Subsidies, Political Control, and Costs of U.K. Urban Bus Provision

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ABSTRACT

In this paper the impact of three aspects of public policy--levels of subsidy, objectives of controlling political authority, and central government's decisions regarding the appropriate scale of local operating units--on the costs of providing urban bus service in the United Kingdom is examined. A cross section of operations is surveyed by using standard econometric procedures and data for the financial year 1979-1980. Several alternative specifications are employed to test the sensitivity of the analysis to the implicit underlying economic assumptions of different model frameworks, and a wide variety of variables is incorporated to normalize across operations. The general conclusions are that public policies of the kind examined do, to differing degrees, exert an influence over the costs of public bus service provision.

Urban bus transit subsidies have risen substantially in recent years. In most countries the rise has been both in absolute terms and as a proportion of overall transit operating costs. The extent of the rise has varied enormously across countries. Countries such as the United States and France have tried to restrain fare increases below their prevailing levels of inflation with the consequential upward drift in subsidy support. A few countries, such as the United Kingdom, have increased subsidies in real terms, because the absolute costs of bus operations have risen faster than the average cost index, but because of government policy, which caused fares to increase broadly in line with the rate of inflation, subsidies as a proportion of costs have not risen so dramatically (1).

One of the main difficulties with providing urban public transit, and a major contributor to the recent rapid rise in costs, is the inherently technologically unprogressive nature of the industry (2). Essentially, there is only limited scope for altering the method of supplying a service by substituting cheaper inputs in place of other inputs where costs change. The particular problem has been that labor costs have tended to rise more rapidly than the costs of other inputs in a situation where manpower is a major component of the production process. The scope for replacing labor by other factors of production is limited.

Equally, on the revenue side, the changing composition of urban areas in which there is a gradual outflow of residents from the core, or inner city, has meant that for social and land use planning reasons many urban authorities have been reluctant to initiate a fare increase (even to cover the rising costs of supply in most countries other than the United Kingdom). This has been coupled with the use of public transport policy as an instrument of traffic management; it has been seen (at least by its advocates) as a second-best strategy for attracting potential motorists away from private automobiles, especially at peak commuting times.

Although these types of situations have something of a universal nature, the actual control and regulation of urban bus transit and the nuances of subsidy policy tend to be specific to individual countries. The central government in the United Kingdom, for example, has tended to exercise much stronger controls over subsidy policies at the local urban level than has been the experience of the United States, at least until recently.

In the U.K. Transport Supplementary Grant system, although local governments are given a high degree of flexibility in the way they use centrally allocated funds, the system still permits the national government to monitor and regulate expenditure at the urban level. Indeed, in the past funds have been withheld when a metropolitan area attempted to indulge in what the central government deemed a policy of excessive bus service subsidization. The system of cash/limits and more recently rate capping also provides control over, respectively, the expenditures of local government from the general support grants from the exchequer and the extent to which local property taxation may be increased. The legislation of the late 1960s [most notably the 1968 Transport Act and the 1969 Transport (London) Act] and the early 1970s (especially the 1972 Local Government Act) provides a framework of checks and balances that has been used, on occasion, by local groups to limit urban authorities' expenditures on bus provision, for example, the legal rejection of the "Fares Fair" transit subsidy scheme proposed by the Greater London Council in 1982.

Despite the fact that by international standards the level of subsidies enjoyed by urban bus operations in the United Kingdom is comparatively low (Table 1), there is still a growing concern about both their efficiency and their long-term funding. The concern may be specifically attributed to a number of factors. First, the absolute level of subsidies is seen as high by the central government, especially in the context of the overall macroeconomic philosophy of the Conservative administration with its focus on low public borrowing and taxation. Second, although there are central controls on local expenditure, there is still concern about their effectiveness. The debate is partly political, because many urban areas are controlled by Labour local governments, but it also proves to be much wider than a simple concern over transport subsidies, embracing an entire range of issues surrounding local

TABLE 1 International Comparison of Levels of Urban Transport Subsidy for 1977 *(3)*

Country	Subsidy (% of costs)	
	Small Towns[a]	Large Towns[b]
Australia	48	29
Canada	37	26
France	26	55
Netherlands	57	67
Sweden	25	41
United Kingdom	14	21
United States	24	26

[a]Population < 400,000.
[b]Population > 400,000.

autonomy and accountability. Transport is, given the powers vested in local authorities, a not insignificant component in these controversies.

