeed, the estimation of a long run cost function allow to study economies of scale and economies of density.

To such purposes, the estimation of a flexible form of long run cost function has been required. So a translog cost function has been estimated from a five years panel data of 40 regional bus companies, the only ones for which data is completely available over the time-range considered [1].

Other than to allow for the distinction of economies of density and scale[2], it will be possible to estimate a cost-efficiency frontier, through which compare the relative efficiency of public and private companies, so to infer the relevance of property on the cost-efficiency performances. This also allows for the analysis of two different efficiency concepts, namely scale efficiency and cost efficiency. Based upon the findings concerning these different types of (in-) efficiency the policy implications in terms of mergers and changes in regulations can be discussed.

In Section 2, the distinction between economies of scale and density is further analysed and a translog cost function including the network effects is estimated for the bus companies. The efficiency issue is treated in more detail in Section 3, where the results on scale efficiency are discussed and a DOLS estimation of the cost frontier is used to measure cost efficiency. In Section 4 the findings on efficiency are discussed in the context of the Italian institutional setting.

2. The cost model for regional bus companies.

2.1 The cost function

As many empirical works do (see, Pestieau, Tulkens, 1990), let me suppose that, in a regulated sector, the minimum cost to provide a public service might represents a common ground to compare performances of public and private companies. Indeed, cost structure and production functions in public transport are well documented in empirical research (see e.g. Caves, Christensen and Swanson 1980, Gathon and Perelman 1987, Berechman 1987, Windle 1988, Thiry and Lawarree 1988).

An important distinction between *economies of scale* and *economies of density* , introduced by Caves, Christensen, Tretheway and Windle in 1985, has been applied. Because transport firms are operating different networks, an analysis of their cost structure must take account of the fact that the same output can be produced on differently shaped networks and that different outputs can be produced on the same network. In the latter case, economies of density reflect the relationship between cost and output with the network held fixed. These are to be distinguished from economies of scale which reflects the cost impact of a simultaneous change of output and network size.

Given a production function defined on a vector of inputs **I**, a vector of outputs **Y** and a vector of (technological) shift factors **T**,

$$f(\mathbf{Y}, \mathbf{I}, \mathbf{T}) = 0 \qquad (1)$$

the properties of the production technology can be inferred from the dual cost function if the production function is strictly convex in the input structure (McFadden, 1978).

$$C = c(\mathbf{Y}, \mathbf{P}, \mathbf{T}) \qquad (2)$$

In (2) **P** is a vector of input prices. The cost function (2) is homogenous of degree 1, non-decreasing and concave in the factor prices. As costs are expected to vary not only with the output size but also with the size and structure of the network, additional variables have to be included in equation (2).

Consider a bus company with two inputs, labour (L) and capital (K) which produces a single output Y on a network of size N. Network size can be defined by the lenght of the routes on the itinerary, the number of stops etc..

If it is assumed that the company minimizes the cost and that the isoquants are convex, a total cost function can be written as:

$$TC = f(Y, N, P_L, P_K, T) \qquad (3)$$

In this study, P_L and P_K stand for the prices of labour and capital, respectively.

The shift variable T is a time index, indicating besides the level of technology [3]. Technical change is therefore viewed as a time related shift of the cost function the parameter of which measures the constant annual rate of neutral technical change in the estimations presented below (for this approach see e.g. Glass and McKillop 1989).

The output Y is measured in seat kilometers, so to specify the analysis in terms of supply-side efficiency. Indeed, given the regulatory framework, there are no cost differences between an empty or full bus.

Traditionally, the level of output has been used to represent firm size in studies of industry cost and productivity. Recently, however, writers have begun to distinguish between firm size and level of output (Caves, Christensen, Tretheway and Windle, 1985). Indeed, it's particularly important to make such a distinction for industries in which services are provided over a network of geographically distributed points. The concept of firm size may be more closely tied to the size of the network and its configuration than to the output provided over that network. Thus, cost per unit of output may vary substantially among firms, depending on the nature of the network.

