# 1. Macroeconomic Effects of Petrol Prices

Don Harding[1]

1.0 Introduction

This article examines the likely size and nature of the macroeconomic shock(s) delivered to the Australian economy by the recent increases in world oil prices. Detail on the oil price rise and its implications for the price paid by consumers is provided in Section 5.2 below. Oil price hikes are often thought of as a typical supply shock. In Section 5.3 I argue that in certain circumstances oil price hikes can also act as an aggregate demand shock. Section 5.4 is concerned with the task of testing for the presence of, and measuring the size of, this petrol price-related demand shock. In section 5.5 I discuss the macroeconomic policy implications.

1.0 Magnitude of the Oil Price Rise

As can be seen from Figure 30, world oil prices have risen by $US19 per barrel from the previous trough in December 1998, and by $US12.50 per barrel over the average price of $US19.50 per barrel for the period March 1987 to September 2000. In nominal terms world oil prices are now at about the same level as they were during the Gulf War.

**Figure 30: West Texas Intermediate Crude Oil, Spot Price $US/Barrel**
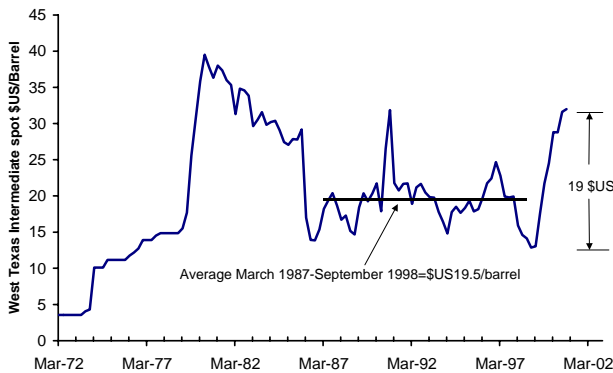
Source: Datastream.

The real price to the Australian consumer of automotive fuel increased by 28.6 percent between the March quarter 1999 and the December quarter 2000 (see Figure 31). Most of that increase (16.2 percentage points) occurred between the December quarter 1999 and the December quarter 2000. Thus, in real terms the price of automotive fuel faced by the Australian consumer is comparable to prices paid during the Gulf War. However, the current shock is now more long-lived than the Gulf War shock and therefore is potentially more serious than that event.

**Figure 31: Real price to consumers of Automotive fuel, index 1989-90=100**
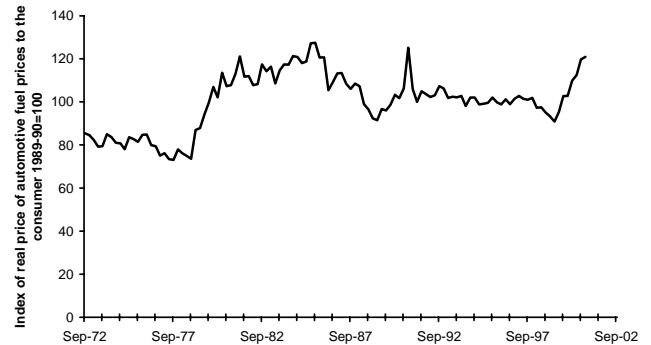
Source: ABS cat. no 6401.0. Consumer Price Index Australia

1.0 Circumstances in which Oil Price Hikes Create Both Supply *and* Demand Shocks

Since the 1970s, macroeconomists have recognized that commodity price rises can cause firms to raise the price of goods relative to wages. In standard macroeconomic analysis this is described as an aggregate supply shock. A diagram found in introductory texts can be used to illustrate the analysis. In Figure 32 the aggregate price level is on the vertical axis and output is on the horizontal axis. In this diagram a supply shock has the effect of shifting the long-run aggregate supply curve to the left. The higher price level asked by firms results in a lower level of output. This new equilibrium is reached via a process of inflation and declining output (stagflation).[11] The exact nature of that stagflation will depend on: how rapidly the short-run aggregate supply curve (not shown on Figure 30) shifts to the left; its slope; and the slope of the aggregate demand curve.

