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AN INVESTIGATION INTO THE PROBLEMS OF USING
TRANSPORT COSTS AS THE BASIS FOR PRICE
DETERMINATION

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Introduction :

Increasing competitiveness in transport has stimulated debate regarding the principles which should guide the determination of the prices of transportation services. A central issue in the debate is whether particular rates should be cost or market oriented. This paper examines such issue. It sets forth the role of cost in pricing and in so doing shows that prices must be both cost and market oriented.

Examining first the basic cost concepts, and then problems involved in cost determination and assignation ; the analysis concludes that the marginal cost provides the valid cost guide for the minimum procing, and that fully distributed costs must be rejected as an economic test of any particular price or rate. The value of the service, on the other hand, provides the proper guide for the upper limit of pricing. These conclusions are reached by reference to the interest both of the pricing carrier and of society as a whole, and they have the same force and relevance of pricing within as among modes of transport..

COST CONCEPTS

The relationship of costs to output and prices is one of the most important factors affecting the behavior of business, and is one of most significant aspects of price theory. Management must constantly keep costs in mind in making its decisions, because it is the marign between costs and income which costitute the profit which business seeks to obtain.

Costs of transport may placed into three broad categories according to the way they are related to varying rates of traffic or to different units or groups of services that are produced, or to the period of escapability. In the first catagory the costs are classified as fixed and variable, in the second, they are specific and joint or commons in the third category they are short run and long run costs.

(a) Fixed versus variable costs :

Fixed costs ,which are sometimes called overhead costs, constant or indirect costs, are those which are independent of the volume of traffic and are essentially costant over a period of the time. Consequently, the average fixed-cost per unit of output will decrease as the output for the period increases.

As ovrhead- costs are not directly related to the value of output, their apportionment poses a problem and this problem takes different shapes with regard to the different modes of transportation. This is largely because of the variation in the amount of fixed investment among the transportation modes, and the difference in the technical nature of their equipment and its active life(1).

The overhead or constant costs may, in general divided into three margin groups, Firstly, there are general overhead costs of managment and administration. Secondly, there are the costs of manning terminals and depots. Thirdly, and perhaps the most important are the track or highway costs. Track costs should include the costs of providing and maintaning the permanent way in addition to the cost of singalling.

Variable costs constitute the second type that is related to the rate of traffic. These costs, which sometimes called direct costs or out of pocket expenses fluctuate directly with an increase

or decrease of traffic. For given production period, the variable costs constitute the controllable part of the costs of production, for they can be discontinued with shutdowns. A large part of the movement and handling costs are variable costs(2). A large part of the costs of labour and raw meterials, for example, are variable costs. Depreciation that is the result of use is also variable. A large part of maintenance and repairs falls in the same category.

Fully Distributed Costs : The full distributed cost refer to the total of fixed and variable costs and include all items of costs that can be arbitrarliy allocated with particular transportation service.

(b) Joint and Common Costs :

Just as some costs are related to the rate of traffic while others are independent of it, so some costs are attributable to specific units of traffic, while others are not. Most transport firms produce more than one service. When this is the case, there will be costs incurred specifically for each of the services and therfore are directly traceable to those services. These are known as specific costs. under such circumstances, however, many of the costs of services are not specifically incurred for a particular service. These are known as joint and common costs.

Costs are joint when the creation of one service unaviodably results in the output of another(3). The usual example quoted is of a service operated between A and B in which the traffic from A to B is permanetly in excess of traffic frim B to A, which may even be zero. Some, or all, of the vehicles used to provide the A — B service will therefore return empty. If there were no traffic from A to B the cost of the B — A journey would be easly escapable or aviodable It is inescapable only in the sense that it is a joint cost with the running of the A — B service and such joint costs only be escaped if niether service is provided.

