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Abraham, J., Prasad, B. C., & Narayan, P. K. (2025). Do Regulated Petroleum Products Share a Long-Run Relationship With the International Market for Crude Oil? Preliminary Evidence From Fiji. *Energy RESEARCH LETTERS*, *6*(Early View).
https://doi.org/10.46557/001c.129145

Peer-reviewed research

Do Regulated Petroleum Products Share a Long-Run Relationship With the International Market for Crude Oil? Preliminary Evidence From Fiji

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Keywords: Price controls, Fiji, Crude oil, Kerosene, Premix, Diesel

JEL Classifications: C32 Time-Series Models - Dynamic Quantile Regressions - Dynamic Treatment Effect Models - Diffusion Processes - State Space Models, Q41 Demand and Supply - Prices, R41 Transportation: Demand, Supply, and Congestion - Travel Time - Safety and Accidents - Transportation Noise

https://doi.org/10.46557/001c.129145

Energy RESEARCH LETTERS

Vol. 6, Issue Early View, 2025

In this note, we examine the long-run co-movement between the regulated domestic petroleum prices in Fiji and international market price of crude oil. The domestic petroleum prices are unique data points that are actual price control orders authorised by the price regulator. We then investigate how the crude oil market conditions affect domestic prices. Our results show that the regular price control orders on petroleum products in Fiji track the crude oil market conditions with a one-month lag. Two out of four petroleum products studied (premix and kerosene) have a stable long-run cointegrating relationship with the international crude oil market. Other products (such as, motor spirit and diesel) fail to comove with the crude oil market (or premix), suggesting that price control-order adjustments to market conditions can be further improved.

I. Introduction

When price controls are heavily practiced and applied persistently, often to keep goods and services affordable, then whether these price controls account for the market conditions, such as the ups and downs of the general movement in the prices, should be an important concern for policymakers, particularly the price regulator. This is because price controls, in general, can distort markets and cause market inefficiencies, thus negatively impacting consumer welfare. Artificially depressed prices produce shortages as individuals increase demand and firms' capacity to increase supply diminishes (Cerda et al., 2021). Price controls on fuel can artificially increase demand and increase carbon emissions (Akimaya & Dahl, 2017). Price controls on coal, which is the main source of heating, are responsible for the increase in the concentration of air pollutants in China during autumn and winter (Lin & Ling, 2021). Price controls which become sensitive to market conditions can reduce the creation of artificial demand and the associated high costs on the firms and the environment.

In Fiji, like many other small island developing states (SIDS), petroleum products, which are fully imported, are heavily price controlled. Indeed, the regulating body, the Fiji Competition and Consumer Commission (FCCC), that commissions this in the market, orders price controls several (four) times on a regular basis within a year to allow for changes in market conditions (see Figure 1). During the COVID-19 pandemic (2020-2021), monthly price controls were commissioned.

The objective of this paper is to test whether these price control practices are at par with changes in market conditions. To this end, we test the presence, or otherwise, of a stable long run relationship between world market crude oil prices (a proxy to capture world market conditions in the crude oil market) and domestic petroleum price control orders regularly by the FCCC.

II. Research Methods

A. Data

The domestic prices are sourced from the FCCC. These are regular price control orders by the FCCC on retail prices per litre of fuel products, namely, motor spirit, diesel (or diesoline) and premix over the period (at a monthly frequency) 2011:01 to 2022:03. The price control order dates for the domestic prices of transport fuel are matched with

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Table 1. Descriptive statistics and unit root test

