What happens when petrol goes up or buses go down?

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ABSTRACT

When petrol prices rose 26% (to $2.18 per litre) in mid-July 2008 compared with mid-February prices, traffic volumes dropped 7% over the same period on the Auckland Harbour Bridge.

In October 2009, one of the city's major suppliers of bus services had an industrial stoppage and over 100,000 passengers per day were left having to find other transport options for a week. Cycle traffic on Tamaki Drive (one of the routes used by the buses affected by the stoppage) increased 15% over this period.

This paper explores various data sets that illustrate transport cross-elasticities. The measures reported here suggest that the extent to which people are willing to change travel behaviour in the face of rapid changes in fuel price or travel mode availability may be greater than previously estimated.

It will be important for urban planners, transport planners and decision makers to consider such behavioural responses to provide a more resilient transport system over the strategic planning horizons used in this country.

1 INTRODUCTION

This technical note takes an opportunistic look at two events over the last two years where significant numbers of people made different transport mode choices. The first of these was in mid-2008, when petrol prices increased rapidly and reductions in motor vehicle traffic across the Auckland Harbour Bridge were recorded.

The second was in October 2009 when NZ Bus services in Auckland were disrupted for a week through an industrial dispute. At the same time, cycle traffic on Tamaki Drive increased noticeably, albeit from a small base.

This brief paper looks at travel behaviour exhibited by car drivers and bus passengers when their chosen mode becomes rapidly more expensive or non-existent and draws simple conclusions about travel mode cross-elasticities. A cross-elasticity is a measure of the responsiveness of the demand for a good to a change in the price of another good. Elasticities which explain travel behaviour can inform transport planners, urban planners and decision makers. Further more rigorous analysis may be beneficial.

Cycle and bus are relatively minor modes of travel for the trip to work of Auckland City residents, with 1.6% cycling and 9.3% travelling by bus compared with 79% who drive or travel as car passengers, according to the 2006 Census. Some 8% walk to work.

2 WHAT HAPPENS WHEN PETROL GOES UP?

Background

In the 2007 Land Transport New Zealand Research Report 331 “Impacts of Fuel Price Changes on New Zealand Transport”, Kennedy and Wallis summarise relevant international transport economics literature and analyse long term national datasets. The elasticities suggested by Kennedy and Wallis were based on data collected before the pronounced 2008 fuel price rises.

Kennedy and Wallis (2007) derived "short-run" (less than one year) and "long-run" (greater than 5 years) elasticities for vehicle kilometres travelled (VKT) relative to fuel price increases of -0.12 and -0.24 respectively.

Australian and New Zealand elasticities are generally considered to be amongst the lowest in the world, perhaps due to the absence of competitive alternative travel modes such as public transport, cycleways and walking facilities. There is also a strong "car culture" present in Australia and New Zealand relative to Europe.

Trends in 2008

Petrol and diesel prices increased steadily during 2008 to July, then fell. Figure 1 shows the rise and fall of petrol prices relative to the price of petrol for the week ending 15 February 2008 ($1.68 per litre), from February to December 2008. Also shown on the graph is the fluctuation in motor vehicle traffic volume on the Auckland Harbour Bridge (AHB), normalised relative to the weekly traffic volume in mid February (1,147,000 motor vehicles per week).

This analysis shows that as the price of motor vehicle fuel rose to mid July 2008, traffic volumes generally declined, and vice versa for the second half of the year. These data confirm that motorists are sensitive to the price of fuel.

In response to a 26% increase in the price of fuel between mid-February and mid-July, AHB traffic volumes decreased by 7%, indicating a cross elasticity of -0.28. For every 10% increase in petrol price, motor vehicle traffic volumes appear to have declined by 2.8%.

