

Petrol prices in Australia

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Abstract

Australian petrol prices are determined by movements in the world oil price, the Australian exchange rate, and numerous other components of the price chain. This paper models these factors, examines a short-term scenario for the world oil price and shows how it would translate into movements in Australian retail petrol prices. Detailing the chain allows an understanding of what is going on during periods of rapid changes, such as during the COVID pandemic, as well as what is behind the long-term trends and thus what might be expected in the foreseeable future.

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 petrol prices.

2. The petrol price chain overview

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 the Organisation of Petroleum Exporting Countries (OPEC) surplus decisions and the oil price. Brent oil price in Special Drawing Rights (SDRs) per barrel is determined by the change in the ratio of oil supply to world Gross Domestic Product (GDP), as well as by the level of world oil stocks relative to oil supply.

Once the Brent oil price is set, putting the price through the Australian exchange rate, and multiplying by 0.61 (a ratio that converts dollars per barrel to cents per litre) gives Brent oil price in Ac/litre. Then adding a processing cost margin gives the Singapore MOGAS95 price.

Then adding excise, and Goods and Services Tax (GST – applied to “MOGAS + excise” giving pre-wholesale GST), gives MOGAS + tax.

Adding wholesale costs and wholesale cost GST gives the Australian Terminal Gate Price (TGP).

Then adding retail margins and retail GST results in the Australian retail petrol price (price at the pump).

The paper examines each of these steps, starting with the world oil price mechanism.

Figure 1: The petrol price chain



3. Determinants of the Brent oil 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 2022). 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 relationship between the change in the 9-quarter average of the ratio of world oil demand to world GDP lagged 4 quarters after 2014 (see variable 10 in the Data list), and the Brent oil price expressed in real Special Drawing Rights (SDRs) per barrel. Figure 3 shows the real Brent SDR oil price and stocks adjusted (variable 14 in the Data list) - the ratio of world oil stocks (previous 3 quarters) to long-term stocks (last 7 years). Both variables show an influence (inverse) on the Brent oil price.

Figure 2: World oil demand/price relationship

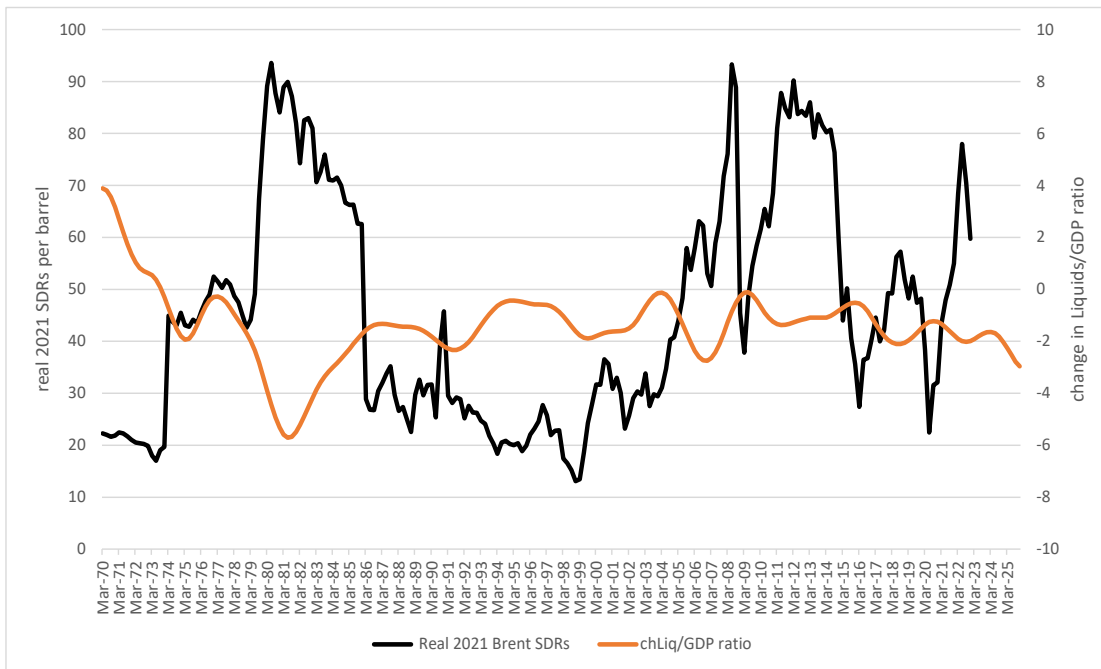


Figure 3: World oil stock/price relationship

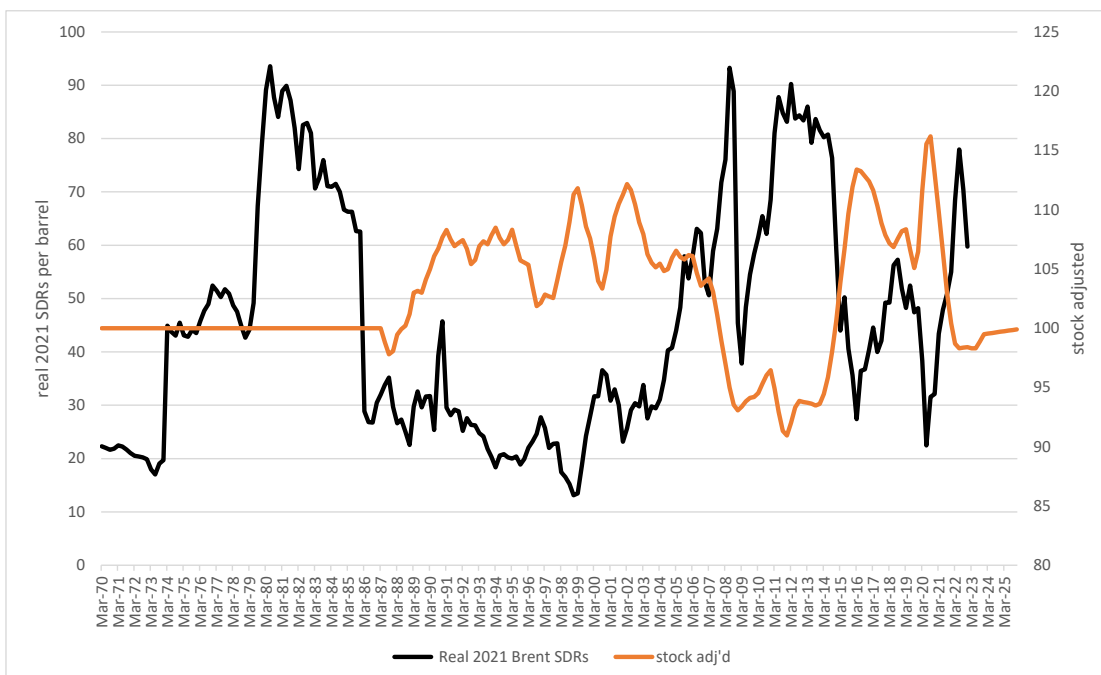


Table 1 shows a regression on the Brent oil price using the change in liquids/GDP ratio, the stock/ supply ratio and dummy variables.