Figure 32: Stylised representation of an oil shock in aggregate supply and demand diagram
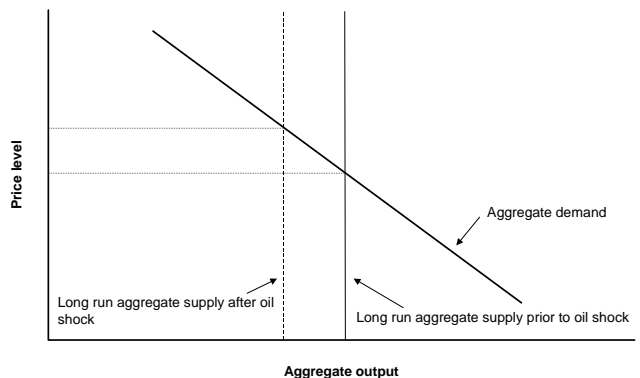
---

In the standard analysis outlined above, the aggregate demand curve is not affected by oil prices because consumers are assumed to be forward-looking and able to smooth consumption by borrowing and lending. Thus, consumption is proportional to real wealth (assets plus the expected present value of the discounted stream of future income). However, it is questionable as to whether all households can borrow and lend. Some may be liquidity-constrained while others may engage in so-called buffer stock saving (i.e. they have a small buffer of saving that they use in the event of sharp falls in income or emergency spending needs).[12]

Liquidity constraints and buffer stock saving behaviour require us to modify standard analysis in the following way. Those households that are liquidity-constrained are restricted to spending no more than current income, while those with a buffer stock are restricted to consuming no more than the sum of income and the buffer. Thus, for such constrained households, consumption moves with real income. Evidence on the proportion of Australian households that might be liquidity-constrained or buffer stock savers is provided in section 5.3.1 below.

Real income is affected by wages, employment, hours worked and the prices of goods and services that people consume. For goods with volatile prices the extent of the effect on *aggregate* real income depends on three factors:

the extent to which the good in question is in widespread use and its share in total household expenditure. For evidence on this see section 5.3.2;

substitution possibilities. For example, volatility of fresh food prices might not have much influence on real income for liquidity-constrained households because they can substitute canned and frozen food for fresh food. For evidence on this see section 5.3.3; and

the magnitude of the price rise. For evidence on this see section 5.4.

1.0.0 Evidence on the proportion of households that are either liquidity constrained or buffer stock savers

Some indication of the proportion of households which are liquidity constrained or buffer stock savers can be obtained from the ING-Melbourne Institute Household Saving Survey. Table 33 reports some evidence from that survey that casts doubt on the hypothesis that consumption is proportional to wealth. First, there is an unusually high proportion of people reporting that they are "managing to make ends meet on their income" (38.7 per cent) or "saving a little" (37.7 per cent) and an unusually small proportion of households reporting that they are "running into debt" (4.0 per cent), "having to draw down savings" (8.6 per cent), or "saving a lot" (9.2 per cent). Given that earnings profiles rise with age one might have expected to observe:

a higher proportion of respondents running into debt or drawing on savings;

a higher proportion of respondents reporting that they are saving; and

fewer households reporting that they are making ends meet on their income.

Thus the survey evidence is consistent with the alternative hypothesis that significant proportions of the population are either liquidity-constrained or buffer stock savers. In short, there is evidence that one of the necessary conditions for petrol price shocks to affect aggregate demand is met.[13]

Table 33. Financial situation of households, March quarters, 1999–2001 (per cent)

Household situation	1999	2000	2001
Running into debt	3.5	3.3	4.0
Having to draw on our savings	5.8	5.5	8.6
Managing to make ends meet on our income	42.7	38.6	38.7
Saving a little	37.8	41.0	37.7
Saving a lot	8.9	8.3	9.2
None/Don t know	1.2	3.3	1.9
Total	100	100	100

Source: ING-Melbourne Institute Household Saving Report, March quarter 2001.