Panel A	*OILP*	*DIESEL*	*KEROSENE*	*MOTOR*	*PREMIX*
	Per barrel	Per litre	Per litre	Per litre	Per litre
Mean	149.15	1.92	1.58	2.24	2.08
Median	146.03	1.89	1.63	2.21	2.03
Maximum	226.28	2.39	2.03	2.75	2.55
Minimum	39.99	1.24	0.91	1.66	1.29
Std. Dev.	45.05	0.32	0.30	0.30	0.36
J-B Prob.	0.02	0.01	0.00	0.01	0.01
C.V.	30.20	16.89	19.06	13.51	17.12
Obs.	135	135	135	135	135
Panel B	***LOILP***	***LDIESEL***	***LKEROSENE***	***LMOTORS***	***LPREMIX***
ADF test: I (0)					
t-stat.	-1.927	-1.143	-2.674	-1.385	-1.883
Probability	0.319	0.697	0.081	0.588	0.339
ADF test: I (1)					
t-stat.	-9.200*	-10.652*	-9.838*	-10.270*	-9.552*
Probability	0.000	0.000	0.000	0.000	0.000

Panel A reports the descriptive statistics on the raw data on brent oil price (*OILP*) and price control orders on diesel, kerosene, motor spirit and premix in Fiji dollars. Panel B presents the ADF test results on the logarithmic form of the prices, denoted with a letter prefix "L" to the original variables of domestic transportation fuel and brent oil. And * denotes statistical significance at the 1% level.

the dates of the brent oil prices. The former prices are taken as capturing general condition in the crude oil market.

Panel A in Table 1 provides selected common statistics on the petroleum products and crude oil market prices expressed in Fiji dollars. Some observations noteworthy are as follows. First, motor spirit is, on average, most expensive at $2.24, followed by premix (FJ$2.08), diesel (FJ$1.92) and kerosene (FJ$1.58). Second, the coefficient of variation (C.V.) shows that Brent oil (*oilp*) is more volatile than the regulated petroleum products in Fiji. Of the petroleum products, kerosene prices have been the most volatile, ranging between FJ$0.91 to FJ$2.02. This is followed by premix, diesel and motor spirit.

In Panel B of Table 1, the Augmented Dickey-Fuller (ADF) unit root test is conducted for the series. The idea is to identify the stationarity properties of the data series—an outcome that dictates the choice of the econometric model. All series are stationary at their first differenced form, suggesting that the series are *I (1)* processes—that is, they contain a unit root.

Figure 1 shows the logarithmic forms of the *LOILP* and the price control orders for the petroleum products in Fiji. The market conditions of crude oil prices are tracked closely by the domestic price control orders with some lags. A look at the correlation matrix of (stationary form of) the prices of petroleum products and crude oil (displayed in Table 2) suggests that there is possibly a one-period lag in the price controls to adjusting to crude market conditions. Moreover, of all the petroleum products, premix is most strongly correlated with crude oil, at 54%. Meanwhile, control prices of motor spirit and diesel are strongly correlated with that of premix (respectively at 91% and 84%), which suggests that the latter two prices are tracking premix price orders very closely.

Given that all series of interest follow *I (1)* processes, we proceed to examine the cointegration (or long-run) relationship between the oil price and each of the petroleum products. For this, we use the Johansen (1988, 1995) cointegration test. The Johansen approach uses the Trace and Maximum eigenvalue tests suitable for multivariate vector autoregression and allows for the possibility of endogenous relationships amongst the variables. Results reported in Table 3 suggest that premix and kerosene have a long run equilibrium relationship with the brent oil price. Furthermore, in Panel A of Table 4, where results of the error correction model (ECM) are presented, shows that the error correction term (ECT) is negative and statistically significant, which implies that the two long run equilibrium relationships are stable.

Table 4, Panel B, also reports the long run association between the cointegrated pairs found above. For both pairs, brent oil price has a positive effect, which says that in the long run, lower (higher) crude oil prices reduce (increase) Premix and Kerosene prices.

The short-run association between crude oil market conditions and the petroleum products in Fiji for the two cointegrated pairs is reported in Table 4 (see Panel A). We find that *dloilp* has a negative effect for both kerosene and premix, and this is significant at the 5% level for kerosene only. While kerosene and premix and the crude oil market conditions may be unsynchronous in the short-term, they tend to have a stable long run relationship as seen through the cointegration test.

