Managing Congestion in Singapore—A Behavioural Economics Perspective

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Abstract

Behavioural economics—an emerging field of research that combines insights from psychology and economics—has significant potential in shaping many urban transport solutions today. Using case studies from Singapore's experience in managing road demand, this paper looks at how perspectives from behavioural economics can be used to complement traditional economic theory in explaining the impact of policy innovations in Singapore.

What is Behavioural Economics?

Economic analysis is an integral part of the decision making process in many government agencies. Standard economics however hinges on strong and narrowly defined assumptions about the rationality of individuals and organisations. In recent years, some of these assumptions have been called into question by an emerging field of study known as behavioural economics. Using insights that are drawn from cognitive and social psychology, behavioural economists have shown that, in many instances, human beings predictably behave in ways that can be very different from what is commonly assumed in standard economics.

Empirical findings from behavioural economics often turn up surprising and counter-intuitive results, and may suggest some novel ways for policy design today. This paper will look at some key findings from behavioural economics, and how these provide valuable alternative perspectives into some of Singapore's traffic demand management measures, such as the Area Licensing Scheme, Vehicle Quota System and Electronic Road Pricing system. A richer understanding of people's actual preferences and their responses to these measures can yield deeper insights into the outcome of these policies and provide fresh guidance on future policy designs.

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Area Licensing Scheme

Raising road charges from zero

The Area Licensing Scheme (ALS) was introduced in 1975 to manage congestion in the Central Business District (CBD). Under the ALS, motorists had to purchase a paper licence if they wished to enter a cordoned

area known as the Restricted Zone (RZ) during the morning peak hours. When it was first implemented, the ALS licence cost $3 for a day or $60 for a month.

Together with the introduction of ALS, the parking charges in the CBD and vehicle taxes were raised. The bus network was also enhanced to give commuters more travel options. Taken together, these measures resulted in an immediate 76% cut in the number of cars entering the RZ during licensing hours (Behbehani et al. 1984). Concurrently, the proportion of bus trips increased from 33% to 46% of inbound RZ trips. Transport researchers generally agree that the ALS was a success.

The standard consumer theory in economics undoubtedly provides one explanation for the drop in RZ-bound trips. By raising the price of a car trip while improving the substitutability of public transport to the car, demand for car travel into the RZ can be reduced. However, recent findings by behavioural economists suggest that more may be going on than just conventional economics alone.

A recent study by Shampaneir et al. (2007) on the power of "free" may be instrumental in advancing our understanding of how the ALS became so successful. Shampaneir et al. found that people strongly preferred free items, even when a better deal was available at a nominal cost. They demonstrated this effect through a series of experiments. In one experiment, people were given a choice between expensive Lindt chocolate truffles for 15 cents and ordinary Hershey kisses for 1 cent. Seeing a good deal, 73 percent went for the truffles. With another group, they dropped the price of both the truffles and the kisses by 1 cent apiece: 14 cents for the truffles and free for the kisses. Under these conditions, the authors found a significant switch in taste: 69 percent chose the free Hershey kisses instead (Table 1).

Table 1: Significant demand shift to a free item

% Choice	15c	1c	14 c	Free
Lindt Truffles	73%	-	31%	-
Hershey Kisses	-	27%	-	69%

This strong emotional attachment to zero cost is an inherent psychological trait with no forthright explanation from conventional economic theory. Based on standard cost-benefit analysis, there would be no change to the net benefits of both products and hence no change to the proportion choosing the truffles when the kisses were priced at zero. However, the results of the experiment showed that people saw zero as more than just another price.

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The power of "free" also suggests that once a free item is priced above zero, demand for that item could plummet significantly, more than what conventional economics would predict. Could this have happened in the case of the ALS? While it is difficult to attribute the 76% fall in car trips into the RZ to either

standard or behavioural economic forces in the absence of a suitable control, what we now know about the zero-price effect gives us some hints that standard economics is not fully accounting for the strength of motorists' aversion to the ALS.