The most important practical manifestion of future change here is likely to be the reformation of the metropolitan tier of local government in the major conurbations (and, in the longer term, the possible removal of the higher tier). There is thus likely to be a need to redefine responsibilities for urban transport finance. Finally, there is a growing interest in the overall efficiency of the urban transport system and, in particular, whether subsidies may result in reduced efficiency (which usually involves arguments couched in terms of X-efficiency as well as allocative efficiency). The question of privatization of certain urban rail services and of profitable, nationally owned interurban bus operations has led to consideration of possible extensions to the urban bus sector. Reports by the Monopolies and Mergers Commission (4) and the House of Commons Select Committee on Transport (5) have also highlighted broader matters of efficiency. The culmination of these debates was the publication in 1984 of the white paper Buses (6), which set out official proposals to initiate franchise bidding for many urban routes with free market conditions prevailing over much of the system.

The aim of this paper is to examine some of the more objective elements of these debates and to introduce a degree of quantification into what has often been essentially a qualitative series of arguments. In particular, the impact of subsidies and the attitudes of the local authority on the costs of providing urban bus services are examined.

There is mounting (although not yet conclusive) evidence from U.S. econometric studies that subsidies do ultimately lead (other things being equal) to higher costs of service provision (7-12), whereas cost savings may well come from leaving the supply of urban bus service to private companies (7,8,12, 13). Statistical analysis along these lines is generally lacking in the United Kingdom, in part because of inadequacies in both the coverage and reliability of data but also because, given the comparatively recent upsurge in concern over the levels of subsidy, more attention has been paid to devising methods of subsidy allocation.

Three specific (although interrelated) questions are addressed. First, is there any evidence that U.K. areas adopting high subsidy policies have experienced higher levels of cost than other areas? Second, does the political composition of the controlling authority (which, one assumes, reflects priorities and objectives) influence the costs of bus transit supply? Finally, is there any evidence to suggest, from the point of view of cost minimization, that the existing size of bus operations is optimal or should policies be adopted for their reorganization?

APPROACH

The econometric analysis required to answer questions of the foregoing type necessitates the specification of an appropriate cost function and its subsequent estimation. A number of fairly sophisticated frameworks have been developed in recent years [e.g., the transcendental logarithmic cost models (14-16), which permit a high degree of generality in the underlying assumptions required], but for reasons set out in the following discussion, a rather more traditional approach is favored here. [In fact, the data used have been subjected to a translog modeling study, but because of the nature of the data available, this only really proved suitable for analyzing the functional form of the cost equation and not for testing policy sensitivity (17).]

In this paper the emphasis is on simple linear and log-linear models, which, in economic terms, correspond to production functions of the Leontieff and Cobb-Douglas types, respectively.

The linear framework has been widely used in U.K. urban bus transport cost studies (18,19) and simply involves regressing costs against a set of explanatory variables. The linear nature of the model implies a so-called Leontieff technology with a zero-factor elasticity of substitution (i.e., one cannot substitute, say, capital for labor if the cost of the latter rises). Such a framework would seem to offer a general approximation to the technologically unprogressive nature of the bus industry mentioned earlier. Because estimation can, in most circumstances, be conducted by using ordinary least squares, this facilitates easy computation. These factors combined with the ease of parameter interpretation and the previous use of the model in U.S. work (9) suggest that some guidelines as to the sensitivity of costs with respect to transport policy may be forthcoming.

Given the need to hold nonpolicy effects constant in the analysis, the following general form of model would seem to be recommended:

Cost = f (size of operator, factor prices, homogeneity of services, physical and traffic environment, financial motivation, political control).

Although a linear regression framework of this kind has much to recommend it, there are, nonetheless, potential weaknesses. In particular, the model form tends to be intuitive in its formulation, although the exact acceptance of parameters tends to place reliance on statistical significance. Also the assumption of zero elasticity of factor substitution may be seen as extreme. An alternative model is the Cobb-Douglas function, which has been widely used in U.S. studies of bus costs in the context of both urban (20) and interurban (21) operations. This model has its weakness (as discussed in the following) but retains the advantages of relative ease of interpretation and computation.