5.3.2 The importance of automotive fuel to consumers

The motor car is the main form of personal transport in Australia. In the March 2001 Melbourne Institute Consumer Sentiment Survey some 82.9 per cent of households reported that the car/utility was their main form of personal transport.[14] Public transport was the main source of transport for only 14 per cent of households.

Table 34: Proportion of households using main types of transport

Type of transport	Per cent of population
Car/ utility	82.9
Motor bike	0.2
Public Transport	14.0
Other eg push bike, walk to work	2.3
Don t know	0.6
Total	100.0

Source: Melbourne Institute Survey of 1400 households conducted 8-11 March 2001

Unsurprisingly, unleaded petrol is the main fuel used for personal transport (62.4 per cent of households), leaded petrol is used by a further 10.7 per cent of households, other fuels account for a further 9.3 per cent of personal transport needs, and some 17.1 per cent of households reported that they used no fuel for personal transport (i.e. they used public transport, bikes, taxis etc for their needs). See Table 35.

---

[12] For explanations of these phenomena see, for example, Shefrin and Thaler (1988), Deaton (1991), Carroll (1992), Carroll and Summers (1991), Hubbard, Skinner and Zeldes (1994).

[13] Evidence that a significant proportion of US households also hold little financial wealth is provided by Mankiw and Zeldes (1991).

[14] Details of the Melbourne Institute survey are provided in Appendix.5A.

Table 35: Main fuel by household (per cent of population), March 2001.

Type of Fuel	Per cent of households
Leaded petrol	10.7
Unleaded petrol	62.4
Diesel	3.8
LPG	4.2
Other	1.3
Don t know	0.5
Don't use fuel for personal transport	17.1
Total	100.0

Source: Melbourne Institute Survey of 1400 households conducted 8-11 March 2001

Petrol accounts for between 2.6 and 5.7 per cent of household expenditure while total expenditure on fuels and lubricants varies from 2.8 per cent to 5.9 per cent of household expenditure. As might be expected, petrol and lubricants are a much larger share of expenditure for poor households than for rich households. This is particularly important because poor households are more likely to be liquidity-constrained and thus, petrol price shocks are more likely to shift aggregate demand than are price shocks to goods that are not as intensively used by low-income households. See Table 36.

Table 36: Expenditure shares on fuels and lubricants by expenditure decile, 1998/99 (per cent of household expenditure)

Expenditure decile	Petrol	Diesel	LPG	Other fuel and lubricants and additives	Oils lubricants	Total
1	5.65	0.10	0.09	0.02	0.13	5.98
2	5.30	0.09	0.19	0.02	0.13	5.74
3	4.74	0.22	0.14	0.01	0.11	5.21
4	4.54	0.18	0.33	0.01	0.11	5.18
5	4.12	0.18	0.19	0.03	0.12	4.64
6	4.23	0.19	0.13	0.02	0.14	4.72
7	3.86	0.18	0.12	0.03	0.10	4.30
8	3.51	0.14	0.15	0.05	0.07	3.92
9	3.06	0.15	0.10	0.04	0.06	3.42
10	2.56	0.16	0.06	0.02	0.04	2.84

Source: Australian Bureau of Statistics: catalogue No. 6544.0.30.331 Household Expenditure Survey 1998-99, Australia: Confidentialised Unit Record File on CD-ROM

5.3.3 Evidence on the capacity of consumers to substitute away from petrol

Automotive fuel and lubricants have few substitutes and are dangerous to store, making it difficult for consumers to even out the effect of price fluctuations in those goods. Increased use of public transport is one avenue for substitution. However, the capacity of households to substitute public transport for automobile transport is limited by current infrastructure; public transport is not readily available in rural areas nor in much of the urban fringe. Nonetheless, public transport accounts for an

important component of the expenditure of low-income households (see Table 37) and could provide such households some scope to limit the adverse affect of petrol price increases. But in present circumstances this option is unattractive because public transport is one of the two "transport" components of the CPI where prices have increased by more than fuel costs.[15] See Figure 33. Thus, rather than being protected by the availability of affordable public transport, low-income households have seen its price rise relative to private transport.

