



Impact of COVID-19 on petrol prices in Australia

Executive Summary

This paper analyses the impact of COVID-19 on world oil prices and the flow through to domestic retail petrol prices.

Australian retail petrol prices are primarily determined by international refined petrol prices (influenced by international crude oil prices) and the AUD–USD exchange rate. The relevant international benchmark for Australian regular unleaded petrol prices is the price of Singapore MOGAS 95 Unleaded (MOGAS95), which is the price of refined petrol in the Asia-Pacific region (ACCC 2020).

The sharp decreases in retail prices during COVID in the June quarter 2020 were driven by significant decreases in international crude oil and MOGAS 95 prices, which both decreased by two thirds. As countries imposed COVID restrictions, demand for crude oil and refined petrol products decreased significantly. This was compounded by the inability of OPEC to agree on further crude oil production cuts.

COVID-19 restrictions in Australia from mid-March 2020 reduced demand for petrol and therefore sales volumes decreased significantly. This contributed to longer lags between changes in international refined petrol prices and changes in Australian retail petrol prices (ACCC 2020).

Pre-COVID (prior to March 19 2020), for the five major capitals the lag between changes in international refined petrol prices and changes in retail prices was about 2 weeks: 1 week from movements in MOGAS95 prices to the wholesale price (Terminal Gate Price) and another week to the trend petrol price. During COVID, this lag has increased to about 3 weeks: 1 week from movements in MOGAS95 prices to the wholesale price (Terminal Gate Price) and another 2 weeks to the trend petrol price.

For the three smaller cities (Hobart, Darwin and Canberra) the lag pre-COVID was around 3 ½ weeks and remained so during COVID: 1 week to the wholesale price and another 2 ½ weeks to the trend petrol price.

Daily Retail Petrol Prices in Australia

In the modelling process presented in this paper, short-term fluctuations in MOGAS and Terminal Gate Prices (TGP) are smoothed over, and the transition from Singapore prices to Australian wholesale prices to retail prices occurs over sequential time frames. Using smoothing and lagging,

the relationship between the three levels in the price chain becomes apparent, as is shown in Figure 1.

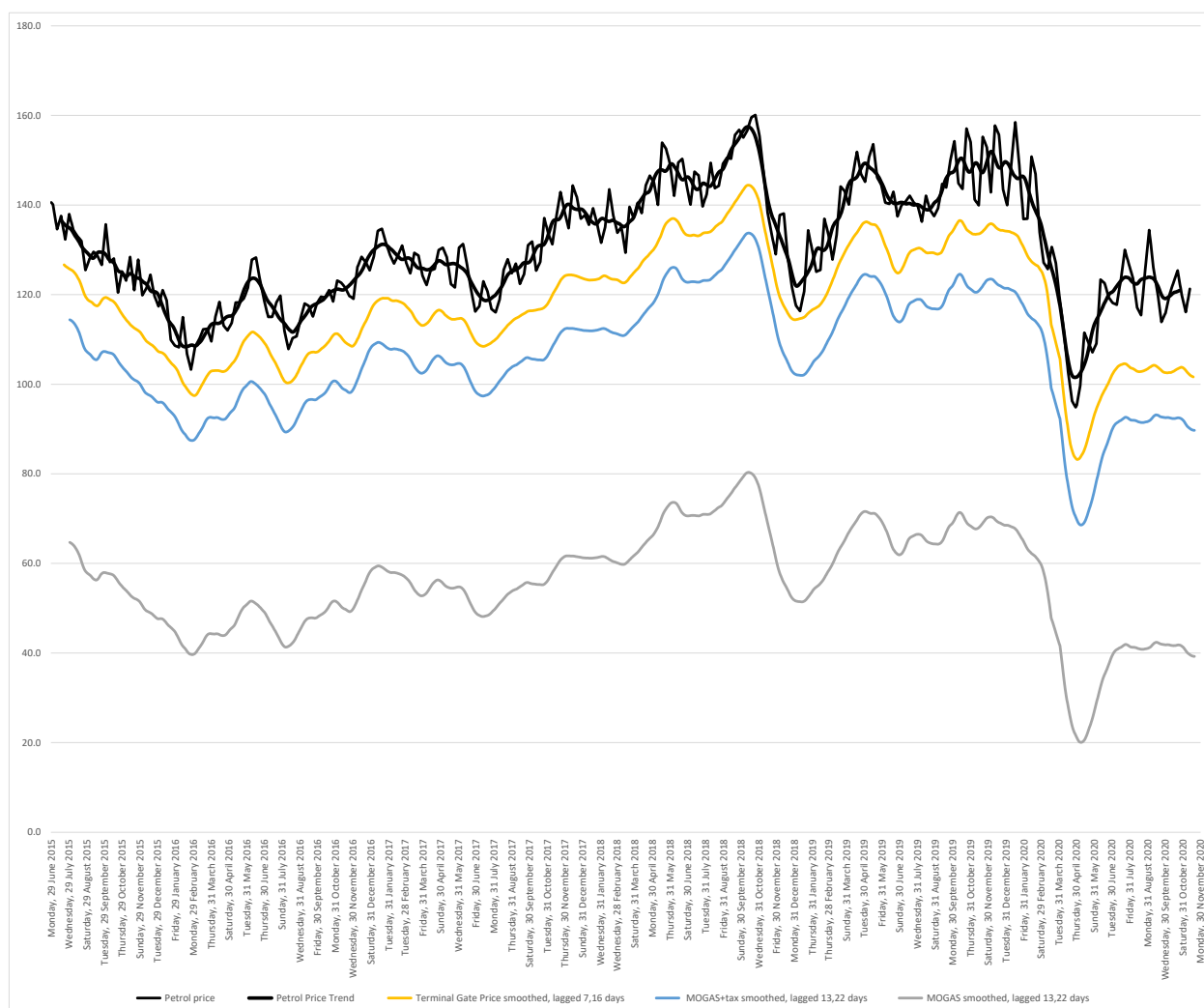
Detailed models of the price chain such as developed in this paper thus allow an up-to-date understanding of the underlying trend in Australia's volatile retail petrol prices.

This Information Sheet examines the determinants of daily petrol prices in Australia. A price chain is derived linking Australian retail petrol prices to Terminal Gate Prices and to the daily price of Singapore MOGAS95. The modelling is based on daily data from July 2015 to September 2020. The charts show data up to mid-November 2020.

Figure 1 shows the 7-day centred rolling average of petrol prices, weighted by sales, over the eight capital cities in Australia from 2015, along with a smoothed petrol price trend. Also shown are smoothed, lagged series for MOGAS, MOGAS + tax and the sales-weighted Terminal Gate Price for each of the seven capital cities.

The aim is to build models linking these components of the price chain.

Figure 1 The Australian petrol price and its components



The Petrol Price Chain

Table 1 details the way the components of the petrol price chain fit together in an accounting framework. This framework starts at the bottom with Singapore MOGAS95. Adding excise tax and pre-wholesale GST results in the MOGAS + tax variable. Adding wholesale costs produces the

wholesale Terminal Gate Price. Then adding retail margins (incl. retail and transport) costs and GST results in the retail petrol price.

The two examples are from an Australian Competition and Consumer Commission report (ACCC 2012) and from the results of modelling for this paper for December 14, 2019.

Table 1 Petrol price chain components

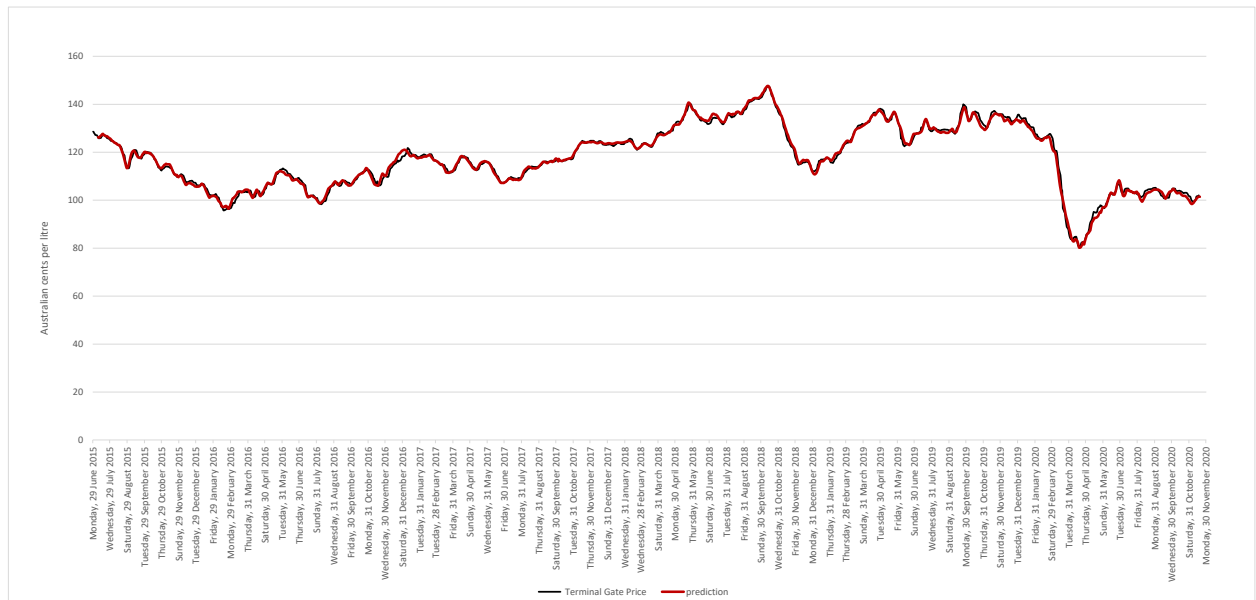
			nominal cents per litre	nominal cents per litre
			Financial Year	smoothed (lagged) daily averages
			2011-12	December 14, 2019
PETROL PRICE TREND	(1+2+3+4)		150.6	149.6
		Retail Margin	14.7	13.3
		GST on Retail Costs	1.5	1.3
	4	Retail Costs	16.2	14.6
TERMINAL GATE PRICE	(1+2+3)		134.4	135.0
		Quality Premium	1.2	
		Freight	2.1	
		Insurance and Loss	0.3	
		Wharfage	0.3	
		Other Costs	0.2	
		Wholesale Margin	6.0	
		Pre-GST Wholesale Costs	10.1	11.3
		GST on Wholesale Costs	1.0	1.1
	3	Wholesale Costs	11.1	12.4
MOGAS plus TAX	(1+2)		123.3	122.6
		GST pre-wholesale	11.2	11.2
		Excise	38.0	41.9
	2	Pre-Wholesale Tax	49.2	53.1
MOGAS	1	MOGAS	74.1	69.6