The Cobb-Douglas specification (22) takes the following general form:

$$Y = a x_1^{\alpha_1} x_2^{\alpha_2} x_3^{\alpha_3} \quad (1)$$

where Y is output and $x_1 \ldots x_3$ are three factor inputs (say, labor, capital, and fuel). The total cost function is, therefore,

$$TC = P_1x_1 + P_2x_2 + P_3x_3 \quad (2)$$

where $P_1 \ldots P_3$ represent the factor input prices.

Equations 1 and 2 are solved for each input (x) to obtain the demand equations for each. Thus,

$$x_1 = K_i Y^{1/r} [(P_1^{\alpha 1/r} \cdot P_2^{\alpha 2/r} \cdot P_3^{\alpha 3/r} \cdot v)/P_i] \quad (3)$$

where

$$r = \alpha_1 + \alpha_2 + \alpha_3,$$

$$K_i = \alpha_i \, (a\alpha_1^{\alpha_1} \, \alpha_2^{\alpha_2} \, \alpha_3^{\alpha_3})^{-1/r}, \text{ and}$$

$$v = a^{-1/r}.$$

Substituting Equation 3 into the production function (Equation 1) and manipulating yields the total cost function:

$$TC = KY^{1/r} \, P_1^{\alpha 1/r} \, P_2^{\alpha 2/r} \, P_3^{\alpha 3/r} \quad (4)$$

where $K = K_1 + K_2 + K_3 = r \, (a\alpha_1^{\alpha_1} \, \alpha_2^{\alpha_2} \, \alpha_3^{\alpha_3})^{-1/r}$.

For estimation purposes the Cobb-Douglas function is conveniently linear in logarithmic form. In this case the exact specification employed follows that of earlier U.S. work (20), which is partly determined by data availability but also influenced by the potential for making useful comparisons. The basic operational form is, therefore,

$$TC = KY^{\beta_1} \, P_L^{\beta_2} \, P_F^{\beta_3} \, B^{\beta_4} \quad (5)$$

where the subscripts L and F relate to labor and fuel, respectively, and B is fleet size (as a proxy for capital). The linear form becomes

$$\ln TC = \ln K + \beta_1 \ln Y + \beta_2 \ln P_L + \beta_3 \ln P_F + \beta_4 \ln B + e \quad (6)$$

To introduce policy variables into this cost-minimizing framework requires that certain assumptions be made regarding their probable impact on cost structures. In this case they may be viewed as factors influencing the production technology employed, that is, as shift variables. Essentially, therefore, an attempt is made to see whether the short-run cost function is shifted (either up or down) as a result of subsidization, and so on. This does not mean a deviation from the idea of cost minimization per se on the part of management but an exploration of whether the nature of the activities of bus operations is so affected by subsidies, the political composition of the controlling body, and so on, that costs are significantly increased or decreased.

The Cobb-Douglas formulation, therefore, provides a hypothesis to be tested that is derived directly from microeconomic theory. The limitation to be borne in mind is that an implicit assumption of the Cobb-Douglas model is that the elasticity of factor substitution is unity, which, if bus transport is technologically unprogressive, cannot hold. Essentially the Cobb-Douglas model assumes complete ease of introducing more of a cheaper factor input if the costs of other inputs increase. There are arguments against this, however, which would seem to offer some justification for empirical analysis with this model form. There is scope in many instances for an urban bus operation to adjust relative factor inputs in the face of input cost variations by policies of rerouting and rescheduling. In other cases changes in operating practice (e.g., one-man operations or automatic fare collection) may provide greater flexibility than is often claimed.

THE DATA

There is no easily accessible national data source in the United Kingdom providing the type of information required for a detailed statistical examination of the sensitivity of urban bus costs to urban policies. This study relies heavily on a specific data base employing information collected by Higginson and White (23) with adjustments and additions made where helpful. The full data matrix covers a period of 8 financial years (1971-1972 to 1979-1980) and embraces 44 district council bus operations in England and Wales, 3 Scottish regional council fleets, 7 Passenger Transport Executives (PTEs), and London Transport. The data provide information for each operation in terms of physical measures (e.g., fleet size and patronage), financial variables (e.g., fuel costs and fare base revenue), and indicators of the local operating environment (e.g., population served). To this was added supplementary geographical information extracted from standard official sources.