Table 37: Household expenditure shares on public transport and taxi fares, (Per cent of household expenditure) 1998/99

Expenditure decile	Public transport	Taxis	Total
1	0.99	0.61	1.59
2	0.60	0.22	0.83
3	0.51	0.27	0.78
4	0.56	0.14	0.71
5	0.55	0.15	0.70
6	0.48	0.18	0.65
7	0.52	0.17	0.70
8	0.46	0.14	0.60
9	0.40	0.21	0.61
10	0.43	0.26	0.70

Source: Australian Bureau of Statistics: catalogue No. 6544.0.30.331 Household Expenditure Survey 1998-99, Australia: Confidentialised Unit Record File on CD-ROM

Figure 33: Real price of urban transport fares and automotive fuel
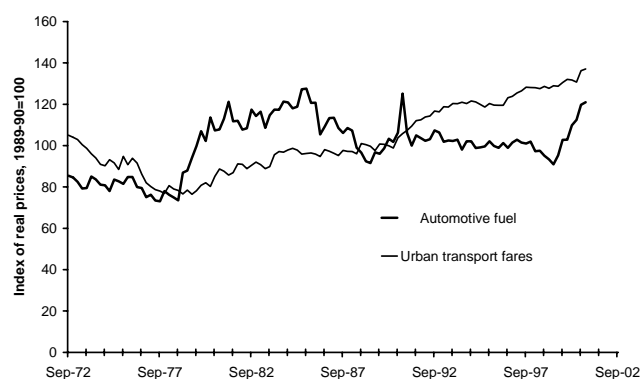
Source: ABS cat no. 6401.0 Consumer Price Index Australia

Against this background it should not be surprising that calculations based on the data from the Melbourne Institute survey suggest that household demand for automotive fuel is price inelastic. Indeed, the median estimate of the short-run price elasticity of demand is zero for all fuel types.[16] The mean estimated own-price elasticity of demand varies

---

[15] The other component is "Other motoring charges" which includes tolls, etc.

[16] This elasticity is based on reported price and quantity changes over one year. Over a longer period households would have an opportunity to purchase more fuel-efficient vehicles and thus in the longer run demand for automotive fuel is likely to be somewhat more price elastic.

from -0.04 for unleaded petrol to -0.11 for diesel (see Table 38).[17]

Table 38: Estimated price elasticity of demand for various automotive fuels, households who reported that the increased their expenditure on fuel

Price elasticity (absolute value)	Leaded petrol	Unleaded petrol	Diesel	LPG	Total
0	72	86	75	78	83
0-0.25	0	0	3	9	1
0.25-0.5	0	2	1	10	2
0.50-0.75	4	3	7	0	3
0.75-1.00	3	1	5	2	2
>1	20	8	9	0	9
Total	100	100	100	100	100
Mean[18]	0.06	0.04	0.11	0.07	0.05

Source: Melbourne Institute Survey of 1400 households conducted 8-11 March 2001

5.3.4 Incorporating effects on demand into the analysis of oil price shocks

The analysis above suggests that it is likely that the petrol price shock shifted both the aggregate demand and aggregate supply curves to the left. In the long-run output is determined by aggregate supply (the natural rate property). The leftward shift in aggregate demand means that prices do not rise by as much as they would have under the case where the oil price shock affected aggregate supply only. See Figure 34. Thus incorporating the effects on demand can help to understand why it might be that prices have not risen by as much as was expected given the size of the oil price rise.