Source: Reproduced from ACCC (2012).

The modelling starts with the unsmoothed Terminal Gate Price, which is modelled as a function of a 7-day centred moving average of MOGAS + tax, lagged 6 days (MOGAS+tax C7 L6) plus dummy variables.

Table A2 gives the results of the regression for weighted-average metropolitan Australian Terminal Gate Prices. The regression shows that the relationship is almost one to one. Figure 2 shows that the fit of predicted to actual is close.

Figure 2 Unsmoothed Terminal Gate Price and prediction



The second step moving up the price chain is to model the petrol price trend as a function of the Terminal Gate Price smoothed and lagged. The petrol price trend is calculated as a 37-day centred moving average of the 7-day centred moving average of the petrol price (petrol price C7 C37). A 31-day centred moving average of the Terminal Gate Price lagged 7 days before COVID and 16 days during COVID (TGP C31 L7,L16) is used as the explanatory variable. Figure 3 shows the prediction fits the petrol price trend very well. The fall of the actual below the predicted from October 2020 is due to the COVID second-wave shutdowns/border closures in Victoria and South Australia.

Figure 3 Petrol price trend and prediction

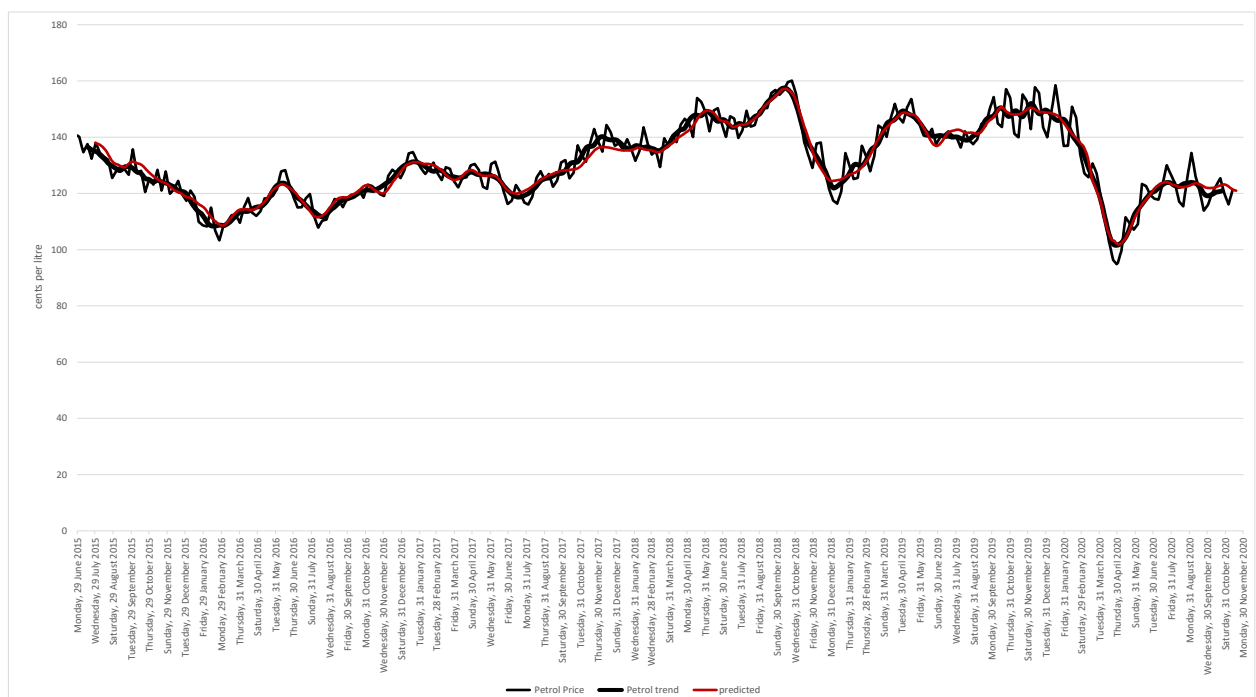


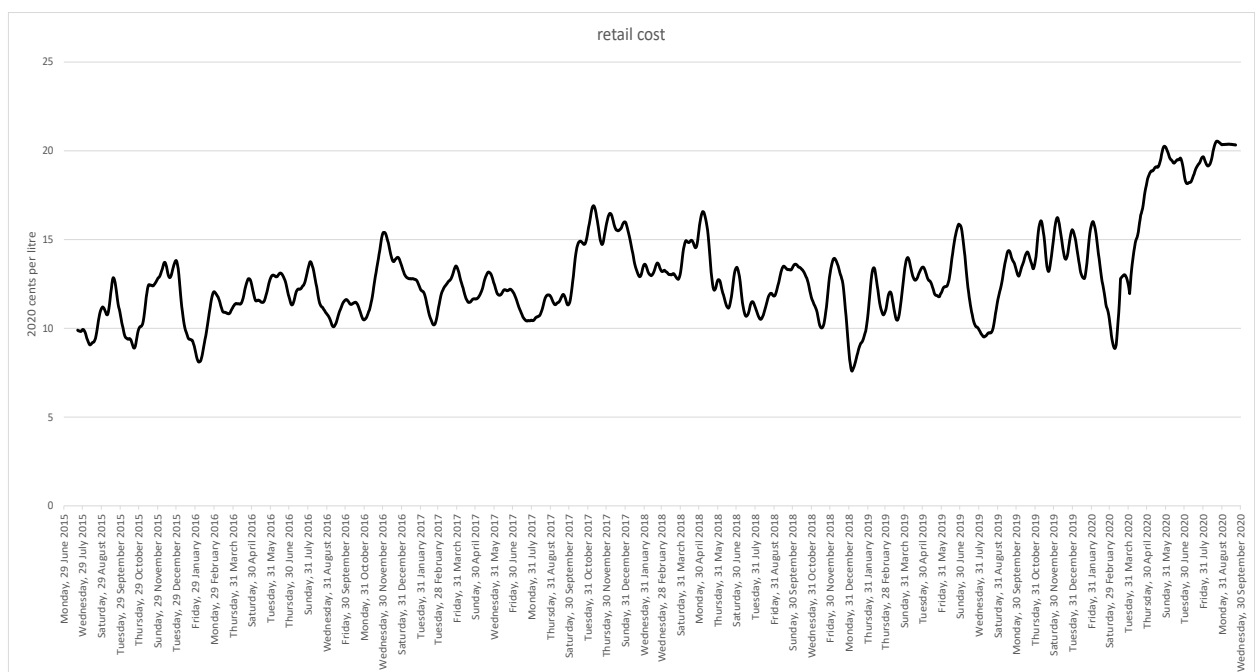
Table A1 gives the results of the regression for weighted-average metropolitan Australian retail petrol prices. The “Terminal Gate Price smoothed lagged 7,16 days” yellow line of Figure 1 is the TGP C31 L7,L16 of Table A1. Again, the relationship is almost one to one.

COVID has affected the level of prices. For example, at the worst of the COVID effects, MOGAS95 was down 40 cents per litre, from 60 cents to 20 cents – a fall of two-thirds! Given the fairly constant additional costs of excise, wholesale costs, retail costs and GST, the trend petrol price was also down 40 cents per litre, from 140 to 100 cents – a fall of less than one third. This phenomenon of reduced percentage reduction at retail level is apparent in overseas countries that have similar petrol tax levels – see BITRE (2019).

COVID has also affected the lag between MOGAS and retail prices. Before COVID the lag was about 2 weeks – about 1 week from Singapore MOGAS to Australian Terminal Gate Price and another week from Terminal Gate Price to retail price. During COVID the lag between Terminal Gate Price and retail price has increased to about 2 weeks, increasing the total lag between MOGAS and retail price to about 3 weeks. This may be due to the effect of lower petrol sales in increasing the time between tanker refuelling at petrol stations.