Car pools provide another interesting perspective on the power of "free." As cars with a minimum of 4 persons were initially exempted from ALS charges, there was a 17 percentage point increase in the car pool market share, out of the total number of cars entering the RZ (Behbehani et al. 1984). Subsequently, the free car pool policy resulted in car pooling evolving in a rather unusual way. Drivers would pick up complete strangers at special car pool pick-up points in order to enter the city without paying ALS. Likewise, car poolers were willing to share car space with other strangers to get a free ride into the city. In the local context where Singaporeans loathe sharing vehicles with strangers, the power of free car pools appeared strong enough to convince a good number of people to overcome their reservations about car sharing[1].

The popularity of free car pools grew and became so attractive that they started to take away bus patronage. The Government eventually decided to abolish the ALS exemption for car pools in 1989 and by doing so, the era of car pools—Singapore-style—came to an end.

The policy conclusion for transport authorities is that the elimination of free roads has a definitive impact on drivers' behaviour. People are so attached to "free" that when roads are priced to manage congestion, travel patterns undergo significant shifts to mitigate the feeling of loss. Unfortunately, the corollary to the power of "free" is the difficult task of convincing car users to give up "free" use of the roads in the first place. The numerous abortive attempts around the world to introduce congestion charging underscore this point.

Vehicle Quota System

Fairness in auctions

In 1990, Singapore introduced a Vehicle Quota System (VQS) to rein in the rapid growth in the vehicle population. Under the VQS, a person who wishes to buy a new car must first obtain a Certificate of Entitlement (COE). The number of COEs available each year is determined by the allowable annual vehicle growth rate. This was fixed at 3% from 1990 and reduced to 1.5% from May 2009.

With a limited supply of COEs, standard economics would prescribe an auction mechanism to allocate the COEs efficiently. But it appears that the general population is not just concerned about economic efficiency alone. Indeed, people dislike the idea of auctions as Kahneman et al. (1986) discovered when they polled 191 adult residents of Vancouver for their response to the following situation:

Due to the popularity of a football team, there is now a shortage of tickets to the next match. The organizers can elect to sell tickets in the

following ways. (1) By auction: The tickets are sold to the highest bidders. (2) By lottery: The tickets are sold to the people whose names are drawn. (3) By queue: The tickets are sold on a first-come-first-served basis.

When asked to rank the three allocation methods in terms of fairness, a large majority of the respondents thought that the queue was the most fair and the auction was the least fair, as shown in Table 2. This preference is opposite to a ranking by an economic efficiency criterion, which would put the auction above the lottery above the queue.

Table 2: Ranking of allocation methods

Allocation Method	Most Fair (%)	Least Fair (%)
Auction	4	75
Lottery	28	18
Queue	68	7

Kahneman et al. concluded that the findings seem to be driven by some general rules of fairness that are held in common by a community. One of these rules states that it is unfair for someone to exploit an increase in market power at the direct expense of someone else.

This rule of fairness is not simply seen in a Western context. During the early stages of the COE debate when the feasibility of using an auction to allocate the COEs was discussed, the Singapore public likewise raised concerns that those who could afford bigger luxury cars would use their superior "market power" to outbid small car buyers.

What was the policy response to these concerns? Firstly, conventional economics still prevailed. A competitive bidding system was adopted, with all successful bidders paying the lowest successful bid price[2]. Nevertheless, to address the social equity concerns, a decision was taken to classify vehicles into different categories, as follows:

- Category 1: Small cars (engine capacity of 1,000 cc and below)
- Category 2: Medium-sized cars (engine capacity of 1,001cc to 1,600 cc)
- Category 3: Big cars (engine capacity of 1,601 cc to 2,000 cc)
- Category 4: Luxury cars (engine capacity of 2,001 cc and above)
- Category 5: Goods vehicles and buses
- Category 6: Motorcycles
- Category 7: "Open" (for any kind of vehicles)

Each category had its own COE quota and COEs obtained under one category could only be used to buy vehicles from that category[3].

