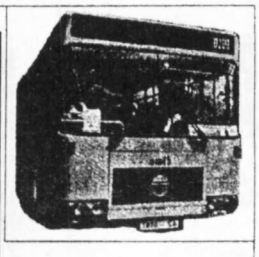
Is it Practical & Beneficial Fixing Price at Marginal Cost on Transport Infrastructure & Service in Sri Lanka?



Dr. Don S. Jayaweera

Pricing is a central tool for resource allocation in the view of economists, who usually recommend that prices be set at marginal cost. Marginal cost is the increase in total cost that occurs from producing one more unit of output or service. Charging transport users their marginal cost ensures that they will make an extra trip or shipment only when the value to them of doing so is at least as great as the cost of providing it. The public sector is often involved in providing transport infrastructure and transportation services; in Sri Lanka, the government typically provides the infrastructure – the highways, airports, bus terminals, and railways while the private sector operates the motor vehicles, aircraft, omnibus, and ships that use the facilities. Although the public sector often provides transportation services, it seldom prices these services at marginal cost. For example, the primary fee for road use in Sri Lanka is the fuel tax, annual revenue fees, registration fees and importation duties and other taxes at the time of importation of vehicles to the country.

The fuel tax effectively charges motorists about the same amount per vehicle, mile no matter when or where they travel. Therefore, motorists using expensive urban roads in rush hour may pay less than the marginal cost, whereas motorists using less expensive roads in an off-peak hour may pay more. By contrast, private sector transportation companies, assuming fees are de-regulated, are more likely to charge their customers close to their marginal cost. This article evaluates the benefits and practicality of the marginal cost pricing in the transport sector in Sri Lanka with reference to current issues.

Prices will deviate from marginal costs when buses and carriers enjoy uncontested markets or monopoly power for a prolonged period of time and when the public sector regulates bus and carrier prices. Prices will deviate from social marginal costs when they do not reflect the costs of carriers contributing to air or noise pollution and congestion. The pervasive involvement of public agencies in transportation (Road Development Authority, Cluster Bus Companies, Private Omni Bus etc.) and failure of these agencies to apply marginal cost pricing principals is caused in part by several peculiar characteristics of transportation.

These characteristics are not unique to transportation. Some are found in other capital-intensive network utilities, such as electricity, and telephones. But they both now make marginal cost pricing and private provision seem more complex and controversial in transportation than in many other industries.

There are homogenous characteristics in the transport sector; (1) different transportation users often share the same services or facilities. Autos, vans, trucks, buses and three wheeler taxies share the roads; a business and pleasure traveler uses the same train or road. Joint use allows transportation

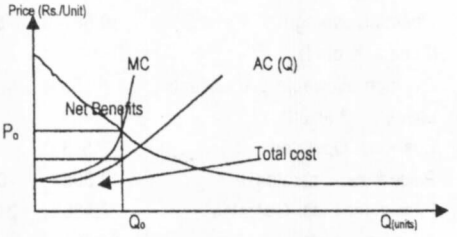
suppliers to reduce the average cost per user by increasing the utilization of expensive facilities and equipment. But joint use can also make it difficult to allocate costs among the different types of users or to determine the marginal costs of each type. This ambiguity leads to the claim that prices are discriminatory or inherently arbitrary and calls for public regulation to ensure a fair allocation of costs and protect the more vulnerable classes (urban and rural poor) users. (2) Transportation facilities and services often exhibit economies of scale and large sunk costs. Firms with these characteristics have marginal costs that are lower than their average costs, so that pricing at marginal cost does not generate enough revenue for the firm to be financially self-sufficient. The most obvious solution – a subsidy from government to balance the suppliers budget-often leads to a public takeover or operation (rural, late night and early morning operation of cluster bus companies), because public subsidies are usually more acceptable when accompanied by public ownership. The complexity of these schemes often makes them difficult to administer, however, vulnerable to charges of unfairness. (3) Transportation often raises equity concerns that seem to conflict with both marginal cost pricing and private provision. Transportation is not as central to ensuring equality of opportunity, as are other services, notably, education and health. But transportation provides access to these services, as well as to jobs and information. Equity concerns are often reflected in policies to ensure a basic level of transportation service to all communities and households. Sri Lanka does not have a clear policy to ensure that the rural communities are better integrated into the economic, social, and political life of the nation. The goal of transport pricing is to maximize net social benefits of providing a transport service. Net social benefits are usually defined as the difference between the willingness of consumers to pay for the service and the cost of producing it.