COVID has also affected the wholesale-retail price difference. As can be seen from Figure 4, retail costs have generally fluctuated between 10 and 15 cents per litre over the past 5 years, but have increased toward 20 cents per litre during COVID. This may be because of 1) reduced sales of petrol, and/or 2) reduced sales of items from within the petrol stations themselves.

Figure 4 Retail costs (retail versus wholesale price)



The prediction of the petrol price trend from the Terminal Gate Price is the key to the modelling, but the prediction of the Terminal Gate price from MOGAS (+tax) allows an understanding of the structure and timing of the full price chain outlined in Table 1.

The bottom line of Figure 1 is the MOGAS data series with double smoothing and lagging, to capture the transition to TGP and then to the petrol trend. First a centred 7 day average is lagged 6 days, and then a 31 day centred moving average of the resulting series is lagged 7,16 days (MOGAS (C7 L6) C31 L7,L16). The result is the series labelled “MOGAS smoothed lagged 13,22 days” in Figure 1.

Adding excise and pre-wholesale GST to this time series produces “MOGAS+tax smoothed lagged 13,22 days”.

Sydney Petrol Prices

Figure 5 shows the 7-day centred moving average of Sydney retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Sydney Terminal Gate Price.

Figure 5 Sydney petrol price and its components

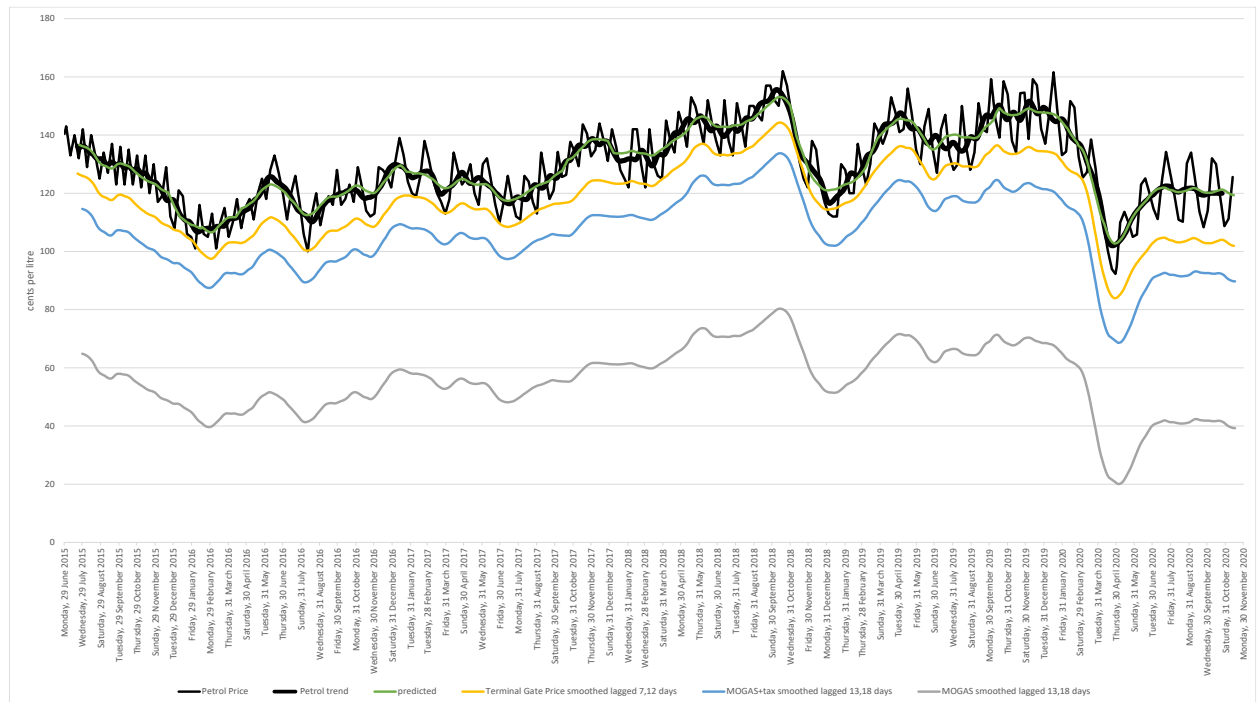
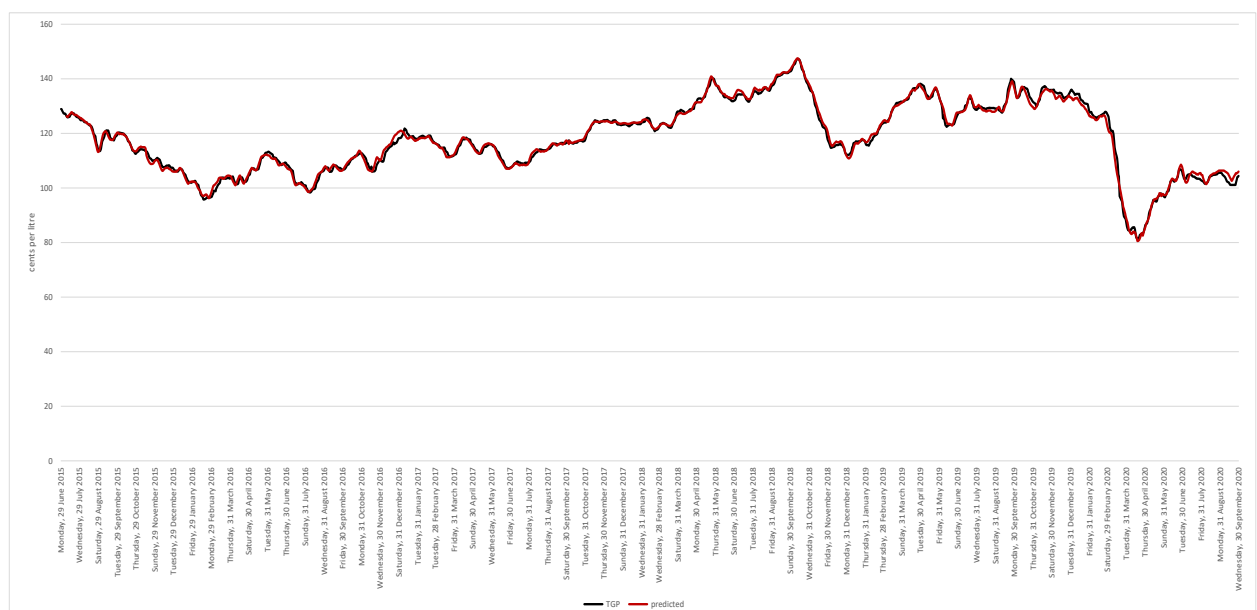


Table A1 gives the results of regressing the 31-day centred moving average of the Sydney Terminal Gate Price lagged 7,12 days on the petrol price trend for Sydney. Figure 5 shows the fit to the petrol price trend.

Figure 6 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 6 days on the Sydney Terminal Gate Price. The regression results are shown in Table A2.

Figure 6 Sydney Terminal Gate Price and prediction



Melbourne Petrol Prices

Figure 7 shows the 7-day centred moving average of Melbourne retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Melbourne Terminal Gate Price.