Table 1: The real Brent oil price regression

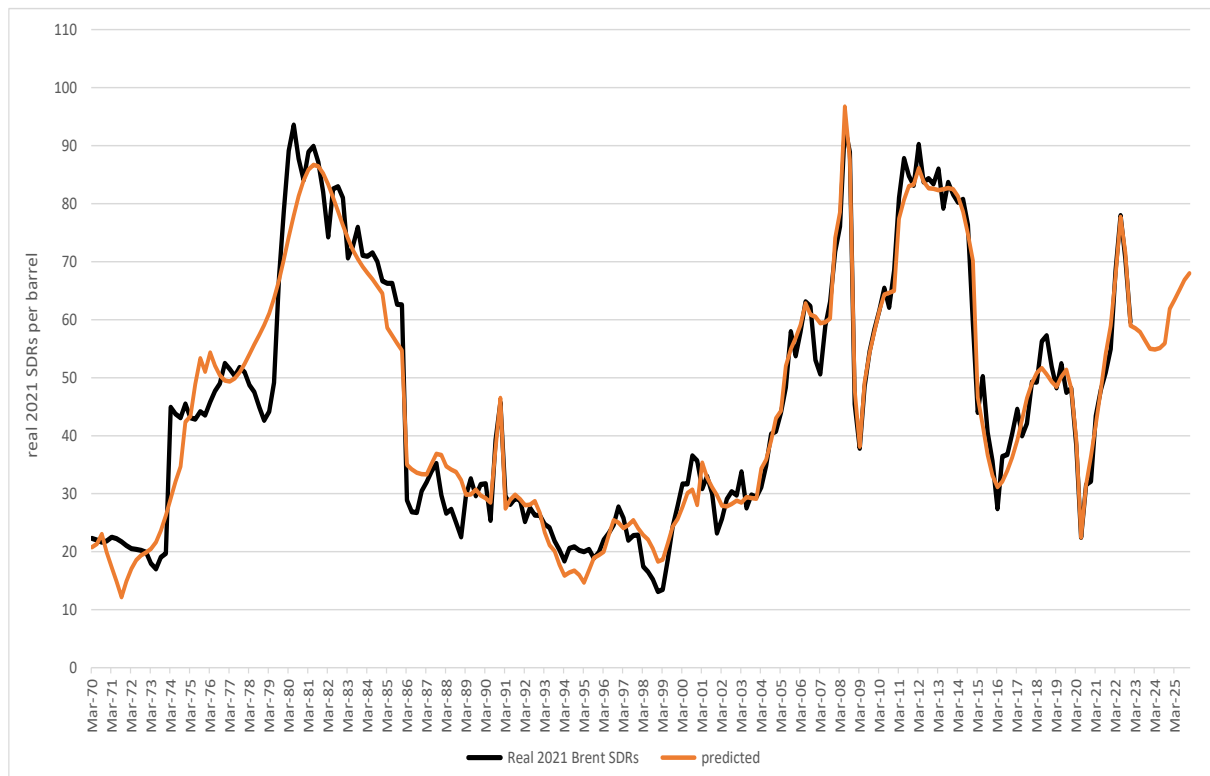
	Coefficients	t-Statistic
Constant	197	21.9 ***
ChLiqs/GDP ratio	-6.87	-27.2 ***
Stocks adjusted	-1.5	-17.4 ***
dumlow	-23.3	-27.6 ***
dumGFC ^a	-38.1	-11.7 ***
dumhi	17.9	13.3 ***
dum99 ^b	18.7	4.11 ***
dumUkraine	14	3.26 ***
Dum COVID	-10.3	-2.01 *
dumRussiaCap	-9.17	-2.01 *
Observations	213	
R ²	0.9748	
Adjusted R ²	0.9480	
Residual Std Error	5.00	
F-Statistic	430.4	

Note: Significance values: *** <0.001, ** <0.01, * <0.05, . <0.1.

Source: BITRE estimates.

The fit of the prediction from the equation to the real Brent oil price is shown in Figure 4. The Brent oil price is the first of the five steps on the petrol price ladder in Figure 1.

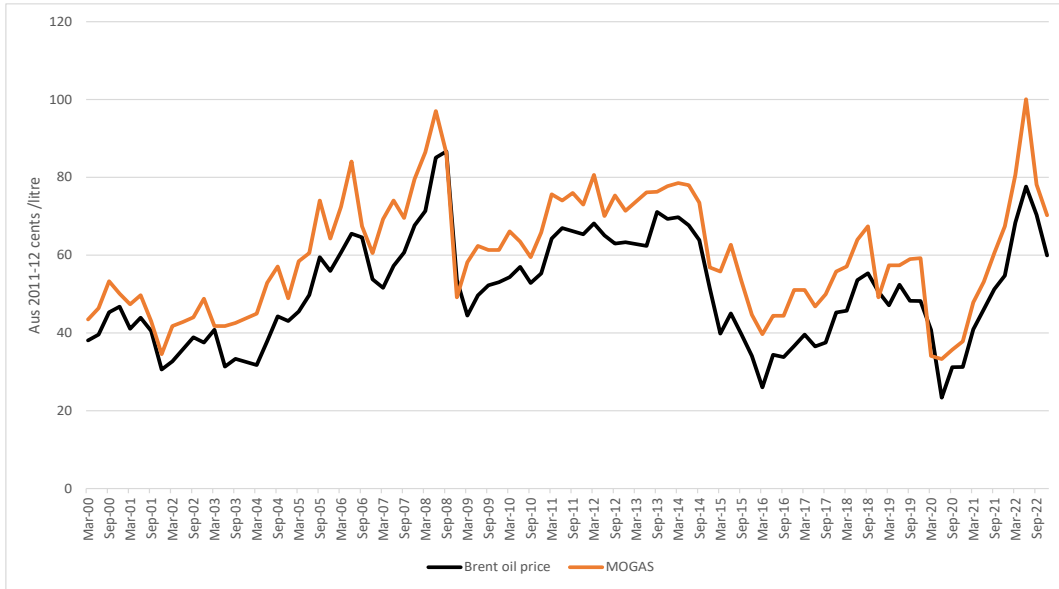
Figure 4: Actual and predicted real Brent oil price



4. The Australian petrol price ladder

The next steps are to 1) convert the Brent SDRs/barrel oil price to A\$/barrel, 2) multiply by 0.61 to convert to Ac/litre, and 3) compare to Singapore MOGAS95 in Ac/litre. Figure 5 shows the fit of the resulting Brent oil price and Singapore MOGAS95 price, both in 2011-12 Ac/litre.

Figure 5: Brent oil price and Singapore MOGAS95



Being a processed fuel, MOGAS is usually a fairly constant margin above the Brent oil price, as shown in Figure 5. The exceptions are times of oil market chaos – for example the Global Financial Crisis in late 2008 and the COVID crisis in March 2020. The model for the processing cost margin between Brent oil and MOGAS involved setting three levels – pre-2003, December 2018 on, and in between – as well as dummies for extremes – September 2006, the GFC, COVID and the war in the Ukraine. The fit of the equation to the processing cost margin is shown in Figure 6. Adding the predicted processing cost margin to the Brent oil price gives the forecast for MOGAS shown in Figure 7. MOGAS is the second of the five steps on the petrol price ladder in Figure 1.