Net social benefits = consumer willingness to pay – production cost.

This formula does not consider the distribution of income for pricing of this service. It assumed that the consumer is the best judge of his or her own welfare. There are no externalities of production and consumption and all other goods that are close to substitutes or compliments which are appropriately priced. The pricing practice in Sri Lanka is critically evaluated

Max (total benefits (Q)-total cost (Q) that is Marginal benefits (Q)=Marginal cost,
Than the price should be set as shown in Figure-1.

Figure 1 – Public Sector Pricing - Buses and Railways



Private sector suppliers maximize their revenue;
Max(Total Revenue(Quantity)-Total Cost(Quantity))
Therefore; Marginal Revenue(Quantity)=Marginal Cost(Quantity)

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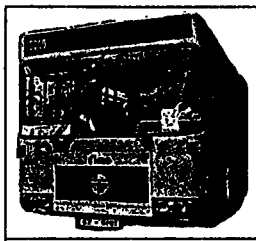


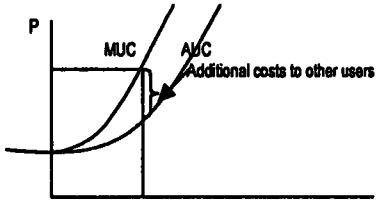
on a theoretical background in order to assess the market failures and its social, political and economic impacts.

Public Bus Fares and Truck Tariffs

Main objectives of setting price at marginal cost is to maximize the economies of a supply of services, if it is by the public sector concerning welfare, and if it is by the private sector concerning the profits. The marginal cost is the increase in total cost that occurs from producing one more unit of output or services. However, when the public sector sets the prices at marginal cost, consider the marginal benefits as marginal cost; as shown as follows:

It should be noted that prices will deviate from marginal costs when markets with limited competition and public sector regulates prices. The Sri Lankan Government regulates the bus fares, which are justified by the market nature. The public sector bus fares are seldom at marginal cost (no industrial in-efficiencies).

Figure 2 -Marginal Cost Pricing for Roads



The government of Sri Lanka has, recently introduced the bus fare policy taking cost of the inputs providing bus services. The inputs variables included in this price index are[1] Fuel, Crew, Oil and Lubricants, Tyre and Tubes, Air Conditioning, Repairs, Daily Overheads, Monthly Overheads, Annual Overheads, Depreciation, Interest on Capital and Risk on Enterprise. The proposed fare index has included all inefficiencies of the industry created by the government regulator and the market. It should be noted that the fare levels introduced by the fare index is higher than the marginal cost of providing bus services, which has resulted from an effective market. The determination of fare at marginal cost for the bus services has observed the following difficulties:

- Joint use of the same services makes it difficult to determine the marginal costs of each user;
- Bus services exhibit economics of scale and large sunk costs; marginal cost lower than the average costs, and pricing at marginal cost does not generate enough revenue for the supplier to be financially self-sufficient;
- Transportation services often raise equity concerns (e.g. bus service) is usually provided at same price during peak and off-peak periods and covers both high and low density.

The state should consider the vicious cycle, economies of scale, second best pricing, and equity consideration at the time of setting the bus or rail. The determination of effect of price change on demand, price elasticity for bus fare in Sri Lanka is 0.042[2]. This indicates increase in fares, decreases the demand, and revenue which result in shifting to more inefficient mode and social inequity. The state (federal or provincial) should increase the social benefits, rather than regulating fares at average cost which is also higher than the marginal cost.