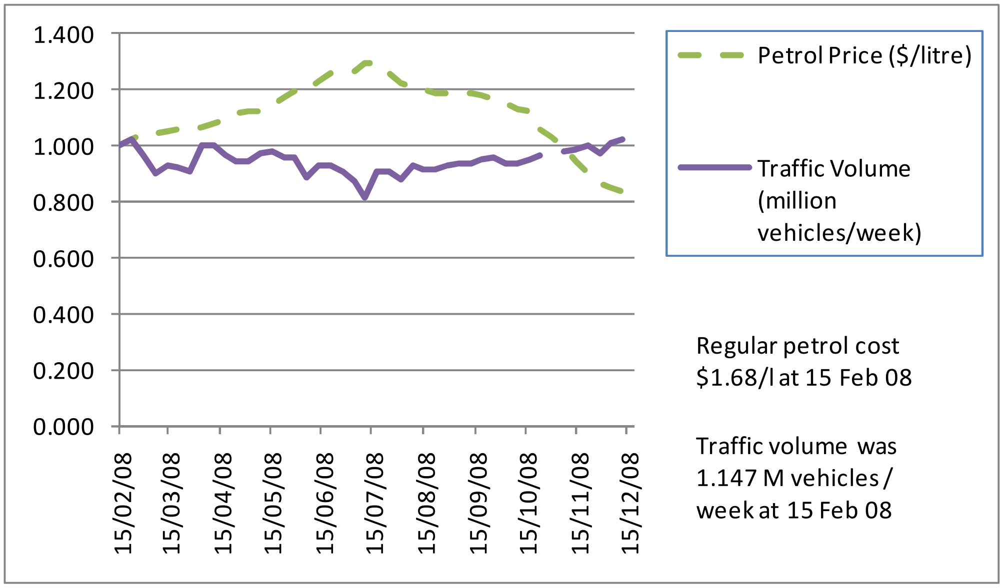

Figure 1: Petrol Prices and AHB Traffic 2008

Oil prices measured in June 2009 dollars and adjustment for inflation peaked in the USA in June 2008 at about US $125 per barrel (monthly average), somewhat higher than the previous high in December 1979 (US $107). Fuel prices now (approximately US $80 per barrel) are higher than at any time since about 1981. Figure 2 shows the inflation adjusted price of crude oil (in US dollars) over the last 65 years.

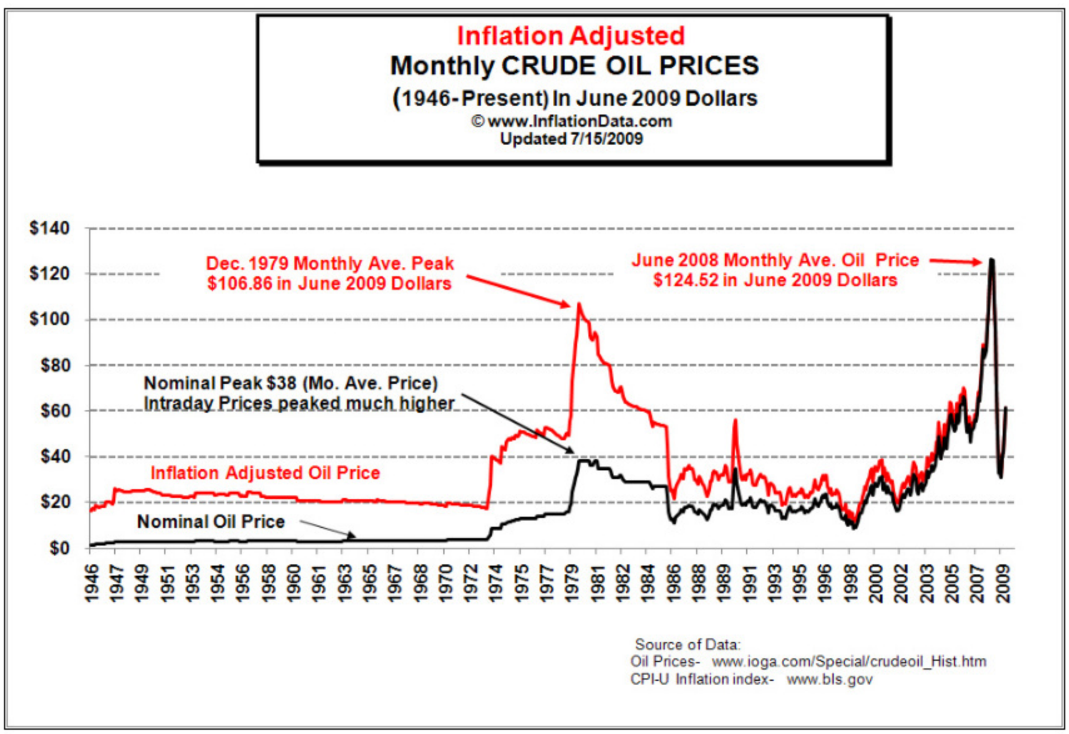

Figure 2: Inflation-Adjusted Crude Oil Prices 1946 to 2009

The price of oil has increased since this graph was produced and has stabilised at around US $75 per barrel.