Figure 6: Margin between Brent and MOGAS

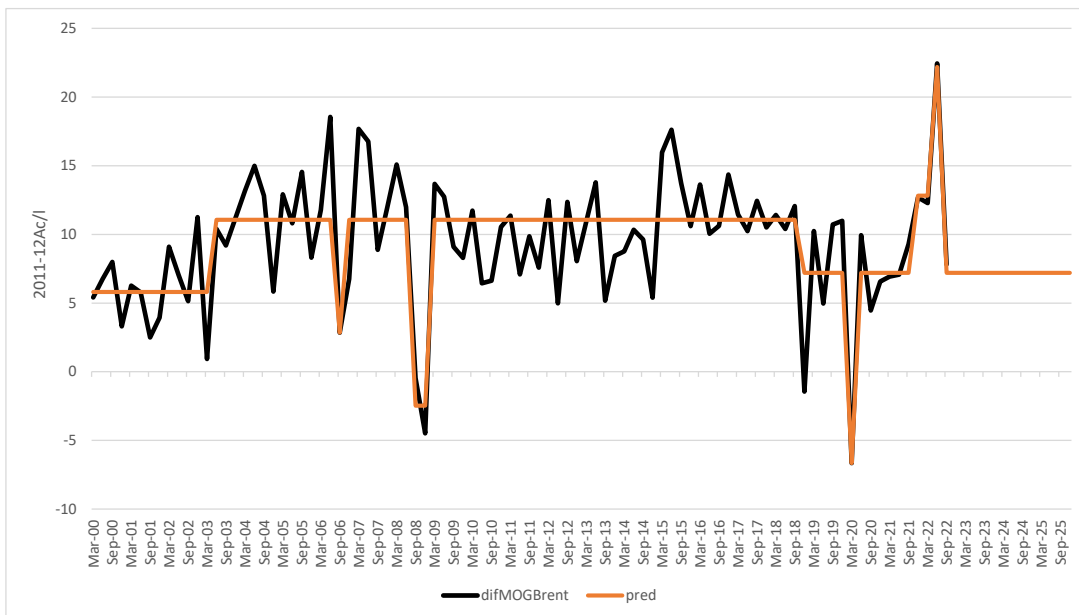
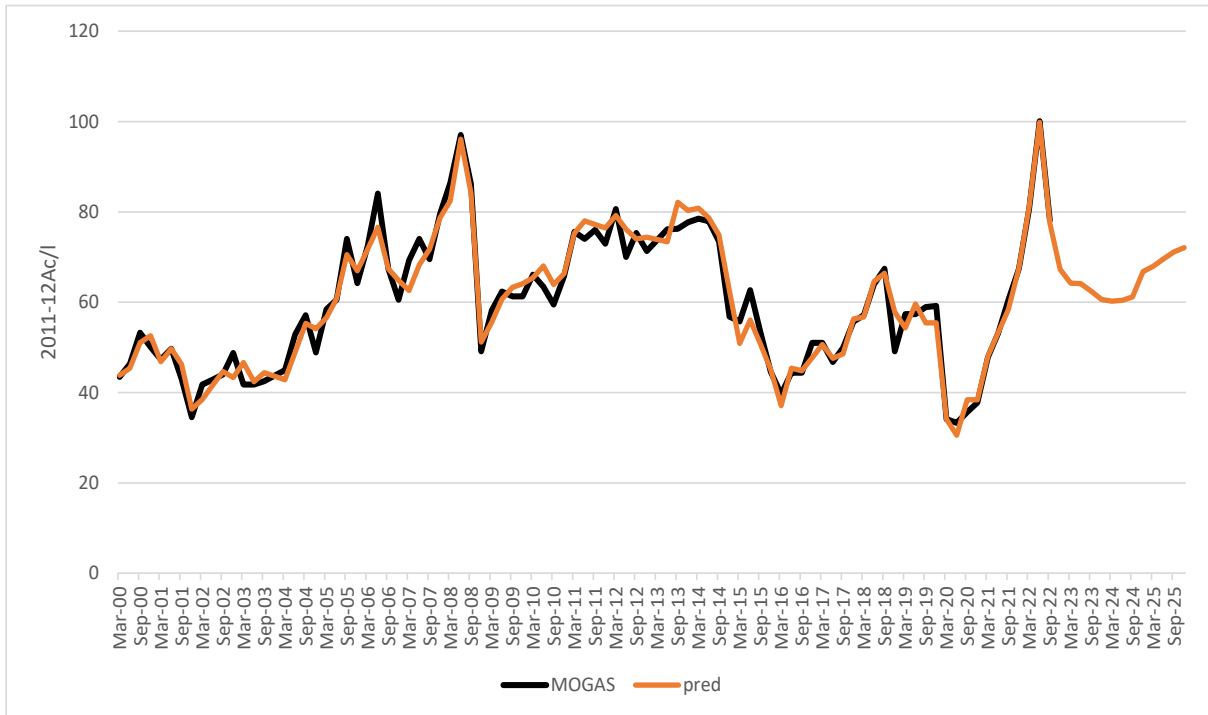


Figure 7: MOGAS and its forecast from Brent oil



The next calculation is to add excise (Federal plus State) and pre-wholesale GST to the MOGAS price, where pre-wholesale GST is $0.1 \times (\text{MOGAS} + \text{excise})$. The result is MOGAS+tax, the third step on the petrol price ladder in Figure 1.

Wholesale cost is next. It is defined as the difference between MOGAS+tax and the Terminal Gate Price (TGP). It includes pre-GST wholesale cost and wholesale GST (calculated as $.1/1.1 \times \text{wholesale cost}$). Wholesale costs are shown in Figure 8. Extremely noisy, they can best be forecast as constant in real terms, except for extreme periods – September 2006, the GFC, COVID and September 2022.

