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The Bus Rapid Transit Project in Bangkok: A Case of Traffic Misallocations?

Thiraphong Vikitset
School of Development Economics, National Institute of Development Administration, Bangkok, Thailand

Abstract

The Bus Rapid Transit (BRT) for the Satorn/Rajpruek route in Bangkok is characterized by four inbound lanes and four outbound lanes separated by a traffic island. The lanes adjacent to the traffic island are designated as the BRT lane where no vehicles, except the BRT buses, are allowed access. The BMA anticipated that the project will reduce the number of vehicles along the Satorn/Rajpruek route which is the major reason used to justify the project. Granted that the BRT project can reduce the number of vehicles along the route it also causes traffic misallocations by causing too few vehicles in the BRT lane and too many vehicles in the remaining lanes which result in welfare losses. It is proposed that all vehicles are allowed access to the BRT lane if their drivers are willing to pay a 'second best' congestion charge. The drivers that are not willing to pay the congestion charge still have free access to the remaining lanes. It is shown that the second best congestion charge can reduce welfare losses from the traffic misallocations when compared to the original BRT project. The second best congestion charge offers an option for vehicle users to be better off by accessing the BRT lane. If they are not willing to pay the congestion charge to access the BRT lane they still have free access to the remaining lanes and, hence, are not worse off than before.

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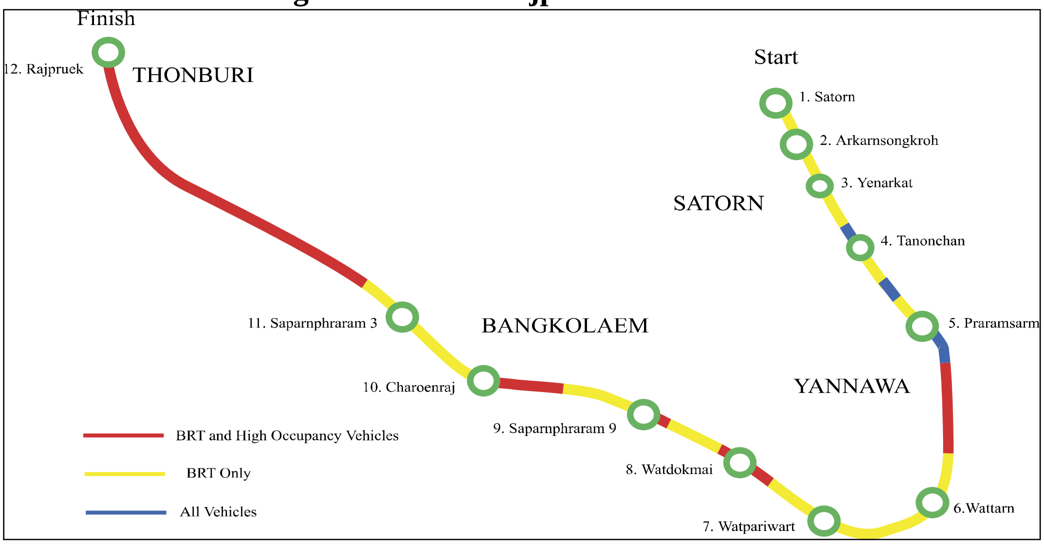
1. Introduction

Traffic congestions are phenomenon that may be observed every day in a large city like Bangkok. Traffic congestions occur simply because the road or highway capacities are not sufficient to satisfy the demand for their usages. The most recent measure to alleviate the traffic congestions in Bangkok is the Bus Rapid Transit (BRT) project that was approved by the cabinet on January 3, 2007 (BMA Brochure, 2010). The main reason given for the approval of the BRT project is the anticipated reduction in traffic congestions (BMA Leaflet, 2010). The BRT project is supervised by the Bangkok Metropolitan Authority (BMA) and is implemented initially for the Satorn/Rajpruek route that covers the distance of 15 kilometers with 12 stations. The BMA plans to expand the BRT concept to 14 other routes in Bangkok covering the distance of 250 kilometers.

The Satorn/Rajpruek route is characterized generally by four inbound lanes and four outbound lanes separated by a traffic island with twelve stations along the route. The BMA designates the lanes adjacent to the traffic island as the BRT lane. There are three main designated areas in the BRT lane (see Figure 1). The first designated area allows entrance only for BRT buses. The second designated area allows entrance for vehicles with at least three occupants and the third designated area allows entrance for all vehicles.