Introducing an indicator of the network size in the cost function together with the output is equivalent to treating this variable as output characteristic; (3) therefore represents a hedonic cost function (see Panzar 1989). Choosing this specification, a percentage change in all inputs can induce a change in output and/or in N.

The argument of the hedonic cost function constitute a central aspect of this analysis because of the fact that italian public transport regulation and route licensing put that aspect beyond the control of an individual company. Thus, it seems possible to treat such a variable as exogenous to the companies. In other words, it's reasonable to interpret the hedonic coefficient as representing technology dictated by the exogenously given network and market characteristic of the companies.

In this paper a trascendental logarithmic (translog) cost function is proposed for studying the extraurban bus costs.

The reason are twofold. First, a translog model makes possible to circumvent limitations of linear or log-linear forms (as Cobb-Douglas function); indeed, such models fail to allow for the fact that changes in various unit cost categories, because of the interconnected effects generated by increases in output, cannot be evaluated independently of other units costs (see, Gold, 1981; Button, O'Donnell, 1985). Accepting the objective of cost minimisation, then a neoclassical cost function can be employed to estimate the characteristic of the underlying production function by invoking Shepherd's duality theorem. It's a generalized function which permits to study the productive characteristics of the transport supply without imposing excessive predefined restrictions on the structure (see, Christensen et al., 1973). Indeed, a U-shaped curve is usually assumed, but since neither slope nor minimum are restricted, any shape of curve can be approssimated. Secondly, the trascendental logarithmic (translog) cost function permits the detailed examination of density and scale economies for different levels of firm's size.

Using a translog function [4], (3) can be approximated by the following second-order approximation at an arbitrary point (the median point, in this case), to produce a (total) minimum cost function [5]:

$$\ln TC = \alpha_0 + \alpha_Y \ln Y + \alpha_N \ln N + \alpha_L \ln P_L + \alpha_K \ln P_K + \frac{1}{2}\alpha_{YY}(\ln Y)^2 + \frac{1}{2}\alpha_{NN}(\ln N)^2 + \frac{1}{2}\alpha_{LL}(\ln P_L)^2 + \frac{1}{2}\alpha_{KK}(\ln P_K)^2 + \alpha_{YN}(\ln Y)(\ln N) + \alpha_{YL}(\ln Y)(\ln P_L) + \alpha_{YK}(\ln Y)(\ln P_K) + \alpha_{NL}(\ln N)(\ln P_L) + \alpha_{NK}(\ln N)(\ln P_K) + \alpha_T T \quad (4)$$

To improve the efficiency of the estimation process, we will append, as is common practice, the factor share equations derived by appling Shephard's Lemma to (4). Note that there is only one linearly indipendent factor share equations since total share for all two factors must sum to unity.

Linear homogeneity in factor prices is imposed on the cost function by the restrictions

$$\sum_i \alpha_i = 1 \;;\; \sum_i \alpha_{ij} = \sum_j \alpha_{ij} = 0 \;;\; \sum_i \alpha_{Yi} = 0 \;;\; \sum_i \alpha_{Ni} = 0 \qquad \text{where } i,j = L,K. \quad (6)$$

In the approximation point, defined by the vector 0 = (Y^*, N^*, P_L^*, P_K^*), the parameters of the function assume the following interpretation (Nastrop, 1986, p.110):

α_0	*total cost corrispondingly to the point of approximation*
α_Y	*cost elasticity respect to the output*
α_N	*cost elasticity respect to the hedonic output characteristic (N)*
α_L,; α_K	*cost elasticity respect to the factor price (P_L; P_K)*
α_{YY}	*changing of the cost-output elasticity respect to change in output*
α_{NN}	*changing of the cost-network elasticity respect to change in network*
α_T	*traslation of the cost function due to neutral technological progress as the time go on*

2.2 Economies of density and scale

The inclusion of an indicator of the network size allows for the distinction of economies of density and economies of scale. Economies of density (ED_{TC}) are defined as the proportional increase in total cost resulting from a proportional increase in output, holding all input prices and the network size fixed. This is equivalent to the inverse of the elasticity of total cost with respect to the output (Caves, Christensen and Swanson 1985) :

$$ED_{TC} = \frac{1}{\frac{\delta \ln TC}{\delta \ln Y}} \quad (6)$$

We will talk of economies of density if ED_{TC} is greater than 1, and accordingly, identify diseconomies of density if ED_{TC} is below 1. In the case of ED_{TC}=1 no economies or diseconomies of density exist. Economies of density exist if the average costs of a bus company decrease as output increases through higher frequency of bus services on the existing itinerary, as well as denser seatting is put forward.

