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Petrol prices in Australia

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Abstract

The objective of this paper is to model how Australian petrol prices are determined by movements in world oil prices, the Australian exchange rate, and numerous other components of the price chain. This paper examines five scenarios for the future of world oil prices and shows how they would translate into movements in Australian retail petrol prices. The findings suggest that petrol prices are likely to be restrained in this decade. However, in the 2020's prices are likely to either rise under peak oil scenarios or continue constrained under the more optimistic world oil supply scenarios.

1. Introduction

The transport of goods and people in Australia is affected by many trends.

One of the most important of these trends, given the dependence of mobility in Australia on liquid fuels, is that of the price of fuel (petrol, diesel, LPG, aviation turbine fuel and avgas).

Using the retail petrol price as an example, the following analysis shows how these trends can be conceptualised and simulated. The conceptual framework developed allows for an understanding of the forces involved in generating trends in Australian fuel prices (in much the same way as has been done for Australian wheat prices – Gargett 2005).

2. An overview of the fuel price chain

The basic mechanism of the fuel price chain is depicted in Figure 1.

Potential supply is a measure of the long-run, business-as-usual level of possible world oil supply, balancing the depletion of older fields by new field development and non-conventional sources of total liquids (where total liquids equals the sum of conventional crude oil, non-conventional crude, and other liquids fuel sources). *Actual* supply (equal to actual demand) is determined by the interaction of OPEC surplus decisions and the oil price.

Once the world oil price is set, adding transport costs, putting the price through the Australian exchange rate, and adding refinery costs produces the Australian refinery gate price. Then adding wholesale/retail margins, excise tax and goods and services tax (GST) results in the Australian retail petrol price (price at the pump).

The following sections of the paper examine each of these steps, starting with the world oil price mechanism.

Figure 1 The Fuel Price Chain

POTENTIAL OIL SUPPLY

less

OPEC SURPLUS

gives

ACTUAL OIL SUPPLY

equals

OIL DEMAND

at

WORLD OIL PRICE

plus

AUSTRALIAN EXCHANGE RATE,

TRANSPORT and REFINERY COSTS

gives

AUSTRALIAN REFINERY

GATE FUEL PRICES

plus

MARGIN, EXCISE, GST

gives

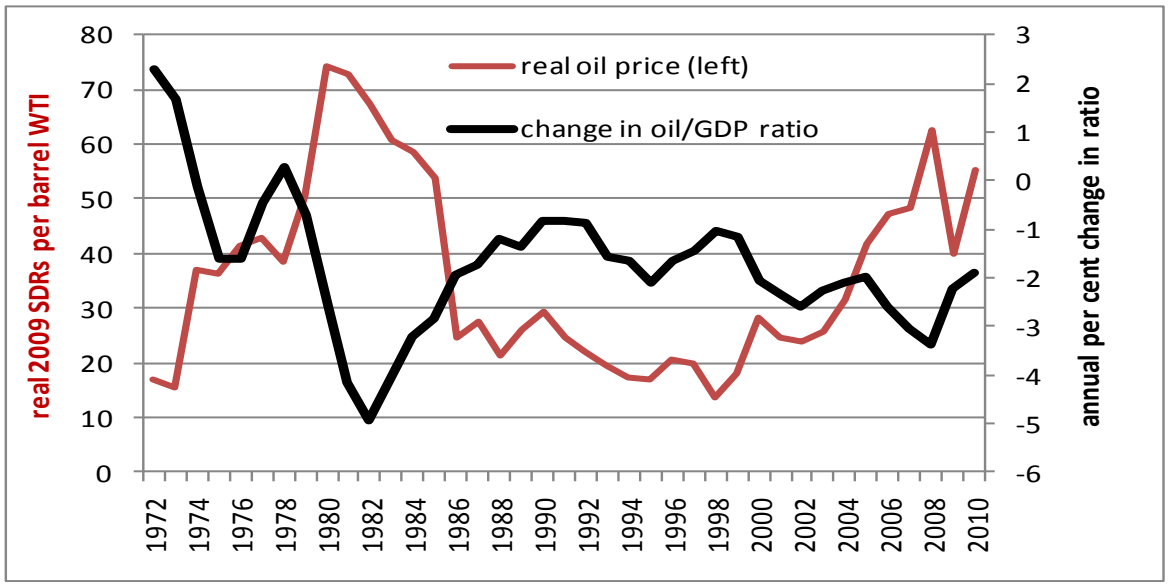
AUSTRALIAN RETAIL PETROL PRICES

3. World oil supply, demand and price

The potential world oil supply is equivalent to the long-run supply forecasts generated by various agents, for example the International Energy Agency (IEA 2009). Actual supply in the short-run (equal to demand) is determined by the additional interaction of levels of OPEC surplus with the price of oil.

Figure 2 shows the close relationship between changes in the 3-year average of the ratio of world oil demand to world GDP, and the real oil price expressed in real Special Drawing Rights (SDRs) per barrel of West Texas Intermediate (WTI). Special Drawing Rights are an international currency unit calculated by the International Monetary Fund averaging five major Western currencies. As such, SDR's attempt to avoid the effects of currency fluctuations in measuring oil prices.

Figure 2 World oil demand/price relationship



The following equation is the result of a regression on the change in world oil/GDP ratio using the log of the real SDR oil price, an 'echo' variable (last year's change less that of 3 years ago) and dummies .

$$\%\text{ch oil/GDP ratio} = \text{constant} - b_1 * \ln \text{oil price} + b_2 * \text{echo} + b_3 * \text{seventiesdum} + b_4 * 9092\text{dum} + b_5 * \text{postGFCdum}$$

The 'seventiesdum' implies that the period before 1980 saw generally less reduction in the oil/GDP ratio for any oil price. It was really after 1980 that the effects of the two major oil price shocks fed through to investments in and technological development to support energy efficiency gains.

THE '9092dum' and the 'postGFCdum' are probably both capturing periods of crisis in the world economy when investment in energy efficiency collapsed (along with most other forms of investment). The GFCdum has been taken off over the 3 years it is judged that a revival in investment will occur.

Table 1 Change in 3-year average of world oil/GDP ratio as a function of the real SDR oil price

Regression Statistics	
Multiple R	0.95722898
R Square	0.91628733
Adjusted R Square	0.90360359
Standard Error	0.43268759
Observations	39

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	67.6243816	13.52488	72.24111	8.36666E-17
Residual	33	6.178212282	0.187219		
Total	38	73.80259388			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2.16095845	0.580110237	3.725082	0.000729	0.980715304	3.341201594
ln real oil price	-1.28168456	0.167200683	-7.66555	7.96E-09	-1.621856902	-0.941512211
echo	0.26778187	0.043121243	6.209976	5.21E-07	0.180051045	0.355512703
seventiesdum	2.11275251	0.178755376	11.81924	2.1E-13	1.749071961	2.47643305
9092dum	1.01689056	0.26646501	3.816225	0.000565	0.474763425	1.559017697
postGFCdum	0.71730975	0.325337619	2.204817	0.034546	0.055405394	1.379214115

The fit of the prediction from the equation to the actual ratio changes is shown in Figure 3. Figure 4 shows the fit of the resulting predicted oil/GDP ratio to the actual ratio.

Figure 3 Actual and predicted annual percentage change in the world oil/GDP ratio