We also provide stationary models for the pairs that were not cointegrated. Here, brent oil price shows a significant

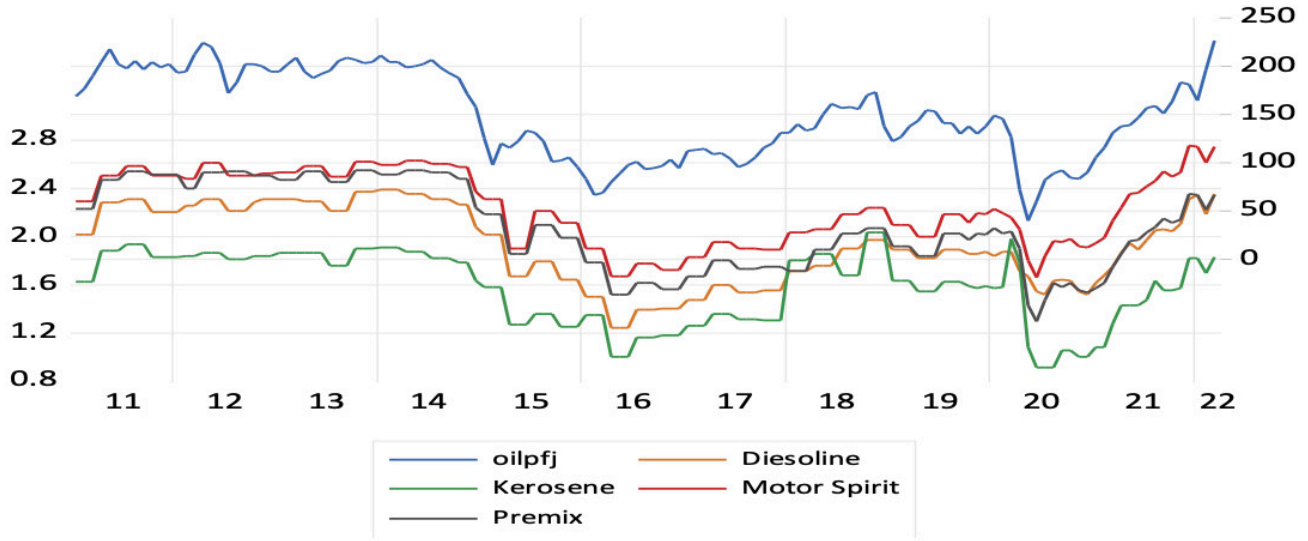

Figure 1. Brent oil price and the price control orders for the domestic fuel prices: 2011:01 - 2022:03

This figure plots the time series data on oil price (Brent oil price, oilpfj) and the price control order prices for diesel, kerosene, premix and motor spirit. Data are monthly and cover the period 2011:01 to 2022:03.

Table 2. Correlation matrix

Correlation Probability	DLOILP (t)	DLOILP (t-1)	DLOILP (t-2)	DLOILP (t-3)	DLDIESOL	DLKERO	DLMOTORS	DLPREMIX
DLDIESEL	0.119	0.318*	0.123	-0.056	1			
	(0.178)	(0.000)	(0.166)	(0.526)				
DLKERO	0.255*	0.435*	0.204	-0.105	0.650*	1		
	(0.004)	(0.000)	(0.021)	(0.236)	(0.000)			
DLMOTORS	0.238*	0.451*	0.037	-0.087	0.841*	0.670*	1	
	(0.007)	(0.000)	(0.681)	(0.327)	(0.000)	(0.000)		
DLPREMIX	0.332*	0.537*	-0.016	-0.074	0.719*	0.678*	0.917*	1
	(0.000)	(0.000)	(0.856)	(0.403)	(0.000)	(0.000)	(0.000)	

This table reports the unconditional correlations between market conditions in the crude oil market represented at present time (*t*) and in lags from *t-1* to *t-3* and the domestic prices of petroleum products. The probability values associated with the null hypothesis that the correlation is zero is reported below each correlation value in parenthesis. And * denotes statistical significance at the 1% level.