The actual variables employed in the linear model are given in Table 2 together with the notation adopted. Although most of the variables are self-explanatory, one or two comments appear appropriate. The data are for a 1-year cross section--the financial year 1979-1980. The large number of missing cells for the earlier years of the data series precluded pooling over the full decade, and no useful purpose would have been served by pooling for the short period 1977-1978 to 1979-1980. Given the differing nature of the broad groupings of undertakings and the differing environments and legal frameworks under which they operate, dummy variables were introduced to see whether these factors significantly affected costs of provision. Scale is reflected in two different ways. The number of bus miles is introduced to reflect a genuine scale effect in the sense of magnitude of operations and potential costs savings resulting from this, whereas the number of buses is examined to see whether there are economies associated with the sheer size of operations.

TABLE 2 Variables and Notation

Variable	Definition
Dependent	
TC	Total operating costs per bus mile (pounds per 1,000 bus miles)
Independent	
X_1	Annual bus miles (million miles)
X_2	Buses
X_3	Bus miles 1980/bus miles 1979
X_4	Labor costs (thousand pounds per employee)
X_5	Peak/interpeak bus output
X_6	Acres per population served
X_7	Percentage of two-man operations
X_8	Miles per bus
X_9	Deviation from mean fuel cost per 1,000 bus miles (pounds per mile)
X_{10}	Bus miles per staff (1,000 bus miles per employee)
X_{11}	Takes value of 1 for districts; otherwise 0
X_{12}	Takes value of 1 for Scottish regions; otherwise 0
X_{13}	Takes value of 1 for PTEs and London Transport; otherwise 0
X_{14}	Takes value of 1 for Conservative-controlled area; otherwise 0
X_{15}	Takes value of 1 for Labour-controlled area; otherwise 0
X_{16}	Percentage of total revenue coming from subsidies
X_{17}	Passengers (1,000s)
X_{18}	Staff
X_{19}	Population served (1,000s)

Although a limited amount of analysis is possible on the determinants of various cost components (e.g., traffic operating costs; management, welfare, and general costs and servicing; repairs and maintenance costs), the attention here is focused on total operating costs per bus mile. [Details of results obtained at a more disaggregated level, in which costs are broken down into their various components, are to be found elsewhere (24)]. Costs and other variables are normalized by bus mileage to reduce statistical problems of heteroscedasticity.

RESULTS

Leontieff Technology

In Table 3 the results are given of a number of runs in which the simple linear framework was used. A number of simple transformations were also examined and several of these are included. In general a stepwise regression approach was adopted to sift through for significant variables, although where it was believed that a variable was likely on strong a priori grounds to influence costs of bus service provision, this was forced into the regression. All the policy-sensitive variables reflecting subsidies, political control, and size or scale of operations were examined both in the context of the stepwise procedure and by being forced either individually or in combinations into the regression.

Models 1 and 2 represent results with no attempt to reflect policy factors other than scale of operations. As can be seen, slightly more than 70 percent of the variations in total operating costs can be explained by variations in a limited number of independent variables. Model 1 offers a quadratic form (i.e., nonlinear), which provides a good fit to the data based on labor output and population served. Costs rise (as one may expect, given the network spread effect) with population served. Costs rise initially with staff employed after an initial fall (i.e., $X_{10} < 0$; $X_{10}^2 > 0$). This may seem rather perverse but is not inconsistent with early work in the United Kingdom (17) explained in terms of the catch-all nature of the variable. Model 2 provides a variation by including labor costs (the stepwise regression being tested with no transformations), which offers intuitively more satisfactory results. Operating costs rise with labor costs and population served but fall (i.e., $X_{10} < 0$) with increased labor productivity.

A key point in both of these simple models is that both the scale variable (X_1) and the size variable (X_2) prove insignificant statistically, which suggests that in these simple specifications there is no evidence that the size of operations pushed up costs.