Figure 34: Stylised representation of an oil price rise that yields both a demand <u>and</u> supply shock
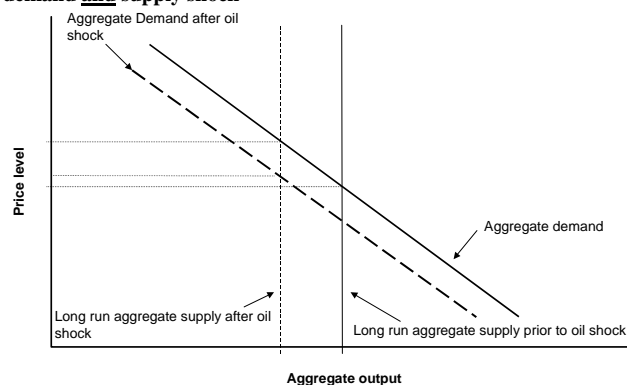
5.4 Estimating the Size of the Consumer Demand Shock attributable to Petrol Price Rises

The effect of the oil price rise on the price to consumers of unleaded petrol, leaded petrol, diesel and LPG is shown in Figure 35 to Figure 38 below. In each of these figures the distribution of the price paid one year ago is shown by the broken line while the distribution of prices in early March 2001 is shown by the solid line. For all categories of fuel there has been a significant price increase.

Figure 35: Frequency distribution — price paid for unleaded petrol
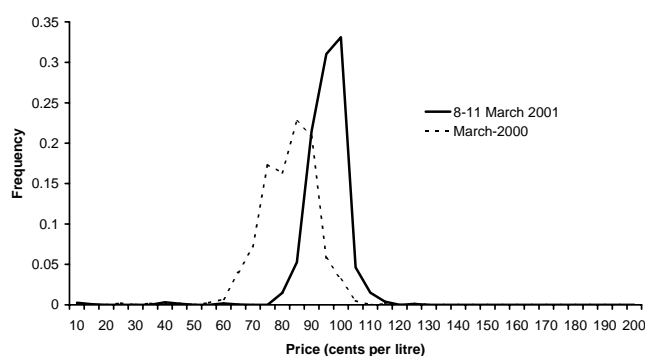
Source: Melbourne Institute Survey of 1400 households conducted 8-11 March 2001

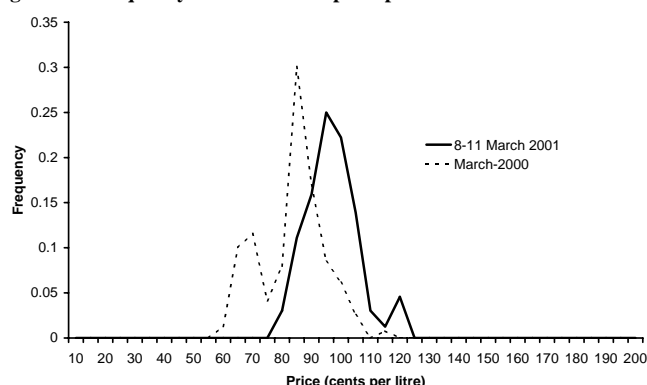**Figure 36: Frequency distribution — price paid for leaded petrol**

---
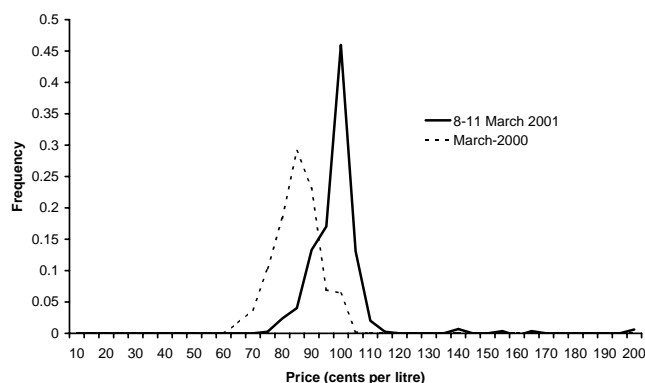
[17] The own-price elasticity is calculated as the ratio of the percentage change in the fuel used per week to the percentage change in the price of that fuel over the last year. Table 38 covers only those households who reported that their expenditure on fuel had increased over the past year. Households who reported price and quantity changes that imply an elasticity of greater than one (in absolute value) are providing an inconsistent response, since if their own-price elasticity were greater than one they would have reduced rather than increased their expenditure on fuel. Interestingly, there is a marked difference in the proportion of inconsistent responses by fuel type. Those who use leaded petrol are more than twice as likely to provide an inconsistent response — perhaps this is further evidence on the adverse effects of lead. Those who gave inconsistent responses were omitted from calculation of the mean own-price elasticity of demand.