Figure 7 Melbourne petrol price and its components

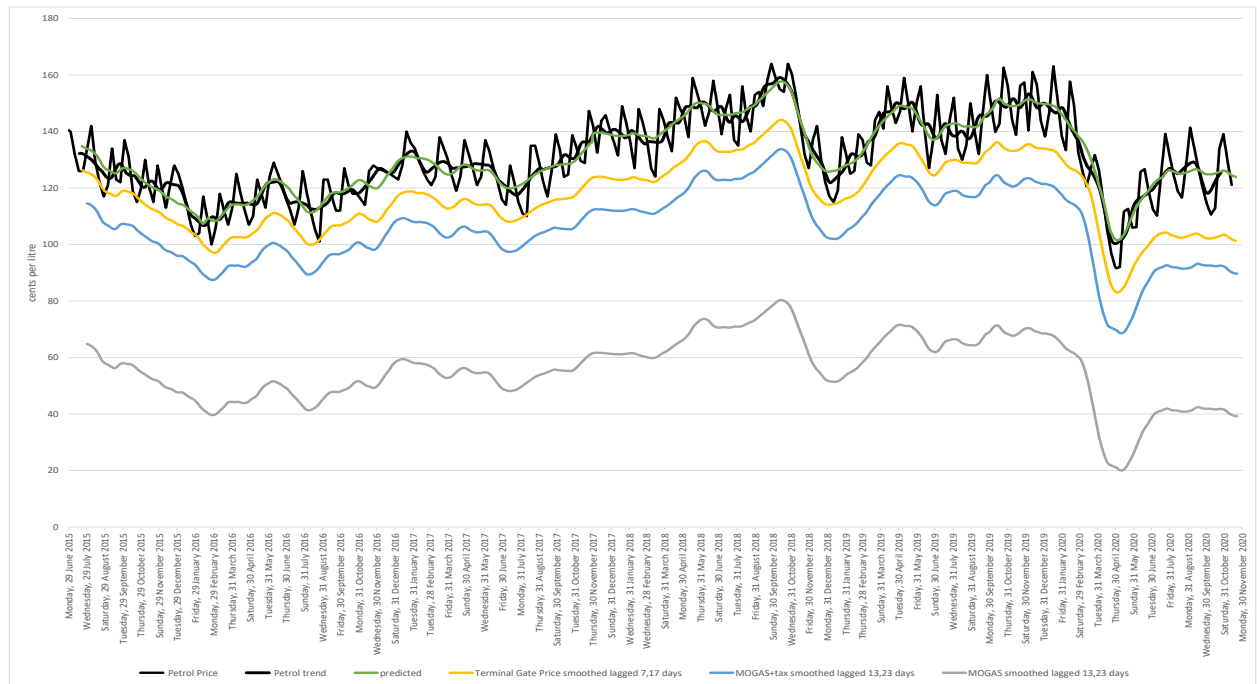
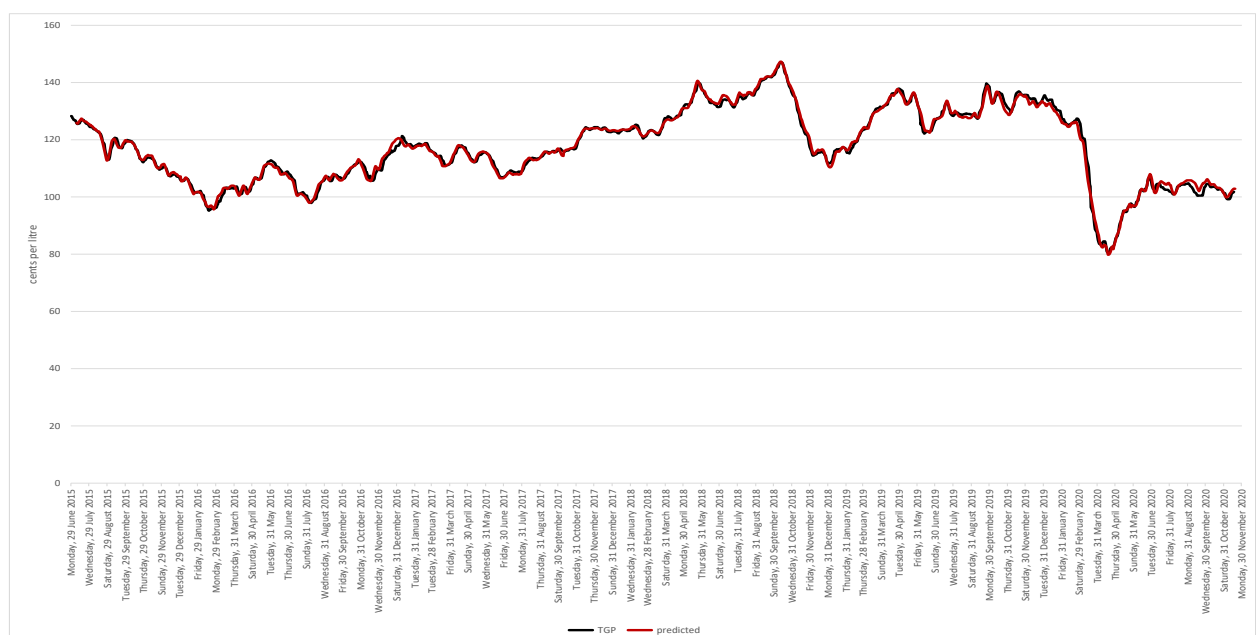


Table A1 gives the results of regressing the 31-day centred moving average of the Melbourne Terminal Gate Price lagged 7,17 days on the petrol price trend. Figure 7 shows the fit to the petrol price trend. The temporary effect of the second-wave lockdown in October is apparent.

Figure 8 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 6 days on the Melbourne Terminal Gate Price. The regression results are shown in Table A2.

Figure 8 Melbourne Terminal Gate Price and prediction



Brisbane Petrol Prices

Figure 9 shows the 7-day centred moving average of Brisbane retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Brisbane Terminal Gate Price.

Figure 9 Brisbane petrol price and its components

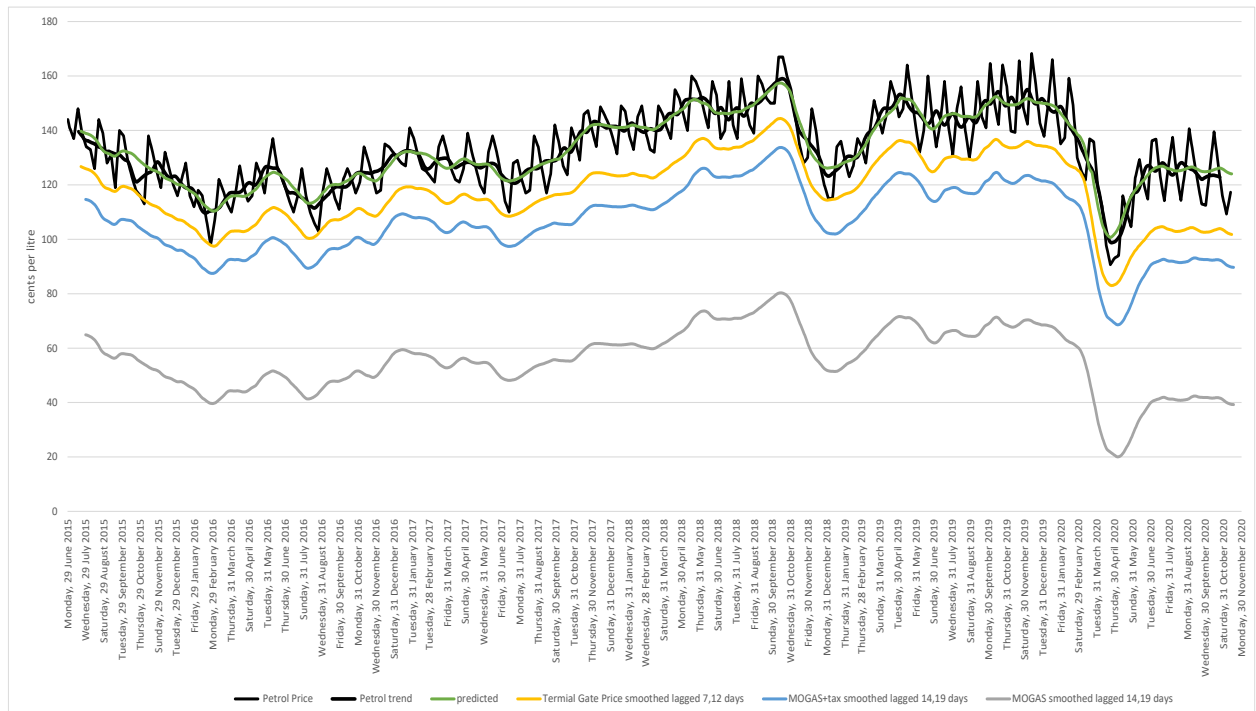
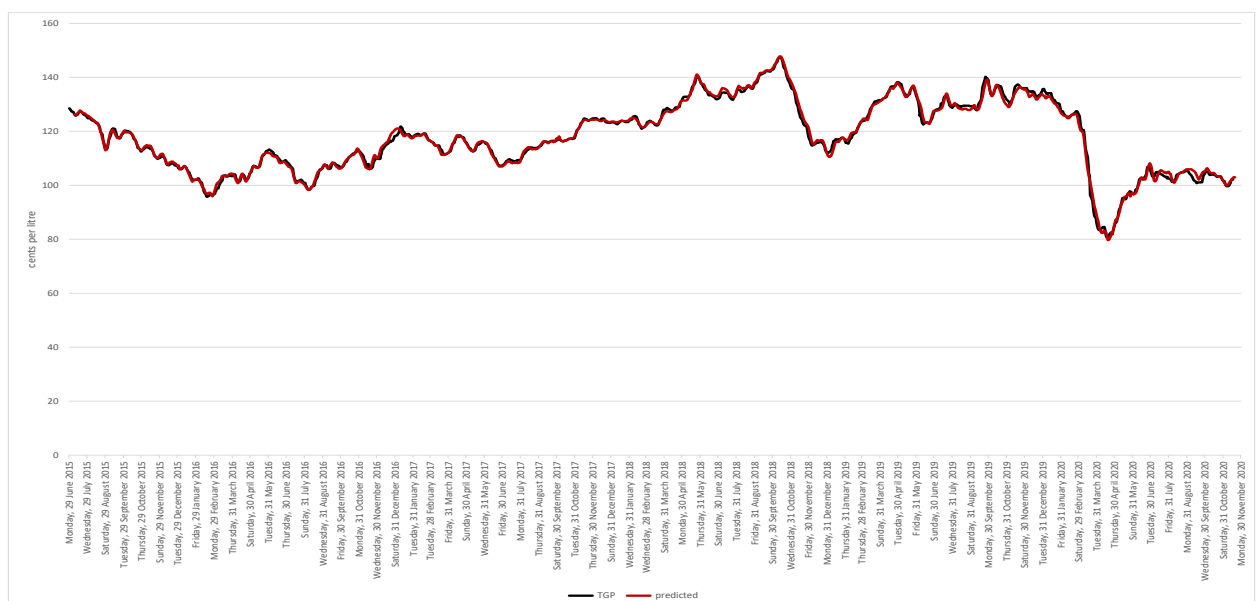


Table A1 gives the results of regressing the 31-day centred moving average of the Brisbane Terminal Gate Price lagged 7,12 days on the petrol price trend for Brisbane. Figure 9 shows the fit to the petrol price trend.