If not only the output but also the network size N is adapted to a change in the inputs, economies of scale occur. Here, economies of scale (ES_{TC}) are defined as the proportional increase in total costs brought about by a proportional increase in output and in the indicator of network size, holding all other factors constant. Hanoch (1975) showed that such a concept of returns to scale yield a measure of Elasticity of Scale at every minimum cost point in the input space along the expansion path (and not along the ray starting from the origin, unless the production function is homotetic). But it's the change of (ES_{TC}) along the expansion path which determines the shape of the average cost curve, and which is therefore relevant for the analysis of firm and industry behavior.

Economies of scale (ES_{TC}) can thus be defined as:

$$ES_{TC} = \frac{1}{\frac{\delta \ln TC}{\delta \ln Y} + \frac{\delta \ln TC}{\delta \ln N}} \qquad (7)$$

Again, we will speak of economies of scale if ES_{TC} is greater than 1, and accordingly, identify diseconomies of scale if ES_{TC} is below 1. Economies of scale are absent if average cost remains constant when a bus company increases the lenght of the network whithout changing the traffic intensity on its network.

2.3 Data and variables

For estimation has been used panel-data for five years (1986, 1987, 1988, 1989 and 1990) on 40 bus companies operating in the region of Emilia Romagna. All data was taken from the Emilia Romagna regional transport statistics.

Total cost is taken to be the total of expenditures of the bus companies. Output is measured in seat kilometers. The majority of the studies on cost structure in transport (for an overview see Gathon and Perelman 1987) use passenger and ton-kilometers as the two outputs in multi-product framework. Because the bus companies only provide passenger transport, there is no scope for a multiproduct approach. While the use of passenger kilometers is common, this ouput indicator is affected by demand-side effects. Therefore, it is used here only for the estimation of the cost function in order to allow for comparisons with other studies on the subject. For the analysis of efficiency, we will rely in this study on the estimations based on the seat kilometers which is a pure supply indicator (see for the same approach Thiry and Lawarree, 1988 and Filippini, Maggi and Prioni, 1992). The use of passenger kilometers may lead to identification problems and can seriously hamper the results. It is not evident why cost should depend on the number of passengers on a bus - running an empty bus is not cheaper than running a full-one. Cost savings could be achieved by not supplying bus services at times of low demand. But this is difficult given the Italian regulation which obligates bus companies to provide regular services. Therefore, in this study, the cost is conceived to be induced by the rolling capacity in terms of seat kilometers being provided regularly.

The prices of labour is taken from the statistics as the outlay for a factor divided by the quantity consumed. Capital price is calculated from the capital costs divided by the capital stock. Capital cost is the sum of Ammortizations, Interests paid and others costs for Capital maintenance. The capital stock is simply measured by the number of buses owned and operated by a company. Unfortunately no data is available which would allow to calculate the capital stock, using the capital inventory method.

As an indicator of the network size we use the lenght of the routes (see Caves et al. 1985). The use of this indicator can be criticised because it does not take account of the network structure. A possible solution would be using a dispersion index from the graph theory which contains information on the size and structure of the network (see Filippini 1991, Filippini and Maggi 1991). Table 1 gives some details on the variables and their values for small, medium and large sized bus companies.

To include demographic and spatial configuration of networks, a proxi like mean commercial speed was tested, but important correlation problems arose and no improvement was reached.

