Energy Economics 61 (2017) 135–146

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

# Do petrol prices increase faster than they fall in market disequilibria?

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ARTICLE INFO

*Article history:*
Received 5 May 2016
Received in revised form 24 October 2016
Accepted 31 October 2016
Available online 17 November 2016

*JEL classification:*
C51
Q43
L16

*Keywords:*
Asymmetric responses
Petrol prices
Threshold error correction model

ABSTRACT

This paper tests the idea that petrol prices respond more quickly to price increases than to decreases. We show that the results previously documented in the literature for Australia are spurious due to failure to establish the stationarity property of the price series, and the co-integration relationship between retail and wholesale prices when neglecting to account for a regime shift in the data. Using a robust approach involving a threshold error correction model, we find little evidence to support the contention that retail petrol price reverts asymmetrically to long-run equilibrium. Asymmetric adjustments in retail prices are found only in four of the twenty-eight retail gas stations in Queensland. These results cast doubt on the previously reported pervasiveness of this asymmetric price response phenomenon in Australia. We further caution on erroneous inference with the use of weekly rather than daily data, and when failing to account for a regime shift in the data.



## 1. Introduction

The established literature has argued that gasoline prices respond quickly to crude oil price increases, but adjust more slowly to crude oil price decreases (Bacon, 1991; Borenstein et al., 1997; Bachmeier and Griffin, 2003). This phenomenon has been referred to as *rockets and feathers* for the reason that gasoline prices 'shoot up like rockets' in the face of positive oil price shocks and 'float down like feathers' in response to negative shocks (Bacon, 1991). While the rockets-and-feathers hypothesis has predominantly been examined in the U.S. market, it has been investigated extensively in other non-US markets such as the Spanish fuel market (Ballguer and Ripolles, 2012) and the Australian petrol market (Valadkhani, 2013), just to name two countries by way of example.[1]

Importantly the Australian study differs from the Spanish one in the use of weekly data rather than daily data. Ballguer and Ripolles (2012) highlighted the importance of using daily data on the basis that gas stations are able to adjust their prices daily, particularly given that gas stations set their prices according to the rapidly changing conditions in the wholesale fuel market. To that end, daily data would reveal more information about the retail price adjustment process. From an econometric standpoint, inadequate temporal disaggregation could result in the omission of important short time lags, which may introduce significant bias to estimates (Geweke, 1978). An important and well-established finding is that estimates from average data per week also suffer from temporal aggregation bias (Bachmeier and Griffin, 2003; Ballguer and Ripolles, 2012). And as we document in our study, this temporal aggregation in weekly price series can give rise to a different stationary property compared with daily price series. An important implication of the difference in results about the mean-reversion behavior of petrol prices is that it hinders the application of the long-run cointegration framework, which is commonly used for testing asymmetry in the retail price adjustments when it deviates from wholesale price. Consequently, there is a need to undertake further research that uses daily retail petrol prices in Australia.

This paper critically evaluates the model used by Valadkhani (2013) in testing the rockets-and-feathers hypothesis for Australia's petrol market. In addition to employing daily data, which overcomes the temporal aggregation bias that has been documented in previous studies, this paper demonstrates the importance of testing for cointegration relationship between retail and wholesale petrol prices in the presence of a structural break, and the need for a robust model specification which captures important features of the data when testing for asymmetric responses of retail petrol price to wholesale price changes. To this end, we focus our analysis on the state of Queensland (QLD), a state which exhibited significant evidence of rockets-and-feathers behavior in retail petrol prices, apart from Tasmania (TAS) and New South Wales (NSW) (Valadkhani, 2013). The number of retail locations in QLD exceeds that of TAS but it is marginally lesser

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[1] Other country studies include Liu et al. (2010) who examined price asymmetry for diesel and petrol in New Zealand, and Bermingham and O'Brien (2011) who tested the rockets-and-feathers hypothesis in the Irish and UK petroleum and diesel markets.

http://dx.doi.org/10.1016/j.eneco.2016.10.024
0140-9883/

than that of NSW and Australian Capital Territory (ACT) combined.[2] For the purpose of exposition, the general reference to petrol is with regard to unleaded petrol.

Following the literature, Valadkhani (2013) estimated a long-run relationship between retail and wholesale petrol prices for which the resulting residuals from that regression form the error correction term which enters a second stage regression. Prior to running the second regression, he tested for the stationarity property of petrol prices. However, when neglecting to account for a structural break in the data, he erroneously concluded that the series are non-stationary when in fact they were stationary with a regime shift in both intercept and trend. Furthermore, he tested for co-integration between retail and wholesale prices even though the two series are I(0). Unfortunately, he also used a wrong set of critical values based on the Augmented Dickey Fuller critical values rather than the appropriate critical values for cointegration test. The results yield erroneous conclusion about the stationarity property of the residuals obtained from the first stage regression. Be that as it may, Valadkhani continued to assess evidence of asymmetry using the second stage regression. Specifically, he relied on the feedback coefficients, which are associated with the error correction term that is proxied by the residuals. The idea is that these feedback coefficients measure the different speeds of adjustment when deviations from the long-run equilibrium occur. For reasons not explained by Valadkhani (2013), he assumed that the residual (or the error correction term) followed a Gaussian normal distribution. The assumption of normality implies a symmetric distribution which allows him to choose two threshold levels (i.e. $0.44\sigma$ and $-0.44\sigma$) that divide the distribution into three equal portions. Here, $\sigma$ denotes the standard deviation of petrol prices. The upper (lower) portion of the distribution is associated with the error correction (or residual) value that is greater (lesser) than or equal to $0.44\sigma$ ($-0.44\sigma$), which he defined as $EC^{+}$ ($EC^{-}$). The test for asymmetry amounts to testing the null hypothesis of equality in the coefficients of $EC^{+}$ and $EC^{-}$.