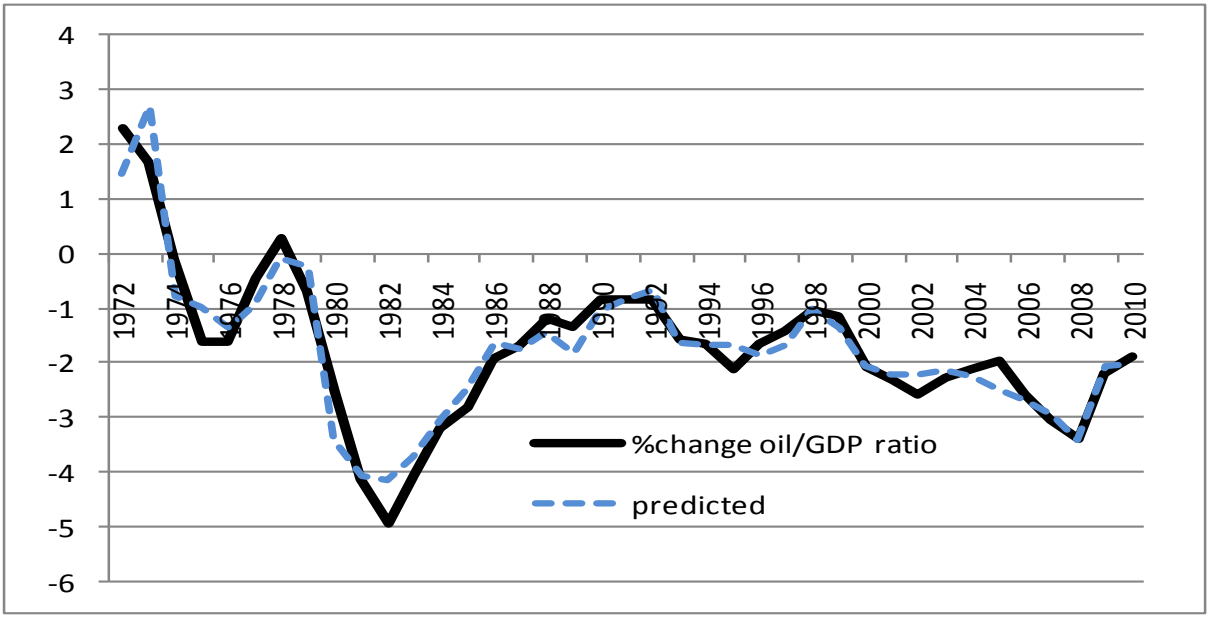
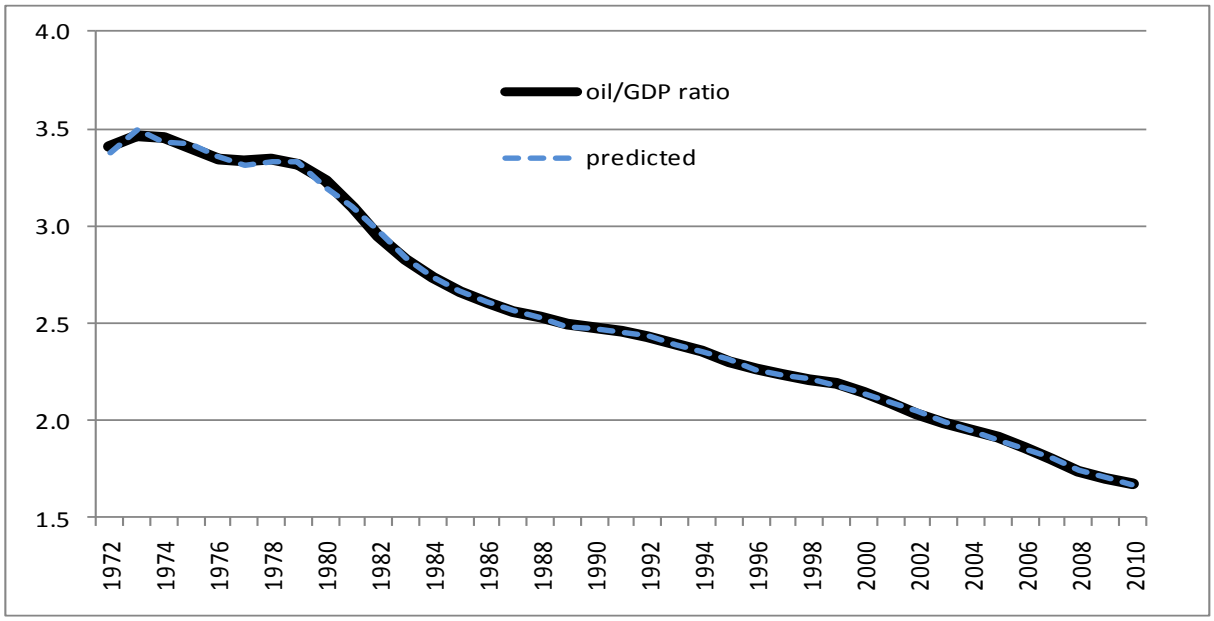


Figure 4 Actual and predicted world oil/GDP ratio



Using the equation in Table 1 and world GDP forecasts, a price of oil can be predicted that will balance demand and actual supply (potential supply less OPEC surplus).

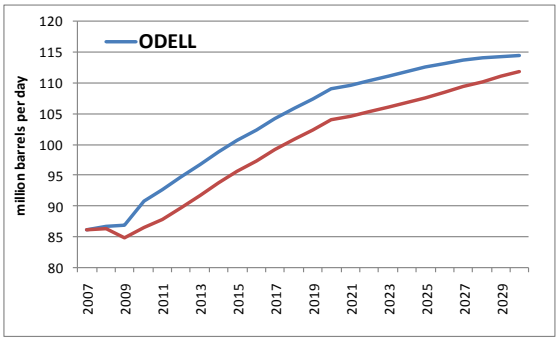
But to do that, it is first necessary to specify the likely future path of the potential world supply of oil. The literature on the likely future potential supply of oil is extensive. One of the best summaries was published by the OECD International Transport Forum in 2008 (OECD/ITF 2008). Opinions vary from those optimistic about supply continuing to expand to those suggesting that world oil production will peak near the end of this decade.

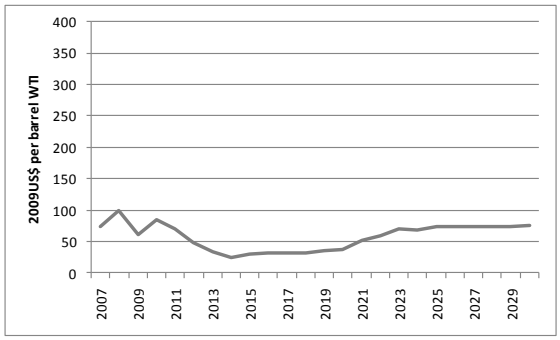
Figure 5 shows four different scenarios for potential world oil supply (defined as total liquids) to 2030, plus a scenario for higher world GDP growth. The highest line on the supply graphs is potential supply. The lower line is actual supply when OPEC cuts have been removed. Also shown are the oil prices per barrel implied by the equation in Table 1.

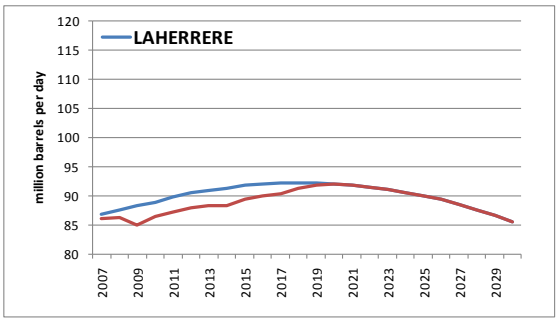
The highest supply scenario comes from a peak oil optimist (Odell 2003). A lower supply scenario is from a peak oil proponent (Laherrere 2007). The IEA scenario has already been mentioned. The 'IEA adjusted' potential supply scenario corrects what some believe are optimistic IEA assumptions regarding supply in the next two decades from non-conventional sources and from fields discovered and developed in that time (Aleklett 2009 – IEA non-conventional growth has been reduced to 75 per cent of what was forecast and discovery/development growth to 50 per cent). These four scenarios have been chosen to represent different views on the likely trend of potential supply to 2030 (increase/decrease, timing of turning points, different methodologies, etc).

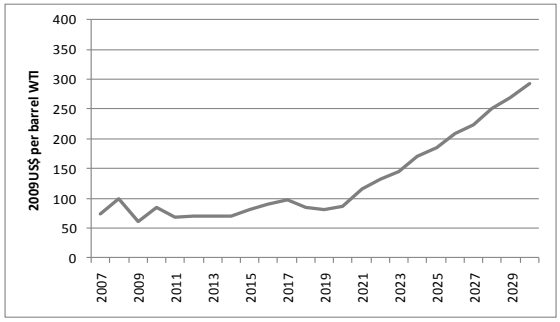
A fifth scenario, the 'IEA high GDP' scenario, lifts assumed long-run world GDP growth, from 3.7 per cent per year in the other scenarios to 4.5 per cent. The aim is to show the effect that higher assumed world GDP growth can have on predicted oil prices. Potential supply is the same as in the 'IEA' scenario, but now the oil price must rise more quickly to cancel out the increased demand pressure.

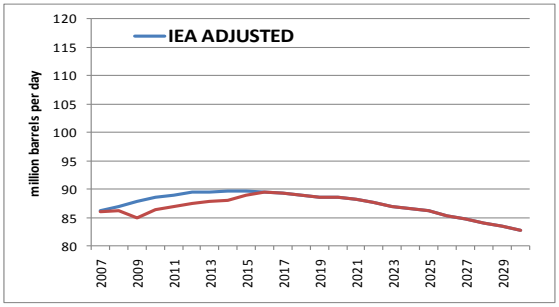
Figure 5 World oil supply ..... and price scenarios