Another extremely important example of joint costs refers to depreciation in the sense of amortization (or capital recovery) payments. Capital assets are durable and have a use which exetnds over several periods of time. During each time period the asset should earn a surplus of revenue over operating costs but the surpluses in each period will only be equal in the special case where the demand for the asset is in stationary equilibrium. The surplus more likely to vary from one period to another as conditions change. In periods when demand is low, it will probably earn little, if any, surplus, while during periods of peak demand, it will probably earn a very high surplus. The only criterion is that the sum of these surpluses, when discounted at the oppropriate social rate of interest, should equal the intitial capital cost of the asset. Under these condition, the cost of the asset is only attributabls to the periods when it is earning a surplus. The only condition the operator has to meet is that these surpluses, when added together, should be sufficient to cover the entire cost of the asset. Before an asset is bought or replaced, the operator must therefore decides, in the light of expected demand, on the asset's capacity to earn surpluses during each period of its operation. These surpluses, can then only be avioded in one period if they can be earned in another. Amortizaiton payments are, therefore, only inescapable in one period in the sense that they are joint costs with other periods.(4)

Common Costs refer to cost categories relating to a set of different outputs. For example, expenditures on the maintenance of railways track serve both rail freight and passenger operations are often considered a common cost of both services. Common coste, therefore, must be apportioned to various services.(5) Attempting to asses the cost relationships for way maintenance, howeever, is an acute problem common to almost to all forms of transportation with the exception of pipeline transportation. The

complexity of assigning maintenance costs of railways to different classes of freight classes of freight and passenger services is matched in the road section by the problem of allocating road maintenance costs to different classes of traffic, such as private motor car, light truck or heavy truck. The line drawn between joint and common costs is fine and often subject to debate and both costs may be present at the same time. (6)

(c) Short-run Versus long-run marginal costs :

Although there a whole range of marginal costs, depending on how far ahead one looks, economic theory usually distinguished between short-run and long-run costs in the following ways : short-run costs refer to costs associated with the use of the existing capital assets, long-run costs cover their existing use as well as their eventual replacement(7).

Short-run merginal cost coincides with average variable cost whenever the latter is constant. Economic theory suggest that short-run marginal cost diverge sharply from the average variable cost whenever the latter is showing an upward or downward trend. Empirical cost studies, which have been made in various industries, indicate that the average variable cost is constant throughout a firms normal operating range and rise only in the range near full capacity. Consequently, in these industries the producer can use his variable cost as an estimate of marginal cost as long as he stays within normal operating limits.(8

Difficulties Of Ascertaining Precise Costs :

Although it is desirable to base prices on precise and total economic costs for the attainment of the efficient utilization of economic resources, the ascertainment of precise production cost of

transportation is surrounded by many difficulties which make the attainment of such goal almost impossible. Firsts the units of output in transportation such ton-kilometer, passenger kilometer, are not uniform. A ton of freight differrs from another in bulk, fragibility, perishability, method of packing and handling.

Commodities that are bulky in relation to their weight take up more space than whose density is high, commodities that are fragile are more costly to handle than those that are sturdy, perishable commodities need special cars and equipment in addition to speedy serviceces which add too, to its costs. Second, costs of tranportation differ according to the size of shipment. When commodities are carried in volume, costs may be lower due to more economical loading and handling. Third, the cost of different hauls may vary. The cost of carrying freight can be divided into terminal costs and line-haul costs. Since terminal costs do not vary with the length of shipment they are as high for short hauls as for long haul. Line haul costs, however, are higher for short hauls since they are often involve fewer cars per train, more frequent stops and poorer loading. It follows that, per mile costs decline with the distance traveled,(9) Fourth, peakness in traffic is another factor affecting the costs of service, commodities that move in steady volume throughout the year cost less than those that move during peak seasone. Since the capacity of the carrier is set to handle peak traffic, it follows that during the offppeak season equipment may be idle or underutilized.

Fifth. The inherent characteristic of transportation enterprise, such as railways, which incurs heavy investment before the traffic takes place-high fixed cost in proportion to the total cost-makes it difficult to ascertain before hand the share of each unit of service in fixed costs. It may be argued however that since the railways have fixed cost known in advance why cannot they allcate it

among the units of output. It is indicated however, that the allocation may be possible and the average may be known after the traffic had been ascertained not before it has been moved. Finally, the problem of ascertaining precise costs is further complicated by joint and common costs. These cannot be allocated rationally to particular product or service. True joint costs require that the joint products be forthcoming in fixed proportion and that there cannot be variations in the proportions resulting from varations in the costs. To the extent that variability in proportion is impossible, there is no way the joint costs can be traced to individual services. Common costs as already noted, are outlays devoted to either of two or more classes of services(10). The proportion of the different classes of services may be varied frequently over a wide ranges with the variation of costs. This makes it possible in principal at least, to trace them to individual services.

The practical consequence is that joint costs are not traceable to individual services and can be allocated only arbitarly. In contrast. common costs are traceable in principal, though it may be impossible - over a wide range, to do so in practice.

