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A Study of Fuel Price Increase and Its Influence on Selection of Mode of Transports

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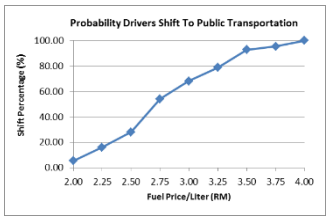
Graphical abstract



Abstract

The sudden increase in the use of private vehicles contributed to the increase in traffic congestion, road accidents and pollution. The rise in ownership of private vehicles is caused by, among others, the problem of public transports being unable to fulfil the public's needs. This made the commuters prefer to use their own vehicles rather than public transports. Based on this scenario, a study has been conducted particularly in UKM (Universiti Kebangsaan Malaysia), to study the factors that can diminish the problem of traffic congestion. The main objective of this study is to form a model of shifts of transportation modes from private vehicles to public transports (buses) based on the 'fuel price increase' factor (Malaysian Ringgit) to see the change in vehicle preference. This study has succesfully produced a model that relates the fuel price to modes of transportation shift by obtaining a correlation exceeding 0.9. The test of sensitivity for the model showed that the rate of fuel price hike influenced at least 88% of private vehicle users to shift to public transports if the fuel price reached RM2.75. From this study, it can also be concluded that the effects of fuel price increase influenced the shift of preference from private to public transports with the types of vehicles and the rate of price increase as variables.

Keywords: Public transport; private vehicles; fuel price hike

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1.0 INTRODUCTION

The transporting of people and goods contribute to a major economical and social significance in maintaining the standards of quality of life [1]. Unfortunately, the transport sector is also the main culprit in polluting the air, and produces a huge demand towards unrenewable sources such as fossil fuels. Apart from that, the rapid growth in the use of private vehicles not only worsens the situation for the environment, but also leads to social problems such as traffic congestion and health issues [2].

In the endevour to reduce the negative effects of overusing private motorised vehicles, a number or potential solutions have been proposed and implemented, with variable success. These approaches include investing in developing private vehicles with minimal fume emissions, land development planning, building infrastructures that reduces congestions and providing alternative modes of transport to private vehicles [3].

Public transports known as 'transits' are also considered as an example of sustainable mode of transport, providing alternative rides to private vehicle use. Public transports give many benefits to commuters and the society, as demonstrated in Table 1. However, these benefits depend on the quality and the level of service of the transits, which can attract the number of passengers and consequently reducing cars on the road and all the relevant costs i.e: traffic congestion, road accidents and polluting emissions.

The fuel price increase directly affects the economic development and planning throughout all sectors including the transportation sector. Thus, the fuel price hike is seen as able to change the perception of road commuters especially students who depend solely on scholarship or loan funds to shift from using private vehicles to public transports. In conjunction with that, the smoothness of transport services not only benefit the road users but even the government in settling issues of transportation such as accidents, jams and pollution. In this study, the public transport mainly focused on is the bus.

Table 1 Advantages of public transport**.** *Source:* Litman 2011 [4]

Mobility Advantage (Benefits from enhanced mobility for non-drivers)	**Efficiency Advantage** (Benefits from reduced car trips)
• Better and comfortable facilities for users • Direct benefit for the users from better mobility • Improving work and education opportunities • Equity objective (benefits for the disabled) • Value of choice (non-drivers have the choice to service)	• Reducing traffic jams) • Saving vehicular costs • Reducing the loads of chauffeuring • Reducing accidents • Increasing the public's fitness and health • Energy conservation • Reducing polluting emissions

2.0 BUS AS A PRIORITY

It is widely known that buses are like living pulses in the transit world. Until now, a vast number of places in cities worldwide make buses as the only mode of public transit of choice. Furthermore, there is not a single city in the world that does not have an operating transit service without buses.

Undeniably, buses provide a basic transport service in most of the places. Buses are able to carry a large load of passengers and offer an efficient and smooth service when given full attention. Sophisticated engineering or special skills are not needed to operate bus services and it is surely economical.