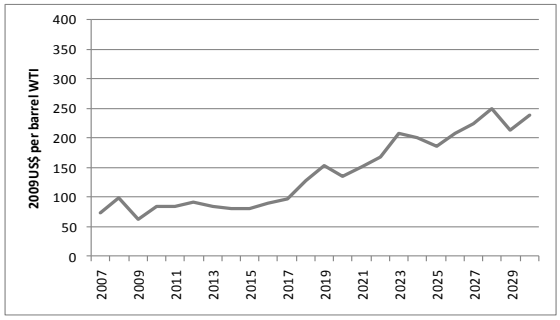


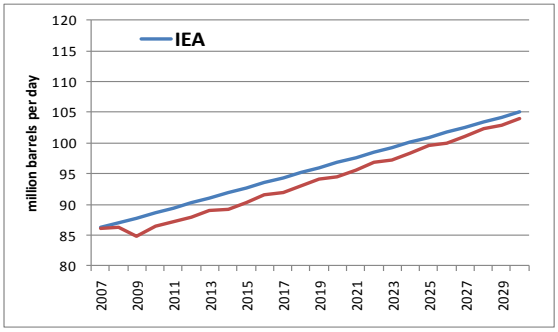


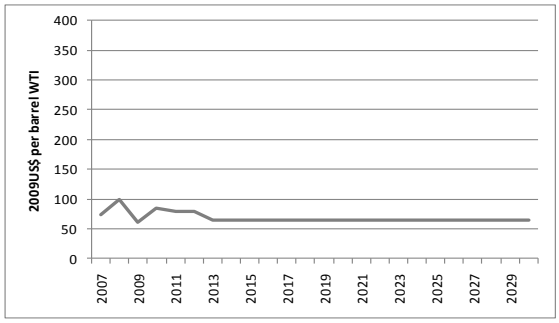


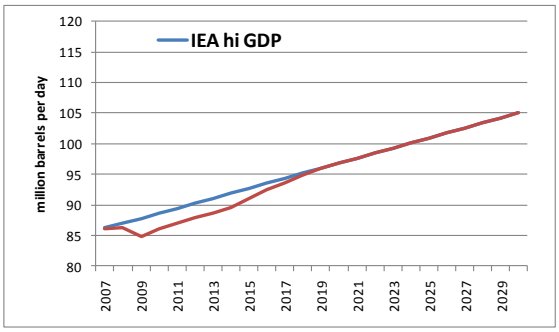












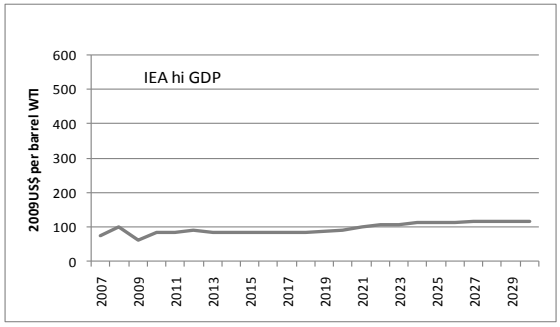


Table 2 shows the calculations behind the world oil price-setting mechanism, using the IEA high GDP potential supply projections.

In forecasting mode (from 2010 onwards), the price of oil (to the nearest dollar) is varied until there is an approximate balance between actual supply and demand. Inventory is assumed unchanged from year to year. Judgement must be made as to the price OPEC will defend and whether the implied OPEC production cuts are achievable.

Table 2 World oil supply/demand/price framework, IEA hi GDP scenario for potential supply

WORLD		000 barrels per day												2009		2009							WTI
							m Geary-							US$	US$	SDR	ln						nom
	potential	OPEC	actual	annual	3yr aver	%ch	Khamis $	3yrmovav	oilgdp	oilgdp		pred		real oil	per	real oil	real oil		dum	dum	dum		US	oilprice
	supply	Cuts	supply	demand	demand	GDP	GDP	GDP	ratio	pred	%ch	% ch		price	SDR	price	price	echo	7279	9092	GFC		cpi	US$
1969			42485	42485	42684		13102	12589	3.390					19.39	1	19.39							21.31	3.35
1970			46066	46066	44276	5.07	13766	13735	3.224		-4.92			18.34	0.966	18.99							22.53	3.35
1971			48596	48596	45716	4.14	14336	13735	3.328		3.25			18.67	1.02	18.30							23.52	3.56
1972			52144	52144	48935	4.76	15018	14374	3.405	3.395	2.28	1.99		18.09	1.065	16.99	2.83	3.00	1	0	0		24.27	3.56
1973			56325	56325	52355	6.64	16015	15123	3.462	3.521	1.68	3.43		18.53	1.196	15.49	2.74	7.21	1	0	0		25.78	3.87
1974			55491	55491	54653	2.33	16388	15807	3.458	3.440	-0.13	-0.64		44.69	1.203	37.15	3.61	-1.57	1	0	0		28.63	10.37
1975			54991	54991	55603	1.53	16638	16347	3.401	3.428	-1.62	-0.86		44.06	1.212	36.35	3.59	-2.41	1	0	0		31.24	11.16
1976			58427	58427	56303	4.88	17450	16825	3.346	3.356	-1.62	-1.34		47.74	1.154	41.37	3.72	-3.31	1	0	0		33.04	12.79
1977			60604	60604	58007	4.05	18157	17415	3.331	3.318	-0.46	-0.83		50.11	1.169	42.86	3.76	-1.49	1	0	0		35.19	14.30
1978			63221	63221	60750	4.40	18955	18187	3.340	3.336	0.28	0.15		48.38	1.258	38.46	3.65	1.16	1	0	0		37.86	14.85
1979			64381	64381	62735	3.58	19633	18915	3.317	3.339	-0.71	-0.05		65.55	1.294	50.66	3.93	1.90	1	0	0		42.16	22.40
1980			61841	61841	63148	2.02	20030	19540	3.232	3.198	-2.56	-3.59		96.34	1.299	74.17	4.31	-0.24	0	0	0		47.85	37.38
1981			59911	59911	62044	1.96	20423	20029	3.098	3.091	-4.15	-4.37		85.68	1.176	72.86	4.29	-2.84	0	0	0		52.79	36.67
1982			58193	58193	59981	1.11	20648	20367	2.945	2.961	-4.93	-4.43		74.04	1.102	67.18	4.21	-3.44	0	0	0		56.04	33.64
1983			57920	57920	58675	2.84	21236	20769	2.825	2.829	-4.07	-3.94		64.82	1.067	60.75	4.11	-2.37	0	0	0		57.84	30.40
1984			59145	59145	58420	4.56	22204	21363	2.735	2.737	-3.20	-3.12		59.85	1.023	58.50	4.07	0.08	0	0	0		60.34	29.28
1985			59391	59391	58819	3.45	22970	22137	2.657	2.667	-2.84	-2.49		55.22	1.024	53.93	3.99	1.73	0	0	0		62.49	27.97
1986			61147	61147	59894	3.54	23782	22985	2.606	2.619	-1.93	-1.43		29.15	1.179	24.72	3.21	1.24	0	0	0		63.65	15.04
1987			62439	62439	60992	3.83	24694	23815	2.561	2.564	-1.72	-1.58		35.83	1.301	27.54	3.32	1.27	0	0	0		65.97	19.16
1988			64238	64238	62608	4.29	25753	24743	2.530	2.529	-1.20	-1.23		28.66	1.343	21.34	3.06	1.12	0	0	0		68.70	15.96
1989			65588	65588	64088	3.20	26576	25674	2.496	2.488	-1.35	-1.67		33.56	1.284	26.14	3.26	0.73	0	0	0		72.01	19.59
1990			66855	66855	65560	2.10	27134	26488	2.475	2.467	-0.84	-1.17		39.80	1.359	29.29	3.38	0.37	0	1	0		75.90	24.49
1991			66864	66864	66436	1.33	27494	27068	2.454	2.453	-0.84	-0.89		33.50	1.368	24.49	3.20	0.36	0	1	0		79.09	21.48
1992			67547	67547	67089	2.12	28077	27569	2.434	2.438	-0.85	-0.69		31.13	1.408	22.11	3.10	0.51	0	1	0		81.48	20.56
1993			67408	67408	67273	2.19	28694	28088	2.395	2.399	-1.58	-1.44		27.13	1.396	19.44	2.97	-0.01	0	0	0		83.91	18.46
1994			68705	68705	67886	3.50	29698	28823	2.355	2.360	-1.66	-1.47		24.63	1.437	17.14	2.84	-0.74	0	0	0		86.06	17.19
1995			69841	69841	68651	4.19	30942	29778	2.305	2.321	-2.12	-1.47		25.68	1.522	16.87	2.83	-0.81	0	0	0		88.50	18.43