Figure 8: Wholesale costs and forecasts

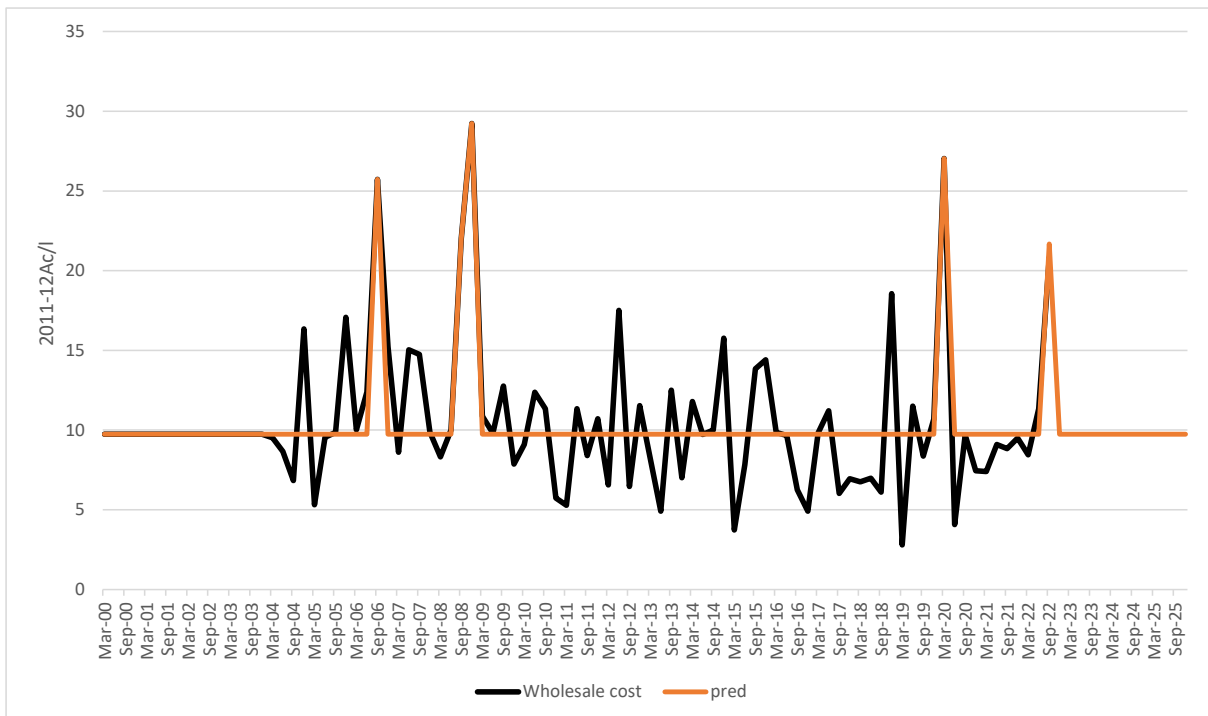
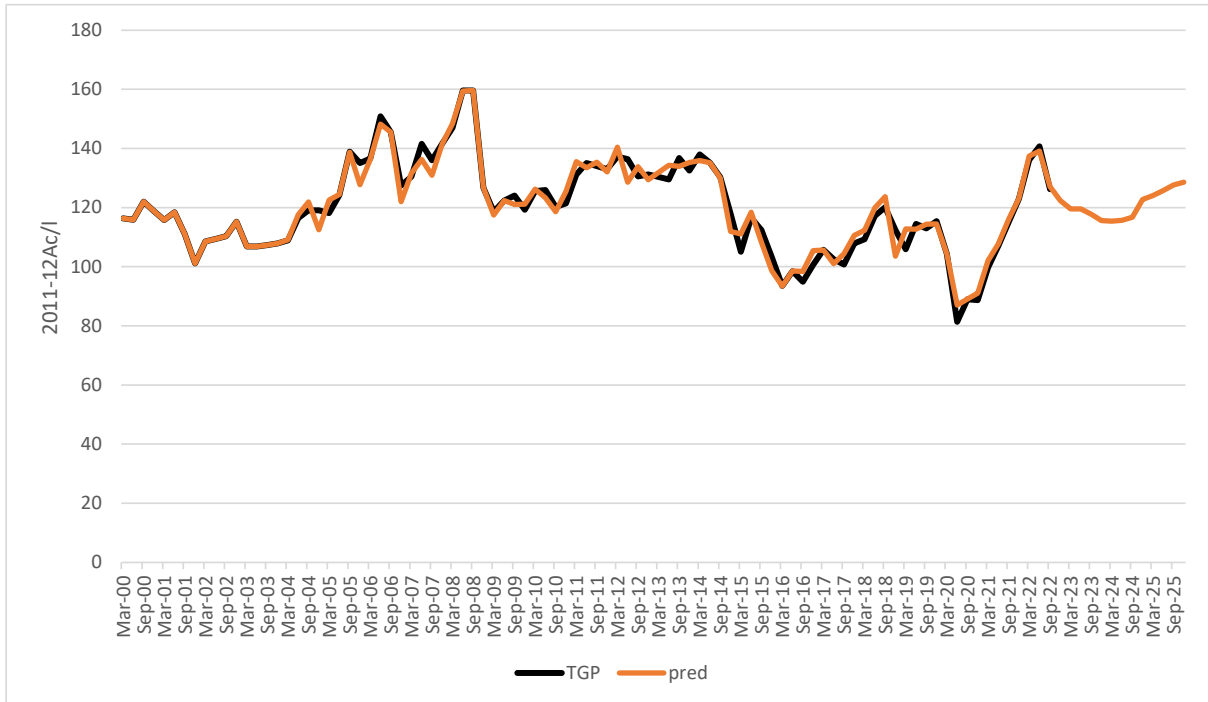


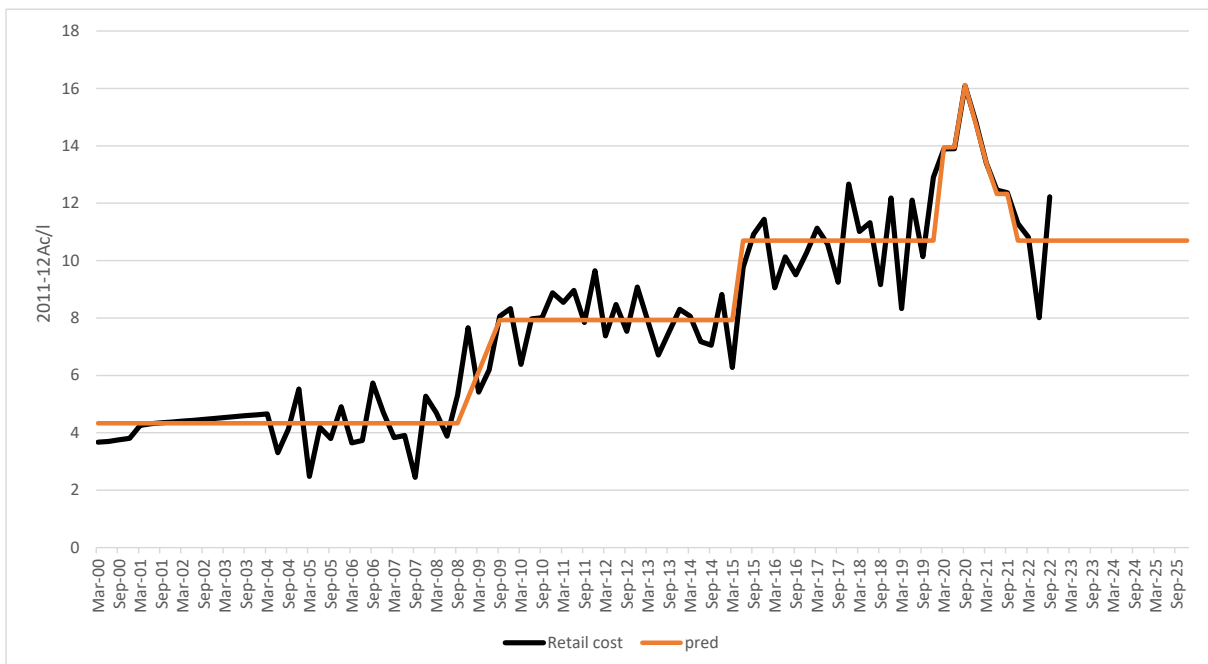
Figure 9 shows the result of adding forecast wholesale costs to MOGAS + tax, giving the forecast Terminal Gate Price (TGP), the fourth step on the petrol price ladder in Figure 1.

Figure 9: Terminal Gate Price and its forecast from MOGAS + tax



Retail cost is next. It is defined as the difference between the retail petrol price and the Terminal Gate Price (TGP). It includes pre-GST retail cost and retail GST (calculated as $.1/1.1 \times \text{retail cost}$). Retail costs and their forecast are shown in Figure 10. Extremely noisy, they can best be forecast as three levels – March 2000 to September 2008, September 2009 to March 2015, and June 2015 on – as well as a COVID dummy.

Figure 10: Pre-GST retail costs and forecast



Adding retail costs to the Terminal Gate Price gives the Australian retail petrol price, the fifth and last step on the petrol price ladder in Figure 1. Figure 11 shows the retail petrol price and its forecast from TGP + retail costs.