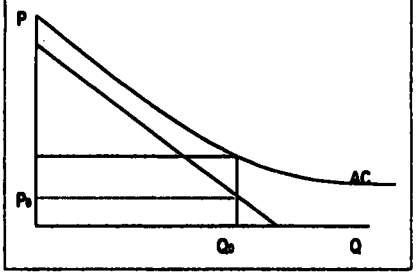
Highway Infrastructure Finance and Road User Charges

Optimal investment for road infrastructure is marginal construction cost equivalent to the user cost saving from capacity investment. This means that the user cost savings, including externalities should justify any road capacity increase. A net social benefit of the road is; (function of inverse X demand function) - (traffic flow X average user cost function). The optimal road pricing is as follows:

The road pricing at marginal cost makes it a more efficient transportation system. This increases the net social benefits, because it discourages all uneconomical trips. However, marginal cost does not produce enough revenue to cover the full cost of the roads. Roads have indirect benefits, which are not illustrated in marginal cost.

Road user charges in Sri Lanka are now charged through fuel taxes, importation duties, revenue licence fees and other related fees, which are more

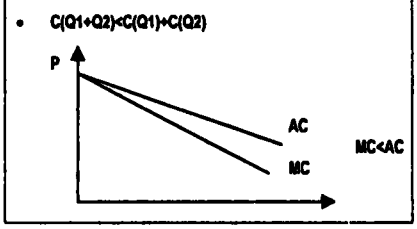
Figure 3 – Need for a subsidy for Rail and Buses



general and not even close to the average user cost (varies according to vehicle category). The road user charges are not specific to the investment and cost of the given road, traffic, or the time where as marginal cost varies accordingly. It is true that marginal cost pricing is more complex for road infrastructure because it includes more sunk cost. Improved road facility can change setting the user charges(toll) at marginal cost (includes externalities).

The average user charges paid by the most of road users are much lower than the public cost which includes road construction, rehabilitation maintenance, air pollution, congestion etc. as shown in **Table – 1**. The analysis of road expenditure of the last ten years indicating that the

Figure 4 – Economies of scale (Bus and Rail)



state is almost subsidizing the road users (See **Table –2**). User charges for low-density roads and feeder roads have to be covered by the general user taxes, which may be difficult to set at marginal cost level. The practical difficulties faced are calculating the consumer and producer surpluses due to the new road facilities in general. It should be noted that Short run marginal cost is not always equal to the Long run marginal cost. Some times marginal cost pricing revenue is sufficient for recovering infrastructure, assuming that there is no scale of economies, and optimal infrastructure investment. It is difficult to apply optimal investment without considering long run investments with long lead-time.

Further, economies of scale in capacity improvements, large increment of capacity improvement may be cheaper than several small ones. There are practical difficulties allocating marginal cost between users. Some people, allocate this cost using

Table 1

Average Public, Private Cost & Charges Paid by the Vehicle Owners (Current prices for 2002 – cost per one vehicle km)

Vehicle Category	Private Cost	Public Cost	User Charges Paid by vehicle Owner
Passenger Car (Gasoline)	24.84	18.34	12.66
Passenger Car (Diesel)	18.13	29.07	9.33
Vans/4WD/Dual Purpose	13.42	15.08	6.82
Buses	24.12	18.32	12.30
Small Trucks(four wheel)	16.05	14.53	8.19
Medium Truck(2 Axle)	21.43	26.78	10.92
3 Axle Truck	24.78	29.04	12.63
Articulated Truck	34.12	40.21	17.40

Source: Author's Calculations

Table 2
Total Revenue from Road Sector and Financing in Road Sector Development (in SLRs. Million)