1996			71489	71489	70012	3.39	31990	30877	2.267	2.266	-1.65	-1.70		29.99	1.451	20.67	3.03	-0.54	0	0	0		91.11	22.15
1997			73598	73598	71643	3.91	33242	32058	2.235	2.234	-1.44	-1.47		27.26	1.373	19.86	2.99	0.01	0	0	0		93.21	20.60
1998			73939	73939	73008	1.69	33803	33012	2.212	2.219	-1.04	-0.70		18.75	1.358	13.81	2.63	0.68	0	0	0		94.66	14.39
1999			75573	75573	74370	3.53	34997	34014	2.186	2.187	-1.14	-1.13		24.55	1.365	17.98	2.89	0.61	0	0	0		96.75	19.25
2000			76340	76340	75284	4.83	36688	35163	2.141	2.144	-2.08	-1.93		37.37	1.317	28.38	3.35	0.30	0	0	0		100.00	30.30
2001			76904	76904	76273	2.86	37739	36475	2.091	2.096	-2.33	-2.11		31.09	1.271	24.46	3.20	-1.04	0	0	0		102.85	25.92
2002			77829	77829	77025	3.40	39021	37816	2.037	2.047	-2.60	-2.11		30.81	1.299	23.72	3.17	-1.19	0	0	0		104.47	26.10
2003			79296	79296	78010	4.58	40810	39190	1.991	1.996	-2.27	-2.02		35.95	1.404	25.60	3.24	-0.52	0	0	0		106.85	31.14
2004			82111	82111	79746	5.25	42950	40927	1.948	1.947	-2.11	-2.17		46.60	1.481	31.46	3.45	0.06	0	0	0		109.70	41.44
2005			84500	84500	81969	4.73	44983	42914	1.910	1.900	-1.97	-2.47		61.41	1.473	41.69	3.73	0.48	0	0	0		113.41	56.47
2006			85100	85100	83904	5.24	47341	45091	1.861	1.858	-2.58	-2.72		69.65	1.473	47.28	3.86	0.30	0	0	0		117.07	66.10
2007	86200	100	86100	86100	85233	4.37	49411	47245	1.804	1.805	-3.05	-3.00		74.17	1.534	48.35	3.88	-0.47	0	0	0		120.35	72.36
2008	87017	717	86300	86300	85833	3.16	50974	49242	1.743	1.739	-3.38	-3.59		99.27	1.584	62.67	4.14	-1.07	0	0	0		123.72	99.57
2009	87835	2935	84900	84900	85767	-0.80	50566	50317	1.705	1.706	-2.21	-2.12		61.69	1.542	40.01	3.69	-0.80	0	0	1		123.35	61.69
2010	88652	2504	86148	86148	85783	3.88	52526	51355	1.670	1.670	-2.00	-2.10		85.00	1.542	55.12	4.01	0.88	0	0	1		127.62	87.94
2011	89470	2448	87022	87022	86023	4.29	54778	52623		1.635		-2.14		85.00	1.542	55.12	4.01	1.49	0	0	0.67		131.45	90.58
2012	90287	2400	87887	87860	87010	4.50	57243	54849		1.586		-2.96		92.00	1.542	59.66	4.09	-0.02	0	0	0.33		135.39	100.98
2013	91104	2400	88704	88715	87866	4.50	59819	57280		1.534		-3.30		84.00	1.542	54.47	4.00	-0.86	0	0	0		139.45	94.97
2014	91922	2400	89522	89526	88701	4.50	62510	59857		1.482		-3.40		84.00	1.542	54.47	4.00	-1.17	0	0	0		143.64	97.82
2015	92739	1700	91039	91012	89751	4.50	65323	62551		1.435		-3.17		84.00	1.542	54.47	4.00	-0.44	0	0	0		147.95	100.75
2016	93557	1150	92407	92400	90980	4.50	68263	65366		1.392		-3.00		84.00	1.542	54.47	4.00	0.13	0	0	0		152.38	103.77
2017	94374	850	93524	93500	92304	4.50	71335	68307		1.351		-2.91		84.00	1.542	54.47	4.00	0.40	0	0	0		156.96	106.89
2018	95191	300	94891	94919	93606	4.50	74545	71381		1.311		-2.96		84.00	1.542	54.47	4.00	0.26	0	0	0		161.67	110.09
2019	96009	0	96009	96002	94807	4.50	77899	74593		1.271		-3.08		87.00	1.542	56.42	4.03	0.04	0	0	0		166.52	117.44
2020	96826	0	96826	96803	95908	4.50	81405	77950		1.230		-3.20		90.00	1.542	58.37	4.07	-0.17	0	0	0		171.51	125.14
2021	97643	0	97643	97653	96820	4.50	85068	81457		1.189		-3.40		101.00	1.542	65.50	4.18	-0.24	0	0	0		176.66	144.65
2022	98461	0	98461	98461	97639	4.50	88896	85123		1.147		-3.50		106.00	1.542	68.74	4.23	-0.32	0	0	0		181.96	156.36
2023	99278	0	99278	99254	98456	4.50	92896	88953		1.107		-3.51		107.00	1.542	69.39	4.24	-0.30	0	0	0		187.41	162.57
2024	100096	0	100096	100089	99268	4.50	97077	92956		1.068		-3.52		112.00	1.542	72.63	4.29	-0.11	0	0	0		193.04	175.27
2025	100913	0	100913	100916	100086	4.50	101445	97139		1.030		-3.52		114.00	1.542	73.93	4.30	-0.02	0	0	0		198.83	183.76
2026	101730	0	101730	101738	100914	4.50	106010	101511		0.994		-3.51		114.00	1.542	73.93	4.30	-0.01	0	0	0		204.79	189.27
2027	102548	0	102548	102565	101739	4.50	110781	106079		0.959		-3.52		115.00	1.542	74.58	4.31	0.00	0	0	0		210.94	196.66
2028	103365	0	103365	103360	102554	4.50	115766	110852		0.925		-3.54		116.00	1.542	75.23	4.32	-0.01	0	0	0		217.26	204.32
2029	104183	0	104183	104183	103369	4.50	120975	115841		0.892		-3.55		116.00	1.542	75.23	4.32	-0.03	0	0	0		223.78	210.45
2030	105000	0	105000	105032	104192	4.50	126419	121053		0.861		-3.54		116.00	1.542	75.23	4.32	-0.02	0	0	0		230.50	216.76