Figure 11: The Australian petrol price and its forecast from Terminal Gate Price

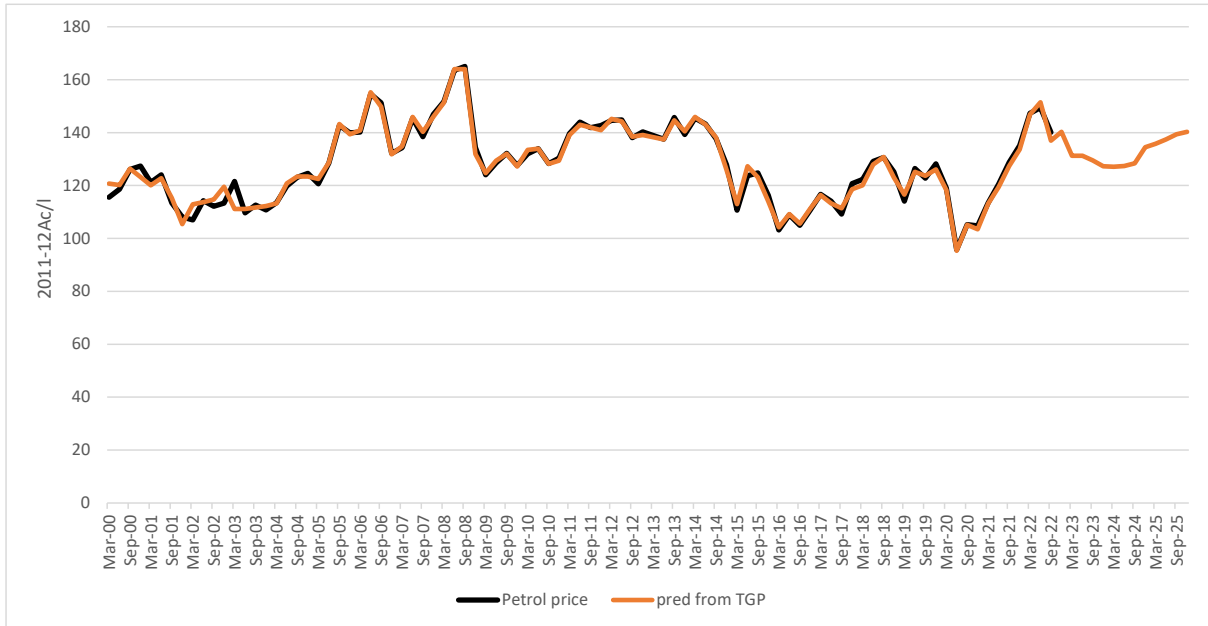
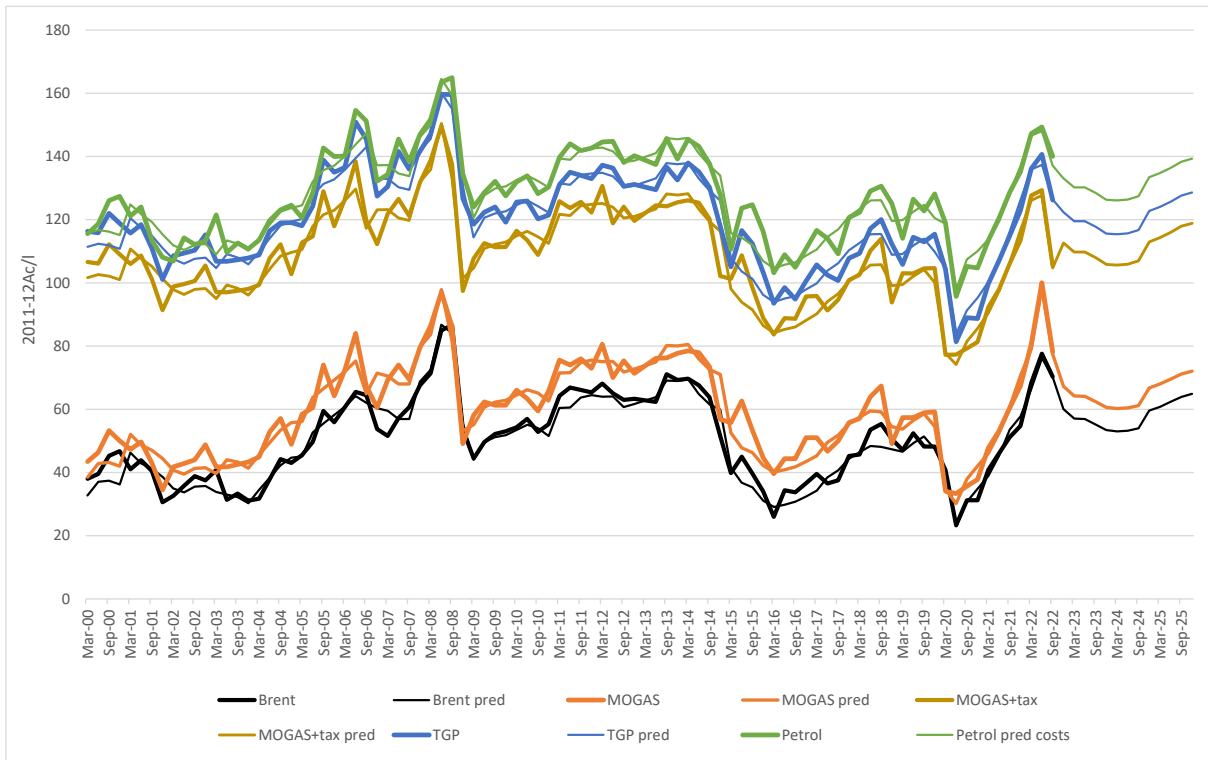


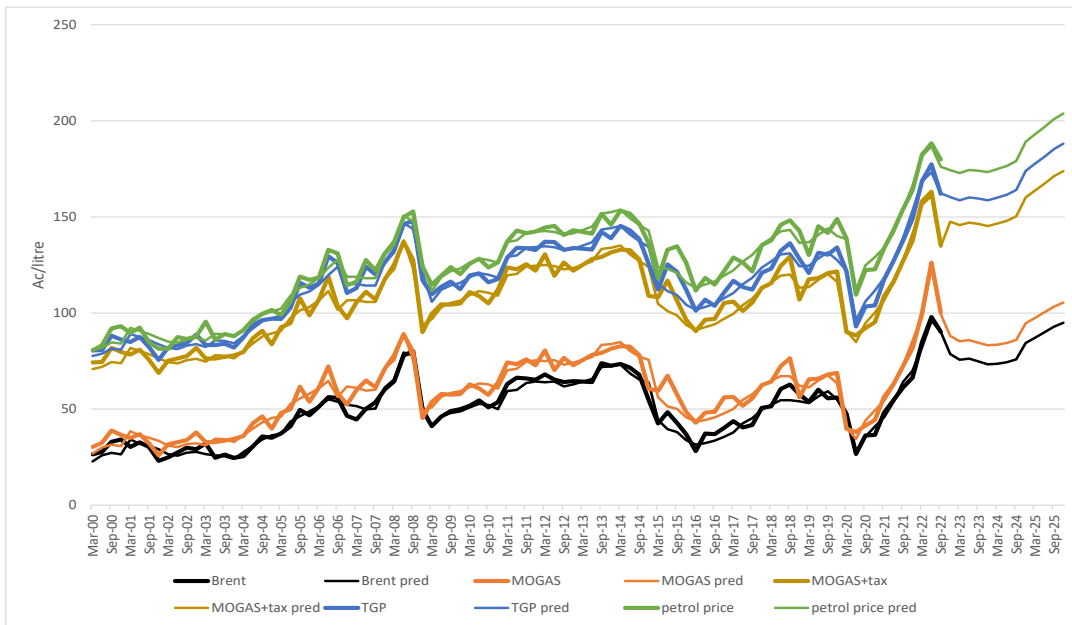
Figure 12 shows all five of the major steps on the Australian petrol price ladder: (1) the Brent oil price, (2) MOGAS95, (3) MOGAS + tax, (4) the Terminal Gate Price, and finally (5) the Australian retail petrol price.