Figure 10 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 7 days on the Brisbane Terminal Gate Price. The regression results are shown in Table A2.

Figure 10 Brisbane Terminal Gate Price and prediction



Adelaide Petrol Prices

Figure 11 shows the 7-day centred moving average of Adelaide retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Adelaide Terminal Gate Price.

Figure 11 Adelaide petrol price and its components

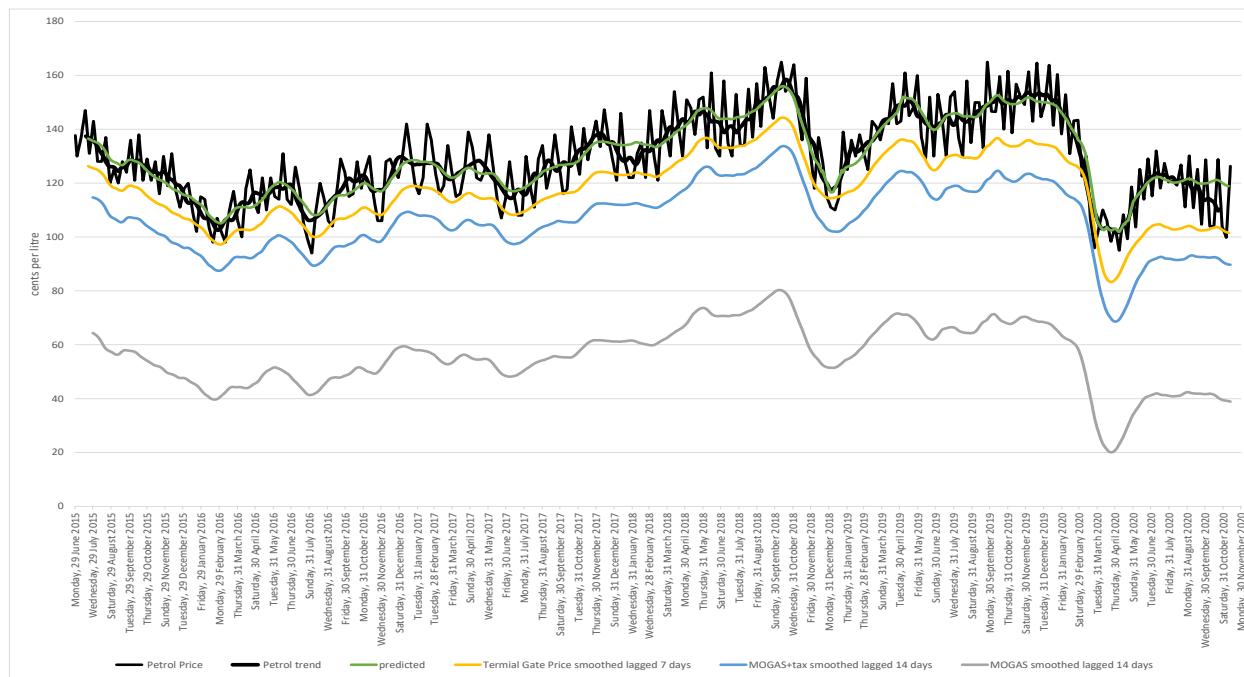
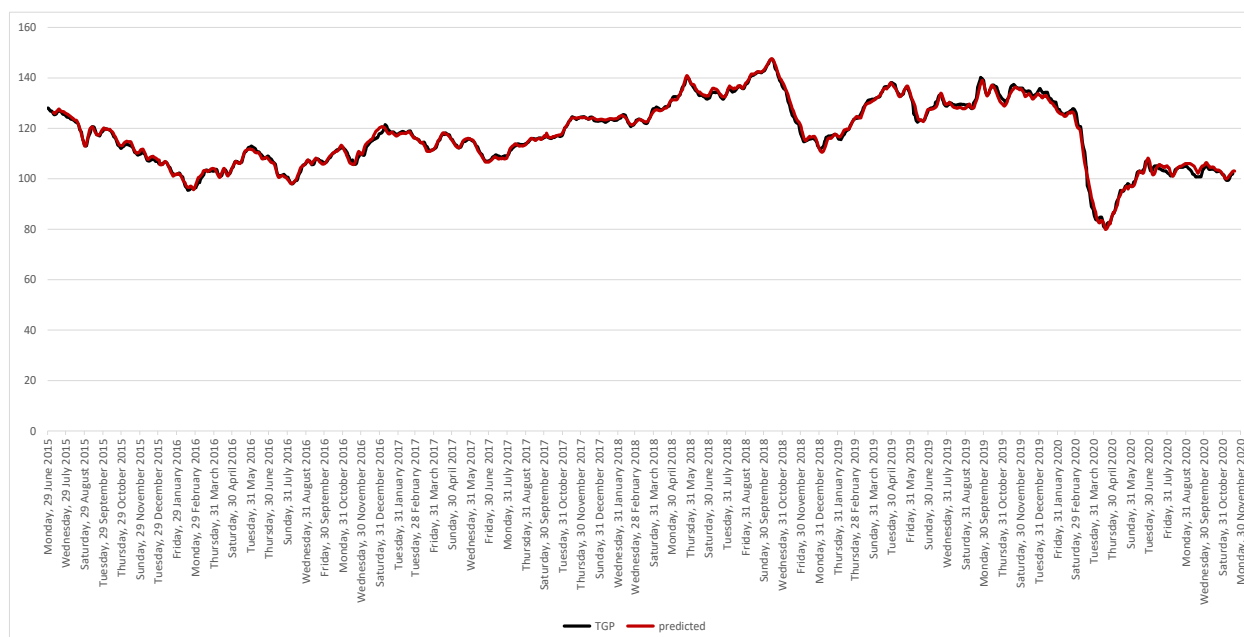


Table A1 gives the results of regressing the 31-day centred moving average of the Adelaide Terminal Gate Price lagged 7 days on the petrol price trend for Adelaide. Figure 11 shows the fit to the petrol price trend. The effect of the hard border closure is apparent from October on.

Figure 12 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 7 days on the Adelaide Terminal Gate Price. The regression results are shown in Table A2.

Figure 12 Adelaide Terminal Gate Price and prediction



Perth Petrol Prices

Figure 13 shows the 7-day centred moving average of Perth retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Perth Terminal Gate Price.