[18] Mean of valid responses. Excludes those who reported expenditure had increased but whose reported price and quantity changes implied an own-price elasticity of demand greater than one in absolute value.

The price distributions also illustrate the obvious point that there is a wide dispersion in the prices that people pay for each fuel. Less obvious but also important is the observation that fuel prices are less dispersed now than this time last year. This suggests that there may be differences across markets in the extent to which fuel companies have been able to maintain their profit margins.[19]

Figure 37: Frequency distribution — price paid for diesel

Figure 38: Frequency distribution — price paid for LPG
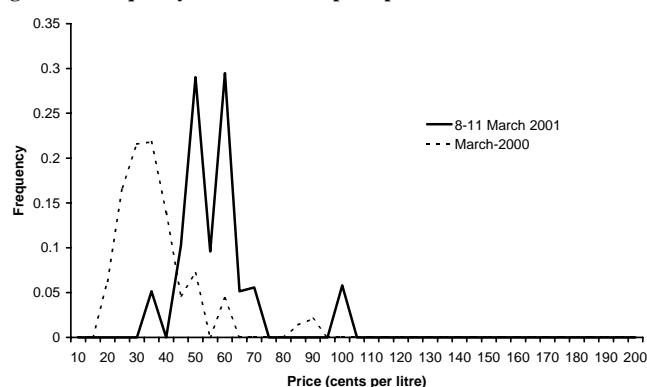
The survey data suggest that the price rise over the past year has caused households to increase their expenditure on automotive fuel by $133.3 million per week or $6.93 billion per year (see Table 39). This represents 1.06 per cent of GDP and 1.80 per cent of private consumption expenditure.

Table 39: Additional expenditure on petrol attributable to price rise between March 2000 and March 2001

	Leaded petrol	Unleaded petrol	Diesel	LPG	Total
$ million per week	13.7	91.9	17.4	10.3	133.3
$ million per year	710.6	4779.7	906.0	534.9	6931.2
Per cent of GDP	0.11	0.734	0.14	0.08	1.06
Per cent of private consumption expenditure	0.18	1.24	0.23	0.14	1.80

Just over one-third of all households reported that they would finance the additional expenditure on fuel by cutting back expenditure on other goods and services (see Table 40). These are the households that I have taken to be liquidity-constrained and it is the estimated reduction in expenditure on other goods and services by these households that I have taken to constitute the negative demand shock due to the oil price rise.

Table 40: Method of financing additional expenditure on fuel by type of fuel (per cent of households)

	Leaded petrol	Unleaded petrol	Diesel	LPG	Total
By reducing expenditure on other goods and services	49.5	31.3	44.2	35.1	34.6
By running down savings	22.3	29.8	27.7	45.0	29.6
Running into debt	7.0	8.1	5.0	7.5	7.8
Don t know	21.1	30.7	23.0	12.3	28.0
Total	100	100	100	100	100

Just under one-third of households said that they would finance the additional expenditure by running down savings and 7.8 per cent of households said that they would finance the expenditure by running into debt.

A large proportion of households (28 per cent) did not know how they would finance the extra expenditure on fuel. I have not included any of these households in the calculations when estimating the size of the demand shock. There are two reasons for this. First, if the household was cutting back on other expenditure to finance higher fuel costs then one might expect them to notice it. Second, as can be seen from Figure 39, households that reported that they did not know how they would finance the extra expenditure generally had higher incomes than did those households giving other responses. Higher income households are less likely to be liquidity-constrained.

---

[19] An alternative explanation of this phenomenon is that the uncertainty in people's recall accounts for the wider dispersion in prices one year ago.