4. From world oil prices to Australian petrol prices

What do world oil prices mean for Australian petrol prices? The level of Australian petrol prices at the pump is currently heavily affected by excise and Goods and Services (GST) taxes. As well there are the wholesale and retail margins, before one gets back to an estimate of the 'refinery gate' price.

And this price is determined not in Australia, but by oil and petroleum prices overseas.

Thus, an analysis has been conducted to work backward from the pump price and forward from the overseas oil price.

Table 3 presents the results from working backward from the pump price for petrol in Australia. The first column is the price of petrol at the pump from 1970. Working back towards the refinery, State and Federal excise taxes, wholesaler and retailer margins, and GST have to be deducted (shaded numbers in Table 3 are interpolations, extrapolations or estimates).

The result is an estimate of the refinery gate price (c/litre) in the left of middle column of Table 3.

The procedure for working forward by 'landing' overseas oil prices is also presented in Table 3. Here the base is the world oil price in US$/barrel (WTI until 1996, then Tapis). This is transported to Australia and then converted into Australian dollars, and a roughly estimated refining cost is added on to approximate a "landed price" of imported crude at the refinery gate, in dollars per barrel (right of middle column in Table 3).

Table 3 Australian petrol prices and world oil prices

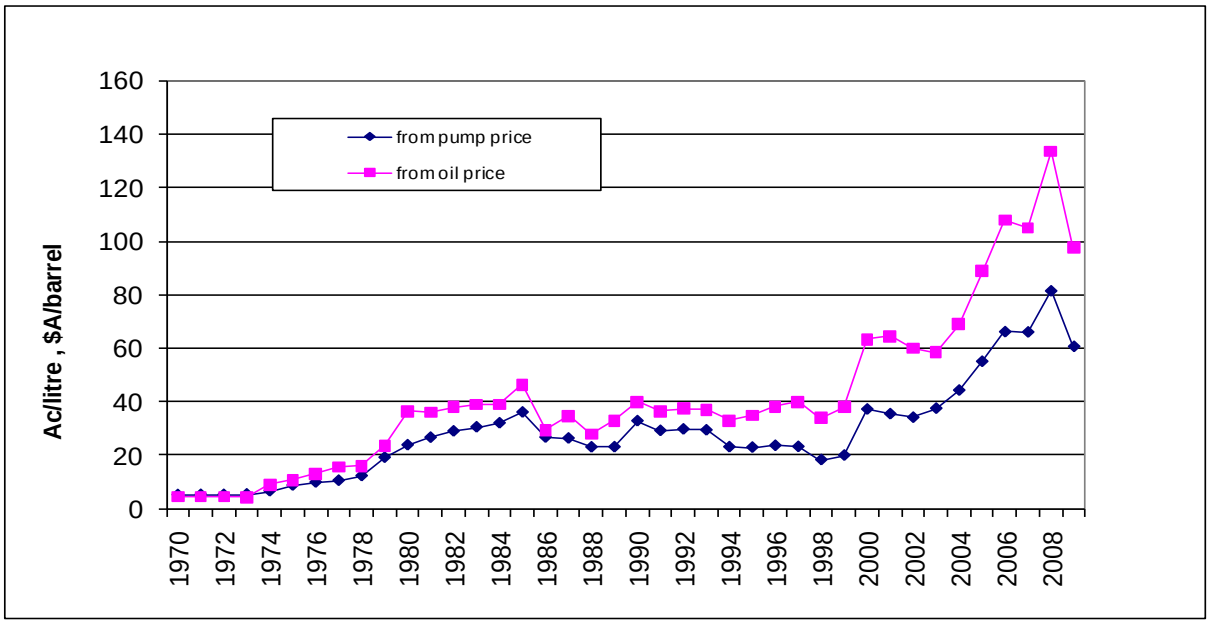
	Australian petrol prices c/l										Oil costs/prices $/barrel			
						pump price back to	oil price landed to	ref cost incl qual			shipping	shipping	world	
	pump	federal	state excise/	margin		refin gate	refin gate	premium	on the wharf	US$/$A	non-fuel	fuel	oil price	
cal year	price	excise	subsidy	c/l	GST	c/litre	$A/b	$A/b	$A/b		US$/b	US$/b	US$/b	cal year
1970	9.15	3.04	0.00	1.06	0.00	5.05	4.40	0.97	3.43	1.116	0.38	0.10	3.35	1970
1971	9.82	3.59	0.00	1.12	0.00	5.11	4.58	1.03	3.55	1.142	0.40	0.10	3.56	1971
1972	10.10	3.81	0.00	1.19	0.00	5.10	4.50	1.09	3.41	1.198	0.42	0.10	3.56	1972
1973	10.94	4.36	0.00	1.30	0.00	5.28	4.30	1.19	3.10	1.429	0.46	0.10	3.87	1973
1974	12.89	4.91	0.00	1.50	0.00	6.48	9.07	1.38	7.69	1.430	0.53	0.08	10.37	1974
1975	15.28	4.91	0.00	1.73	0.00	8.64	10.68	1.59	9.10	1.307	0.61	0.11	11.16	1975
1976	16.64	4.91	0.00	1.96	0.00	9.77	13.05	1.80	11.25	1.210	0.70	0.13	12.79	1976
1977	17.61	5.03	0.00	2.15	0.00	10.43	15.55	1.98	13.57	1.120	0.77	0.14	14.30	1977
1978	19.68	5.16	0.00	2.34	0.00	12.18	15.96	2.15	13.81	1.148	0.83	0.17	14.85	1978
1979	26.82	5.16	0.00	2.59	0.00	19.08	23.50	2.38	21.12	1.116	0.92	0.25	22.40	1979
1980	32.07	5.16	0.30	2.85	0.00	23.76	36.52	2.62	33.90	1.142	1.02	0.32	37.38	1980
1981	35.49	5.16	0.64	3.11	0.00	26.59	36.07	2.86	33.22	1.148	1.11	0.36	36.67	1981
1982	38.96	5.66	0.94	3.40	0.00	28.95	37.93	3.13	34.80	1.011	1.21	0.34	33.64	1982
1983	43.73	7.55	1.95	3.74	0.00	30.48	39.00	3.44	35.56	0.901	1.33	0.31	30.40	1983
1984	47.51	9.39	2.15	3.98	0.00	32.00	38.98	3.65	35.33	0.877	1.42	0.29	29.28	1984
1985	52.63	9.82	2.50	4.25	0.00	36.06	46.32	3.91	42.41	0.701	1.52	0.24	27.97	1985
1986	52.07	17.72	3.07	4.64	0.00	26.64	29.45	4.27	25.19	0.671	1.65	0.21	15.04	1986
1987	54.91	19.88	3.71	5.03	0.00	26.29	34.75	4.62	30.13	0.701	1.79	0.17	19.16	1987
1988	53.23	21.06	3.83	5.38	0.00	22.96	27.80	4.94	22.86	0.790	1.92	0.18	15.96	1988
1989	55.55	22.70	4.13	5.71	0.00	23.02	32.94	5.24	27.70	0.788	2.03	0.20	19.59	1989
1990	68.05	24.50	4.69	6.07	0.00	32.79	40.03	5.58	34.45	0.780	2.16	0.22	24.49	1990
1991	66.47	25.70	5.32	6.29	0.00	29.15	36.52	5.79	30.74	0.779	2.24	0.22	21.48	1991
1992	67.71	26.15	5.45	6.42	0.00	29.69	37.43	5.90	31.53	0.731	2.29	0.20	20.56	1992
1993	67.45	26.35	5.20	6.55	0.00	29.35	36.97	6.02	30.94	0.678	2.33	0.19	18.46	1993
1994	66.74	30.94	6.11	6.67	0.00	23.03	32.99	6.13	26.86	0.735	2.38	0.18	17.19	1994
1995	69.28	33.00	6.51	6.90	0.00	22.86	34.85	6.35	28.51	0.739	2.46	0.19	18.43	1995
1996	71.05	33.75	6.66	7.10	0.00	23.54	38.25	6.52	31.72	0.785	2.53	0.21	22.15	1996
1997	72.34	34.50	7.50	7.21	0.00	23.13	39.99	6.62	33.36	0.737	2.57	0.19	21.84	1997
1998	68.41	34.80	8.12	7.29	0.00	18.20	33.98	6.70	27.28	0.629	2.60	0.18	14.37	1998
1999	70.66	35.20	8.20	7.39	0.00	19.87	38.08	6.79	31.28	0.644	2.63	0.20	17.31	1999
2000	87.22	36.74	-1.54	7.62	7.24	37.17	63.39	7.00	56.39	0.576	2.71	0.24	29.53	2000
2001	87.06	38.14	-1.54	7.85	7.20	35.42	64.40	7.21	57.19	0.513	2.80	0.27	26.26	2001
2002	85.84	38.14	-1.54	8.08	7.07	34.09	60.06	7.43	52.63	0.546	2.88	0.27	25.59	2002
2003	89.72	38.14	-1.61	8.31	7.40	37.48	58.52	7.63	50.89	0.657	2.96	0.32	30.17	2003
2004	97.22	38.14	-1.76	8.50	8.07	44.27	68.88	8.32	60.56	0.736	3.03	0.43	41.14	2004
2005	110.38	38.14	-1.98	10.00	9.13	55.09	88.76	8.16	80.60	0.761	3.11	0.56	57.63	2005
2006	124.24	38.14	-2.21	11.90	10.21	66.20	107.92	10.32	97.60	0.757	3.22	0.68	70.02	2006
2007	124.29	38.14	-2.16	12.00	10.21	66.10	104.94	8.08	96.86	0.843	3.30	0.84	77.52	2007
2008	141.00	38.14	-2.39	12.00	11.73	81.52	133.64	6.24	127.40	0.853	3.44	0.82	104.41	2008
2009	119.61	38.14	-1.01	12.00	9.78	60.70	97.66	11.20	86.46	0.799	3.50	0.82	64.76	2009

Figure 6 shows that the agreement in movement between the two "refinery gate" series is fairly good. An equation linking the two series is:

Ln (from pump price) = constant + b_1*ln (from oil price) + b_2*dum7073

+b_3*dum8693 + b_4*dum9602 +b_5*dum03on

Figure 6 The two refinery-gate series



Fitting this equation gives the results shown in Table 4. The equation results in a fit to the total pump price (using world oil price plus the transmission framework) that is quite good – see Figure 7 and Table 4.

Figure 7 Actual and predicted petrol prices

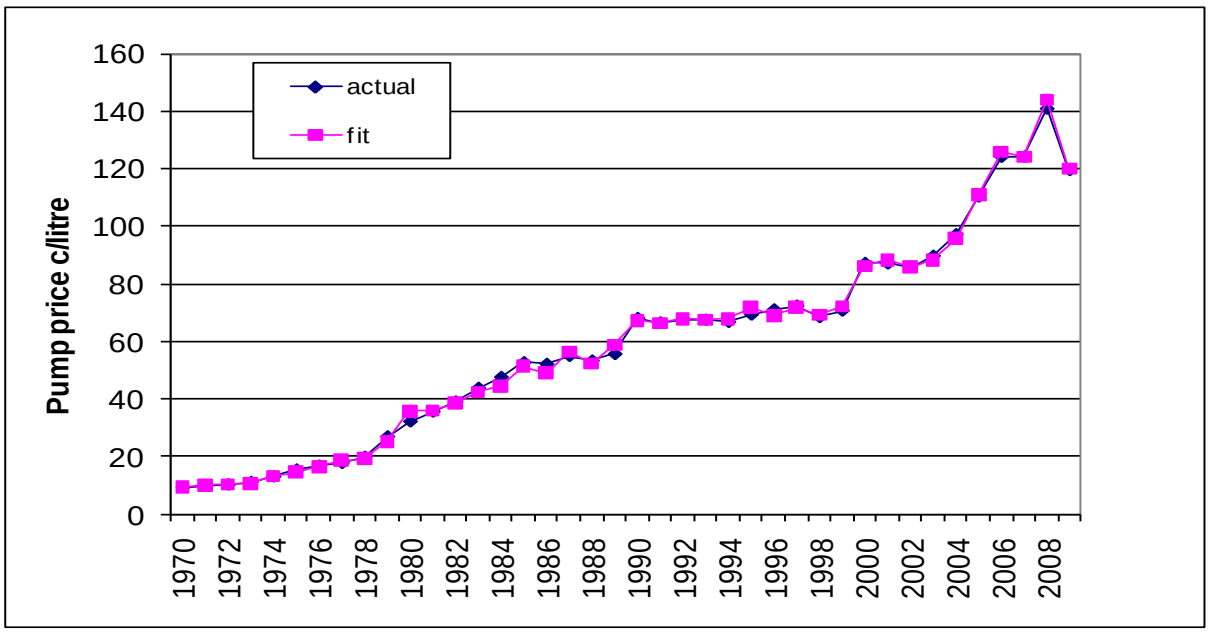


Table 4 Regression linking log of the 'estimated' refinery gate price in real c/litre to the log of the 'landed' price in real $A/barrel, 1970 to 2009