Interestingly, the dummy variables reflecting the nature of operations (e.g., district council or PTE) proved statistically insignificant in the calculations. Further, additional regressions based only on the sample of district council bus operations proved very similar in their nature to those for the full set of bus fleets. This would appear to suggest that the differing remits under which the various forms of urban bus providers operate have no significant impact on their costs.

Models 3 to 5 introduce the subsidy and political control variables into the analysis. Equations 3 and 4 simply involve introducing X_{16} into the stepwise procedure to examine the extent to which operating costs are affected by levels of subsidy. (Again this was done with and without the inclusion of transformations.) The subsidy variable proves statistically significant. Interpretation is not simply, however, in the single-equation framework. Of course, one explanation may be that high subsidies induce laxity in management and this in turn leads to higher costs of provision. Alternatively, however, the reasons that subsidies are provided may well be influenced by the costs of provision of bus services in various cities; operations in high-cost areas are provided by funds to compensate them for their inabilities to raise revenues through the fare box. Whereas such variables as peak- and off-peak service, population served, and so on, attempt to reflect these cost variations, they are unlikely to do so perfectly. Only a comprehensive equation system beyond the scope of this study could shed light on the exact direction of causation.

Model 5 embraces both the subsidy variable and the political control dummies [in the latter case only the Labour control (X_{15}) and the Conservative control (X_{14}) were included; other authorities, i.e., no overall control or control by another party, were omitted from the procedure]. The two political control dummies do not perform well when included in tandem but provide consistent results when introduced separately; the Conservative control dummy yields negative coefficients consistently and the Labour control dummy is associated with positive coefficients. (Model 5 simply shows the case of the inclusion of the Conservative control dummy.) Of course, the simple interpretation of this is that Labour control means (other things being equal) that the costs of providing urban bus services will be

TABLE 3 Results from Linear Equation Models

Independent Variable	Dependent Variable[a] by Model (pounds per 1,000 bus miles)									
	1		2		3		4		5	
	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio
Constant	2,150.3		1,442.3		2.046		1,354.5		1,436.7	
X_4			44.95	2.43						
X_5							49.84	2.76		
X_8									-0.017	4.02
X_{10}	-203.3	3.71	-77.22	8.46	-186.2	3.31	-72.32	7.90		
X_{10}^2	7.622	2.53			6.884	2.25				
X_{13}									154.6	1.99
X_{14}									-32.29	1.02
X_{16}					1.16	1.23	1.905	2.09	1.68	1.28
X_{18}					0.039	3.05			0.049	1.95
X_{19}	0.040	3.08	0.045	3.57			0.041	3.35	-0.176	1.42

Note: Definitions of variables are shown in Table 2. R^2 for the models is as follows: Model 1, 0.703; Model 2, 0.701; Model 3, 0.706; Model 4, 0.719; Model 5, 0.531.
[a]Operating costs per bus mile.

higher than they would otherwise be, whereas Conservative control means that they will be lower. Several qualifying points must, however, be made.

First, the level of significance of the political control dummies is poor; they had to be forced into the stepwise regression, indicating that the statistical foundations of this conclusion are tenuous. Second, the introduction of the political control dummies generally reduces the absolute t-ratio associated with the subsidy variable (X_{16}) and results in smaller coefficients, which indicates potential problems of multicollinearity. Finally, the point needs repeating that the analysis is based on single-equation models and thus simultaneous equation bias may be exerting an influence (e.g., Labour authorities may be elected in areas where, for a variety of reasons, there is a desire on the part of the electorate to have high-cost urban public transport).

Cobb-Douglas Model

The Cobb-Douglas calculations essentially involve employing regression procedures to estimate the parameters of Equation 6 and those reflecting policy effects (the latter being entered directly into the otherwise log-linear specification). The main findings are shown in Table 4 where the notation is as given earlier with the addition of S for subsidy level, PE for the peak/off-peak ratio, PC for a dummy reflecting political control by the Conservative Party of the local administration, and D for the urban population residential density. Both the dependent variable, total operating costs, and the independent variables are divided through by bus mileage per operation to minimize potential problems of heteroscedasticity.