Year	Total Revenue	Routine Maintenance	Periodic Maintenance	Rehabilitation of Road & Bridges	Widening, Improvement & new Construction of Roads and Bridges
1990	8,340	183.3	148.0	1,072.2	581.5
1991	8,424	181.9	210.0	951.0	664.5
1992	8,343	195.9	190.1	1,074.9	631.5
1993	8,232	195.9	370.1	792.5	745.0
1994	8,754	198.1	473.1	1,535.1	1,202.9
1995	9,900	208.3	800.0	2,142.1	1,456.4
1996	9,700	278.2	930.0	2,090.0	1,923.5
1997	10,870	279.5	700.0	1,875.2	2,440.3
1998	11,675	278.6	800.0	2,203.0	3,008.3
1999	12,363	315.3	700.0	2,199.0	3,656.7
2000	11,120	415.2	700.0	2,870	4,450
2001	10,900	410.0	678.0	3,013	3,450

Source: Road Development Authority

Passenger Car Equivalent unit, damage to pavement by an axle pass, economy of scale in paving, and congestion cost etc.

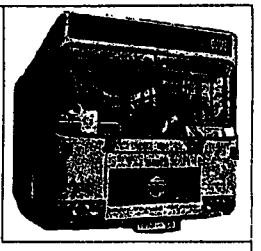
Rail Fares

The rail fares setting objective is to maximize the revenue consistent with a fixed and variable, cost structure. In practice it is not possible to set the fares on this because there are highly elastic markets and inelastic markets. Railway can raise fares in elastics markets and lower fares in inelastic markets with access capacity to meet increased demand. The Sri Lankan railway fares are not fixed at marginal cost price or any other pricing strategy, this is the case from the commencement of its services in late 1980s. Railways cannot set the fares without considering the main alternatives such as buses, cars, and trucks. Even, there they have to closely monitor the market responses.

This shows the difficulty of setting rail fares at marginal cost. There are practices in most world railway companies of using segment pricing and yield management. The danger of the segment pricing is that the lower fare passenger may largely take available inventory (if it is fixed as Sri Lankan Railways). Yield management pricing can be applied only for reserved trains. Pricing of commuter services at marginal cost is much more difficult than the other services because net social benefits of the railways are much more than the personnel benefits of the services.

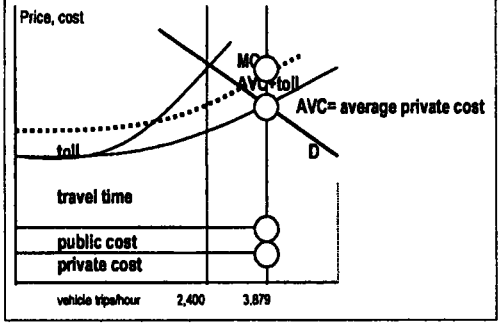
Pricing of commuter services at marginal cost is much more difficult than the other services because net social benefits of the railways are much more than the personnel benefits of the services. The Sri Lankan railways average cost is Rs.2.12 (Current Rs.) including variable and fixed costs per one passenger km. They earn only Rs.0.17 (twenty-three cents) per passenger km., which varies from 4 cents(amount paid by the public sector employees) to 25 cents per passenger km (refers to **Table 1**). Marginal cost pricing need to consider appropriate subsides, which can helps to increase the economic efficiency.

When prices fixed at P_0 level demand is Q_0, which is lower than the average cost (AC). However, it has marginal benefits more than that as consumer surplus ids high. If the price set at average cost or marginal cost demand will reduces and substitute mode (motor cycles, cars, vans, etc.) will come to road which have high marginal societal cost. This is a vicious cycle effecting to the economically efficient transportation services;



The economies of scale for railway is one of the issues faced by the railway and buses at marginal cost pricing as shown in **Figure 4**. It applies right of way cost, especially for exclusive right of ways, frequency of public transportation service costs and passenger waiting time. It is very clear that average cost is higher than the marginal cost for especially for railway and buses. The present bus fares has been fixed on average cost (new policy), and railway is victimized for low revenue because of the issue of fixing prices at average cost. On the view of above, the marginal cost pricing is very much effective for road infrastructure and not for the public transportation services.

