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Retail and wholesale gasoline price adjustments in response to oil price changes

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ABSTRACT

This research examines the long-run relationship between the spot oil price and retail and wholesale gasoline prices. Recent research suggests that the response of the retail gasoline price is faster and the size of the change is larger, in magnitude, following a crude oil price increase compared with periods when the crude oil price is falling; however, some recent papers examining potential asymmetries present mixed results. Our results from a common threshold model estimating the adjustment of gasoline prices and the spot oil price suggest a long-run relationship between retail and wholesale gasoline prices and the crude oil price. Further, results here suggest that both retail and wholesale gasoline prices respond symmetrically to an oil price shock in the long run, indicating little market power by gas stations and wholesalers.

1. Introduction

There is a common belief that gasoline retailers and wholesalers have market power causing the retail gasoline price to respond differently in periods when the price of crude oil is rising compared to periods of a falling oil price. Previous research finds a faster and larger, in magnitude, change in the retail price of gasoline in response to oil price increases than to oil price decreases. We test the long-run retail gasoline price adjustment in response to oil price changes and the long-run wholesale gasoline price adjustment to oil price changes using a common threshold model. We investigate the potential long-run asymmetric response of these gasoline prices to oil price changes. Findings here suggest a potential long-run symmetric response of both gasoline prices to oil price fluctuations. The long-run symmetric response finding suggests the limited ability of retailers and wholesalers to permanently control the price of their product.

2. Literature review

Although multiple variables explain gasoline price fluctuations, the literature indicates that the primary explanation is changes in the price of oil (Chouinard and Perloff, 2002; Ginn and Gilbert, 2009). However, responses of the gasoline price to oil price changes vary. Borenstein et al. (1997) find that the retail gasoline price responds more quickly to increases than to decreases in the oil price in the first four weeks following a change in the price of oil. They estimate the rate at which the gasoline price adjusts to oil price changes by assuming a simple linear long-run relationship between these prices. They specify a linear relationship rather than log in nominal prices because the latter would imply that the crude-retail margin increases with the price of crude oil, which they note does not appear to be supported by the data. However, their results are very similar to results using log values.

Using weekly and semi-monthly data sets ranging from March 1986 to December 1992 and estimating ten different equations, they find a one-dollar increase in the oil price leads to a gasoline price increase of 55 cents in the first two weeks and an additional 12 cents increase in the next two weeks, giving a total increase of 67 cents after four weeks. Conversely, a dollar decrease in the oil price leads to an increase of 15 cents in the first two weeks and a decrease of 30 cents after four weeks.

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They conclude, "The regression results indicate that the contemporaneous response of retail prices to crude oil price changes … is much greater for increases in crude prices than for decreases" (Borenstein et al., 1997, page 319). Possible sources of this asymmetry are production/inventory adjustment lags and market power of some sellers. By looking at the price transmission at different points in the distribution chain, they find that the spot price for generic gasoline exhibits an asymmetric response to oil price changes, potentially reflecting inventory adjustment effects. An asymmetric response also appears in the response of the retail gas price to wholesale gas price changes, possibly indicating short-run market power among retailers.

Borenstein, Cameron, and Gilbert, however, impose a long-run symmetric adjustment in their estimates and examine short-run asymmetries only. They find that the retail price of gasoline responds directly to changes in the price of oil. Further, a one-dollar change in the per gallon price of oil leads to an eighty-one cent change in the retail price of gasoline. The long-run retail gasoline adjustment parameter, θ_1, is -0.175 (see Eq. 10 and Table 1, Borenstein et al., 1997, page 320).

Borenstein and Shepphard (1996) estimate that about two-thirds of the eventual pass-through of oil price fluctuations to changes in the price of gasoline occurs in the first two weeks following the oil price shock. Their results also show retail–wholesale gasoline price margins are higher when wholesale prices are expected to decline in the next period than when they are expected to increase.

Deltas (2008) uses monthly 1988 to 2002 state-level data for the forty-eight contiguous states except Nevada and notes there is an asymmetric response of the retail gasoline price to changes in the wholesale price, which is dependent on the average price margin across states. For example, smaller gasoline-price margin states experience lower asymmetries than those with a larger margin. One explanation for an asymmetric response is that there is less search for a low retail gasoline price by customers when the price is falling and therefore less incentive for gasoline stations to lower their price (Lewis, 2011). Honarvar (2009) employs a hidden cointegration technique to examine gasoline price asymmetry, and the results indicate asymmetric gasoline price adjustments to an oil price shock.