Buses hold a few advantages as a mod of transit, whether from its vehicular aspect itself or how and where it operates. The following lists why buses have the priority from its vehicular and service operation aspects [5].

2.1 Vehicle

2.1.1 Availability

Buses do not rely on state-of-the-art technology and it can be manufactured by many producers in many countries. Every day, numerous models from all sorts of producers offer a variety of specifications, available in the global market. But there is still a slight setback in spare parts, in which usually the spare parts have to be acquired from the manufacturer's country of origin. Nevertheless, this setback can be overcome by opening branches overseas.

2.1.2 Not Requiring A High Level of Research and Development (R&D)

Even though the technical improvements of buses are ongoing, and new elements are introduced from time to time, but this is quite a slow-evolving process. The existing buses are enough to fulfill the basic necessities of any, if not most, agencies or situation; and thus the demand for a special performance specifications will be a very rare event.

2.1.3 Not Requiring Special Skills or Work Force

Buses and diesel engines have long exist and have represented the basic technology all these while. They are very well-known to anyone who is involved in this field. Any truck foremen who understand engines can repair buses with a little extra training. Apart from that, rarely a mechanic in any place in this world does not possess that ability. As for the bus driving any Tom, Dick and Harry who has a driving license can learn to drive a bus with some specific training and practice.

2.1.4 Low-Cost Investment

Because buses almost everytime use existing urban roads, no extra expenditures are needed to build the transit lines. However, a small added budget should be allocated for preparing concrete pads (hardstands) at bus stops because the asphalt surface can creep and become wavy under prolonged heavy load in hot weather, not to mention other facilities in bus stops. But then again, it is not a big monetary issue. Other than that, the cost of the bus itself is fair, considering the long life and service expectancy of buses, estimated, as roughly, 12 years.

2.1.5 Energy Consumption

Buses offer a big opportunity to save fuel as compared to other mode of transportation due to the efficiency of the engine to generate power and considerably light chassis/body. Table 2 shows the rate of energy consumption of several modes of transportation.

Table 2 Energy consumption rate. *Source*: Grava 2003 [5]

Vehicle	**Btu/milage**
Cars	8360
Monorail	3080
Car pooling	2390
MRT	2320
LRT	2590
Buses	1420

2.2 Service Operation

2.2.1 Flexible Service

Bus service operations are very flexible as compared to rail-based mode of transport due to the fact that buses are not bound to metal rails or any kinds of guideway. Buses can move on any solid road surface. Besides, bus routes can change and shift without spending any extra capital. These criteria are very important for the ever-expanding or ever-changing society in distributing their main activities. Buses can offer a service that can tolerate with the demands of the public.

2.2.2 Long-distance Ability

Buses make frequent stops as passengers get on and off, but they can also go fast without stops. Long-distance ability is a key-criterion for express buses i.e: buses that operate between two distant districts and bypass alternate areas. On an open and uncongested route, buses are at par with transit trains in terms of speed.

2.2.3 Mobility

Even though buses are mammoths among vehicles, they can cope with almost all road configurations such as narrow streets, as long as motorised vehicles can fit into the paths and the drivers are competent. In certain circumstances, a smaller bus can be utilised.

2.2.4 Temporary Detour

An obvious ability possessed by bus services, not found in other modes of transit transport is that, buses can avoid temporary obstacles that can pop up in urban roads. Besides that, buses can overtake slower bus in front of them. On the contrary, rail-based

transport like trains, even a trolley carriage will get stuck at the back once an obstacle is found ahead of it. Individual buses are free to overtake or find other unobstructed roads.

3.0 PRECEDENT STUDY

With regards to the previous studies conducted by prior researchers on fuel price hike, most of the studies were on the relations of economic factors and traffic accidents. The results of those studies, conducted in advanced countries, found that generally, economic crisis lead to road safety improvements. This was due to the fact that when the economy was in a bad shape, a part of the commuters will cut down their travels in terms of frequency and distance or they will car-pool [6].