Table 3. Cointegration test results

Series	LOILP-LDIESEL		**LOILP-LKERO**		LOILP-LMOTORS		**LOILP-LPREMIX**	
Panel A. Trace test								
No. of CE(s)	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.
1	14.397	0.073	19.108*	0.014	7.891	0.477	0.118*	0.007
2	2.444	0.118	3.592	0.058	1.867	0.172	0.034*	0.033
Panel B. Max-Eigen test								
No. of CE(s)	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.
1	11.953	0.112	15.515*	0.032	6.024	0.610	0.118*	0.024
2	2.444	0.118	3.592	0.058	1.867	0.172	0.034*	0.033

This table presents the Johansen (1988, 1995) test results based on the trace and max-eigen tests. And * denotes significance at the 5% level.

and a positive association with diesel and motor spirit, which indicates these prices do have the tendency to be in tuned with crude oil market in the short-term, although this is not stable over the long run.

Finally, since we noticed through the correlation matrix that Diesel and Motor spirit may be closely associated with premix, we check whether this suggests culminates into long run co-movement between the three petroleum prod-

Table 4. Long run model, error correction model (ECM) and other regression models

Variable	Kerosene		Premix	
	Coef.	Prob.	Coef.	Prob.
Panel A. ECM				
DLOILP (1)	-0.154*	0.002	-0.011	0.720
ECT (-1)	-0.425*	0.000	-0.356*	0.000
DLKERO (-1)	0.026	0.708		
DLPREMIX (-1)			0.001	0.991
C	0.000	0.978	0.000	0.960
Adjusted R-squared	0.442		0.377	
Panel B. Long run				
LOILP	0.568	0.000	0.508	0.000
C	-1.032	0.000	-0.781	0.000
Adjusted R-squared	0.678		0.760	
Panel C: Regression result: Other petroleum products				
Dependent variable	DLDIESEL		DLMOTORS	
Variable	Coef.	Prob.	Coef.	Prob.
DLOILP (-1)	0.116*	0.000	0.160*	0.000
DLDIESEL (-1)	0.023	0.782		
DLMOTORS (-1)			-0.004	0.966
C	0.000	0.771	0.001	0.718
Adjusted R-squared	0.089		0.191	

This table reports results from two models: Panel A has results from the error correction model estimated based on the ordinary least squares estimator whereas Panel B contains the long-run results obtained using the fully modified ordinary least squares estimator. D denotes first difference of the variable.

Table 5. Cointegration among the regulated prices of Petroleum products

	Premix - motors		Premix - diesel		diesel-motors	
Panel A. Trace test						
No. of CE(s)	stat.	Prob.	stat.	Prob.	stat.	Prob.
None	7.256	0.548	10.415	0.250	12.999	0.115
At most 1	1.057	0.304	2.250	0.134	2.489	0.115
Panel B. Max-Eigen test						
No. of CE(s)	stat.	Prob.	stat.	Prob.	stat.	Prob.
None	6.199	0.588	8.165	0.362	10.510	0.181
At most 1	1.057	0.304	2.250	0.134	2.489	0.115

ucts. Table 5 captures the Johansen test results. And all these show that a long run relationship between the petroleum products is not maintained.

III. Concluding remarks

In this note, we tested whether price-regulated (imported) petroleum products in Fiji sufficiently account for international market conditions in the long- and the short-term. To this end, we examined the cointegration relationship between the brent oil price, which depicts market conditions internationally, and the price control orders on petroleum products. Our key results are as follows. First, premix and kerosene align with crude oil market conditions well in the long-run and they adjust to market conditions in a stable manner. This may be related to the frequency of the implementation of the price controls and the forecasting capabilities of the models used. Diesel and motor spirit fail to show any cointegration link with the crude oil market or premix. High frequency of price control orders can be a costly outcome for the regulator. In such cases, adoption of models that align regulated prices to market conditions better can be useful for policymaking and for maximising both consumer and producer welfare. Future research needs to address this policy gap.

Submitted: October 11, 2024 AEDT. Accepted: January 28, 2025 AEDT. Published: April 30, 2025 AEDT.

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