Economics of Managing Energy Related Transport Externalities: A Strategic Niche in Defending Public Transport Modal Share

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INTRODUCTION

Transportation constitutes an essential ingredient of development, particularly by way of providing the necessary mobility to factors of production (including labour and material) and outputs of economic activities (Centre for Economic Research and Industrial Policy Analysis, 2012). It is also recognised as having a significant bearing on development sustenance in all three angles, namely, Social, Economic and Environmental. Transport activities, as a productive sector in the economy, also contributes to the national value added, to the tune of around 12% by the end of 2012. Over 2.3 million motorised vehicles and 3 million bicycles were used for 10 million passenger trips daily (over 95% of which is on land), and nearly 1.5 million were employed, either directly or indirectly in the sector, of which 85% was informal (Kumarage, 2009).

However, transportation, at the same time, is recognised as associated with significant negative externalities. Emission of fumes (due to combustion of fossil fuels) causing morbidity and mortality, road congestion leading to increased travel times and thus increasing generalised costs, and accidents are the commonly found negative externalities associated with transportation. Increased traffic has

resulted in severe congestion, reducing travel speeds to little over 10 kmph in the peak hours. This has caused inefficient burning of fuel, excessive and toxic vehicular emissions, and loss of valuable time of commuters in long hours of travel. According to Yatagama et al. (2010), Colombo's atmosphere looks "unhealthier" than that of Hong Kong, Singapore, Bangkok, Taipei or Tokyo.

The consequences are costly. Sirithunga et al. (2006) found high prevalence of cough, throat irritations, nasal discharges and respiratory disorders among school children attending Colombo and Kandy schools compared to those of rural areas. Also, only 8% of children attending "city schools" could be categorised as having "perfect health" whereas the corresponding share of children attending schools outside the cities was 32% (Yatagama et al., 2010). This is mirrored by Sri Lanka's "Disability-Adjusted Life Years" (DALYs) related to transportation (Table 1), where total life years lost owing to transportation works out to be over 280000, which amounts to a value loss of approximately USD 930 Mn, if estimated based on the per-capita GDP of the economy in 2013.

Table 1: DALYs Associated with Transportation – As at 2010

Category	DALYs	Share (%)
Ambient Particulate Matter	77992	28%
Ambient Ozone	3126	1%
Lead Exposure	43041	15%
Transport Injuries	159402	56%
Total – Transport Related	283562	100%

Note: DALYs for a disease or health condition are calculated as the sum of Years of Life Lost (YLL) due to premature mortality and Years Lost due to Disability (YLD) for people living with the health condition or its consequences.
Source: Institute of Health Metrics and Evaluation (http://ghdx.healthmetricsandevaluation.org/record/sri-lanka-global-burden-disease-study-2010-gbd-2010-results-1990-2010)

It therefore becomes evident that managing transport externalities is a national priority. This research attempts to appraise the strategy of promoting public transportation in view of managing fuel consumption related transport externalities, and to assess, wherever possible, economics associated with such a strategy.

RESEARCH METHODOLOGY

The research adopts a scenario-based futuristic examination, using transport modal shares as the key to project externality effects and their economics. It considers three hypothetical scenarios (Low, Medium and High) of transport demand growth over the period between 2015 and 2020, and uses projected public and private modal ratios to constitute the "base case" applicable for each scenario. The estimated fuel savings and the corresponding emission reductions are worked out using the hypothesis that appropriate strategic interventions could prevent public transport modal share drop below 50%. Possible policy interventions which would help realise this objective also are discussed at the end. Necessary information and data are obtained from secondary sources such as published reports, professional data bases, and regulatory stipulations.

ANALYSIS

Growing Fuel-Related Negative Externalities

Inefficient burning of fuel drives this unfavourable trend; the main cause behind being high and increasing share of private transport modes, having lower carrying capacities in relation to their road space usage, and thus leading also to severe traffic congestion. It is estimated that over 80% of total fuel consumed in passenger transportation is attributable to highly "fuel intensive" private transport modes, which caters to a mere 45% of the estimated passenger transport modal share (Kumarage, 2009).