Regression Statistics	
Multiple R	0.982675639
R Square	0.965651411
Adjusted R Square	0.960600147
Standard Error	0.06489228
Observations	40

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	4.025097926	0.805019585	191.1702841	7.19656E-24
Residual	34	0.14317427	0.004211008		
Total	39	4.168272196			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.444399349	0.196326765	-2.263569869	0.030097582	-0.843383337
ln real landed price	1.033043161	0.044696664	23.11231031	2.26223E-22	0.942208612
dum7073	0.469315068	0.049742302	9.434928648	5.06333E-11	0.368226549
dum8693	0.08272343	0.031752131	2.605287514	0.013521372	0.018195337
dum9602	-0.263778617	0.0322242	-8.185730569	1.50459E-09	-0.329266069
dum03on	-0.176860594	0.031657574	-5.586675485	2.96751E-06	-0.241196525

5. The Australian exchange rate

In Table 3, before the world oil price is landed on the wharf in Australia, we come to the Australian dollar ($A) exchange rate, which plays a crucial part in determining Australian fuel prices. But what determines the value of the Australian dollar?

The Australian dollar used to be a commodity currency within the US dollar block of currencies. But since the introduction of the Euro in 1999, the Australian dollar has joined the ranks of the US dollar alternative currencies. Its value is, for the most part, set by the value of the US currency in terms of a basket of Western currencies – the so-called 'Special Drawing Rights' (SDRs). As Figure 8 shows, there is an inverse relationship between the SDR values of the US and Australian currencies. Figure 9 shows what this means for the bilateral US$/$A exchange rate. When the US dollar depreciates 10 per cent against the basket of Western currencies (the SDR), then the Australian dollar rises 20 per cent against the US dollar (see Gargett 2005). The strength of the US dollar is what took our currency to 50 cents against the US dollar in 2001, and its subsequent weakness is what took the Australian dollar, just over two years later, to 80 cents. This cycle then repeated itself with the US dollar strengthening with the flight to safety at the onset of the Global Financial Crisis (GFC), and then weakening again with the recovery. The Australian dollar did the opposite, but also independently weakened some more, as a result of the GFC. This negative effect has worn off, with the US dollar currently at about 0.64 SDRs/US$, which from Figure 9 should mean an US/Australian exchange rate of about 88 cents – close to current (February 2010).

Figure 8: Movements in the SDR Values of the US and Australian Dollars

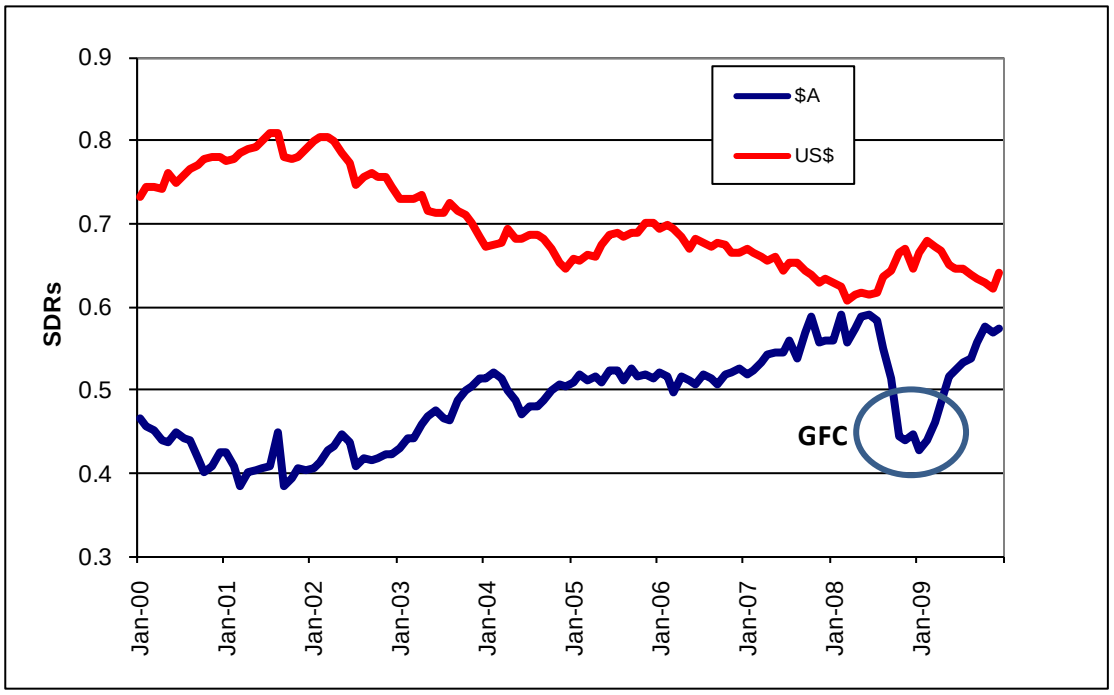
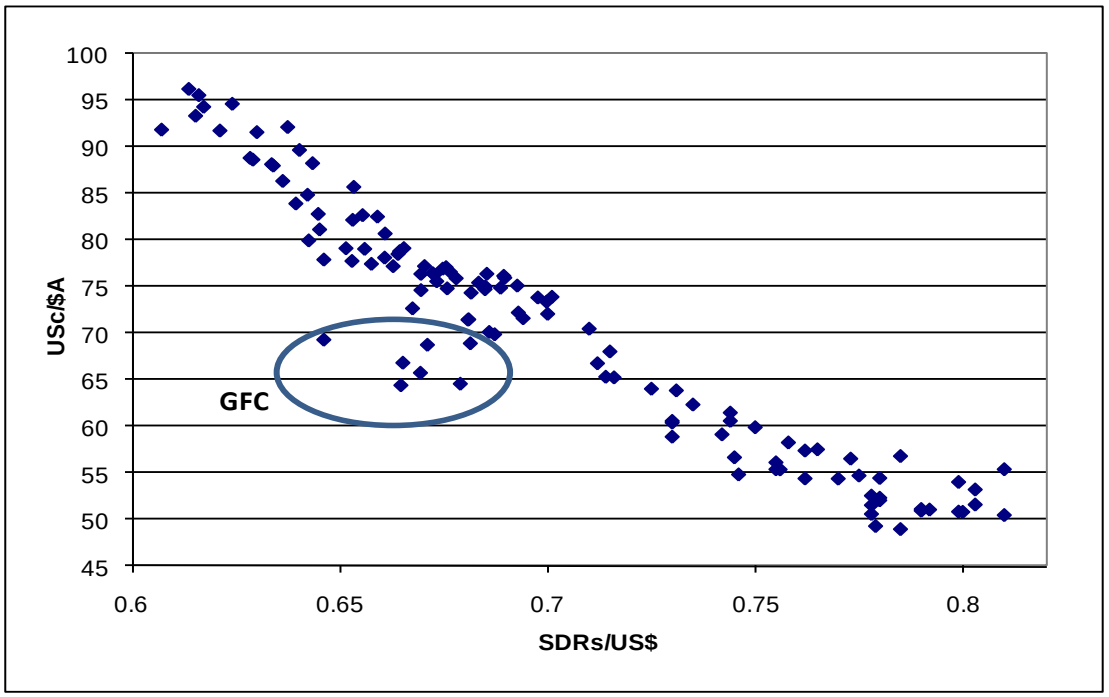


Figure 9: Resulting Relationship between the Two Currencies



To understand why this relationship holds, we need to consider the fact that the Australian dollar/US dollar is the fifth most traded currency pair in the world. This is not due to the volume of our exports and imports. Rather, think of the Australian dollar as a car park. Carscome in off the street, park in a parking space, and then leave back to the street. There is a constant flow in and out. But this car park is special - the price of parking spaces rises when more cars are coming in than are leaving. The street is the US dollar, the cars are

money flows, and the price of parking spaces is the value of the Australian dollar. When the US dollar is depreciating, more money wants to escape the street and comes and parks in the Australian dollar, driving up its value, and vice versa. This is the best analogy I can think of, to explain the relationship shown in Figures 8 and 9.

An equation to explain the Australian exchange rate is as follows:

$$SDRs/\$A = constant + b_1*ussdrinv + b_2*chnetals + b_3*chir + b_4*usdev + b_5*curs + b_6*chxrl11$$

$$+ b_7*compd1 + b_8*compd2 + b_9*nz\$dum$$

Table 5 presents the results of a regression from January 2000 to June 2007 using daily data. The dependent variable is the value of the Australian dollar in SDR's. The main explanatory variable is the inverse of the value of the US dollar in SDR's (ussdrinv), adjusted by the ratio of G7 to Australian consumer price indices (22 week moving average).