The VQS example illustrates a more general principle about policy making in Singapore. While the conventional economic prescription may guide the overall policy direction, behavioural economics often has a useful role in tailoring the solution to better suit the needs and aspirations of the population. Hence, although having a single COE category is economically more efficient, separate categories were introduced to improve public acceptance of the scheme and to address concerns of social equity[4].

Electronic Road Pricing System
From sunk costs to variable charges

The transition in 1998 from the ALS to the Electronic Road Pricing (ERP) system signalled a fundamental shift in Singapore's road pricing strategy. The manual ALS system charged motorists a fixed fee for the day or the month, regardless of actual usage. The ERP, on the other hand, provides greater flexibility for the congestion charges to be fixed based on different locations and times of the day, depending on the prevailing traffic condition. It is also based on a pay-as-you-use principle, where the congestion charge is instantaneously deducted from a stored-value card in an In-vehicle Unit (IU) every time the vehicle uses a priced road (Chin and Menon 2004).

From what we know of people's behaviour, charging a fixed fee—as in the case of the ALS—may lead to more, rather than less, consumption. This is termed the "sunk cost effect"—the tendency to continue in an activity once an investment of time, money or energy has been made. Standard economics states that sunk costs are irrelevant to current decisions and should therefore not be taken into account. However, it appears that people routinely do the opposite, as Arkes and Blumer (1985) discovered.

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In one experiment, people buying season tickets to a theatre group's performance were randomly given one of three different classes of tickets: full-priced tickets at $15, tickets with a small $2 discount and tickets with a sizeable $7 discount. If these people were to behave like homo economicus (rational man) and weigh the marginal costs and benefits of attending each play, then the average number of plays attended should not differ across the three groups as the discounts were randomly assigned. However, what Arkes and Blumer found was that those who paid full price, i.e. a higher sunk cost, attended significantly more plays than the other groups, at least in the first half of the season.

Table 3: People who paid higher sunk costs attended more plays

Types of tickets	Average number of plays attended
Full price ($15)	4.11
$2 discount	3.32
$7 discount	3.29

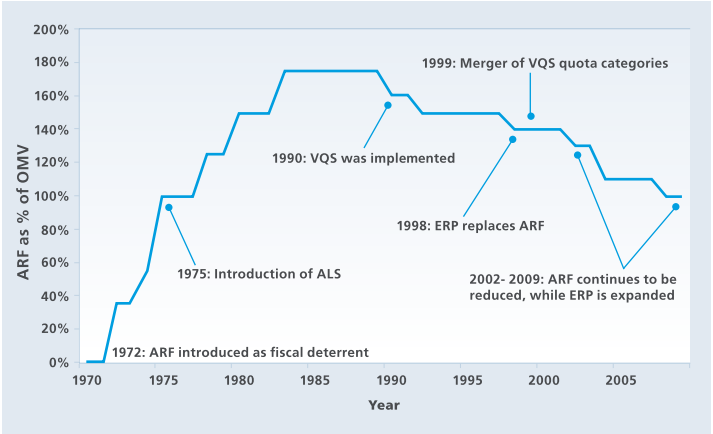
Viewed from this perspective, designing the ERP on a pay-per-use principle is thus a better option, compared to fixed fee charging like the ALS. As seen in the Arkes and Blumer experiment, the latter option might encourage even more consumption of limited road space. Likewise, because sunk costs matter, the high fixed cost of car ownership can be inimical to our objective of restraining car usage. Thus, instead of simply relying on high car ownership cost to manage congestion on the road, the Government has been reducing vehicle taxes and shifting more towards usage charges (through the ERP) to manage the demand for road space. *Figure 1* traces

changes to the Additional Registration Fee[5] for cars. It illustrates the Government's move to rely less on fixed ownership cost to manage congestion with the introduction of VQS and subsequently, ERP.