Economical pricing Reflects Costs :

The main factors affecting the costs of transportation and contributing to the uncertainty in deciding upon the precise costs of the unit of service have been clarified. The above discussion has indicated that the segregation of joint and common costs between particular classes of traffic, and the allocation of indirect or fixed costs are by no means easy problems to solve and they have not been completely solved even today. The only costs that can be precisely ascertained at particular time are variable costs that are specific. These however, form only the minimum basis upon which decesions can be made.

Fixed costs, because the amount of them is invariable for a given period of production, as noted, will be incurred whether there is any output or not. They will not therefore enter into the decision of management on how much to produce, because they are independent of the decision. The problem is to recover as much of fixed costs as possible from the sale of products. In other words, the economical thing for a transport firm to do is to ignore its fixed costs when deciding on its production and pricing policies. They, therefore play no part in calculation of precise or minimum pricing. A firm can exercise control over its variable costs and it is on these costs that its decisions for a given production will have to rest. If sales will only just cover the variable costs, the decision whether to produce is really a matter of indifference, but if sales will more than variable costs, then the economical decision will be to undertake production, because the difference between the sales price and variable costs will contribute toward the covering of fixed costs. In other words, if the firm act economically it will not consider fully distributed costs or total costs in making its decisions. Average total unit costs are not therefore, bench mark for policy decisions, because for a given period the variable costs are the only conrollable element in them, the fixed costs are inescapable for the period, regardless the volume of output.(11)

Average variable costs and average total can be ascertained for the units of a homogenous output. These average are not oblainable when joint and common costs are present, since there is no rational method of allocating these costs as has already been noted. To the extent that they are part of fixed costs it is not possible to ascertain the precise fixed cost per traffic unit. To extend that they are part of variable costs, it is not possible to obtain the precise variable costs. The only precise cost that can be ascertained for a particular traffic unit is the specific variable cost. This sets

the minimum price below which the enterprise cannot afford to sell. In other words, the marginal(12) cost of the specific service is the decisive one for decision making purposes. This does no determine what the price will be. It merely sets the minimum which should be accepted if the higher one cannot be obtaines.

Value of Service And Price Determination :

The transportation enterprise may be considered as a multiple product one, in which the products number in the thousands. This is so because a considerable amount of commodites are transported between hundred of fifferent points. The demand schedule for moving X from A to B may be quiet different from demand schedule for moving y bet ween the same points, and the demand schedule for moving x from A to B may be quite different from the demand schedule from moving it from A to C or A to D. For purposes of rate making, therefore, the demand for transport service should be analayzed in terms of the movement of particular commodity between specific points. It is in connection with such movement that we encounter the phrase «the value of the service», which marks the upper limit of freight charge. If more than this is charged, the traffic will not move(13).

The transportation enterprise rarely attempts to charge the entire value of the service on each commodity or haul. The valu of the service sets the upper limit boyend which the traffic will not move. Average variable cost or marginal cost, on other hand, fix the lower limit below which the rate must not fall, a fully discussed above. But where, between the upper and lower limit, will the rate be fixed ? The answer is summed up in th phrase, charging what the traffic will bear or what the market will bear. In essence this means that some commodities or hauls may bear charges that can be explained neither by assignable cost nor by joint costs. The nonallocable costs mainly fixed and joint costs are apportioned on the basis of what the market is willing to contribute or on how much the protential buyer of the service values

(14). To be more precise charging what traffic will bear means charging the rate on each commodity, in such a way which, when the volume of traffic considered, will make the largest total contribution to overheads and other nonallocable costs.