The actual data base employed in these calculations relates solely to the 44 district council bus fleets. This is because they offer a more homogeneous set of undertakings and avoid possible distortions due to extreme observations. (Examination of the full data base produces broadly identical results, but London Transport in particular tended to be an outlier.) The sample is also large enough to facilitate sensible estimation.

The introduction of subsidies into the specification seen in Equation 8 provides the parameters of Model 1. Subsidies would appear to push up costs (S is significant at the 90 percent level), but the model is not entirely satisfactory given the sign and level of significance of the price-of-fuel variable (P_F). Model 2, therefore, excludes P_F. [Interestingly, the rather perverse P_F has proved equally problematic in U.S. studies of a similar nature (20).] In practical terms, although the overall model is more satisfactory, the exclusion of P_F makes little difference to the sign or level of statistical significance of the subsidy variable.

The fleet-size variable (B) is significant in both equations and takes a positive sign, indicating the existence of negative scale effects. This result differs from the findings of the linear model but may, in part, be due to the rather smaller range of variables employed. Indeed, as may be seen in the following discussion, the addition of further variables reduces both the size of the parameter (slightly) and the degree of statistical significance.

Model 3 introduces both a fuller range of variables to reflect the nature of the conditions under which the various operators provide bus services and also the political nature of the responsible authority. The results are clearly similar to those obtained from the linear models; subsidies tend to correlate with higher costs of provision, whereas Conservative-controlled urban areas have, other things being equal, lower costs of provision. The parameters are, however, not statistically significant at the 10 percent level, so once more caution must be exercised in placing excessive weight on the findings. Further, the adjusted coefficient of determination ($\bar{R}^2$) suggests that the addition of the three variables does nothing to enhance the explanatory power of the model.

CONCLUSIONS

In this paper an attempt has been made to use available U.K. data to examine the impact of a number of policies on the costs of providing urban bus services. Two modeling approaches are examined: one is essentially empirical in its underlying basis, whereas the other is more directly derivable from standard economic theory. In general the approaches yield broadly similar conclusions, although the statistical strength of the policy-sensitive variables is sometimes rather weak.

Broadly, costs of urban bus services would appear to be higher in those areas where subsidies are greater and where the Conservative Party does not have control of the responsible local government. There is limited evidence of scale economies from the data, which suggests that administrative reorganization of bus operations to change the scale of operations either upward or downward is not really justified by the analysis. [A caveat is that this type of result obtained from U.S. studies employing methods similar to those used here has subsequently been reworked with translog cost functions and dis-

TABLE 4 Results from Cobb-Douglas Model

Independent Variable	Dependent Variable[a] by Model					
	1		2		3	
	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio
Constant	1.561		1.530		1.573	
ln Q	-0.034	0.69	-0.035	0.72	-0.041	0.81
ln P_L	0.729	7.05	0.730	7.15	0.741	6.79
ln P_F	-0.008	0.15			-0.019	0.32
ln B	0.183	2.21	0.181	2.24	0.180	1.81
S	0.281	1.43	0.283	1.46	0.228	1.07
PE					0.001	0.01
PC					-0.028	1.20
D					-0.009	0.32

Note: R^2 for the models is as follows: Model 1, 0.756; Model 2, 0.762; Model 3, 0.746.

[a]Log of total bus operating costs per bus mile.

economies of scale have emerged. A similar reworking of this data set (17) produced identical results, although the conclusions regarding subsidies, and so forth, proved robust.]

Of course, evidence of higher costs of service provision is not in itself necessarily a bad thing. Demand factors may, for example, mean that higher costs are associated with greater benefits with resultant enhanced net benefits, demand here being viewed in a social sense rather than the more traditional economic idea of effective demand. Similarly, costs may be higher because working conditions and methods of labor payment push them up. Although in one sense this may be viewed as inefficient, in another sense an enhanced working environment may in itself be seen as an additional cost that society ought to bear. The conclusions reached previously, therefore, should be seen in this wider context of a cost-benefit assessment and as only contributing to one side of the equation. In the past, however, there has been a tendency to focus on the benefit side in the United Kingdom to the almost total neglect of costs and efficiency.