Table 1: Description of variables

Variables	*Symbol*	*Unit of measure-ment*	*1. Quartile (small)*	*2. Median (medium)*	*3. Quartile (large)*	*4.Max Values*
Total Cost	CT	Mil. £.	106.93	204.14	574.83	46'510,00
Labour price	P_L	£.for worker unity	29'847'140	40'496'173	46'565''104	56'579'115
Capital price	PC	£.for capital unity	4'974'692	9'907'681	14'294'162	314'960'000
Capital	C	N° of buses	2	4	9	230
Output	Y	Seat-km	4'036'248	18'366'432	123'690'000	142'300'000
Network	N	Lenght of Network	21	34	42.5	67,6

By using the indicators just described the total cost function is estimated.

As a standard practice, the cost and share equations are estimated simultaneously using Zellner's (1962) Seemingly Unrelated Regression technique.

2.4 Estimation results

Estimation results and economies of density and scale in the case of total cost using the data and variable specifications described above are given in table 2. This table contains only the first order coefficients. The full regression results are presented in the appendix. Since total cost as well as the dependent variables are in natural logarithms and have been normalised at the mean data point, the second-order coefficients can be dismissed for the interpretation of the elasticities and the cost economies at the median point. Thus the first order coefficients are interpretable as cost elasticities evaluated at the sample median.

The results are satisfying in so far as all coefficients, with exception of the shift variables, that are significant and carry the expected sign. As can be seen from the full results presented in the appendix, the corrected R^2 is also satisfying with values around 0.95.

At the median, the cost elasticities with respect to factor prices are equivalent to the cost shares. Hence, labor accounts for 80% of the costs of an average bus company while capital for the remaining 20% of costs. Interestingly enough the share of labour is the same as in the case of bus companies in Switzerland (see Filippini, Maggi and Prioni, 1992).

As could be expected, the influence of the network length on cost is positive. The cost elasticity is 0.20. It's interesting to observe that this cost elasticity is of the same order of magnitude as in the case of the Swiss and US Bus Industry (see Windle, 1988; Filippini, Maggi and Prioni, 1992).

The shift factor for time is not significant , indicating that no neutral technical change is present in the five-year period.

Table 2: Estimation results for the total cost function - first-order coefficients and indicators for economies of scale and density.

Variables	*parameter (t-values)*
output	0.3828
(Y)	(23.491)
price of labour	0.8085
(P_L)	(35.644)
price of capital	0.1915
(P_K)	(8.449)
lenght of network	0.209
(N)	(2.199)
time trend	0.0211
T	(0.835)
ED_{TC}	2.61
ES_{TC}	1.70

The results indicate further that important economies of scale and density are present in the production of the Italian regional bus companies. Such a result is very important from the point of view of overall regulation and organization of the sector: as we'll discute in the last section, strong evidence to merger policies can be emphansized.

3 Efficiency of the Italian Regional Bus Companies

In this section, a closer look is taken at the estimation results as far as efficiency is concerned. Basically, two different approaches to efficiency are used. The first one is given simply by discussing the above results on economies of scale and density in order to identify efficiency. Scale efficiency indicates the degree to which a company is producing at optimal scale. Frisch (1965) defines the optimal scale as the level of operation where the scale elasticity is equal to one. In the present context, economies of scale and density are distinguished. Hence, efficiency can be defined in terms of scale and density. In order to have a better idea of the effects, Table 3 presents the results for small, medium-sized and large companies, respectively.

A first glance at the results in Table 3 reveals that all the values of the indicator for economies of scale and density are greater than 1 which means that significant increasing returns to scale and network density are observed at all data point. ED_{TC} and ES_{TC} range, respectively, between 2,64 and 2,11 for the small companies to 2,47 and 1,68 for the larger companies. Thus, it's possible to argue that Italian bus companies operate at an inappropriately low scale and density level and/or face insufficient levels of demand, perhaps because of the concurrence of others vectors (railways services, private cars and so on).

Furthermore, we can observe that all cost economies indicators decrease with increasing size, hence, the importance of scale and density economies is decreasing with size.