Figure 1 Satorn/Rajpruek BRT Route



The Satorn/Rajpruek route was opened on May 15, 2010 on a trial basis where commuters can use the BRT service free of charge for three months (BMA Leaflet, 2010). After the trial period, the fare between 12 and 20 baht depending on the distance will be collected. While the BRT is a new transportation mode for Thailand, it is in operations in many cities throughout the world. The Transportation Research Board (2009) has published the BRT case studies for 26 countries in terms of passengers carried, speed, and land development changes.

A brief example of the BRT performance evaluation for Vancouver is that 20 percent of the BRT riders previously used automobiles and 5 percent of whom were taking new trips. For the case of Bangkok, the BMA anticipates that about 6000 commuters by private vehicles along the Satorn/Rajpruek BRT route will switch to the BRT mode of travel which is equivalent to a reduction of about 5000 vehicles along this route (BMA Leaflet 2010).

Granted that the BRT project can reduce the total number of vehicles on the Satorn/Rajpruek route, it also causes traffic reallocations among the four lanes along the route as some vehicles in the BRT lane are now forced to divert to the remaining three lanes. The traffic diversion implies that there will be fewer vehicles in the BRT lane and more vehicles in the remaining lanes. The relevant question is how to evaluate the impact of traffic reallocations from the BRT project on traffic congestions.

It is the purpose of this short article to propose an analytical framework to evaluate the impact of the traffic reallocations caused by the BRT project and to suggest some modifications to improve social welfare. The next section presents the analytical framework for the evaluation of the BRT project; section 3 proposed some modifications to the BRT project; summary and conclusions are then presented in section 4.

2. Analytical Framework

The effects of the BRT project on traffic congestions along the Satorn/Rajpruek route may be illustrated by the traffic density and flow diagrams in Figure 2. The relationship between the traffic flow, traffic density, and vehicle speed are presented in linear form for simplicity of illustration. It is reasonable to assume that the traffic flows in the four lanes are perfect substitutes since drivers can freely switch lanes while driving along this route prior to the BRT project. Let the traffic density and traffic flow in each of the four lanes before the BRT project is implemented equals D_1 vehicle per kilometer and F_1 vehicle per hour with an average speed of v_1 kilometer/hour.

When the BRT lane is implemented, the traffic density and the traffic flow in the BRT lane is expected to decrease to a free flow level, say, D_{BRT} and F_{BRT} since fewer vehicles can enter this lane. The vehicle speed in the BRT lane is expected to increase to the free flow level of V_{BRT} kilometer/hour. The traffic density and traffic flow in the three remaining lanes are expected to increase to, say D_2 and F_2, as some of the flows in the BRT lane are diverted to these lanes and the average speed in these lanes falls to v_2 kilometer/hour.

The effect of the BRT project on the total traffic flow and its reallocations among the four lanes can be evaluated in terms of its impact on social welfare. Economists as early as Knight (1924) have recognized traffic congestions as one form of externality from the use of vehicles.[1] The effect of the BRT project on social welfare is presented analytically in Figure 3. D is the total traffic demand for the four lanes, APC is the average generalized costs of a vehicle user that can be disaggregated into fuel, oil, tires, maintenance, depreciation, and time (Walters, 1961), and MSC is the marginal social cost which is the cost imposed on other vehicle users by a marginal increase in traffic flow. The left and middle panels show the APC and MSC for the BRT lane and the remaining lanes respectively. The right panel presents the APC and MSC for the entire route.

A utility maximizing vehicle user will only consider his private generalized costs and not the social costs imposed on other drivers. Before the BRT project is implemented, an equilibrium traffic flow where the average generalized costs equal the marginal benefits is T_1 vehicles/hour. The total traffic flow allocations are B_1 in the BRT lane and A_1 in the remaining lanes. The average and marginal generalized costs for all lanes are equal at equilibrium other wise drivers will switch to lanes with lower costs.