Chen et al. (2005) use the weekly retail gasoline price and the spot oil price, and they find evidence of long-run and short-run gasoline price asymmetry in response to an oil price shock. They find "significant evidence indicating the presence of asymmetric transmission from crude oil prices" (Chen et al., 2005, page 237). Further, their findings indicate long-run asymmetric adjustment "from crude oil prices … to retail gasoline prices" (Chen et al., 2005, page 237).

Two recent papers, however, find weak evidence of asymmetric gasoline price adjustment. Douglas (2010) considers a threshold model and concludes that any asymmetric evidence in the results is influenced by a few outlying observations, whereby the retail gasoline price generally responds symmetrically to gasoline spot prices. Grasso and Manera (2007) also employ threshold and momentum threshold models to explore the relationship between the gasoline price and oil price in five European countries. Asymmetries are found, but most of the asymmetric adjustment occurs at the distribution stage; they find mixed evidence of long-run asymmetric adjustment in the retail gasoline price following oil price shocks.

These mixed results concerning the long-run asymmetric response of both retail and wholesale gasoline prices to an oil price disturbance in the literature leave more questions than answers for the relationship between these prices. In particular, do gasoline stations or wholesalers have market power to determine gasoline price changes in the long run when the oil price increases or decreases?

To answer these questions, this paper attempts to provide two main contributions. First, we consider a longer time series for the retail gasoline price that begins in 1976 and the wholesale gasoline price that starts in 1983. Recent research uses weekly data that begins between 1985 and 1991. Second, we show that the cointegration methods and restrictions imposed in the previous research may be inappropriate and may contribute to researchers finding long-run gasoline price asymmetries.

Much of the previous research examining this issue use the Engle and Granger (1987) method to test for cointegration between these two prices. Specifically, this method uses a two-step process to determine if the linear combination of two time series that are integrated of the same order has a long-term relationship. The results in the first stage yield the long-run relationship between the two prices. The estimated long-run relationship is also used to calculate the error-correction term. In the second stage, the estimated coefficient for the error-correction term, or speed of adjustment, indicates how quickly these series will return to their long-run relationship (or equilibrium found in the first stage) following a change in the price of oil. However, the Engle–Granger method may lead to estimated parameters that are potentially biased. Banerjee et al. (1993) show that the Engle–Granger method may omit short-run dynamic elements. These omitted dynamic terms are captured by the residual, which may bias the long-run coefficients and create autocorrelation. The size of this bias may be substantial in finite samples. Phillips and Durlauf (1986) show that traditional hypothesis tests are not valid using the Engle–Granger method.

Biased long-run parameters may create mismeasured error-correction terms. Tests based on these error-correction terms created from biased long-run parameters may be imprecise. For example, the term structure of interest rates literature shows that this potential bias is substantial and leads to radically different conclusions regarding interest rate pass-through from short-run interest rates to long-run interest rates [see Cook (2008) or Hegwood and Tuttle (2013)]. We use an alternative, but common, cointegration test. Our results indicate that neither the retail nor wholesale gasoline price responds asymmetrically to an oil price change, indicating gasoline stations or wholesalers exert little or no market power.

3. Data, methods, and unit root tests

This research uses the monthly U.S. city average retail price for regular unleaded gasoline from January 1976 to January 2012, which is provided by the Energy Information Administration. Several studies use weekly data, but the weekly series has a starting date of August 20, 1990, potentially missing some of the dynamics between gasoline and oil prices.[1] Our use of the monthly series allows us to consider a longer time span. The monthly wholesale gasoline price (resale price by refiners) data is for the January 1983 to January 2012 period. The oil price series is the spot price for West Texas Intermediate from January 1976 to January 2012, which is available from the Federal Reserve Bank of St. Louis' FRED database. The oil price is adjusted into cents per gallon by dividing the series by 42 (the number of gallons in a barrel of oil) to match the gasoline price series. Fig. 1 presents the history of the three prices over the data range.

Table 1 presents the results of unit root tests on gasoline and oil prices. The general form of the unit root tests is given by Eq. (1).

$$\Delta y_t = \gamma y_{t-1} + \delta_0 + \delta_1 t + \sum_{i=1}^{n} \beta_i \Delta y_{t-i} + \varepsilon_t \tag{1}$$

A series is non-stationary (has a unit root) if testing fails to reject the null hypothesis that γ is statistically zero. All three price variables appear non-stationary in levels, since the tests fail to reject the null hypothesis of a unit root. Unit root testing rejects the null of non-stationarity in first-differences for these variables, i.e. rejects the null of zero for γ in Eq. (1). These unit root test results are common in the literature and found in several recent papers cited in the previous section.

[1] Examples include Chen et al (2005) and Douglas (2010).