With respect to the intensification of operation it must be noted that in reality, the demand met by these bus companies is often very limited and hence an intensification strategy might not be the best option.

Table 3: Economies of scale and density for three groups of bus companies [6].

	Economies of density	Economies of scale
small	2,64	2,11
medium sized	2,61	1.70
large	2,47	1.68

The finding clearly indicates a potential for a merger policy. Only the largest companies operate at a reasonable level of activity. Without giving a detailed description of the situation it can be said that in our sample we find several constellations of bus companies where mergers would be feasible.

To do an example, it's possible to calculate the level of cost saving that can be derived from merger and acquisition policy.

Held costant the price system (in the third example of merger we have consider also change in factor price because to strong increase in post-merger dimension of firm), we can compute the total cost savings of a few new efficient firm constituted by a lot of private small local firm, operating on the same provincial district.

District Merger	N° of Firms mergered	Output aggregated	Cost Savings
PC	5	59.084.237	25,11%
RA	4	88.125.324	38%
FO	12	157.336.370	34,33%

The above results for the scale efficiency will now be compared to the performance of the bus companies in terms of cost efficiency. Following Kopp and Diewert (1982), who extended Farrel's (1957) concept of efficiency to flexible and non-homothetic cost functions, an overall measure of cost efficiency may be defined as:

$$CE = \frac{C_F(Y, N, P_L, P_K, t)}{C_{Observed}} \qquad (8)$$

where CE is the indicator of cost efficiency and C_F is the estimated frontier cost function. This approach to efficiency results from an indicator which measures both allocative and technical efficiency. The indicator evaluates the actual cost of a firm by comparing it to the estimated frontier cost. The indicator thus takes the value of 1 for the most efficient company. A frontier cost function must be estimated from the actual data. This can be done by different approaches. A good overview is given by Thiry and Tulkens (1989). Among the methods they distinguish, the displaced ordinary least square (DOLS) approach is used in the present study. This approach has first been proposed by Greene (1980).The method consists in adjusting the constant term of the estimated cost function in a way which allows all observations to lie above or on the frontier and at least one observation lies on the frontier. This is done by adjusting the constant term using the negative OLS residual with the highest absolute value. Greene (1980) has shown that the resulting constant term is consistent but biased and of unreliable efficiency.

Table 4 : Cost efficiency indicator for public and private firms in 1990

Firms	Efficiency-index	Firms	Efficiency-index	Firms	Efficiency-index
1 Public	0.9650	15 Private	0.9459	29Private	0.9463
2 Public	0.9738	16 Private	0.9707	30Private	0.9542
3 Public	0.9610	17 Private	0.9424	31Private	0.9504
4 Public	0.9738	18Private	0.9508	32Private	0.9404
5 Public	0.9673	19Private	0.9308	33Private	0.9520
6 Public	0.9679	20Private	0.9519	34Private	0.9397
7 Public	0.9459	21Private	0.9291	35Private	0.9481
8 Public	0.9420	22Private	0.9568	36 Public	0.9862
9 Public	0.9497	23Private	0.9339	37Private	0.9247
10 Private	0.9557	24Private	0.90	38Private	0.9782
11 Private	0.9647	25Private	0.94	39Private	0.9386
12 Private	0.9474	26Private	0.9757	40Private	0.9522
13 Private	0.9693	27Private	0.9056		
14 Private	0.9509	28Private	1		

Performing this analysis resulted in efficiency indicators varying between 0.78 for the least efficient and 0.99 for the second most efficient company over the entire range of observations.

Once we analized the cost-inefficiency coefficients respect to all companies and all observed years, a classical problem of property rights theory put itself forward. In a regulated context as Public Trasport Sector, is there some relation between degree of cost-efficiency and characteristics of property on the assets? Briefly, are Public Companies less efficient respect to Private ones?

For this purpose, we calculated the correlation coefficient between the indicator of the cost efficiency (CE) and a dummy-variable for the ownership. This variable takes the value of 1 if the company is public and 0 if the company is private. The value of the correlation coefficient indicates the irrilevances of ownership respect to inefficiency (r=0,05).