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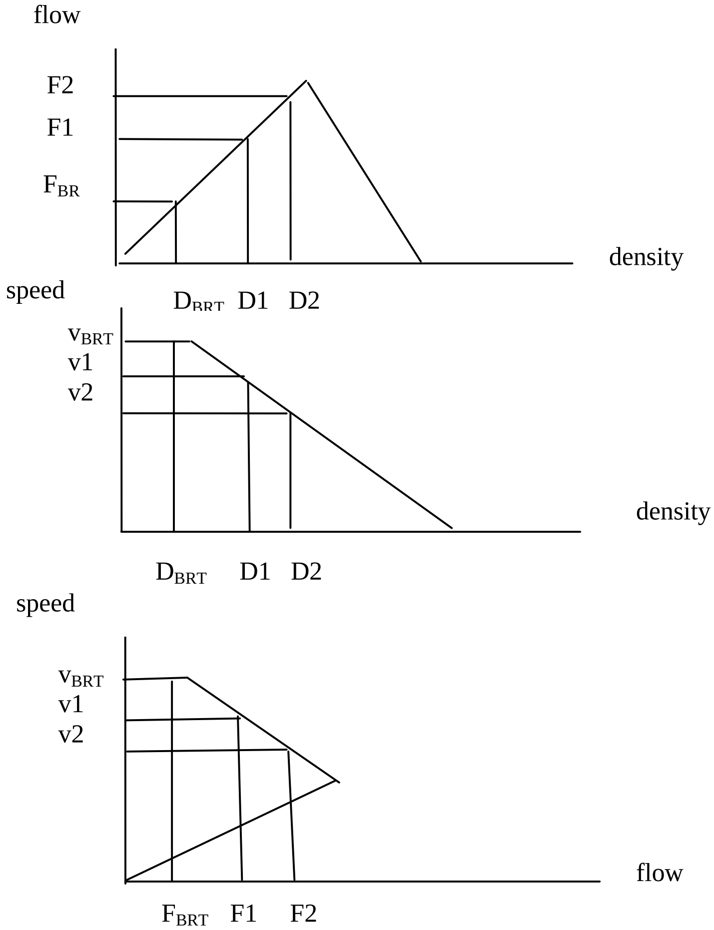
[1]There are other exernalities associated with the uses of vehicles. See Parry et al (2009) for an excellent summary of the other types of vehicle related externalities.

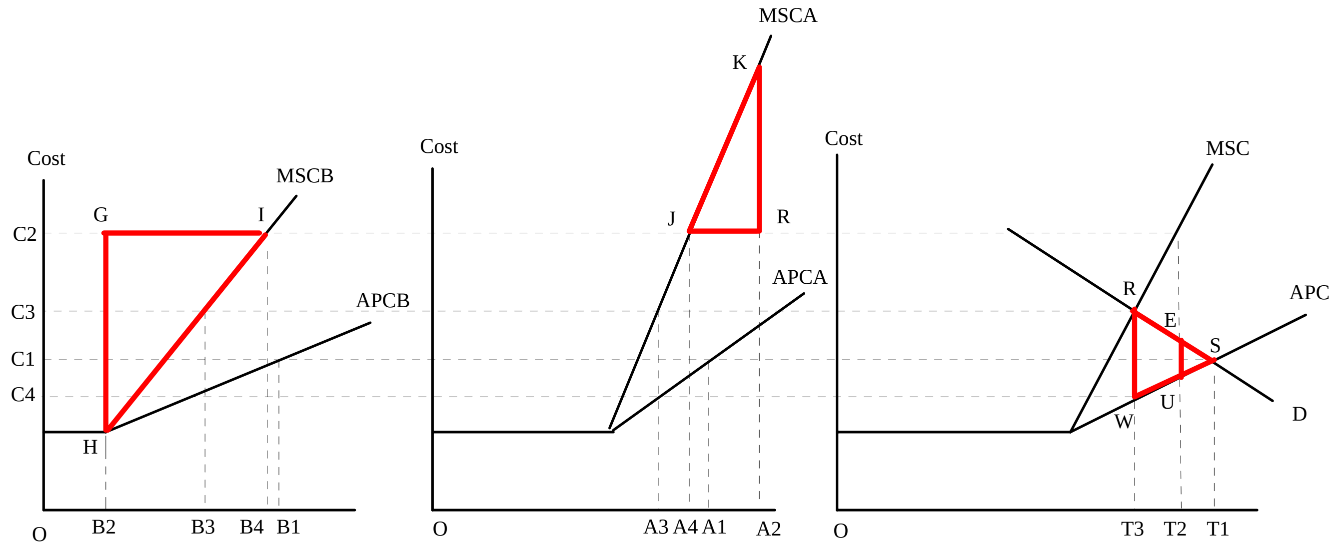
Figure 2 Traffic Flow Diagram for the Satorn/Rajpruek Route



Even though the average and marginal generalized costs in each lane are equal the equilibrium traffic flow is not efficient from a social welfare point of view because the marginal costs from the total traffic flow exceed their marginal benefits. An efficient equilibrium requires an internalization of the marginal congestion costs of RW for all lanes which will reduce the total traffic flow to T_3 in the right panel of Figure 3. The efficient T_3 total traffic flow consists of B_3 in the BRT lane and A_3 in the remaining lanes. The welfare losses from allowing free access to all lanes along this route are then equal to the area RSW in the right panel.