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REFERENCES

1. R.L. Oram. Peak-Period Supplements: The Contemporary Economics of Urban Bus Transport in the UK and USA. Progress in Planning, Vol. 12, 1979, pp. 81-154.
2. W.J. Baumol. Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis. American Economic Review, Vol. 57, 1967, pp. 415-25.
3. R.B. Reid. Subsidies in British Transport. Transport, Sept.-Oct. 1983, pp. 20-21.
4. Bristol Omnibus Company Ltd., Cheltenham District Traction Company, City of Cardiff District Council, Trent Motor Traction Company Ltd. and West Midlands Passenger Transport Executive: A Report on Stage Carriage Services Supplied by the Undertakings. HC 442. Monopolies and Mergers Commission, London, 1982.
5. The Efficiency of British Urban Bus Operations. HC 127 (3 vols). House of Commons Select Committee on Transport, London, 1982.
6. Buses. Cmnd 9300. Department of Transport, London, 1984.
7. S.C. Anderson. The Effect of Government Ownership and Subsidy on Performance: Evidence from the Bus Transit Industry. Transportation Research, Vol. 17A, 1983, pp. 191-200.
8. J. Pucher and A. Markstedt. Consequences of Public Ownership and Subsidies for Mass Transit: Evidence from Case Studies and Regression Analysis. Transportation, Vol. 11, 1983, pp. 323-345.
9. J. Pucher. A Decade of Change for Mass Transit. In Transportation Research Record 858, TRB, National Research Council, Washington, D.C., 1982, pp. 48-57.
10. J. Pucher, A. Markstedt, and I. Hirschman. Impacts of Subsidies on the Costs of Urban Public Transport. Journal of Transport Economics and Policy, Vol. 17, 1983, pp. 155-176.
11. J.E. Sale and B. Green. Operating Costs and Performance of American Public Transit Systems. Journal of the American Planning Association, Vol. 1, 1977, pp. 22-27.
12. J. Bonnell. Transit's Growing Fiscal Crisis. Traffic Quarterly, Vol. 35, 1981, pp. 541-556.
13. B.P. Pashigan. Consequences and Causes of Public Ownership of Urban Transit Facilities. Journal of Political Economy, Vol. 84, 1976, pp. 1239-1259.
14. P.A. Viton. A Translog Cost Function for Urban Bus Transit. Journal of Industrial Economics, Vol. 29, 1981, pp. 287-304.
15. J. Berechman and G. Guiliano. Analysis of the Cost Structure of an Urban Bus Transit Property. Working Paper UCl-1TS-SP-82-3. Institute of Transportation Studies, University of California, Irvine, 1982.
16. M. Williams and A. Dahal. Estimation of the Elasticities of Factor Substitution in Urban Bus Transportation: A Cost Function Approach. Journal of Regional Science, Vol. 21, 1981, pp. 263-275.
17. K.J. Button and K.J. O'Donnell. An Examination of the Cost Structures Associated with Providing Urban Bus Services in Britain. Scottish Journal of Political Economy, Vol. 32, 1985, pp. 67-81.
18. N. Lee and I. Steedman. Economies of Scale in Urban Transport: Some British Municipal Results. Journal of Transport Economics and Policy, Vol. 4, 1970, pp. 15-28.
19. S.J. Wabe and O.B. Coles. The Short- and Long-Run Costs of Bus Transport in Urban Areas. Journal of Transport Economics and Policy, Vol. 9, 1975, pp. 127-40.
20. M. Williams. Firm Size and Operating Costs in Urban Bus Transportation. Journal of Industrial Economics, Vol. 28, 1979, pp. 209-218.
21. F.D. Fravel. Returns to Scale in the US Intercity Bus Industry. Transportation Research Forum, Vol. 19, 1978, pp. 55-560.
22. M. Nerlove. Estimation and Identification of Cobb-Douglas Production Functions. Rand-McNally, Chicago, Ill., 1965.
23. M.P. Higginson and P.R. White. The Efficiency of British Urban Bus Operations. Research Report 8. Polytechnic of Central London Transport Study Group, 1982.
24. K.J. Button and K.J. O'Donnell. The Determination of the Costs of Urban Bus Operations in Great Britain. Occasional Research Paper 71. Department of Economics, Loughborough University, England, 1983.

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