Figure 12: The Australian petrol price ladder in real currency



Converting back to nominal cents/litre, the ladder is shown in Figure 13.

Figure 13: The Australian petrol price ladder in nominal currency

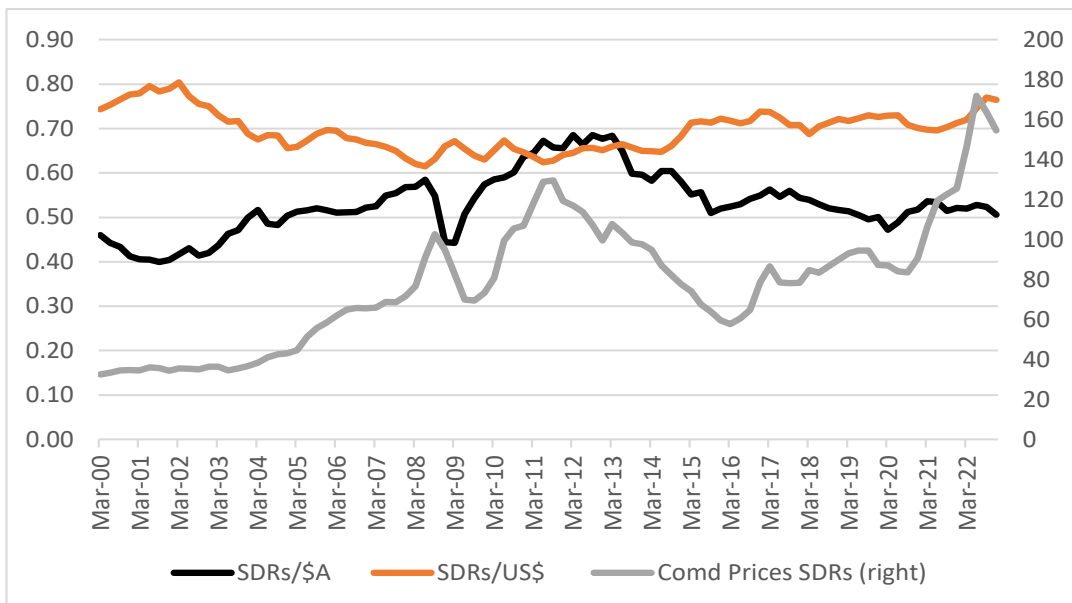


5. The Australian exchange rate

In Figure 1, before the Brent oil price is translated into Singapore MORGAS, we come to the Australian dollar (\$) exchange rate, which plays a crucial part in determining Australian fuel prices. But what determines the value of the Australian dollar? Its value is, for the most part, set by the value of the US currency (both expressed in terms of a basket of Western currencies – the so-called ‘Special Drawing Rights’ SDRs). As Figure 14 shows, there is an inverse relationship between the SDR values of the US and Australian currencies. The strength of the US dollar is what took our currency to 50 cents against the US dollar in 2001, and its subsequent weakness during the early 2010s is what took the Australian dollar to over one US\$.

The other factor for the Australian currency is the level of commodity prices (in SDRs). As shown in Figure 14, there is a direct relationship between high commodity prices and a dollar that is higher than it would be from the effect of the US currency alone.

Figure 14: Movements in the SDR Values of the US and Australian dollars



A regression with SDRs/\$A as the dependent variable, used SDRs/US\$ plus commodity prices in SDRs and dummy variables to come up with the equation in Table 2.

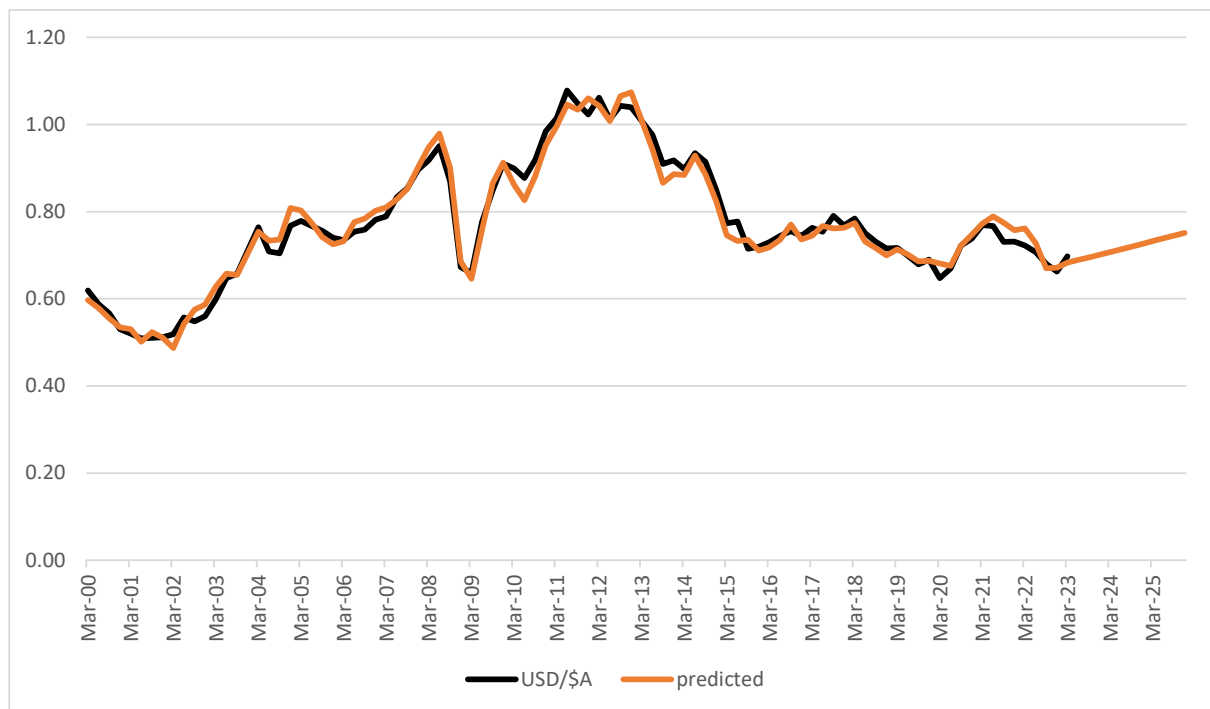
Table 2: The SDRs/\$A regression

	Coefficients	t-Statistic
Constant	1.08	37.6 ***
SDRs/US\$	-0.893	-23.0 ***
Commodity prices (SDRs)	0.00103	13.3 ***
dumGFC	-0.111	-10.5 ***
dumHi ^a	0.123	16.8 ***
Observations	92	
R ²	0.9538	
Adjusted R ²	0.9517	
Residual Std Error	0.0155	
F-Statistic	449.0	

Note: Significance values: *** <0.001, ** <0.01, * <0.05, . <0.1.
Source: BITRE estimates.