When the BRT lane is implemented, the total traffic flow along the route is expected to fall to, say, T_2. If there are no restrictions to enter the BRT lane the efficient allocations of the T_2 total traffic flow are achieved when the marginal costs are equal for all lanes. The efficient allocations of the total T_2 traffic flow are then B_4 in the BRT lane and A_4 in the remaining lanes. However, the restricted entrance into the BRT lane leads to a traffic flow of less than B_4 in this lane and more traffic flow than A_4 in the remaining lanes. Let the vehicle speed in the BRT lane increases to the free flow level so the traffic flow in this lane falls to B_2 and the traffic flow in the remaining lanes increases to A_2 in the remaining lanes.

Figure 3 Welfare Losses from Traffic Misallocations



As the total traffic flow T_2 is now closer to the efficient flow T_3 it may appear that the BRT project improves social welfare by the area SUE in the right panel. Granted that the BRT project is able to reduce the total traffic flow, but it also creates misallocations of traffic flow between the BRT lane and the remaining lanes as the marginal costs in the BRT lane are now lower than the marginal costs in the remaining lanes. The misallocations of traffic flow imply that there are too few vehicles in the BRT lane and too many vehicles in the remaining lanes. The misallocations of traffic flow thus result in welfare losses of HGI in the BRT lane and JRK in the remaining lanes.

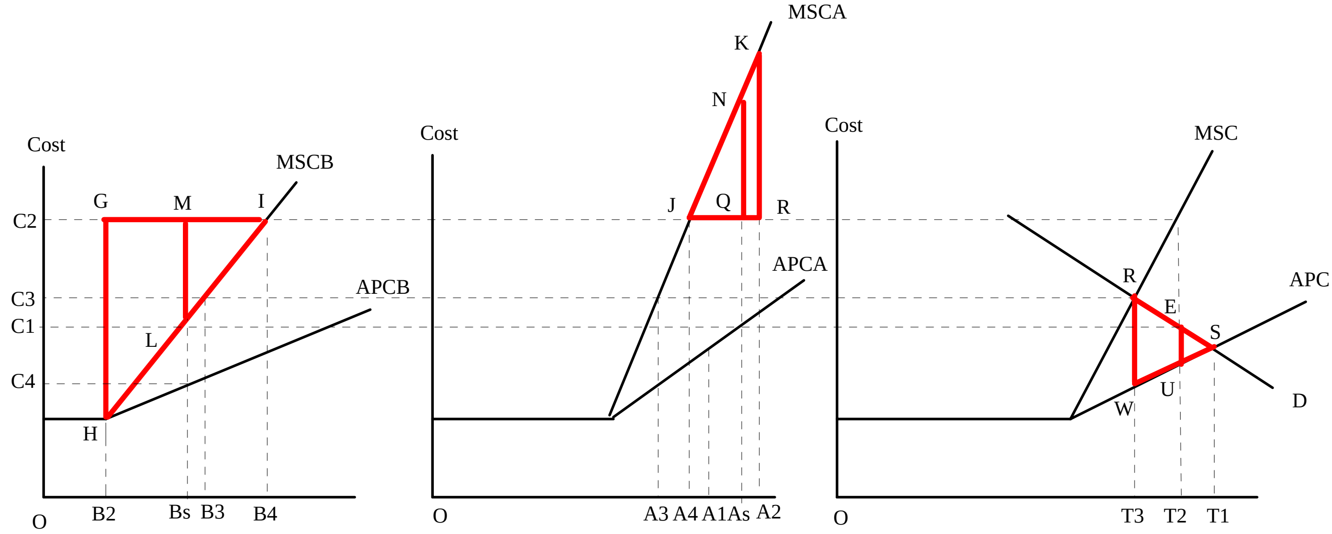
3. Some Recommendations

The limitation of the BRT project to alleviate traffic congestions along the Satorn/Rajpruek route is the reduction of total traffic flow by traffic control rather than by the price mechanism through the collection of congestion charge. The traffic control results in welfare losses from the misallocations of traffic flow. Even though economists accept the collection of congestion charge as one of the solution to the traffic congestion problems, the initial obstacle to its implementation is the fear of socio-political repercussions and resistance from the general public. A political willingness and commitment is required to implement the congestion charge. A good example of the political willingness to implement the congestion charge in spite of the initial resistance to its proposal is the introduction of the congestion charge for London by Mayor Livingstone in 2003 which, after strong initial resistance, steadily gains public support when the public recognized its benefit (Litman, 2006).