Apart from that, some researchers studied about the relation between fuel price hike and deaths from road-traffic accidents such as Grabowski & Morrisey [7]. The results of their study showed that the increase in fuel price had reduced the mortality in road accidents for car-users/motorists, but on the other hand, an increase was seen in motorcyclist mortality.

Meanwhile, Hyatt *et al.* [8] studied about the relation between fuel price increase with motorcycle accidents. The results of their study showed fuel price increase caused many people to shift to motorcycles as their main mode of transportation. This lead to more injury and death among motorcyclists. According to them, the rise in numbers of motorcycles on the road contributed to the increase in motocycle accidents in the period of their study. However, the study on fuel price factor and its relation to vehicle selection is still limited in numbers.

4.0 METHODOLOGY

This study was conducted at the main campus of Universiti Kebangsaan Malaysia (UKM) Bangi, Selangor. Respondents were students who settled in colleges in the main campus of UKM, Bangi, comprising of graduates and undergraduates.

In this study, the data collection method done on the respondents is by distributing questionnaire forms to faculties and institutes. The questionnaire forms are distributed especially to students who use cars and motorcycles as their main transport to their place of study. As the data was collected, a total of 150 respondents have answered and returned the questionnaires.

The data was then analysed using the logistic model analysis and linear regression analysis to develop the logistic model. Logistics functions that are commonly used in transport modelling is shown in Equation (1):

$$P = 1/(1 + De^{(\alpha x + \beta y)}) \quad (1)$$

Where, P is the probability,
x and y are independent variables,
α and β are the coefficients to be calibrated
D is a constant

5.0 DISCUSSION AND RESULTS OF STUDY

The datas obtained were classified according to the rate of fuel price increase for respondents who shift to public transport from private vehicles. From the datas also, they will be aggregated according to independent variables as follow:

i. Aggregating by percentage of all respondents based on options of fuel price to shift to public transport.
ii. Aggregating by percentage of all respondents based on type of vehicle used.

Furthermore, analysis will be done through plotting of graph and obtaining percentages from each data comparison. Table 3 shows the percentage of individuals who will shift to public transport referring to all individuals in relation to fuel price increase per litre (in RM). From this table, Figure 1 has been plotted and it is found that the percentage of shift increases, beginning when the fuel price reaches RM2.75. However, this shift does not reach 100% yet, even though the fuel price have reached RM4.00 a litre. This probably happened because of the many factors stemming from the desire to have the comfort using their own private cars.

Table 3 Shift Percentage based on varies fuel price

Probability Shift To Public Transportation			Fuel Price/Liter (RM)
Yes	**No**	**Shift Percentage (%)**	
8	142	5.33	2.00
24	126	16.00	2.25
42	108	28.00	2.50
81	69	54.00	2.75
102	51	68.00	3.00
118	32	78.67	3.25
139	11	92.67	3.50
143	7	95.33	3.75
150	0	100.00	4.00

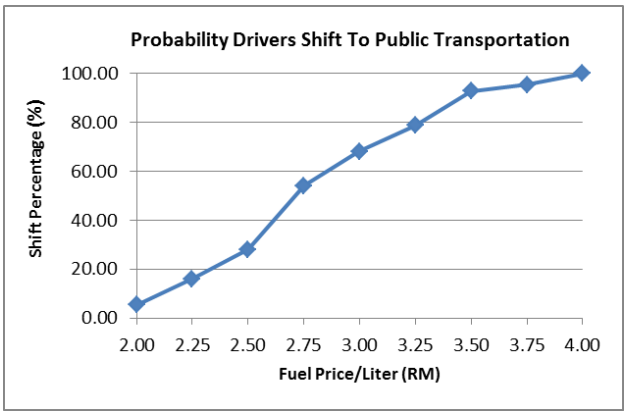

Figure 1 Probability drivers shift to public transportation

Meanwhile, Table 4 demonstrates the percentage shift for individuals who own cars and motorcycles who shifted to public transport in relation to the increase of fuel price per litre rate (in RM). From this table, Figure 2 and Figure 3 has been plotted and it is found that the percentage of shift increases. The results of the study shows that, sudden shift happens when fuel price per litre reaches RM3.75.