With SDRs/US\$ assumed to fall from 0.76 to 0.73, and the commodity price index assumed to remain constant at 100, the forecast US\$/\$A rises from 0.70 to 0.75, as shown in Figure 15. This forecast was used in the price chain forecasts.

Figure 15: Movements in the Australian dollar



5. Summary

There are several implications of the above analysis:

- The future potential supply of oil onto world markets and the short-term movements in oil stocks have major implications for 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.
- There are seven cost rungs on the price ladder outlined above: Brent-to-Mogas margin, excise, pre-wholesale GST, pre-GST wholesale costs, wholesale GST, pre-GST retail costs, and retail GST. Although they are extremely variable, rough trend estimates can be established.
- This allows use of the price ladder to examine different oil price scenarios and their likely impact on Australian petrol prices. Thus, there exists a fairly stable mechanism for translating assumptions about world oil markets into retail petrol prices at the pump in Australia.

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U.S. Energy Information Administration (2023) Petroleum & Other Liquids [Europe Brent Spot Price FOB \(Dollars per Barrel\) \(eia.gov\)](https://www.eia.gov/europe-brent-spot-price-foob)

Data: Sources and Calculations

- 1 **Brent Crude** US Energy Information Administration (EIA) Petroleum and other liquids [Europe Brent Spot Price FOB \(Dollars per Barrel\) \(eia.gov\)](#)
- 2 **US CPI** Trading Economics <https://tradingeconomics.com/united-states/consumer-price-index-cpi>
- 3 **Real Brent US\$/b** (1) / (2) * 269.3 (June 2021)
- 4 **SDR/US\$** Special Drawing Rights per US dollar [Historical Data | RBA](#) ((SDR/\$A) / (US\$/\$A))
- 5 **Real Brent SDR/b** (3) / (4)
- 6 **Actual Liquid Supply Gb/yr** World oil production, US Energy Information Administration (EIA) Short-term Energy Outlook (mb/day*365/1000) [Short-Term Energy Outlook - U.S. Energy Information Administration \(EIA\)](#)
- 7 **World GDP** US Energy Information Administration (EIA) Short-term Energy Outlook [Short-Term Energy Outlook - U.S. Energy Information Administration \(EIA\)](#)
- 8 **Smoothed Liquids/GDP ratio** 9-quarter centred moving average of (6)/(7)
- 9 **Change in Liquids/GDP** 4-quarter percentage change in 8
- 10 **Smoothed, lagged change in Liquids/GDP** 9-quarter centred moving average of 9, lagged 1 year from 2014 on.
- 11 **Stock Drawdown** US Energy Information Administration (EIA) Short-term Energy Outlook [3atab.pdf \(eia.gov\)](#)
- 12 **World Stock** Previous quarter stock + (11*365/4*1000)
- 13 **7-year average World Stock** Average of past 7 years of 12.
- 14 **World Stock Adjusted** Average of past 3 quarters of 12 divided by 13, lagged 2 quarters pre 2010.
- 15 to 20 **Brent, MOGAS, Excise, TGP, Petrol Price** [Quarterly report on the Australian petroleum market - June quarter 2022 | ACCC](#) [Excise data - Dataset - data.gov.au](#)
- 21 **US\$/\$A** [Historical Data | RBA](#)
- 22 **SDR/\$A** Special Drawing Rights per Australian dollar [Historical Data | RBA](#)
- 23 **SDR/US\$** Special Drawing Rights per US dollar [Historical Data | RBA](#) ((SDR/\$A) / (US\$/\$A))
- 24 **Commodity Prices** Index in Special Drawing Rights [Index of Commodity Prices 2023 | RBA](#)