The prnicipal of charging what the traffic will bear can be easily represented by the following diagram.
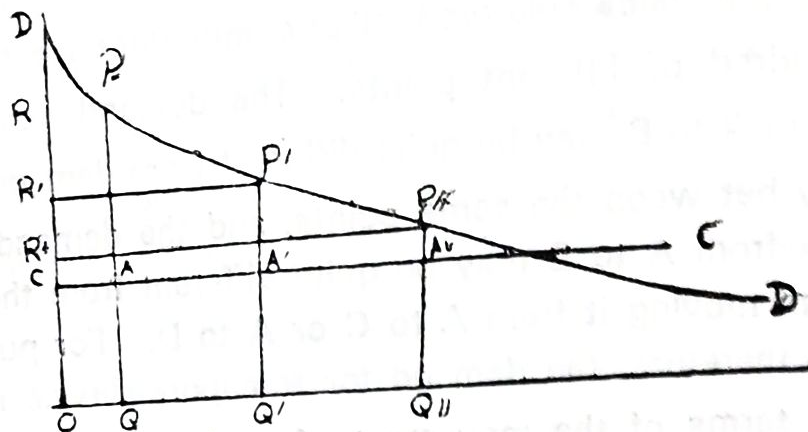
Suppose in the above figure that the line DD represents the demand curve for the transportion of acertain article. Let the line CC represent the cost curve. This will be a horizontal line because we are here concernd not with total costs but with variable or direct costs and these costs are the same per unit regardless the quantity shipped(15. If the rate OR is charged the gross revenue will be represented by the area ORPQ, the direct costs by OCAQ and total contribution to nonallocable costs (mainly overhead and joint costs) by the area CRPA. If a low rate OR" is charged the total contribution will be CR" P" A". But somewhere between these two extremes, say the rate OR', the contribtion to overhead and other nonallocable costs will be the largest.

It should be noted that freight rates on high value commodities represent a small precentage of the selling price, and high rates tend not to affect the movement of the goods. For bulky and heavy commodities, freight rates represent a substantial percentage

of their selling price. Therefore, if rates are too high, these goods will never move. Shippers obviously cannot afford to pay the carrier a rate higher than is justified by the higher price of the commodities in one place over another.

Charging what the market will bear although practiced by the railway since the beginning of its operation, have been severly criticized. The most common criticism is that the low rates on low-grade traffic result in higher rates on other traffic. The low grade traffic, it is alleged, is subsidized by higher rates on high grade traffic. The favored consumer is considered parasitic on other consumers. If a wants a thing says one writer «There is .... no reasonable excuse for refusing to let him have it and it is perfectly inequitable to charge him more than its cost in order that a different thing may be furnished at les. than cost to some one else»(16). And as to preffered low-grade traffic the same writer says : «Traffic which will not bear the cost of carrying it ought not to be carried. its owners have no vested right to live at other people's expenses, and that is what happens if they pay only part of the cost of their service while the utility collects the rest from other». It is clear that the writer quoted believes that the low rates on some traffic throw the burden on other traffic. Of course, it is true that the low rates on some traffic is carried at less than average cost, some must be charged more than average cost. But the implication that the low rates on some traffic mean that other traffic must be charged more than it otherwise would have been is entirely erroneous. If the distinction between constant and variable expenses has been fully grasped, it will be apparent that preferential rates relieve ratre than increase the burden on other traffic if two conditions are fulfilled. These are (1) that the rate must more than cover the direct costs and (2) that the traffic will not move at higher rates. When these conditions are fulfilled preferential rates are of benefit to all concerned.

After the advent of motor transportation and the improvement in water transportation, competitive condition influenced the demand for transportation. The value of service is thus limited by competition of other carriers. The value of service principal, how-

ever, is still applicable to extent it determines the upper limit of changes beyond which the traffic is not able to move or will not move. The lower limit of the rate came to be the costs which would be incurred if the traffic is taken or would not be incurred if it is refused. These are the variable costs as defined above. Thus through the application of the value of service principle the transpartation carriers are able to recover not only the variable costs associated with the traffic, but also non allocable costs such as overheads, through the differentiation in their pricing practices. Greater elasticity of demand for the services tends to push prices of services down but not below the relevant varibale cost however, When the demand of service is relatively inelastic, because of the ability to pay for the service or the absence of a substitute carrier, price of services tend to go up, but under the ceiling of the value of service (17).

Conclusion :

The foregoing analysis shows that prices of transportation services must be both cost and market oriented. Pricing decisions should be based on the costs of the service on the one hand and on the value of service on the other, to the exetent that the minimum price a carrier may offer is one which should cover at least the average variable costs associated with the traffic.

Fully distributed costs, derived by apportioning unallocable cost have no economic significance in determining the menimum of prices.

Pricing below average variable costs assoicated with the traffic may lead to losses and waste of ecomic resources and may be harmful not only not to transport industry, but, above all it is not in the interest of the society as a whole. The upper limit or the ceiling of the service price will be the one above which the particular traffic will not move. This would come about through differential pricing according to the value of the service. This pricing system has the virtue of encouraging the utilization of fixed capital, the costs for which are sunk, and at the same time permit

ting full or maximum coverage of the overhead costs. Moreover, under such a system there will be no room for destructive com- petition between carriers, or cross subsidization of services within the same enterprise and after all there will be no waste in economic resources. The adoption of such a pricing system will thus serve both the interest of the carriers and that of the society as a whole.