Discussion

Possible explanations for the higher elasticity observed in New Zealand are the recent significant investments in Auckland public transport (the Northern Busway opened in February 2008) and the potential that a psychological trigger point was reached when petrol price exceeded $2.00 per litre during the analysis period.

Generally, it is assumed that technological advances to replace oil will obviate the need for large scale reallocation of transport and urban planning priorities. However, should such advances not be sufficiently practical, scalable or cost-effective, it is instructive to consider the increasing volatility in the oil markets as they relate to the elasticities described above.

So what is likely to happen when fuel prices increase again? Factors that influence the likelihood of car drivers changing their travel behaviour, travel mode or fuel choice in response to increased fuel prices can be summarised as:

1. Whether there are many substitutes (for example, more fuel-efficient vehicles, cheaper alternate fuels, public transport, car-pooling, HOV lanes, walking or cycling);
2. Whether these substitutes are readily available and perceived as safe, attractive and convenient;
3. Whether fuel is a considered a luxury that consumers can do without;
4. Whether fuel is important in terms of the proportion of income spent on it; and
5. Whether the consumer has had ample time to search for substitutes.

Some of these factors are within the power of governments to influence. For example, central, regional and local government can support the establishment of good public transport systems and cycling facilities, vary fuel taxes or even charge for the use of roads.

Consumers are increasingly aware of the likelihood of future fuel price increases, through media coverage of "peak oil", potential carbon taxes and the emissions trading scheme. Longer term individual and family decisions (such as residential and employment locations and the need for a second car) can be made, to reduce fuel and transport dependency.

New Zealand is at the end of the global fuel supply chain and it would be good government policy to create a more resilient transport system. National, regional and local government all have parts to play. With 79% of the workforce using cars to get to work in Auckland City (and nearly 87% for the Auckland Region), we clearly are vulnerable to fuel price rises and potential supply interruptions. Investment in travel demand management, walking, cycling, public transport and good urban form (integrated land use and transport planning) are more important now than ever.

3 WHAT HAPPENS WHEN BUSES GO DOWN?

Background

Rather than establish the cross elasticity of demand generated by changes in price, as in the previous analysis, we have attempted to establish whether, as a result of a change in availability of one mode (riding the bus), there is a change in demand for a substitute mode (cycling). Where public transport is unavailable, mode shift elasticities tend to be based on stated preference surveys rather than empirical evidence. Litman (2008) reports on two surveys from the U.S. where 4% and 8% of respondents indicated they would take up cycling if public transport were unavailable.

Trends in October 2009

Between Thursday 8 October 2009 and Wednesday 14 October 2009 inclusive, NZ Bus experienced an industrial stoppage and no NZ Bus buses were in operation. NZ Bus has bus service contracts for the majority of Auckland, including all routes traversing Tamaki Drive to the eastern suburbs. School holidays (Mon 28 Sep to Fri 9 Oct inclusive) overlapped with the bus stoppage. Approximately 4,000 bus passenger trips per weekday occur on Tamaki Drive.

Cycle traffic volumes on Tamaki Drive before, during and after the bus stoppage were analysed to see if there was an effect on cycle use. Cycle traffic volumes were obtained from ARTA's automatic cycle counter on Tamaki Drive. Counts for the north side shared path (both directions of travel) and the eastbound cycle lane were combined for this analysis. Only weekdays were analysed. Tamaki Drive is a principal leisure and sports cycling route on weekends and these types of cycling are not substitutes for bus travel.

Scaling methodology developed for the Cycle Network and Route Planning Guide (LTSA, 2004) and recently updated with Auckland specific factors was applied to the raw data to normalise for weather and school holidays. Hourly weather data obtained from the Grey Lynn weather station historical database was referenced to determine which days should have the rain scaling factor applied. Days where only light showers occurred were not classified as rain days, and the data show that on these days cycle volumes were only slightly lower than on days with no precipitation.