Figure 39: Financing of additional expenditure by income[20]
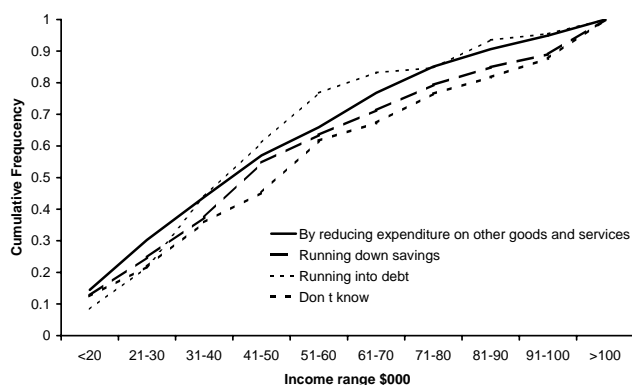
Source: *Melbourne Institute Survey of 1400 households conducted 8-11 March 2001*

As can be seen from Figure 39, low-income households (i.e., those with annual incomes of $40,000 or below) are less likely to respond that they financed the increased expenditure by running into debt or running down saving and are more likely than other households to report that they have financed the expenditure on fuel by reducing expenditure on other goods. This finding supports the contention that there exists a significant proportion of households that are liquidity-constrained.

Using the responses of households that reported an increase in expenditure on fuel financed by cutting back on expenditure of other goods and services, I obtain an estimate that the demand shock attributable to petrol price increases amounts to about $46.7 million per week or $2.4 billion per year. This is just under 0.4 per cent of GDP and just over 0.6 per cent of private consumption (see Table 41).

Table 41: Estimated size of aggregate demand shock stemming from increase in oil prices

	Leaded petrol	Unleaded petrol	Diesel	LPG	Total
$ million per week	8.6	28.489	6.079	3.57	46.738
$ million per year	447.2	1481.4	316.1	185.6	2430.4
Per cent of GDP	0.07	0.23	0.05	0.03	0.37
Per cent of private consumption expenditure	0.12	0.38	0.08	0.05	0.63

5.5   Macroeconomic Policy Implications

The analysis above has major implications for macroeconomic policy. It suggests that in the background, hidden by the GST-related gyrations and the artificial stimulus of the Sydney Olympics, there was a significant negative shock to aggregate demand attributable to the effect of petrol price hikes on liquidity-constrained households. This negative demand shock helps to explain why prices have not risen in response to the supply shock that was also created by the rise in world oil prices. If one

accepts that oil price rises create both a demand and supply shock then some and perhaps all of the Reserve Bank's tightening of monetary policy looks like a mistake.[21]

Moreover, the oil price rise will have created comparable demand and supply shocks around the world. This in part may explain both the world economic slowdown and the fact that what seemed like a build-up of inflation pressures last year, particularly in the US, did not translate into inflation. Thus with 20/20 hindsight and in light of the analysis above the tightening of monetary policy by a number of central banks, but most notably the US Federal Reserve, may have been a mistake.

It is important to observe that a policy of stimulating demand through aggressive easing of monetary policy is not supported by the analysis above as such a policy will lead to additional inflation. Nonetheless, it may be possible to design a fiscal policy that achieves better outcomes in the presence of oil price shocks. This policy would involve higher automotive fuel taxes when the world price of oil is low and lower taxes when the world price is high. Such a policy could, in principle, be designed so that the periods of high and low petrol taxation balance out, making the policy neutral for government debt in the long run. I leave detailed discussion, analysis and design of such a policy to another paper.

Appendix 5A: Survey details

The survey was conducted for the Melbourne Institute by OZINFO over the period 7-11 March 2001. The survey is administered by computer aided telephone interview (CATI) to a randomly chosen sample of Australian households. The sample covers persons 18 years and over in all Australian states and the ACT. It is stratified by gender and location. Results are weighted so as to be representative of the Australian population as a whole. In March 1400 completed records were obtained from the survey.