Indeed, the absence of effective competition and the strong regulation of behaviours, give no rise to important differences in efficient incentives between Public and private operator.

4. *Conclusions*

The conclusion consist of a brief discussion about the implication of our finding for a reform in public transport policy.

This paper discussed efficiency in the context of the Italian regional bus companies. For this purpose, a cost function was estimated for a sample of 40 of these companies over the period 1986-1990. By introducing an indicator for the network size (N) in the cost function it has been possible to derive indicators for scale efficiency and density efficiency. An additional measure for efficiency was gained through the calculation of a frontier cost function and the calculation of an overall cost-efficiency index.

The first interesting result of this study indicate that there exists no difference between the public and the private enterprises in the italian regional bus industry, in terms of cost efficiency. So we confirm the convinction sustained by a moltitude of empirical works (see table C in the *appendix*) on the field of public service supply (see, Pestieau, Tulkens, 1990).

The above conclusion is confirmed by the analysis of correlation existing between (CE_i), the estimated coefficients of Cost-Efficiency for every i-th bus company, and the nature of property (Public/Private), the Capital/Labour ratio and the total revenue and the intensity (hours) of bus utilization during every observed year (IBU).

Variables	*Symbols*	*Correlation with CEi*
Public Property	PP	$r^{CEi}_{PP} = 0{,}068$
Capitl-Labour ratio	K/L	$r^{CEi}_{K/L} = 0{,}189$
Total Revenue	TR	$r^{CEi}_{TR} = 0{,}212$
Intensity of Bus utilization	IBU	$r^{CEi}_{IBU} = 0{,}282$

While the above conclusion on cost efficiency are of some interest, it should not be forgotten that in the given context of small bus companies, the question of the optimal scale is much more relevance.

Based upon the estimation of the cost function we can see that the majority of the bus companies are not operating at an optimal scale. That claim for an urgent reform of policy licencing, so to induce important mergers between small and medium companies.

This paper concludes that, to develop transport policies promoting efficiency, more emphasis should be put on promoting concurrence-for-the-market (competitive auction for the licence) and merger policy.

In presence of persistent economies of scale, traditional economic theory held that such a characteristic requires a strong entry and price regulation to achieve an acceptable outcome in terms of social welfare (Scherer, 1980). Indeed, according to the traditional perspective we are in front of a natural monopoly. But the recent analysis of Contestability theorists (Baumol, Panzar, Willig, 1982) challenges the traditional position. They develop a model of "*for-the-market-competition* " based on the effectiveness of potential competition, not only the actual one. Such a model is characterized by declining unit costs and show that there are conditions under which such a market will produce socially desiderable results, even if only a few efficient producers effectively operate. Two conditions that are sufficient for such an outcome are: first, the contestability of the market and the total flexibility of every assets, and second, the existence of a sufficient magnitude of fixed (but not sunk) costs, so to obtain strong decreasing of unit costs respect to market extent; that to exclude problems of monopoly's sustainability.

If such conditions will be satisfied, we can think to exploit technical efficiency (economies of scale and density) without loss on social welfare. If all this will be the case, we cannot need to traditional regulation, even because deregulation can induce a process of efficient mergers between small and medium operators so minimize production costs and, consequently, to supply services at an optimal scale of activity.

A new policy regulation of public sector emphasizes the necessity of a re-design of the aspects of accessibility to the network: the network is inherently a public good utilized by private firms in mutual competition. Such a competition can be improved through the implementation of some forms of concorrence-for-the-market (competitive auction is a good example). In such a case, the new role of public authority will be to coordinate the ex-ante competition, to design efficiently that single licensing network and to enlarge the number of effective potential competitors.

Finally, as Douglas, Caves and Christensen (1988, p.4) emphasize, the persistence of unexploited economies of scale and density can also be explained by insufficient demand or concurrence by other vectors (railways and private cars). Thus, the peculiarities of transport sector pose the question of coordination between different vector of human transport: railways, bus and private car must be seen as complementar factors to improve general efficiency.