Figure 13 Perth petrol price and its components

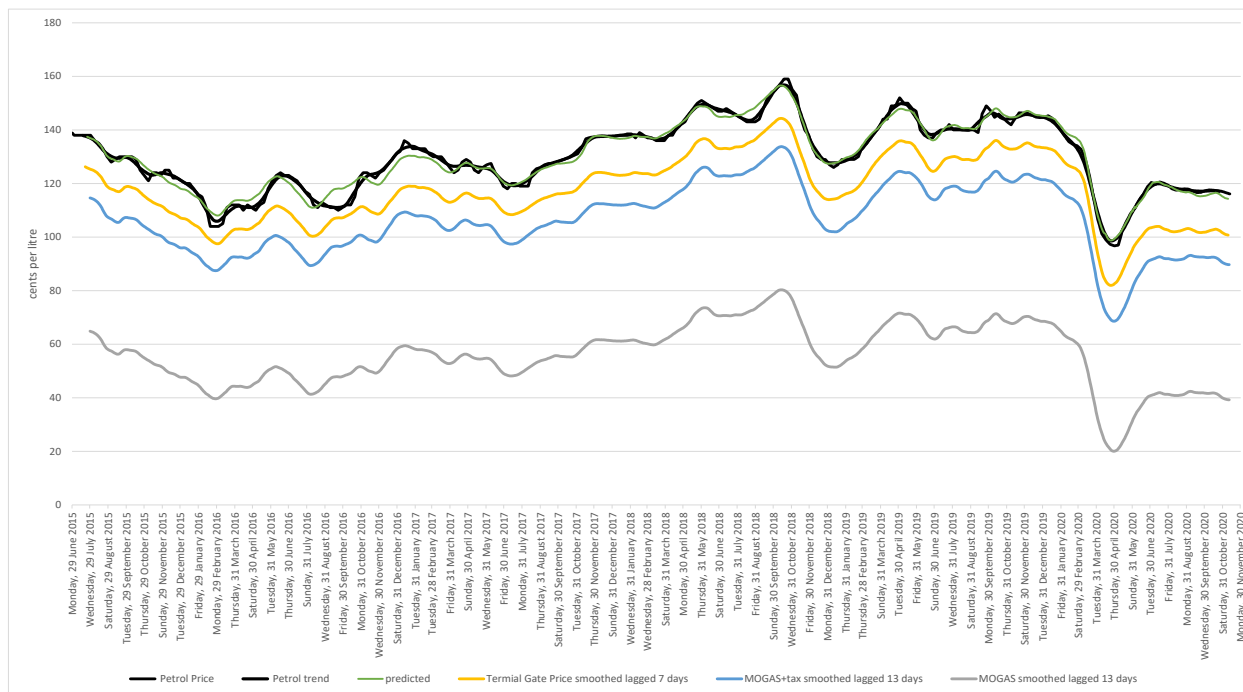
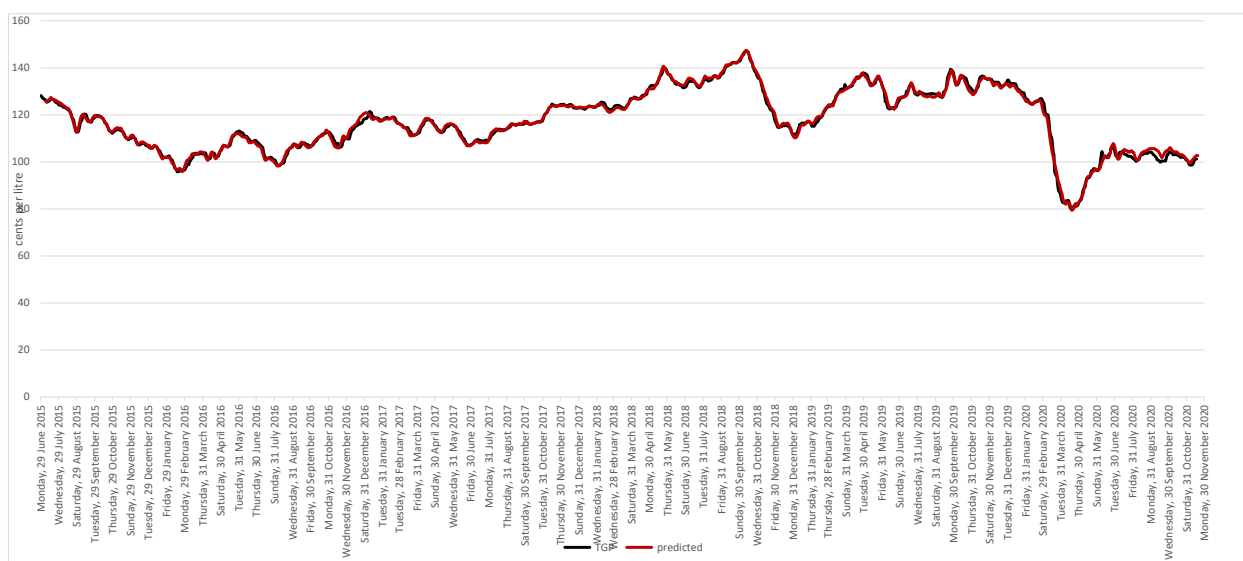


Table A1 gives the results of regressing the 31-day centred moving average of the Perth Terminal Gate Price lagged 7 days on the petrol price trend for Perth. Figure 13 shows the fit to the petrol price trend.

Figure 14 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 6 days on the Perth Terminal Gate Price. The regression results are shown in Table A2.

Figure 14 Perth Terminal Gate Price and prediction



Hobart Petrol Prices

Figure 15 shows the 7-day centred moving average of Hobart retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Hobart Terminal Gate Price.

Figure 15 Hobart petrol price and its components

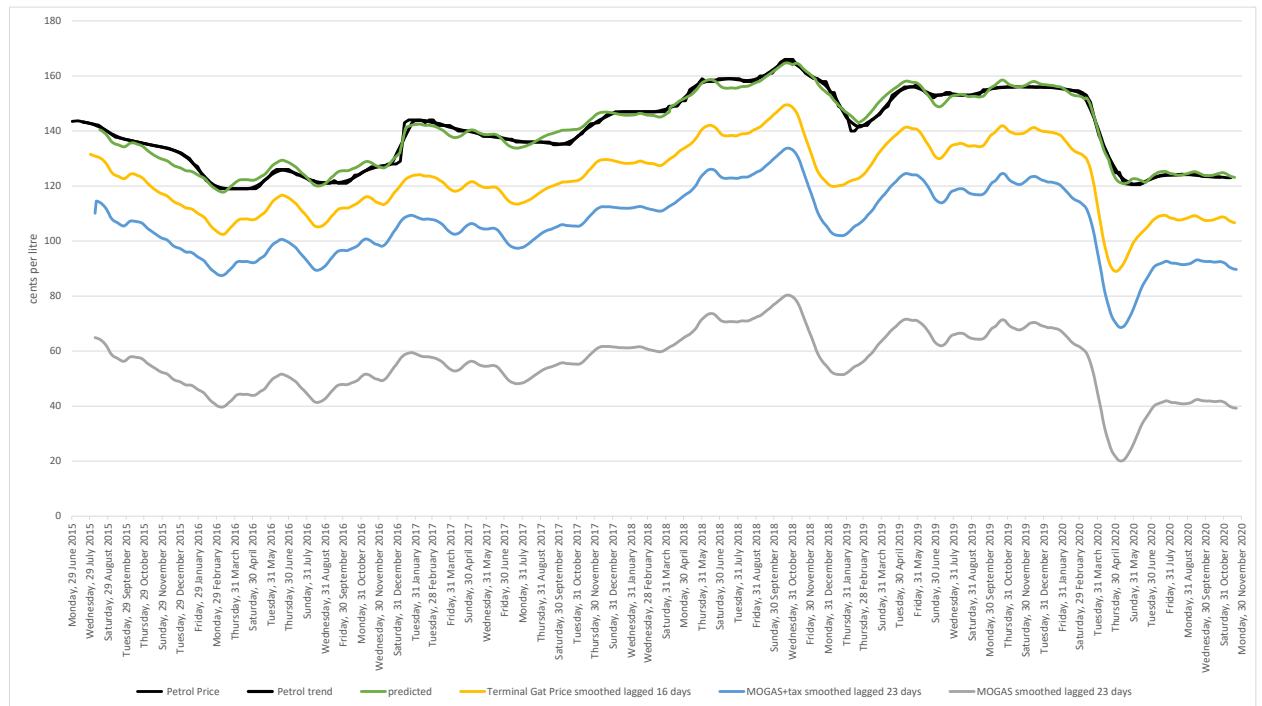
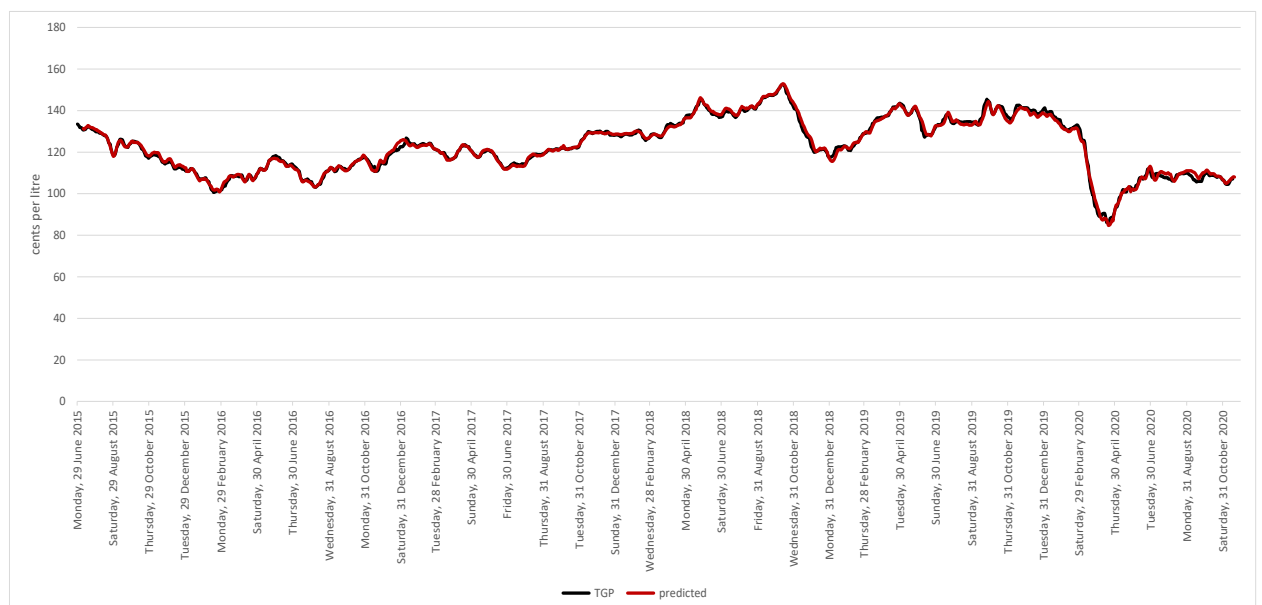


Table A1 gives the results of regressing the 31-day centred moving average of the Hobart Terminal Gate Price lagged 16 days on the petrol price trend for Hobart. Figure 15 shows the fit to the petrol price trend.

Figure 16 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 7 days on the Hobart Terminal Gate Price. The regression results are shown in Table A2.

Figure 16 Hobart Terminal Gate Price and prediction



Darwin Petrol Prices

Figure 17 shows the 7-day centred moving average of Darwin retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Darwin Terminal Gate Price.