The proportion of revenue which the non-scheduled service is higher than that is to be accepted.   (Op. Cit. P. 56 - 57).

(3)   I.G. Heggie op. cit. P.89 - 90.

(4)   A.W. Lewis. Overhead Costs, Allen & Unwin, London, 1949, pp 11 - 43.

(5)   D.F. Pegrum op. cit. P.P. 90 - 106.

(6)   Op. Cit. P. 100.

(7)   Munby, Transport, Middlesex, England, Penguin Book, 1968, P.P. 68 - 69.

(8)   Tibor Scitovsky, Welfare and Competition, George Allen & Unwin, London, 1971, P. 351 - 54.

(9)   C.R. Philips. The Economics of Regulation, R.D. Irwin, Illinois, 1969, P.P. 311 - 12.

(10) D. Munby Op. Cit. P.P. 118 - 119

(11) J. Heggie Op Cit. P.P 69 - 71.

(12) Marginal cost equal to variable cost whenever the latter is constant. Such equality occurs as long as the carrier stays within normal operating limits. This issue is discussed above. (See short run versus long - run marginal costs section).

Notes And References

(1) D.F. Pergum, Transportation Economics And Policy, R.D. Irwin, Illinois, 1973, P.P 153 - 56.

(2) I.G. Heggie, Transport Engineering Economics, Mc Graw Hil, London, 1977.
The proportion of variable cost for non-sheduled service is higher that that it is for scheduled. (Op. Cit, P 56 - 57).

(3) I.G. Heggie, op. cit., PP 58 - 60.

(4) A.W. LEwis, Overhead Costs, Allen & Unwin, London, 1949, PP 11 - 43.

(5) D. F. Pergum, op. city., P.P. 59 - 158.

(6) Op. Cit., P. 160.

(7) Munby, Transport, Middlessez, England, Pengiun Book, 1968, P.P. 68 - 89.

(8) Tibor Scitovsky, Welfare and Competition, George Allen & Unwin, London, 1971, P.P. 351 - 54.

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(10) D. Munby Op. Cit., P.P, 118- 119.

(11) J Heggie. Op Cit., P.P. 69 . 71.

(12) Marginal cost equal to variable cost whenever the latter is constant. Such equality occurs as long as the carrier stays within normal operating limits. This issue is discussed above, (See short run versus long - run marginal costs section).

(13)   M.O. Lorenz. «The Role of Value of Service in Rate Making» Quartely Journal of Economics Vol. 59, (1969) P.P. 336 - 51.

(14)   Clifford Sharp, The Problem of Transport, Oxford, Pergamon Press, 1956, P.P. 44 - 45.

(15)   In our discussion, costs which vary with output but not in direct proportion thereto, are broken down into a fixed and variable element, and the variable element consists of that portion which varies in proprotion to output. This means that variable cost curve is horizontal. The more common exposition of price theory, however, define variable costs as those which vary to some extent with output; and a cost curve representing such costs is usually represented as declining with increasing output until the point of greatest effeciency is reached after which the unit variable cost rise with increasing output. The analyses which we have used to demonstrate transport rate theory is adequate for practical purpose when, as here, we are considering rates for small segment of output for carriers who operate within the normal range. The variable cost-curve for those carriers are constant as noted above (See 8 above). For carriers who operate, within considerably large range of output, assumption that unit variable costs remain constant may be unrealistic, at least if rigid assumptions are made with respect to inexpansionsibility of the plant so that substantial increases in output result in operating the plant considerably beyond its point of greatest efficiency. In fact, however the assumption of rigid inexpansionibility of a transport plant is unrealistic. Often comparatively small capital expenditures, were bottlenecks occur, can permit large increase in traffic and greater utilization of other portion of the plant with little or no change in unit variable cost. (See D. Munby, opcit., P.P. 148 - 49).

(16) H. W. Edgerton. «Value of the Service as a Factor in Rate Making», **Harvard Law Review**, 1969 Vol. 61, No. 2 P.P. 541 - 46.

(17) W. J. Baumol and D.F. Bradford, «Optimal Departures from Marginal Cost Pricing», **American Economic Review** 1971, Vol. 60, No. 2, P.P. 265 - 283.