There are also five acceleration components that are associated with the shorter-term movements in the currency:

1. chmetals - the 3-month rate of change in an index of spot metal prices on the London Metals Exchange (expressed in SDRs).
2. chir - the 3-month rate of change in the Australian 3 year bond rate.
3. usdev - the change in the current US dollar per SDR rate from that of the last 22 days.
4. currs - the 3-month change in three currencies that the market treats similarly to the Australian dollar, i.e. the New Zealand dollar, the Canadian dollar and the Korean Won.
5. chxrl11 - the 6-week change in the value of the Australian dollar itself, lagged 2 weeks. This captures some of the feed-back dynamics in short-run changes to the $A.

Finally, there are three dummy variables necessary to explain factors causing fairly long-lived shifts in the dollar's value:

1. compd1 - a commodity boom dummy coming on from 0 at April 25, 2005 to 1.0 at June 14, and then being held constant. This simulates the realization by the market that Australia would benefit from much higher contract prices for its commodities, iron and coal especially. It has a positive effect.
2. compd2 - another commodity boom dummy coming on from 0 at May 31 2007 to 1.0 at June 14, and then being held constant. This simulates the next rise in contract prices for Australian commodities. It has a positive effect.
3. nz$dum - a New Zealand dollar collapse dummy that mirrors the V-shaped collapse and partial recovery of the New Zealand dollar from March 20, 2006 to April 18, then remains constant to June 2006, and then reduces to zero by June 2007. It has a negative effect.

Table 5 Equation for the daily value of the Australian dollar in SDR's

Regression Statistics	
Multiple R	0.9855159
R Square	0.9712416
Adjusted R Square	0.9711086
Standard Error	0.007816
Observations	1956

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	4.014866489	0.446096	7302.357	0
Residual	1946	0.118879892	6.11E-05		
Total	1955	4.13374638			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.0593279	0.003660351	-16.2082	1.61E-55	-0.066506487	-0.052149246
ussdrinv	0.8174874	0.005803674	140.8569	0	0.806105348	0.82886949
chmetals	0.1059773	0.005280123	20.07099	1.36E-81	0.095622009	0.116332592
chir	0.2327521	0.007714786	30.16962	2.3E-164	0.21762202	0.247882244
usdev	0.7926556	0.066632254	11.89598	1.5E-31	0.661977546	0.92333373
currs	0.3385629	0.023556329	14.37248	1.36E-44	0.292364642	0.384761221
chxrl11	0.0029278	0.000249509	11.7342	9.02E-31	0.002438452	0.003417117
compd1	0.0356738	0.000579142	61.59759	0	0.034537965	0.036809574
compd2	0.0172621	0.002062399	8.369931	1.09E-16	0.013217393	0.021306879
nz$dum	0.9751488	0.036024498	27.06905	3.2E-137	0.904498181	1.045799499

Figure 10 shows 1) the fit of the equation during the period of estimation, from January 2000 to June 2007, and then 2) the fit in the two and a half years subsequent - to December 2009. The equation fits the daily data remarkably well until the onset of the global financial crisis (GFC) in October 2008. The gap between actual and fit in the period from October 2008 to October 2009 can be understood as measuring the effect of the GFC on the Australian dollar, and is linked to the collapse and subsequent recovery in commodity prices. Figure 11 shows the ex-sample period in more detail.

Figure 10 Fit and ex-sample fit of exchange rate equation, 2000 to 2009

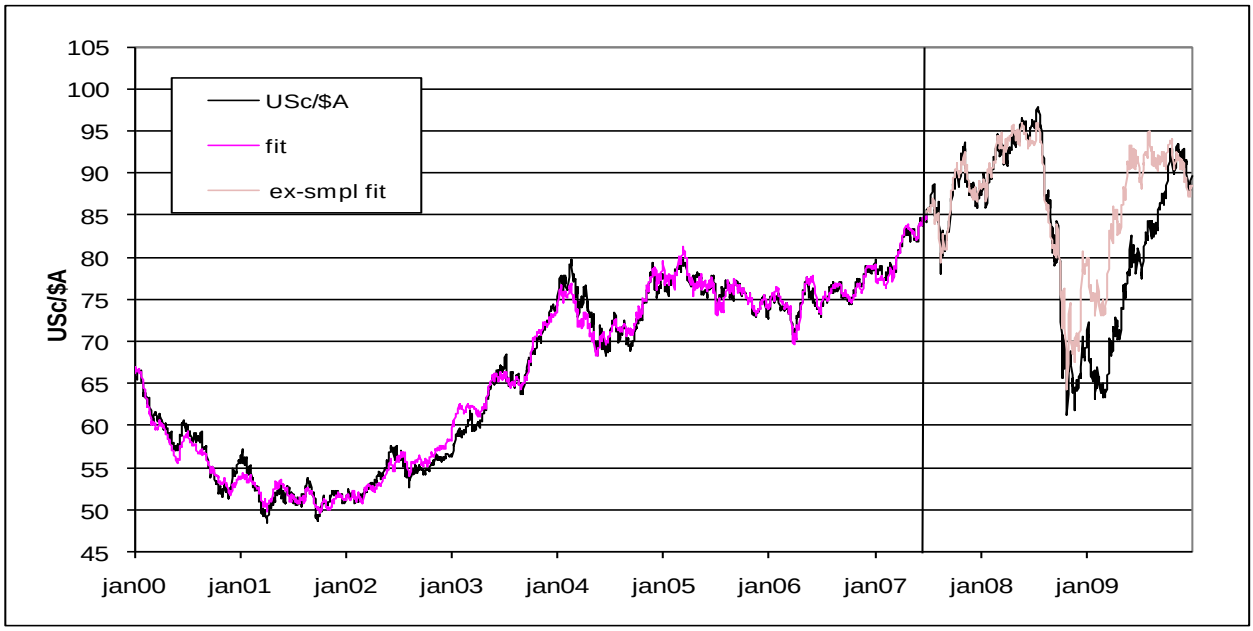
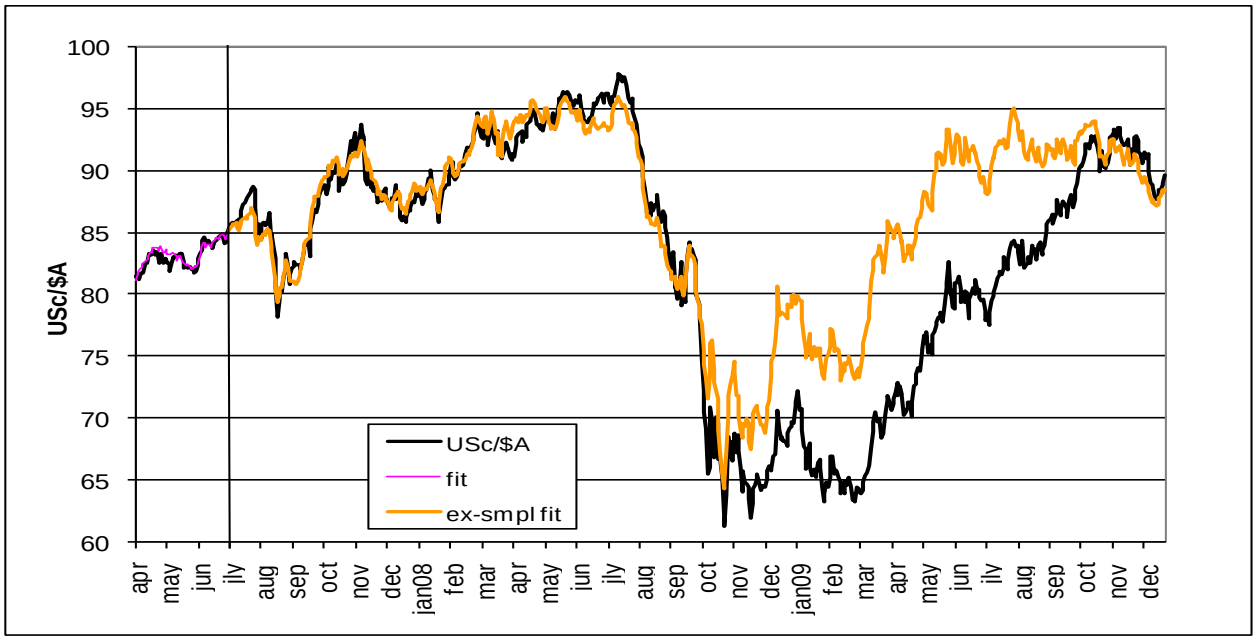