As the scaling methodology was developed to translate a single sample of cycle traffic into an average annual daily traffic (AADT) figure, the application of scale factors to multiple days would be expected to yield a relatively consistent daily traffic volume and any non weather or holiday related variation should be readily apparent. Developed to represent an entire school term, the week of year scale factors were reduced slightly to account for the shorter analysis time frame, closer to the transition between one time period and another relative to the school terms and holidays.

The bars in Figure 3 represent weekday average cycle traffic volumes over seven weeks, scaled as described previously. A week has been defined as Thursday to Wednesday in order to compare the stoppage period (shown in red) against prior and subsequent weeks.

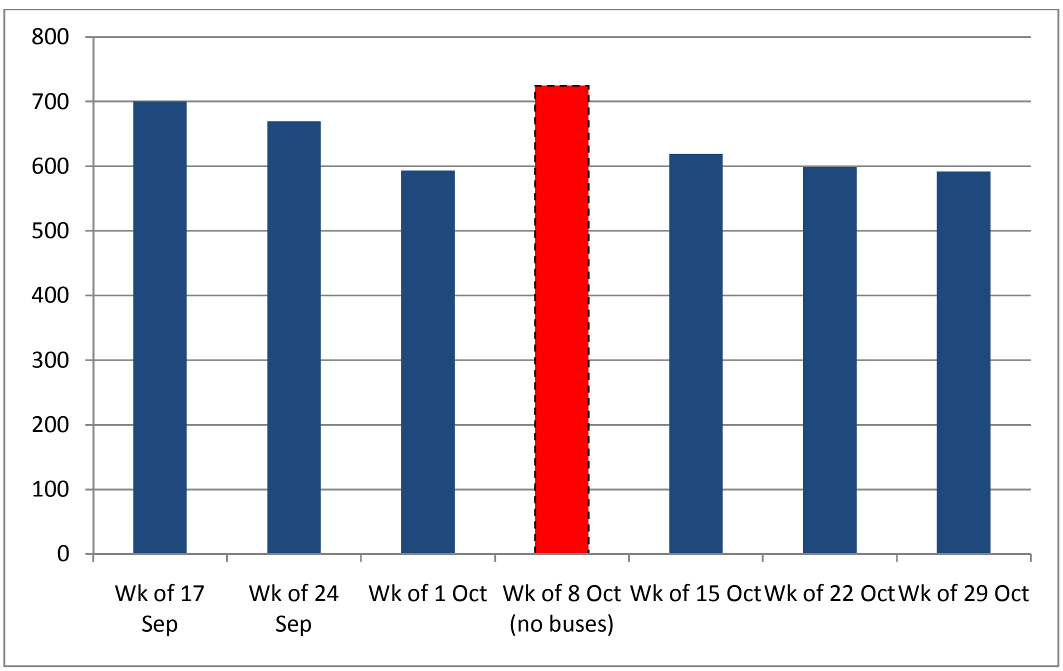

Figure 3: Tamaki Drive Average Weekday Cycle Traffic

This analysis shows that for the week of the bus stoppage, cycle traffic was 15% higher than the average weekday cycle traffic during the six shoulder weeks (three before and three after). Statistical t-test analysis indicates that this is a significant difference only at the 86% confidence level. However, it is suggested that some bus patrons probably used bikes to commute during the stoppage. Evidence from other sites would have been useful, reinforcing the merits of having a robust cycle traffic monitoring programme with a selection of continuous counting sites.

A mode shift cross elasticity between buses and cycles was estimated using the following assumptions. About 4,000 people per day normally use buses on Tamaki Drive (or perhaps 2,000 who use the bus in each direction), but the numbers of bus passengers transferring to cycle during the stoppage appears to be low. Approximately 100 additional cyclists per day (or perhaps 50 in each direction) used Tamaki Drive during the stoppage, suggesting that only 2.5% of people who otherwise use the bus chose to cycle during the stoppage. Thus Auckland bus passengers do not appear to consider cycling as a viable alternate travel option.

As an aside, NZ Bus patronage figures for Auckland (city wide) were analysed for the three weeks prior and three weeks post stoppage in an effort to determine any trends (Figure 4).