Figure 6 – Marginal and Average costs of bridge trip

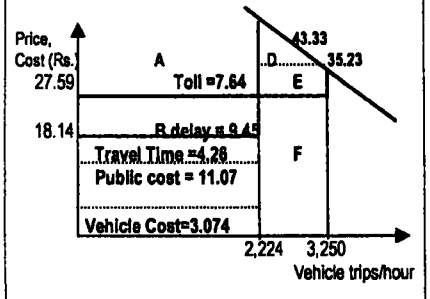


The **Table 3** – shows the average cost, marginal cost, and the current fares of railways and private buses, which demonstrate the fare distortions of the public transportation systems. This kind of fares is encouraging the demand for urban and inter regional road space by the private motorization which are low productive.

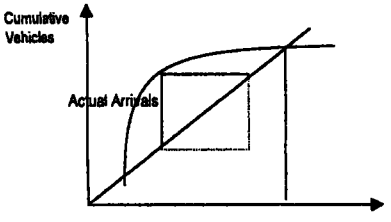
Urban Transport Infrastructure Pricing

Urban transport infrastructure marginal pricing is much more complex than the marginal cost pricing in the inter-region and countryside. The marginal cost of urban roads includes private cost which consists of vehicle cost and travel time cost. Public cost consists of congestion costs, environmental costs, and accident costs. The congestion costs and accident costs varies during the day, and functional role of the road links with networks according to the demand for the infrastructure. Sri Lanka does not apply average cost pricing or marginal cost pricing for any transport infrastructure in the country.

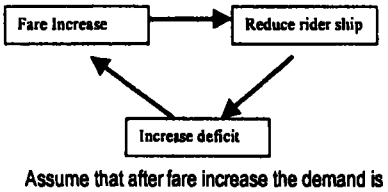
Figure 5- Incremental costs and benefits of urban roads



Graph 3 – Peak Delay – Galle Road



The vicious cycle on marginal cost pricing (buses and rail)



Assume that after fare increase the demand is elastic E<-1.
Estimated elasticity ~(0.42) (Jayaweera 1999)

[2] Final Report, Committee on Formulation of fare policy of buses – Ministry of Transport, August, 2001
[3] Emission Study, Final Report, The world Bank and LIFE, 2002

The demand for urban transport infrastructure varies by time of day as shown in **Figure – 6**. Therefore, Short Run Marginal Cost(SRMC) (cost of extra congestion from an extra vehicle) is almost equal to the Long Run Marginal Cost (LRMC) (cost of facility improvement needed to keep same level of congestion with an extra vehicle).

The urban road optimal investment and pricing should be SRMC = LRMC = Toll. There can be situations where the SRMC is lower than the LRMC indicating excess capacity. The shortage of capacity indicates SRMC is higher than LRMC. It is a prime requirement to introduce toll congestion equal to SRMC and the LRMC.

Figure – 7 shows the toll setting for urban roads during the peak period, which was applied, to Galle Road(A2). This shows that private motorists who are using low occupancy vehicles have to pay the private cost and the public cost incurred by them. This toll is fixed to marginal cost which consists of average private cost and public cost which is shown in **Figure – 5**.

Galle Road traffic can have designed traffic by introducing the toll , correcting highway infrastructure, price and peak toll which will have demand only for 2,400 vehicles otherwise demand is 3,879. The Galle Road traffic can be designed by introducing toll, correct highway infrastructure, price and peak toll which will reduce the demand to 2,400 vehicles from 3,879.