The issue of implementing the congest charge for Bangkok has been mulled but has not received serious consideration from the BMA. A former BMA governor had told Mayor Livingstone of London, a pioneer of congestion charge for London, that he was interested in the success story of the London congestion charge but had little clue how the measure could begin in Bangkok without a good public transport system (Asia Finest Discussion Forum, 2007).

A survey was conducted in Bangkok to gauge the public acceptance of the congestion charge (Kunchornrat et al., 2008). When the respondents were asked if they would support the congestion fee policy on all freeways in the region, only 22 percent of the respondents support the policy. But when the respondents were asked if they would support the congestion fee policy if it is collectable only on the left-most lane of all free ways leaving the remaining lanes for free travel, 45 percent of the respondents now support the policy.

Figure 4 Second Best Congestion Charge for BRT Lane



Taking the socio-political barriers to the implementation of congestion charge into consideration, it is proposed that the congestion charge is initially implemented on a very small scale. Within this perspective, the BRT project provides an opportunity to try out the congestion charge concept for Bangkok. The BMA can modify the BRT project by allowing all vehicle owners an option to enter the BRT lane if they pay an entrance fee or the congestion charge. When compared to the original BRT project where no vehicles other than the BRT buses are allowed entrance to the BRT lane, the vehicle owners are offered the chance to be better off by paying for the right to enter this lane. In the extreme case where no vehicle owners are willing to pay the congestion charge, they still have free access to the remaining lanes and, hence, are not worse off than before.

The congestion charge collected only for the BRT lane is the second best charge that is lower than the first best charge RW in Figure 2 since it does not internalize all of the congestion externality along this route. Verhoef et al. (1996) provide a mathematical derivation of the optimal second best congestion charge for an equivalent case where a congestion charge is collected for one route while allowing free access to the other route that is its perfect substitute. The second best congest charge for the BRT lane would be such that the average costs of vehicle users in the BRT lane plus the second best congestion charge equals the average costs of vehicle users in the remaining free lanes. This equalization ensures equilibrium between the lanes, other wise vehicles in the lane with higher average costs will shift to the lane with lower average costs.

The effect of the second best congestion charge on social welfare is illustrated in Figure 4 which is redrawn from Figure 3. A second best congestion charge of C_1C_4 collected from vehicle users that enter the BRT lane will increase the traffic flow from B2 to B_s which is less than the traffic flow of B3 when the first best congestion charge of RW is collected for all lanes. This is because some vehicles users will divert to the free lanes under the second best congestion charge scheme.

An option for all vehicle users to enter the BRT lane will decrease the traffic flow in the remaining lanes from A_2 under the original project to A_s where the average costs of vehicle users in these lanes equal the marginal benefits. It is seen that the welfare losses are reduced by GMLH in the BRT lane and by JQN in the remaining lanes. The welfare losses of MIL in the BRT lane and JNQ in the other lanes from traffic misallocation still remain and can be removed only by the first best congestion charge.

4. Summary and Conclusions

The BRT project has been implemented in Bangkok for the Satorn/Rajpruek route covering the distance of 15 kilometers. Under the BRT project, vehicles are generally prohibited to enter the BRT lane that is reserved for the BRT buses. The BMA anticipated that the project can reduce the number of traffic along this route. However, the impact of the project on traffic allocations along the route has not received attention of the authority. It is shown that the BRT project causes traffic misallocations along the route which result in welfare losses.

The Satorn/Rajpruek BRT project provides an opportunity for the BMA to propose the second best congestion charge for the BRT lane while allowing free access to vehicles in the remaining lanes. The second best congestion charge has been shown to improve social welfare compared to the original BRT project. The vehicle users are now given an option to enter the BRT lane. Even in the extreme case where no vehicle users choose to pay the congestion charge, they are no worse off than before. This option increases the chance of public acceptance for the congestion charge when compared to the original BRT project. After the second best congestion charge is implemented for a given interval, the BMA can evaluate its impact on traffic and public acceptance. The next step is to use the evaluation results to consider the possibility of implementing a more comprehensive congestion charge for the entire route.

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