The rapid growth of private vehicle ownership is driven by the increased affordability of the general public in line with increased per-capita income (Dargay et al., 2007). Simultaneous expectations for greater comfort, travel flexibility and reduced travel times, would increasingly induce public to own and use their private modes of transport. This trend has been observed in almost all countries through their process of development. This, together with the relative stagnation of the supply and qualitative standards of public transport, have pushed the public transport modal share down to less than 60% by 2012, from as high as over 80% by the turn of the millennium. Unabated continuation of this trend would mean Sri Lanka facing greater ill-effects in the years to come, on her way towards achieving middle income country status.

Future Projections: A Scenario-Based Analysis

Table 2 depicts the platform for the scenario-based analysis to estimate the potential of reducing fuel consumption related ill-effects of transport. Public and private transport modal shares by 2020 are presented under three plausible scenarios of transport demand growth, and under the hypothesis that no explicit policy intervention would be made to manage the modal split. It is observed that the private vehicular modal share, estimated using the average income elasticity of travel demand (Gunaruwan and Jayasekera, 2012), could increase beyond 55% by 2020 if the events evolve without any policy interventions.

Expected Benefits of Sustainable Policy Interventions

The economic and environmental benefits that could be secured through the avoidance of wasteful burning of fuel, proposed to be brought about by strategic intervention to control the above projected declining trend of public transport modal share, thus, could be estimated by academically studying the hypothetical case of maintaining a minimum public transport modal share of 50% (the level in 2014) by 2020.

Table 2: Projected Modal Split – 2020: "Business as Usual" Case

Modal Class	2010 (Psgr km Bn)	2020 Low Estimate (Psgr km Bn)	2020 Medium Estimate (Psgr km Bn)	2020 High Estimate (Psgr km Bn)
Public Modes	65.65 (65%)	59.85 (45%)	72.45 (45%)	85.50 (45%)
Private Modes	35.35 (35%)	73.15 (55%)	88.55 (55%)	104.50 (55%)
Total	101	133	161	190

Source: Author's estimates based on data sets maintained by Jayaweera D S, and Kumarage A S.

Fuel Saving Potential

Table 3 summarises fuel savings that could be achieved by realising the targeted public transport modal share assuming the entire shift is from private cars to public buses.

Table 3: Expected Fuel Savings if 50% Public Modal Share is Maintained by 2020

Benefit / Cost	Low	Medium	High
Shift of Psger Km (Bn) from Pvt to Public modes	6.5	8.5	10
Saving of Pvt Veh km (Bn) @ 3 psgsr/vehicle (Vans)	2.16	2.83	3.33
Saving of Fuel on Vans (Mn Lts) @ 8 km/l	264	345	407
Addl Bus km (Bn) @ 45 psgrs / vehicle	0.14	0.18	0.22
Addl fuel (Mn Lts) @ 3.4 km / l	42	55	65
Net Fuel Saving (Mn Ltrs / Yr)	222	290	342
Foreign exchange savings potential by 2020 ($ Mn /Yr)	222	290	342

Total Fuel Savings over 6 Yrs (Mn Litres for 6 years)	666	871	1024
Total Foerx Savings on fuel over 6 years ($ Mn)	666	871	1024

Source: Estimations by the Author.

These estimates show that the transport sector could potentially reduce nearly 7% of its fuel consumption by encouraging the growing additional transport market to use public transportation instead of relying on private modes of transport. The annual savings potential corresponding to the "Medium scenario" would be USD 0.3 Bn by 2020, which would correspond to nearly 1% of the total expenditure on imports, or nearly one-third a percent of the projected GDP at market prices of the economy. The cumulative savings over the six years from 2015 to 2020, under an assumed straight-line growth of savings potential, would be nearly USD 900 Mn; which could pay off nearly 4% of the total outstanding (by end 2012) foreign debt of the country, or, if invested, could newly construct 1200 km of high-speed single carriage-way rail track, almost doubling the extent of Sri Lanka's present railway network.

Emission Avoidance Potential

These estimated fuel economics would translate into substantial reduction of vehicular emissions. Table 4 depicts the avoided emissions corresponding to the estimated fuel savings over the period of six years up to 2020, expressed in terms of total emissions, Carbon emissions and Carbon Dioxide emissions to the atmosphere. This, no doubt, will translate into substantial environmental health benefits in the medium to long run, potentially easing healthcare expenditure burden on the public coffers.