Table 3 – Bus and Railway Passenger Fares – July 2002

Long Distance	Bus Fares	Railway Fares	Average Cost		Marginal Cost	
			Bus*	Rail	Bus	Rail
Colombo - Kandy	47.00	25.00	80.62	254.40	42.50	28.4
Colombo - Badulla	103.50	60.00	104.13	619.04	62.50	34.50
Colombo – Galle	42.50	23.50	70.00	239.56	44.50	21.50
Colombo – Matara	58.00	32.50	110.07	233.20	55.50	30.50
Colombo – Awissawella	21.50	12.50	42.77	332.84	22.50	9.50
Colombo – Chilaw	26.00	17.50	57.49	129.32	27.30	12.50
Colombo – Anuradhapura	80.50	42.00	143.73	173.84	72.70	36.50
Colombo – Anuradhapura (Via Puttalam)	65.50	42.00	115.68	434.60	56.50	36.50
Short Distance						
Colombo – Moratuwa	12.00	5.00	12.62	38.16	4.32	2.00
Colombo – Panadura	13.50	7.00	21.03	63.60	7.50	3.20
Colombo – Nugegoda	8.00	3.50	7.71	23.32	2.50	1.50
Colombo – Gampaha	14.50	7.50	18.93	57.24	6.50	2.75
Colombo – Kalutara	18.00	10.50	33.65	101.76	12.50	4.25
Colombo – Kelaniya	7.00	2.50	4.20	12.72	1.75	1.00
Colombo – Negambo	14.00	10.00	10.52	31.80	3.50	1.75
Colombo – Ragama	11.00	4.50	26.64	80.56	11.15	4.00

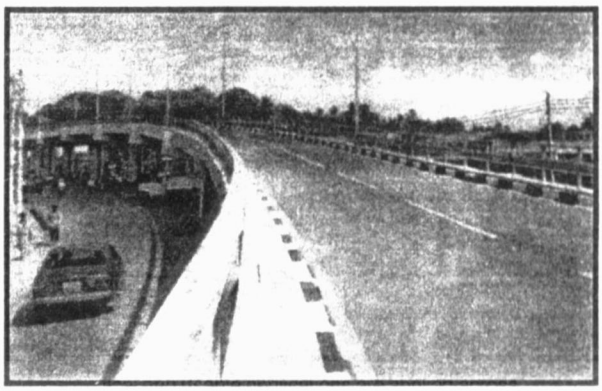
Source: Ministry of Transport, Bus fare Committee report, 2001 and Author's calculations
* Calculated using average cost recommended by the bus fare committee

Political Viability of Marginal Cost Pricing

Political viability of the marginal cost pricing is not encouraged on short-term basis according to world experience. The reasons are introduction of new parking charges, road user fees and tolls which are not attractive to the private motorists on short term. There is enough evidence to prove the political viability in long term using marginal cost pricing for road, and urban transport infrastructure.

The vote bank of the low occupancy vehicle owners are not big enough to make any changes in countries like Sri Lanka; considering the number in the operational fleet which is 120,000 cars, 80,000 vans, 130,000 three wheelers, and 460,000 motor cycles totaling to 790,000. It should be noted that developed countries who own autos have a bigger vote bank.

The problem in the developing countries is that the population who own cars and vans are the politically influential class who can influence to keep the fees, and charges low for their benefits. On the view of appropriate pricing, most of the ill effects in the transportation system and the financial crises can be addressed using marginal cost pricing for transport infrastructure and the fixing of fares at marginal cost, without fixing prices at average cost. The political viability of marginal cost pricing in the transport sector is very positive, if the practical and usable applications are applied across the whole sector.



Conclusion

Marginal cost pricing is an effective and efficient tool for the transport sector infrastructure and services in order to achieve economic efficiency with high productivity. There are some practical problems in applying marginal cost pricing due to its complexity.

Sri Lanka does not have any experience in using marginal cost pricing for land transport sector, especially for roads. There are several positive impacts with marginal cost pricing in sectors like transport. In view of the above review, it can be recommended that marginal cost pricing be applied in the sector as much as possible (overcoming practical difficulties), in order to achieve the country's economic goals together with sector economic efficiencies which have been demonstrated in countries like Singapore and Malaysia.

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