Table 4 Shift Percentage based on type of vehicle

Probability Drivers Shift To Public Transportation				Fuel Price/Liter (RM)
		Shift Percentage (%)		
Motorcycle	Car	Motorcycle	Car	
5	2	5.05	3.92	2.00
12	6	12.12	11.76	2.25
30	12	30.30	23.53	2.50
42	15	42.42	29.41	2.75
69	33	69.70	64.71	3.00
69	36	69.70	70.59	3.25
75	36	75.76	70.59	3.50
75	36	75.76	70.59	3.75
99	51	100.00	100.00	4.00

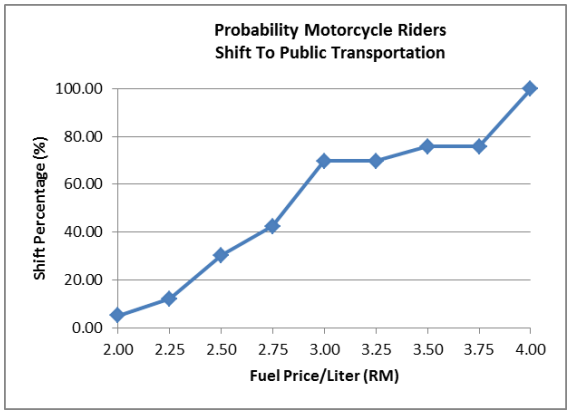

Figure 2 Probability motorcycle riders shift to public transportation

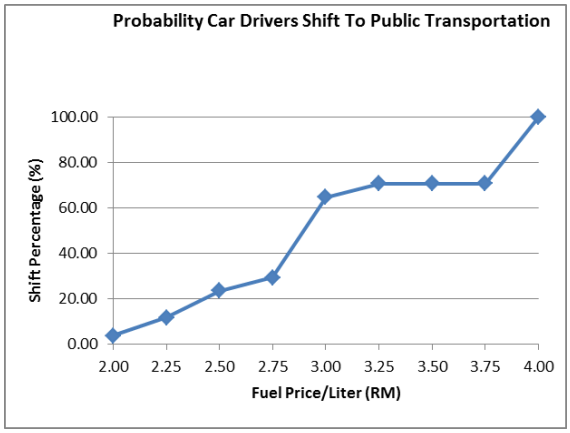

Figure 3 Probability car drivers shift to public transportation

6.0 CONCLUSION

In this study, the *stated preference survey* method was conducted upon all parties particularly the respondants who use private vehicles for trips in UKM's vicinity to produce the mode of transport shift model based on the fuel price increase factor. Even though there were many problems and obstacles especially during the process of data collection, the problems were managed to be overcome and the process was perfectly done.

In total, this study has successfully achieved its objective i.e: to obtain a model of mode of transportation shift, formed by using logistics function. This logistics function has been used for all conditions and types of variables aggregated for this study. For conditions of choice for individuals who shift according to the rate of fuel price increase per litre (RM), is stated in Equation (2):

$$P = 1/(1 + 1116.026644e^{-2.700843579x}) \quad (2)$$

For individuals who shift, using public transports based on the types of vehicle, those who use motorcycles is stated in Equation (3):

$$P = 1/(1 + 5629.315095e^{-2.970679448x}) \quad (3)$$

For individuals who shift, using public transports based on the types of vehicle, those who use cars is stated in Equation (4):

$$P = 1/(1 + 8768.108801e^{-3.047031472x}) \quad (4)$$

In general, this study has successfully achieved its goal and the study objectives in demonstrating the relation between the shift in mode of transportation with the rate of fuel price increase per litre (RM). Through this study, the rate of increase of fuel price according to the private vehicle of users can determine a percentage of users who will shift to public transports. Regardless, good moral ethics need to be the priority and principle held by every engineers apart from keeping other interests, such as people's characteristics and current situation, in mind.

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