Figure 11 Fit and ex-sample fit of exchange rate equation, 2007 to 2009



6. Australian retail petrol price scenarios

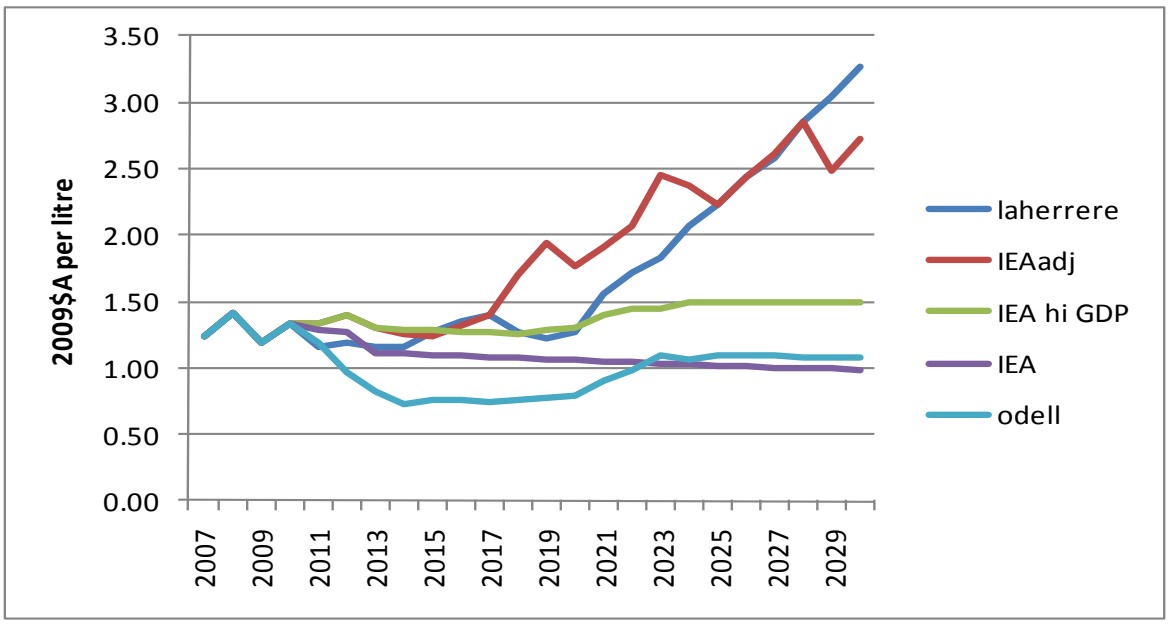
Table 6 shows the calculated landed refinery gate price (in real 2009 A$/barrel from 2009 on), derived from the IEA adjusted scenario for projected world oil prices (Tapis set at 1.05 times WTI), with shipping fuel costs varying proportionally to oil prices and the Australian dollar held constant against the US dollar. The result is the scenario for the total Australian petrol price also presented in the table. This involves adding in forecasts for excise, GST and margins (real 2009Ac/l from 2009 on). The GST is taken as 10 per cent of the refinery gate price plus excise. Excise (under current legislation) is held constant in nominal terms, and so is progressively diminished, with inflation assumed to be 2.5 per cent per year. Finally, the margin is assumed to be a constant fraction of refinery gate price plus GST.

Table 6 Translating the IEA adjusted scenario into Australian retail petrol prices (2009 c,$)

	Australian petrol prices c/l										Oil costs/prices $/barrel			
						petrol price	oil price	ref cost						
			state			landed to	landed to	incl qual	on the		shipping	shipping	Tapis	
	pump	federal	excise/			refin gate	refin gate	premium	wharf	US$/$A	non-fuel	fuel	oil price	
cal year	price	excise	subsidy	margin	GST	c/litre	$A/b	$A/b	$A/b		US$/b	US$/b	US$/b	cal year
2007	124.29	38.14	-2.16	12.00	10.21	66.10	104.94	8.08	96.86	0.84	3.30	0.84	77.52	2007
2008	141.00	38.14	-2.39	12.00	11.73	81.52	133.64	6.24	127.40	0.85	3.44	0.82	104.41	2008
2009	119.61	38.14	-1.01	12.00	9.78	60.70	97.71	11.20	86.51	0.80	3.50	0.86	64.76	2009
2010	134.24	37.21	-0.01	14.28	10.91	71.86	114.36	10.40	103.96	0.90	3.50	0.81	89.25	2010
2011	133.32	36.30	-0.01	14.28	10.82	71.93	114.47	10.40	104.07	0.90	3.50	0.92	89.25	2011
2012	139.18	35.42	-0.01	15.27	11.26	77.24	122.64	10.40	112.24	0.90	3.50	0.91	96.60	2012
2013	130.37	34.55	-0.01	14.10	10.57	71.16	113.28	10.40	102.88	0.90	3.50	0.90	88.20	2013
2014	125.49	33.71	-0.01	13.50	10.18	68.10	108.57	10.40	98.17	0.90	3.50	0.85	84.00	2014
2015	124.59	32.89	-0.01	13.49	10.10	68.12	108.59	10.40	98.19	0.90	3.50	0.87	84.00	2015
2016	132.53	32.09	-0.01	14.78	10.70	74.97	119.16	10.40	108.76	0.90	3.50	0.93	93.45	2016
2017	139.65	31.30	-0.01	15.94	11.25	81.17	128.68	10.40	118.28	0.90	3.50	1.10	101.85	2017
2018	169.54	30.54	-0.01	20.45	13.55	105.00	165.10	10.40	154.70	0.90	3.50	1.33	134.40	2018
2019	194.61	29.79	-0.01	24.25	15.49	125.09	195.58	10.40	185.18	0.90	3.50	1.46	161.70	2019
2020	176.02	29.07	-0.01	21.62	14.04	111.30	174.67	10.40	164.27	0.90	3.50	1.55	142.80	2020
2021	191.15	28.36	-0.01	23.95	15.20	123.65	193.40	10.40	183.00	0.90	3.50	1.60	159.60	2021
2022	206.54	27.67	-0.01	26.32	16.38	136.18	212.34	10.40	201.94	0.90	3.50	1.85	176.40	2022
2023	245.96	26.99	-0.01	32.22	19.43	167.33	259.20	10.40	248.80	0.90	3.50	2.02	218.40	2023
2024	237.26	26.33	-0.01	31.03	18.75	161.16	249.93	10.40	239.53	0.90	3.50	2.08	210.00	2024
2025	222.53	25.69	-0.01	28.96	17.60	150.29	233.60	10.40	223.20	0.90	3.50	2.08	195.30	2025
2026	243.95	25.07	-0.01	32.20	19.25	167.44	259.36	10.40	248.96	0.90	3.50	2.17	218.40	2026
2027	260.56	24.45	-0.01	34.74	20.53	180.85	279.45	10.40	269.05	0.90	3.50	2.39	236.25	2027
2028	285.11	23.86	-0.01	38.44	22.42	200.40	308.64	10.40	298.24	0.90	3.50	2.41	262.50	2028
2029	248.26	23.28	-0.01	33.10	19.56	172.33	266.69	10.40	256.29	0.90	3.50	2.46	224.70	2029
2030	272.17	22.71	-0.01	36.70	21.41	191.36	295.16	10.40	284.76	0.90	3.50	1.83	250.95	2030

Australian petrol price projections from all five scenarios are shown in Figure 12. The price of a litre of petrol varies from around $1 up to $2.50 to $3.50 under the different scenarios.

Figure 12 Australian retail petrol price scenarios



7. Conclusions and Implications

There are several conclusions to be drawn from the above analysis:

- There exist very divergent views on the future potential supply of oil onto world markets.
- These generate very divergent scenarios regarding the future path of world oil prices.
- There is a fairly stable translation mechanism from world oil prices to Australian petrol prices.
- A key element of this translation mechanism is the value of the Australian dollar, which is shown to depend in the long run on the value of the US currency, plus shifts in long-run expectations about commodity prices received by Australia.
- The divergent supply scenarios have 2030 oil prices (in 2009US$) varying from $65 to $300 per barrel.
- At a constant Australian dollar exchange rate, this generates a variation in Australian petrol prices at the pump (in 2009$A) of from $1 to $3.30 per litre
- The obvious conclusion: it all depends on what you assume!
- But, that said, there exists a fairly stable mechanism for translating assumptions about world oil markets into retail petrol prices at the pump in Australia.

There are also some implications that can be drawn for Australian transport:

- All but one of the scenarios have petrol prices restrained for the rest of this decade.
- But in the 2020s the major difference that emerges is between the IEA and Odell scenarios and the two peak oil scenarios. Under the former, Australian petrol prices are likely to be fairly flat in the range of $1 per litre. But under the latter they would rise by 2030 to the range $2.50 to $3.50 per litre.

- If an average Australian household drives 375 kilometres per week, with an average fuel efficiency of the light vehicle fleet in 2010 of 11 litres per 100 kilometres and 9 litres per 100 kilometres in 2030, the peak oil scenarios would see the weekly cost of petrol rise from $55 today to between $90 and $110 in 2030.
- The price and cost of petrol would be higher under all scenarios if the world economy grows faster in the future.
- Increases in the fuel efficiency of the vehicle fleet will be an important factor in mitigating the effects on consumers of any rise in petrol prices, but such increases are very slow given the longevity of the Australian fleet.
- The demand for urban public transport in liable to rise significantly if some of the higher petrol price scenarios are realised. But given urban public transport is only some 10 per cent of metropolitan trips, and the nature of our cities is unlikely to change substantially in 20 years, the impact of any petrol price rises would still be felt.

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