Figure 17 Darwin petrol price and its components

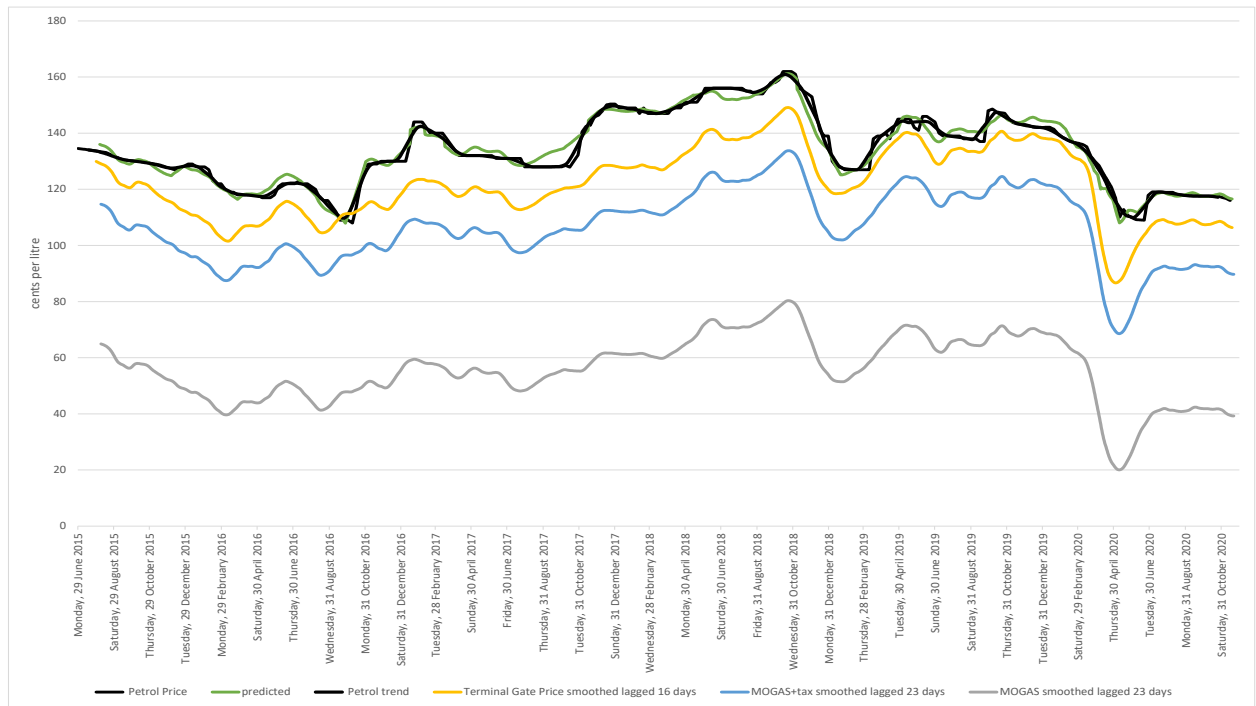
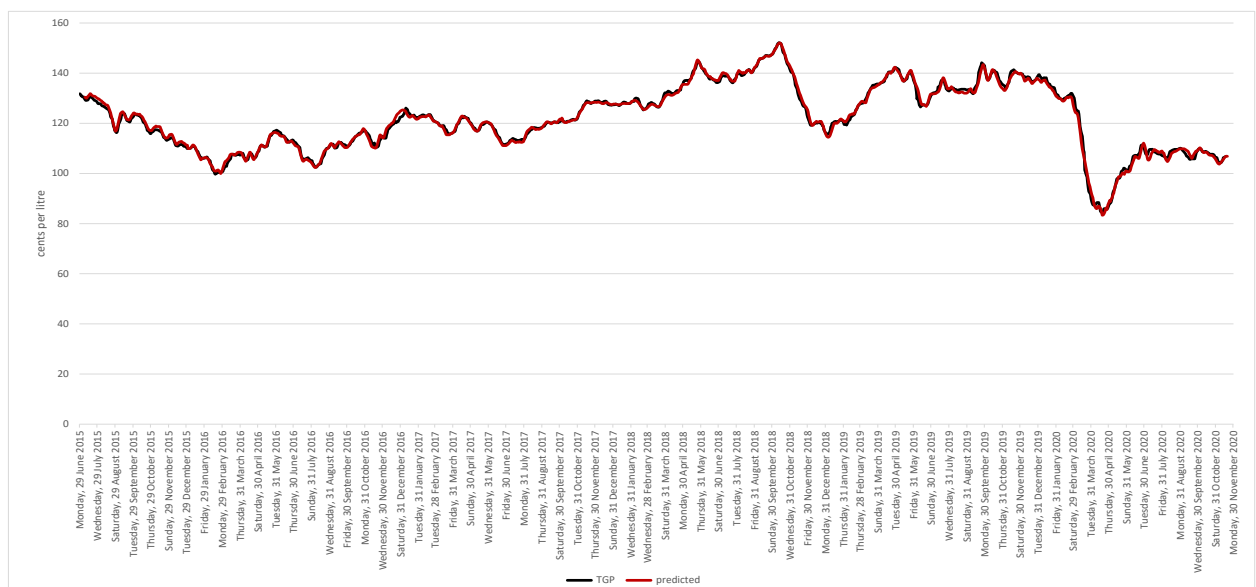


Table A1 gives the results of regressing the 31-day centred moving average of the Darwin Terminal Gate Price lagged 16 days on the petrol price trend for Darwin. Figure 17 shows the fit to the petrol price trend.

Figure 18 gives the results of regressing the 7-day centred moving average of MOGAS+tax lagged 7 days on the Darwin Terminal Gate Price. The regression results are shown in Table A2.

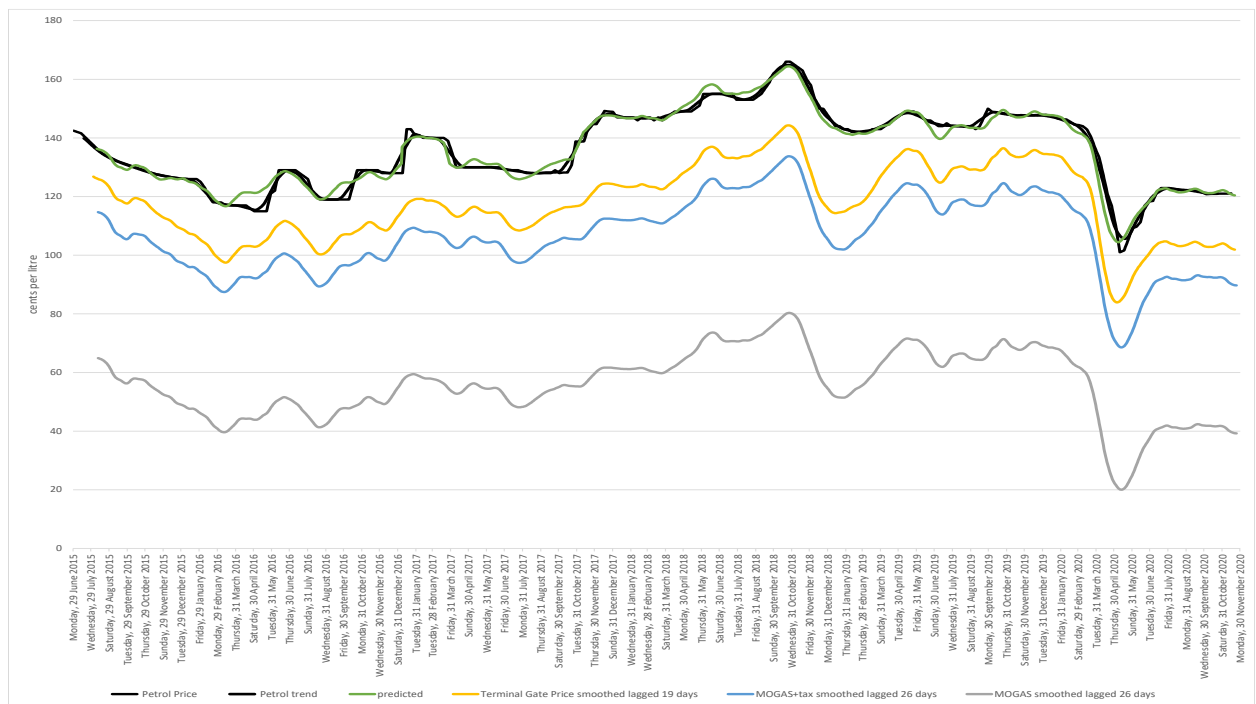
Figure 18 Darwin Terminal Gate Price and prediction



Canberra Petrol Prices

Figure 19 shows the 7-day centred moving average of Canberra retail prices from 2015, along with a smoothed petrol price trend and prediction. Also shown are smoothed, lagged series for MOGAS, MOGAS+tax and the Canberra (Sydney) Terminal Gate Price. Table A1 gives the results of regressing the 31-day centred moving average of the Sydney Terminal Gate Price lagged 19 days on the petrol price trend for Canberra. Figure 19 shows the fit to the petrol price trend.