Table 4: Avoidable Emissions (in Million Tons) by Strategic Management of Transport Modal Split 2015-2020

Emission Type	CO2	CO	HC	Tot C	NOx	PM	Total
Low Estimate	1.773	0.011	0.008	0.490	0.033	0.0016	1.827
Medium Estimate	2.318	0.015	0.011	0.641	0.044	0.0021	2.390
High Estimate	2.728	0.017	0.012	0.754	0.051	0.0025	2.811

Sources:

- *Estimates based on USEPA data (www.epa.gov/otaq/climate/documents/420f11041.pdf)*
- *Hong et at (2012), Atmospheric Environment Vol: 54; p.163*
- *Mobile Emission Factors, Environment Canada (www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=AC2B7641-1)*

It is also noteworthy that any portion of such effort to defend the public transport modal share, through railway playing a greater role, would further enhance the realisable fuel saving benefits as transport by railway is likely to be much less fuel intensive. For instance, Gunaruwan and Sannasooriya (2013) demonstrated that a modal shift of freight transport from road to railway would help secure significant fuel saving benefits.

Investment Requirements

The above analysis indicates the potential savings on fuel imports and reduction of emissions that could be achieved through relying more on public modes for both passenger and freight transportation. A question could, however, be raised as to what levels of capital injections that would be necessary to realise such an objective. Technically, 4500 more buses would be needed to the fleet by 2020 if the bus sector is to carry 10 Bn more passenger kilometres by then, corresponding to the "High" estimate in Table 3, which would mean an additional capital injection of approximately USD 200 Mn in six years. This estimated injection is only one-fifth of the realizable fuel saving benefits of USD 1 Bn, even if the external benefits are

completely ignored, indicating the overall viability of such a strategic approach.

It must be noted, however, that such a modal shift would make approximately 3 Bn private vehicle km (if three persons per vehicle in average is assumed) unnecessary, which would amount to a potential capital saving on private vehicles of approximately USD 1.5 Bn over the next six years, assuming a lower side estimate of investment requirement on four wheeler vehicles. Moreover, the necessity to expand the highway capacity also would be correspondingly less because public modes of transport are much more "space efficient" than private vehicles.

Therefore, such a modal shift from private modes of transport to public modes can be considered "investment economising" and not needing any additional capital injections, and thereby would correspond to a "win-win" strategy.

A similar modal shift, if realised towards railway, would be even more beneficial in the long run, though the initial additional capital outlay required railway would be more. This is because railway rolling stock have several fold longer life spans compared to buses and also because greater relative fuel savings could be realised through a modal shift from road to rail.

CONCLUSIONS

The study clearly demonstrated that a modal shift away from private transport modes to public modes will be associated with significant national economic and environmental benefits, particularly at the angle of fuel consumption efficiency. It could therefore be concluded that the Government of Sri Lanka should strategically intervene to prevent or retard the presently observed declining trend of public transport modal share. It should vigorously pursue a public transport

priority policy, particularly focusing on greater fuel economics, which yields both foreign exchange saving and emission reduction benefits.

This strategy of public transport promotion would figure in the middle of three-pronged strategic framework to secure economic and environmental benefits through reduction of fossil fuel consumption in the transport sector (Gunaruwan, 2014). Firstly, the Government should further intensify its currently pursued efforts to reduce emissivity in all modes of transportation. This should essentially consist of improving combustion efficiency of existing fleet of motor vehicles, introducing new and less energy intensive vehicles (such as hybrid and electric motorisation) within the current modal structure, and switching for better and less polluting fuel varieties. The Government may also consider strategically adjusting taxation and pricing policies associated with vehicle imports and petroleum products. Secondly, and in the middle, figures the vigorous pursuance of public transport promotion policy, the core theme of the present research. All encouragements should be provided to promote public transportation, with particular emphasis on the railway mode. Railway infrastructure development should be strategically favoured over highway or expressway development in relation to public investment choice. A vigorous drive to uplift the standards and attractiveness of railway services is a necessity. The existing policy biases against railway transportation, such as railway having to cover infrastructure maintenance cost while the road-based competitor modes are given highway usage right free of charge, have to be explicitly addressed and eliminated. Third, sustainable mobility drive also requires minimization of unproductive transport demand, which has to be addressed through transport demand management strategies. Transport substitution methods such as telecommunication have to be implemented with a view to minimise that share of derived demand for mobility which is costly and avoidance, wherever feasible, is beneficial. Appropriate land-use planning and bringing the social infrastructure facilities (such as schools, hospitals and public

services) closer to human settlements also will help reduce demand for travel, thus saving on transport costs and reducing emissions.

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