In addition to the standard questions included in Melbourne Institute surveys the following questions related to fuel use and fuel prices were included in the survey.

1. Thinking now about the forms of personal transportation that your household uses. What is the main form of personal transportation used by your household? (read out options)
   a. Car/ utility etc (Go to question2)
   b. Motor bike (end questions)
   c. Public Transport (end questions)
   d. Other eg push bike walk to work (end questions)
   e. Don't know (end questions)

2. I would like to ask you some questions about the fuel that your household uses for personal transportation. What is the main fuel that your household uses for personal transportation (read out options)?
   a. Leaded petrol (Go to question3)
   b. Unleaded petrol (Go to question3)
   c. Diesel (Go to question3)

---

[20] Figure 39 shows the cumulative frequency of each response by income, a cumulative frequency curve that is to the right of the other curves means that high income households are more likely to make that response than the other responses.

[21] At the time of the last interest rate increase, the author did not see the Reserve Bank's action as a mistake. It is only with hindsight and in light of the analysis above that it can be seen as a mistake.

d. LPG (Go to question3)
e. Other (end questions)
f. Don't know (end questions)

3. Compared with this time last year has your households expenditure on {insert fuel from q2} increased, decreased or stayed the same?
a. Increased. (Go to question4)
b. Decreased (Go to question5)
c. Stayed the same (Go to question 7)
d. Don't know (Go to question 7)

4. Compared with this time last year, by how many dollars per week has your expenditure increased on {insert fuel from q2}
a. _____ Dollars per week (Go to question 6)
b. Don't know / refused (Go to question 6)

5. Compared with this time last year, by how many dollars per week has your expenditure decreased on {insert fuel from q2}
a. _____ Dollars per week (Go to question 7)
b. Don't know / refused (Go to question 7)

6. How has your household financed this increase in expenditure on {insert fuel from q2}?
a. By reducing expenditure on other goods and services
b. Running down savings
c. Running into debt
d. Don't know

7. How many dollars do you spend per week on {insert fuel from q2}
a. _____ Dollars per week
b. Don't know / refused

8. The last time that you "filled up" your {type of vehicle from Q1} what price did you pay in cents per litre for {insert fuel from q2}
a. _____ Cents per litre
b. Don't know/refused

9. Thinking back one year what price did you paid for {insert fuel from Q2} one year ago?
a. _____ Cents per litre
b. Don't know refused

10. How many litres of {insert fuel} would your household use per week for personal transportation?
a._____ Litres per week
b. Don't know/refused

11. Has the recent rise in petrol prices caused your household to cut down on the quantity of {insert fuel from Q2} that you use for personal transportation?
a. Yes Go to q12
b. No (end questions)
c. Don't know (end questions)

12. By how many litres per week has your household reduced your usage of {insert fuel from Q2} because of its higher price.
a. _____ Litres per week.
b. Don't know/refused

References

Carroll, C.D. 1992, "The Buffer-Stock Theory of Saving: Some Macroeconomic Evidence" *Brookings Papers on Economic Activity*, no 2, pp 61-156

Carroll, C.D. and L.H., Summers 1991. "Consumption Growth Parallels Income Growth: Some New Evidence" In B.D., Bernheim and J.B Shoven, eds., *National Saving and Economic Performance*, pp. 305-343. Chicago: University of Chicago Press.

Deaton, A., 1991, "Saving and Liquidity Constraints." *Econometrica* 59 (September) pp 1221-1248.

Hubbard, R.G., Skinner, J., and S.P., Zeldes 1994, "The Importance of Precautionary Motives in Explaining Individual and Aggregate Saving" *Carnegie-Rochester Conference Series on Public Policy* 40 (June) pp 59-125.

Mankiw, N.G., and S.P., Zeldes 1991, "The Consumption of Stock Holders and Nonstockholders", *Journal of Financial Economics* 29 (March) 97-112.

Shefrin, H.M., and R.H., Thaler 1986, "The Behavioral Life-Cycle Hypotheses" *Economic Inquiry* 26 (October) pp 609-643