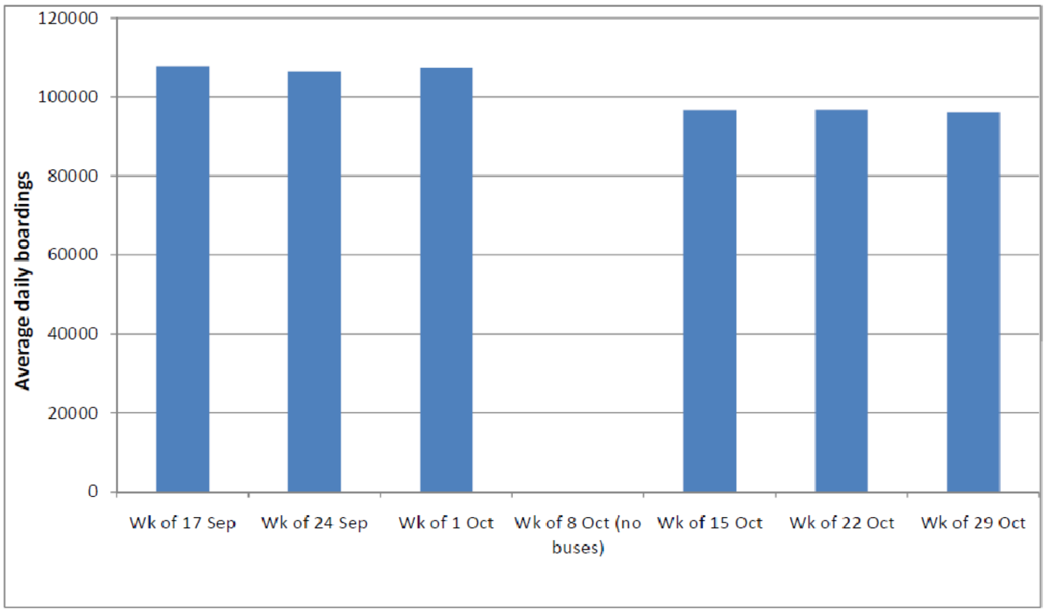

Figure 4: NZ Bus Patronage

For the three weeks after the stoppage, the average patronage was 11% lower than the three weeks prior. Statistical t-test analysis showed that the means of the before and after data are significantly different at the 95% confidence level. The difference may indicate that some patrons chose to remain with their new travel arrangements.

4 CONCLUSIONS

Analysis of the Auckland Harbour Bridge traffic data referenced against petrol prices show a negative cross elasticity of 28% through the first half of 2008. This is relatively elastic compared to other estimates and suggests that further work on fuel price elasticity for New Zealand may be warranted since the fuel price changes of 2008.

It is probable that up to 2.5% of Tamaki Drive bus patrons used bikes to commute during the bus stoppage of October 2009. For Auckland, this may reflect the more likely behaviour of bus patrons when services are withdrawn relative to estimates derived from stated preference surveys. Further research could include the analysis of cycle traffic in cities where cycle commuting is a more likely substitute for public transport than in Auckland (e.g., Christchurch). Another area for further research could be determination of motor vehicle traffic elasticities with respect to substantial variations in public transport supply.

REFERENCES

INFLATIONDATA.COM (2010) Inflation adjusted crude oil prices, http://www.inflationdata.com/inflation/images/charts/Oil/Inflation_Adj_Oil_Prices_Chart.htm accessed 14 Jan 2010.

STATISTICS NZ (2006) Census. www.stats.govt.nz/census/default.htm. Wellington, Statistics New Zealand.

KENNEDY, D., WALLIS, I. (2007) Impacts of fuel price changes on New Zealand transport. *Land Transport New Zealand Research Report 331*. Wellington, Land Transport New Zealand.

NZTA (2009) Auckland Harbour Bridge traffic volume data. New Zealand Transport Agency

ITS (2009) Tamaki Drive cycle count data. Integrated Traffic Solutions Limited

NZ Bus (2009) Patronage data. NZ Bus

LITMAN (2008) Transport Elasticities. Retrieved from: www.vtpi.org/elasticities.pdf

LTSA (2004) Cycle Network and Route Planning Guide. Wellington, Land Transport Safety Authority.

WEATHER UNDERGROUND (2010) Historical weather data for Grey Lynn weather station, http://www.wunderground.com/global/stations/93119.html accessed 9 Jan 2010.