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	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l	Ac/l
	Brent	Brent pred	MOGAS	MOGAS pred	excise	MOGAS+tax	MOGAS+tax pred	TGP	TGP pred	petrol price	petrol price pred	USD/SA	predicted	SDRs/SA	predicted	SDRs/US\$	Commodity	Price	dumGFC	dumHi
Mar-00	26.52	22.82	30.30	26.86	37.25	74.30	70.87	80.53	77.66	80.56	80.67	0.619	0.597	0.460	0.444	0.743	23.43	0	0	0
Jun-00	27.78	26.01	32.53	30.09	35.20	74.51	72.06	80.77	78.90	83.27	81.94	0.588	0.578	0.443	0.435	0.753	24.03	0	0	0
Sep-00	33.01	27.27	38.84	31.50	35.55	81.83	74.49	88.19	81.59	91.93	84.74	0.567	0.555	0.434	0.425	0.766	24.96	0	0	0
Dec-00	34.18	26.47	36.60	30.71	35.90	79.75	73.86	86.21	80.98	93.12	84.15	0.531	0.535	0.412	0.415	0.777	25.09	0	0	0
Mar-01	30.34	34.20	34.97	38.49	36.25	78.35	81.86	84.90	89.06	89.57	92.26	0.520	0.531	0.405	0.413	0.779	24.99	0	0	0
Jun-01	32.70	31.97	37.01	36.29	36.60	80.97	80.25	87.61	87.51	92.42	90.74	0.509	0.502	0.405	0.399	0.796	26.04	0	0	0
Sep-01	30.25	30.81	32.13	35.15	36.60	75.60	78.62	82.29	85.90	84.72	89.13	0.510	0.523	0.400	0.410	0.783	25.81	0	0	0
Dec-01	23.06	29.13	26.03	33.50	36.60	68.89	76.36	75.63	83.71	81.49	86.97	0.512	0.511	0.404	0.404	0.790	24.82	0	0	0
Mar-02	24.86	26.61	31.78	31.03	36.60	75.22	74.47	82.01	81.88	81.38	85.17	0.519	0.488	0.417	0.392	0.804	25.64	0	0	0
Jun-02	27.42	25.82	32.80	30.27	36.60	76.34	73.81	83.18	81.27	87.53	84.58	0.557	0.542	0.431	0.419	0.773	25.59	0	0	0
Sep-02	29.97	27.40	33.93	31.87	36.58	77.57	75.51	84.45	83.02	86.46	86.35	0.548	0.575	0.414	0.434	0.756	25.25	0	0	0
Dec-02	29.12	27.72	37.85	32.22	36.57	81.85	76.23	88.78	83.79	87.92	87.15	0.560	0.587	0.420	0.440	0.750	26.21	0	0	0
Mar-03	32.09	26.62	32.83	31.18	36.55	76.31	74.66	83.30	82.32	95.51	85.72	0.599	0.627	0.437	0.458	0.730	26.20	0	0	0
Jun-03	24.65	25.93	32.83	34.63	36.53	76.29	78.09	83.33	85.75	86.16	89.15	0.648	0.657	0.463	0.470	0.715	24.90	0	0	0
Sep-03	26.39	25.52	33.66	34.27	36.49	77.17	77.78	84.00	85.48	89.10	88.91	0.658	0.655	0.472	0.469	0.717	25.68	0	0	0
Dec-03	24.73	24.09	34.46	32.89	36.46	78.01	76.44	82.00	84.18	88.04	87.62	0.725	0.720	0.499	0.496	0.688	26.45	0	0	0
Mar-04	25.47	27.67	36.04	36.55	36.42	79.70	80.21	87.33	88.02	91.07	91.49	0.765	0.753	0.516	0.509	0.675	27.67	0	0	0
Jun-04	30.52	30.96	42.61	39.88	36.38	86.89	84.16	93.87	92.01	96.53	95.50	0.708	0.732	0.485	0.502	0.685	29.60	0	0	0
Sep-04	35.82	34.24	46.19	43.19	36.33	90.77	87.77	96.30	95.65	99.63	99.15	0.705	0.735	0.483	0.503	0.685	30.73	0	0	0
Dec-04	35.10	36.44	39.86	45.46	36.27	83.74	89.35	97.07	97.28	101.57	100.81	0.768	0.807	0.503	0.529	0.656	31.17	0	0	0
Mar-05	37.35	37.02	47.96	46.11	36.22	92.59	90.74	96.97	98.74	99.01	102.29	0.779	0.802	0.513	0.528	0.659	32.12	0	0	0
Jun-05	41.07	43.52	50.00	52.66	36.16	94.78	97.44	102.67	105.49	106.13	109.06	0.767	0.773	0.516	0.520	0.673	37.07	0	0	0
Sep-05	49.60	46.30	61.73	55.53	36.10	107.61	101.41	115.83	109.54	119.00	113.15	0.756	0.742	0.520	0.510	0.688	40.26	0	0	0
Dec-05	46.86	48.76	53.83	58.03	36.05	98.86	103.07	113.17	111.23	117.28	114.86	0.740	0.725	0.516	0.505	0.696	42.27	0	0	0
Mar-06	51.25	54.45	61.20	60.80	35.99	106.91	106.51	115.37	114.74	118.45	118.40	0.735	0.732	0.511	0.509	0.695	44.66	0	0	0
Jun-06	56.28	55.16	72.21	64.67	35.93	118.95	111.41	129.60	119.78	132.81	123.49	0.754	0.776	0.511	0.526	0.678	46.88	0	0	0
Sep-06	55.97	53.82	58.44	56.30	35.94	103.82	101.68	126.13	123.99	131.11	127.74	0.759	0.784	0.512	0.529	0.675	47.53	0	0	0
Dec-06	46.56	52.27	52.42	61.85	35.96	97.22	106.64	110.40	115.08	114.48	118.82	0.782	0.802	0.522	0.535	0.668	47.30	0	0	0
Mar-07	44.66	51.54	59.98	61.12	35.97	105.54	106.68	113.00	115.12	116.32	118.86	0.789	0.809	0.525	0.538	0.665	47.64	0	0	0
Jun-07	50.21	49.94	64.91	59.65	35.98	110.98	105.72	124.17	114.26	127.59	118.05	0.833	0.828	0.549	0.546	0.659	49.63	0	0	0
Sep-07	53.55	50.31	61.39	60.08	35.92	107.04	105.73	120.07	114.33	122.23	118.15	0.854	0.852	0.555	0.554	0.650	49.48	0	0	0
Dec-07	60.25	61.24	70.89	71.10	35.87	117.43	117.64	126.23	126.32	130.93	130.17	0.897	0.901	0.568	0.571	0.633	51.73	0	0	0
Mar-08	64.44	65.52	78.05	75.51	35.81	125.25	122.71	132.77	131.50	137.01	135.41	0.918	0.946	0.569	0.587	0.620	55.41	0	0	0
Jun-08	77.89	79.50	88.86	89.64	35.75	137.08	137.85	146.23	146.77	149.79	150.73	0.951	0.979	0.585	0.602	0.615	65.72	0	0	0
Sep-08	80.30	77.92	79.88	75.64	36.10	127.58	123.33	148.00	143.74	152.92	147.76	0.869	0.900	0.549	0.568	0.631	74.20	0.25	0	0
Dec-08	49.57	51.42	45.43	49.15	36.44	90.06	93.77	117.07	120.79	124.15	125.62	0.673	0.686	0.444	0.453	0.660	68.46	1	0	0
Mar-09	41.14	40.78	53.79	51.02	36.79	99.64	96.86	109.70	105.87	114.71	111.54	0.659	0.646	0.442	0.434	0.672	59.71	1	0	0
Jun-09	46.12	46.12	57.96	56.40	37.13	104.59	103.04	113.70	112.09	119.45	118.62	0.776	0.757	0.508	0.495	0.654	50.49	0.5	0	0
Sep-09	48.99	48.03	57.52	58.41	37.38	104.40	105.28	116.37	114.42	123.93	121.85	0.849	0.865	0.543	0.533	0.639	50.66	0.1	0	0
Dec-09	50.01	48.85	57.83	59.29	37.64	105.01	106.47	112.43	115.65	120.28	123.13	0.910	0.912	0.574	0.575	0.630	52.91	0	0	0
Mar-10	51.74	50.88	62.91	61.41	37.89	110.88	109.38	119.53	118.65	125.61	126.20	0.899	0.862	0.586	0.561	0.652	58.24	0	0	0
Jun-10	54.60	52.82	60.78	63.42	38.14	108.81	111.45	120.67	120.78	128.31	128.38	0.877	0.827	0.590	0.557	0.673	71.90	0	0	0
Sep-10	50.99	52.19	57.39	62.87	38.14	105.09	110.56	116.03	119.96	123.77	127.61	0.919	0.882	0.601	0.577	0.654	76.25	0	0	0
Dec-10	53.56	49.99	63.78	60.71	38.14	112.11	109.04	117.67	118.48	126.27	126.16	0.985	0.953	0.637	0.616	0.647	77.15	0	0.25	0
Mar-11	63.14	59.40	74.32	70.28	38.14	123.70	119.67	128.90	129.24	137.30	137.03	1.014	0.996	0.645	0.634	0.636	85.47	0	0.25	0
Jun-11	66.39	60.06	73.42	71.04	38.14	122.72	120.33	133.97	130.00	142.86	137.86	1.078	1.047	0.673	0.653	0.624	93.09	0	0.25	0
Sep-11	60.00	62.03	75.85	74.66	38.14	125.38	124.20	133.77	133.92	141.60	141.83	1.048	1.035	0.658	0.650	0.628	93.60	0	0.25	0
Dec-11	65.24	64.35	72.81	75.40	38.14	122.05	124.63	132.73	134.35	142.37	142.26	1.023	1.060	0.655	0.680	0.641	86.20	0	0.65	0
Mar-12	68.07	63.94	80.54	74.99	38.14	130.55	125.00	137.10	134.73	144.47	142.65	1.062	1.043	0.685	0.674	0.646	84.46	0	0.65	0
Jun-12	65.33	64.36	70.33	75.47	38.14	119.32	124.45	136.90	134.23	145.40	142.19	1.012	1.008	0.664	0.662	0.656	82.14	0	0.65	0
Sep-12	64.11	61.82	76.69	73.09	38.14	126.32	122.71	132.90	132.63	140.57	140.70	1.043	1.065	0.685	0.699	0.657	77.53	0	1	0
Dec-12	64.58	62.93	72.80	74.21	38.14	122.03	123.45	133.80	133.38	143.06	141.47									