Figure 19 Canberra petrol price and its components



Conclusions

The petrol price chain stretches from the price of MOGAS95 in Singapore to the Terminal Gate Price at Australian ports to the trend in daily petrol prices at the pump. In the process, short-term fluctuations in MOGAS and Terminal Gate Prices are smoothed over, and the transition from Singapore prices to Australian wholesale prices to retail prices occurs over sequential time frames. For the five major capitals this time frame pre-COVID was about 2 weeks – 1 week from movements in world oil prices to the wholesale price (Terminal Gate Price) and another week to the trend petrol price. During COVID, this time frame has increased to about 3 weeks – 1 week from movements in world oil prices to the wholesale price (Terminal Gate Price) and another 2 weeks to the trend petrol price. For the three smaller cities (Hobart, Darwin and Canberra) the time frame has remained around 3 ½ weeks – 1 week to the wholesale price and another 2 ½ weeks to the trend petrol price.

Using smoothing and lagging, the relationship between the three levels in the price chain becomes apparent, as was shown in Figure 1. For example, at the worst of the COVID effects, MOGAS95 was down 40 cents per litre, from 60 cents to 20 cents – a fall of two-thirds. Given the fairly constant additional costs of excise, wholesale costs, retail costs and GST, the trend petrol price was also down 40 cents per litre, from 140 to 100 cents – a fall of less than one third. This phenomenon of reduced percentage reduction at retail level is apparent in overseas countries that have similar petrol tax levels – see BITRE (2019).

Detailed models of the price chain such as developed in this paper thus allow an up-to-date understanding of the underlying trend in Australia's volatile retail petrol prices.

Appendix – Regression results

Table A1 Petrol price trend (C7 C37) relationship

Term	City								
	Metro ^a	Sydney ^b	Melbourne ^c	Brisbane ^d	Adelaide ^e	Perth ^f	Hobart ^g	Darwin ^h	Canberra ⁱ
<i>Parameter estimates</i>									
TGP	1.035 (0.003)	0.938 (0.004)	1.034 (0.004)	1.300 (0.005)	1.078 (0.006)	1.037 (0.005)	0.814 (0.007)	0.805 (0.007)	0.842 (0.004)
DV1	-1.84 (0.248)	-4.407 (0.157)	-0.522 (0.092)	-1.202 (0.198)	-7.132 (0.659)	2.240 (0.190)	12.185 (0.316)	3.442 (0.186)	-4.545 (0.169)
DV2	-1.683 (0.180)	3.660 (0.066)	2.902 (0.206)	2.703 (0.161)	4.922 (0.189)	7.389 (0.367)	2.301 (0.400)	-8.024 (0.138)	5.439 (0.213)
DV3	2.168 (0.157)	5.828 (0.192)	14.183 (0.439)	9.324 (0.234)	12.353 (0.529)	2.143 (0.162)	10.887 (0.556)	3.872 (0.160)	8.292 (0.099)
DV4	8.072 (0.778)	-6.187 (0.265)	5.200 (0.329)	4.760 (0.164)	4.680 (0.828)	2.062 (0.587)	-0.103 (0.178)	-5.810 (0.204)	-1.944 (0.515)
DV5		-2.415 (0.122)	-4.512 (0.155)		1.175 (0.172)		-7.047 (0.158)	-11.057 (0.214)	
DV6		3.878 (0.200)	2.942 (0.170)		4.368 (0.958)		-1.576 (0.175)	5.056 (0.377)	
DV7			5.058 (1.736)				-6.719 (0.511)	-6.775 (0.402)	
<i>Summary statistics</i>									
R ²	0.985	0.982	0.977	0.974	0.970	0.975	0.975	0.972	0.981
Adj. R ²	0.985	0.982	0.977	0.974	0.970	0.975	0.975	0.972	0.981
Std Error	1.564	1.650	2.029	2.075	2.451	2.040	2.089	2.071	1.771
Obs.	1839	1847	1826	1854	1805	1819	1787	1797	1797

- a. All metropolitan areas – TGP lag structure: C31 (L7, L16)
- b. Sydney – TGP lag structure: C31 (L7, L12)
- c. Melbourne – TGP lag structure: C31 (L7, L17)
- d. Brisbane – TGP lag structure: C31 (L7, L12)
- e. Adelaide – TGP lag structure: C31 (L7)
- f. Perth – TGP lag structure: C31 (L7)
- g. Hobart – TGP lag structure: C31 (L16)
- h. Darwin – TGP lag structure: C31 (L16)
- i. Canberra – TGP lag structure: C31 (L19).

Table A2 Terminal Gate Price relationship

Term	City							
	Metro ^a	Sydney ^b	Melbourne ^c	Brisbane ^d	Adelaide ^e	Perth ^f	Hobart ^g	Darwin ^h
<i>Parameter estimates</i>								
MOGAS	0.970 (0.002)	0.960 (0.002)	0.968 (0.002)	0.977 (0.002)	0.970 (0.003)	0.975 (0.002)	0.978 (0.002)	0.986 (0.002)
DV1	6.717 (0.289)	6.740 (0.312)	6.905 (0.302)	7.842 (0.285)	6.989 (0.313)	4.632 (0.280)	10.064 (0.305)	6.196 (0.287)
DV2	-1.621 (0.060)	-1.755 (0.064)	-1.746 (0.062)	-1.501 (0.059)	-1.864 (0.067)	-1.278 (0.058)	-1.671 (0.063)	-1.265 (0.059)
DV3	-1.999 (0.270)							
<i>Summary statistics</i>								
R ²	0.994	0.992	0.993	0.994	0.992	0.994	0.993	0.994
Adj. R ²	0.994	0.992	0.993	0.994	0.992	0.994	0.993	0.994
Std Error	1.040	1.126	1.098	1.033	1.117	1.017	1.105	1.040
Obs.	1855	1849	1848	1848	1788	1848	1847	1848

- a. All metropolitan areas – MOGAS lag structure: C7 (L6)
b. Sydney – MOGAS lag structure: C7 (L6)
c. Melbourne – MOGAS lag structure: C7 (L6)
d. Brisbane – MOGAS lag structure: C7 (L7)
e. Adelaide – MOGAS lag structure: C7 (L6)
f. Perth – MOGAS lag structure: C7 (L6)
g. Hobart – MOGAS lag structure: C7 (L7)
h. Darwin – MOGAS lag structure: C7 (L7).

References

- Australian Competition and Consumer Commission (ACCC) 2012, *Monitoring of the Australian petroleum industry*, Report of the Australian Competition and Consumer Commission into the prices, costs and profits of unleaded petrol in Australia. URL: https://www.accc.gov.au/system/files/ACCC%20Petrol%20Report%202012_0.pdf.
- 2020, *Report on the Australian petroleum market*.
URL: <https://www.accc.gov.au/publications/quarterly-reports-on-the-australian-petroleum-industry/quarterly-report-on-the-australian-petroleum-market-june-quarter-2020>.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2017, *Petrol Prices and Diesel Prices in Australia*, Information Sheet 82, BITRE, Canberra. URL: https://www.bitre.gov.au/publications/2017/is_082.
- 2019, *Prices for Petrol and Gasoline – Modelling a Global Phenomenon*, Research Report 150, BITRE Canberra. URL: <https://www.bitre.gov.au/publications/2019/prices-for-petrol-and-gasoline-modelling-a-global-phenomenon>.
- Gargett, D. 2010, 'Petrol Prices in Australia', Paper presented to the Australian Transport Research Forum, Canberra. URL: https://www.australasiantransportresearchforum.org.au/sites/default/files/2010_Gargett.pdf.

© Commonwealth of Australia 2020

ISSN 1440-9593

December 2020

Creative Commons Attribution 3.0 Australia Licence is a standard form licence agreement that allows you to copy, communicate and adapt this publication provided that you attribute the work to the Commonwealth and abide by the other licence terms. A summary of the licence terms is available from <http://creativecommons.org/licenses/by/3.0/au/deed.en>.

The full licence terms are available from <http://creativecommons.org/licenses/by/3.0/au/legalcode>.

This publication should be attributed in the following way: Bureau of Infrastructure and Transport Research Economics (2020), *Impact of COVID-19 on Petrol Prices in Australia*, Information Sheet 111, BITRE, Canberra.

Acknowledgement

This Information Sheet was prepared by Dr. David Gargett. BITRE acknowledges the Australian Competition and Consumer Commission and the Department of Industry, Science, Energy and Resources for comments on an earlier version of this report.

Use of the Coat of Arms

The Department of the Prime Minister and Cabinet sets the terms under which the Coat of Arms is used. Please refer to the Department's Commonwealth Coat of Arms and Government Branding web page <http://www.dpmc.gov.au/guidelines/index.cfm#brand> and in particular, the Guidelines on the use of the Commonwealth Coat of Arms publication.

Contact us

This publication is available in PDF format. All other rights are reserved, including in relation to any Departmental logos or trade marks which may exist. For enquiries regarding the licence and any use of this publication, please contact:

Department of Infrastructure, Transport, Regional Development and Communications
Bureau of Infrastructure and Transport Research Economics (BITRE)
GPO Box 501, Canberra ACT 2601, Australia

Phone: (international) +61 2 6274 7210

Fax: (international) +61 2 6274 6855

Email: bitre@infrastructure.gov.au

Website: www.bitre.gov.au