This study shows that the use of weekly data employed in Valadkhani (2013) fail to justify the application of a cointegration framework given the stationary property of petrol prices. In contrast, our results show that daily petrol prices exhibit non-stationary property when the regression specification used for testing a unit root properly accounts for a structural break in the data. For the 28 gas stations data examined, we find that only 15 retail prices display a long-run relationship with wholesale prices when a structural break is accounted in the cointegration regression. In addition, we show that the normality assumption imposed by Valadkhani (2013) on the error correction term and the residual of the regressions, are tenuous and that the data fail to support them. The Jarque-Bera test overwhelmingly rejects the null of normality in the resulting regression residuals of the 15 retail prices. A plot of their empirical distributions superimposed on a normal distribution visually suggests that the normality assumption is untenable. Since Valadkhani fails to establish the normality of the residual, there is a flow-on effect on the ad hoc determination of the threshold levels, which – contrary to his assertion – fail to demarcate the distribution into three equal portions. Given that the threshold levels are chosen incorrectly the test of the null hypothesis on the equality of the coefficients, which are associated with the different regions of the distribution would be erroneous.

We present a model which better captures certain empirical features of the data compared to the one estimated by Valadkhani (2013). First, we establish that there is a long-run equilibrium relationship between retail and wholesale prices when a structural break is taken into consideration in the cointegration regression. Failure to accommodate a regime shift in the cointegration relationship can result in failure to reject the false null of no cointegration (Gregory and Hansen, 1996a, 1996b), which is corroborated in our findings. The resulting residual from this cointegration regression can be used to determine whether there is asymmetric adjustment in retail prices whenever the market is in disequilibrium. We also relax the assumption of normality in the distribution of the residual. Given the evidence of departure from normality in petrol prices, we use a Student's t distribution. As we show in the sensitivity analyses, this assumption matters for correct inference. Secondly, there is no a priori reason other than for convenience that the threshold levels are chosen so as to divide the error distribution into three equal portions. It is common in the literature to employ zero as the default threshold since positive and negative values can be easily associated with the different speeds of adjustment when the deviation is above or below the long-run equilibrium level.

Rather than fix this threshold at zero, we consider an alternative approach which allows the data to determine the threshold level. This approach is similar to the threshold adjustment which is developed by Enders and Siklos (2001). Their method permits asymmetry in the speed of adjustment towards equilibrium with the threshold level purely determined by the data. Having estimated the model, we test the null of equality in the coefficients which measure the speed of adjustment when the discrepancies are positive and negative from the threshold level. This forms the basis for testing the asymmetric price responses. Thirdly, the volatility specification of retail petrol prices is permitted to respond asymmetrically to the sign and size of the shocks. By appropriately modelling the empirical features in the data, we show that the results fail to support the pervasiveness of rockets-and-feathers behavior in petrol prices in the Queensland state as claimed by Valadkhani (2013). Our results provide new and robust evidence for the lack of asymmetric retail price adjustments, which has been a topic of significant interest by the public due to its implications for consumer welfare.[3] Of the 28 retail stations examined, only four retail petrol prices are found to exhibit asymmetric price adjustments.

The rest of the paper is structured as follows. Section 2 provides a review of the literature. Section 3 discusses the data sources, explains the summary statistics of the data and preliminary results of the cointegration test and the empirical distribution of the resulting residuals. Section 4 presents the model, the procedure for determining the threshold and the test for asymmetric price responses. Section 5 discusses the results. Section 6 concludes the paper with a summary of the main arguments presented here.

## 2. Literature survey

### 2.1. What gives rise to oil price asymmetric adjustments?

Empirical observation of oil price asymmetric response to changes in wholesale prices can be rationalized by oil companies taking advantage of their dominant market power in an oligopolistic industry (Contín-Pilart and Correljé, 2009). The extent of price asymmetry depends on the number of competitors in the market; fewer competitors are associated with more price asymmetry. Oligopolistic markets exist due to high barriers to entry. Some barriers include the requirement for government licensing and large economies of scale that exist in the fuel market. Collusive behavior is thought to be a common practice in the oligopolistic fuel market where prices are set unfairly higher for consumers. Borenstein et al. (1997) show that tacit collusion is practised by firms in which they use past prices as a focal point to exploit market power. Tacit collusive behavior is an undeclared agreement, where collusion occurs either through excessive advertising or when a market leader sets a benchmark price for competitors to follow. In the event that

[2] TAS has 8 retail locations, NSW and ACT (combined) have 30 while QLD has 28.

[3] The social concern is based on studies documenting that oil companies have a propensity to take advantage of oil price variations in the international market. Their aim is to increase revenues by failing to adjust retail prices in accordance with movements of the wholesale prices. Consequently, consumers are expected to pay higher prices which reduce their welfare. (Galeotti and Lanza, 2003; Contín-Pilart and Correljé, 2009; Ballguer and Ripolles, 2012).