Indeed, from 1998 to 2007, the average ownership cost of a medium-sized car dropped by about 40%, while average usage cost increased by only about 20%. This means that motorists are paying less today to own and use a car, compared to 10 years ago. Yet, traffic on the road continues to be relatively smooth flowing, showing that demand can in fact be effectively managed with lower fixed costs and higher usage charges.

Nevertheless, owning a car is still a substantial investment even without the taxes. There is thus an inherent tendency for the car owner to maximise its usage once the car is bought. Hence, the Government thinks it is important to strike a balance between using ownership control and implementing usage charges to manage overall road congestion.

Figure 1: Changes to Additional Registration Fee for cars from 1972 to 2009



…..the experience of 'having the meter running' is generally unpleasant … as it is both salient and directly linked to the consumption activity.

Refining the ERP System

Making charges more salient

Behavioural economists have observed that people use cognitive processes known as "mental accounting" to record their financial transactions and assign activities to specific accounts (Thaler 1999). In particular, if payment is decoupled from consumption, i.e. put in separate mental accounts, the perceived cost of consumption is reduced and this encourages more consumption, as in the case of the credit card. Conversely, the experience of "having the meter running" is generally unpleasant to most people as it is both salient and directly linked to the consumption activity. For example, Thaler (1999) notes that many car owners would be financially better off selling their cars and taking taxis to the supermarket. But this is rarely done because paying $10 for each taxi trip seems to raise the cost of groceries in ways that paying off a monthly car loan does not.

With this insight, one way to enhance the effectiveness of ERP is to make ERP charges more salient i.e. make people take greater account of the charges. To this end, the

LTA has installed real-time electronic display of ERP charges at all gantries since 2008 (*Figure 2*). This is expected to raise motorists' awareness of the actual cost of a trip and help them make a considered decision, for example, whether to shift some trips to a less congested time period where the ERP charges are lower or zero.

The next generation In-Vehicle Units (IUs) will also help to make ERP charges more salient to the motorist. Unlike the current IUs which only display the balance in the stored-value card, the new IUs will display the actual charge incurred every time the vehicle passes under an ERP gantry.

Figure 2: ERP grantry with real-time display of ERP charges

Conclusion

Behavioural economists have made much progress in recent years in understanding the psychological basis for our human preferences and tendencies. Unlike standard economic theories which have an established history of influencing policy debates, behavioural findings are only just beginning to make inroads into the public policy domain. As these become more widely understood and accepted, behavioural economics surely represents a rich body of insights for the design of effective, bold and innovative policies for the future.

Notes

1. As an example of how strangers are generally reluctant to share space in the same car, a scheme to encourage taxi sharing among taxi users heading in the same direction did not enjoy a high take-up rate and was eventually discontinued.

2. When the COE open bidding system was introduced in 2002, some changes were made to the auction process and successful bidders pay the highest unsuccessful bid price + $1.

3. The exception is the "Open" category whose COE can be used to purchase any type of vehicle. This is meant to give the VQS greater flexibility to respond to changing demand for different types of vehicles.

4. A government committee recommended in 1999 to consolidate the four car categories into two, quoting examples of economic inefficiencies associated with too many quota categories. See "Report of the Vehicle Quota System Review Committee" (March 1999) at http://www.lta.gov.sg/corp_info/doc/VQS%20Review%201999.pdf.

5. The Additional Registration Fee (ARF) was introduced in 1972 as a fiscal deterrent to curb the growth in car population. It is pegged to a certain percentage of the car's assessed value i.e. its Open Market Value.

Acknowledgements

We would like to acknowledge the helpful comments provided by Jack Knetsch, Emeritus Professor of Economics at Simon Fraser University. We also wish to thank Mageret Ely and Teo Yee Lan from the Policy and Planning Group in LTA for their assistance with the data and charts in the paper.

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