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Oil prices, exchange rate, and the price asymmetry in the Taiwanese retail gasoline market☆

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ABSTRACT

This study used the asymmetric autoregressive distributed lag model to evaluate the influence of oil price and exchange rate fluctuations on retail gasoline prices in Taiwan. Unlike the numerous previous studies, we considered the unit root tests with a structural break and suggested that all price variables were stationary series. We also showed that the adjustments of retail gasoline price follow a politico-economic asymmetry. Moreover, gasoline price responses to exchange-rate shocks were slow and complex and exhibited reverse adjustments during periods of initial exchange-rate depreciation. This is potentially because domestic petroleum companies must purchase foreign currency before purchasing crude oil.

1. Introduction

In the field of energy economics, the high correlation between oil prices and economic variables is widely discussed. Studies on this topic are mainly divided into three research categories. Numerous studies in the first category have primarily focused on researching the influence of oil prices on macroeconomic variables such as the impacts or prediction effects of real output and inflation. These studies have employed data on developed and some emerging countries, verifying the evident correlation between oil price shocks and economic depression (see, for example, Counado and Perez de Garcia, 2005; Gisser and Goodwin, 1986; Gronwald, 2008; Hamilton, 1988; Hamilton and Herrera, 2004; Keane and Prasad, 1996; Kilian, 2008a, 2008b; Kilian and Vigfusson, 2011a; Mork, 1989; Rotemberg and Woodford, 1996), and determining that oil prices are predictors of economic growth (see, for example, Hamilton, 1983, 2011; Kilian and Vigfusson, 2011b; Narayan et al., 2014). In addition, some studies have indicated that changes in oil price are passed through into domestic inflation (Chen, 2009a, 2009b; Hamilton, 1996; Hooker, 2002). Therefore, an increase in oil price raises the input cost in production processes, and the consequent increase in domestic price levels reduces the real money balance in an economic system; moreover, this double effect can lead to recession (see, for example, Hamilton, 1983; Hoover and Perez, 1994; Mork, 1989, 1994).

Studies in the second category have considered oil price as a predictor of stock returns or stock prices; however, the results from such studies have differed considerably. For example, Driesprong et al. (2008), Jones and Kaul (1996), Park and Ratti (2008), and Miller and Ratti (2009) have determined that oil price changes and stock returns are negatively correlated, whereas Gjerde and Saettem (1999), Park and Ratti (2008), Narayan and Narayan (2010), and Narayan and Sharma (2011) have shown that oil prices exert positive effects on stock prices. Moreover, other studies have reported no significant correlation between changes in oil prices and stock returns (see, for example, Chen et al., 1986; Huang et al., 1996; Wei, 2003). Narayan and Sharma (2011) and Phan et al. (2015a, 2015b) have also indicated that the prediction differences in the correlation between oil prices and stock return are related to the characteristics of relevant industries.

Because the price of petrochemical products is influenced by oil prices, studies in the third category have directly investigated the influence of adjustment mechanisms for petrochemical product prices on oil price shocks, with retail gasoline prices drawing the most attention from the public. Galeotti et al. (2003) indicated that people today are highly reliant on automobiles, thereby creating inelastic gasoline demand. Therefore, gasoline price reductions are encouraging and price increases are concerning. The public frequently assumes that increases in oil prices rapidly raise the price of gasoline, whereas oil-price reductions correspond to slow downward price adjustments. Bacon (1991) described this type of asymmetrical adjustment as the "rockets and feathers" assumption; that is, gasoline price adjustments rise similar to rockets in response to an increase in oil prices, but when oil prices drop, gasoline prices exhibit a slow downward adjustment, similar to that of feathers. Although this description by Bacon

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(1991) is exaggerated, the description conveys long-standing public and economist concerns regarding asymmetrical gasoline-price adjustments.

Price asymmetry refers to the differences in magnitude and interval adjustments in product prices subsequent to positive or negative cost shocks (e.g., high (low) increases and low (high) reductions or rapid (slow) increases and slow (rapid) reductions). Numerous international studies have shown that the rockets and feathers asymmetrical-adjustment pattern occurs in the gasoline market (see, for example, Asplund et al., 2000; Bacon, 1991; Bettendorf et al., 2003; Borenstein and Shepard, 1996; Borenstein et al., 1997; Galeotti et al., 2003; Grasso and Manera, 2007; Manning, 1991; Radchenko and Shapiro, 2011; Reilly and Witt, 1998). The literature has attributed this price asymmetry primarily to the trigger or collusive pricing strategies of oligopolistic sellers in the market. In other words, cost increases erode retail profits, which raise the difficulty of maintaining collusive prices among operators and results in immediate gasoline price increases; however, cost reductions increase retail profit and operators benefit from collusion, causing slow downward price adjustments.

Although numerous studies have referred to the reaction of gasoline prices in response to fluctuating oil prices as the "rockets and feathers" phenomenon, they have verified that local market power exerted by sellers in oligopolies controls the adjustment of gasoline prices. Nevertheless, some gaps also exist in these studies. First, most studies have adopted the asymmetric error correction model (asymmetric ECM) as the reduced form for analyzing the dynamic relationships among crude-retail prices (see, for example, Al-Gudhea et al., 2007; Borenstein et al., 1997; Chen et al., 2005; Galeotti et al., 2003; Grasso and Manera, 2007; Manning, 1991; Reilly and Witt, 1998). Specifically, an analysis must be established on the premise that the price series are all I(1) variables, which require cointegration tests to be conducted. However, in-depth investigations of the nonstationarity of energy variables have drawn wide attention recently (see, for example, Narayan and Liu, 2011, 2015; Narayan and Popp, 2010; Narayan and Smyth, 2007; Smyth, 2013; Smyth and Narayan, 2015). Energy variables are characterized by structural breaks and thus may generate spurious results in conventional univariate unit root test, resulting in the erroneous acceptance of null hypothesis of a unit root. In other words, if the price series itself is stationary, then previous studies that have adopted cointegration analyses for inferences were redundant and not precise enough. Accordingly, the present study considered the unit root tests with structural break when analyzing the price variables in order to precisely determine the nonstationarity of the variables and to propose an effective estimation procedure.

Second, most previous studies have focused on industrialized countries such as the United States and countries in Europe (for example, the United Kingdom, France, Germany, Sweden, and Italy) as their research subjects. Gasoline market prices are relative to market mechanisms; thus, price adjustments correspond broadly with the stylized fact of the "rockets and feathers" phenomenon. The market mechanisms in developing or emerging countries are less robust, and gasoline is a crucial consumer good; thus, governments and the public pay particular attention to gasoline price volatility. Kirchgassner and Kubler (1992) indicated that vendor politico-economic considerations cause gasoline prices to exhibit slow rises and rapid reductions. When oil prices increase, vendors are reluctant to increase their prices immediately because they wish to avoid being labeled as an abusive market force or "price gougers". However, this motivation does not appear when oil prices fall, which Kirchgassner and Kubler (1992) described as "politico-economic asymmetry" (Kirchgassner and Kubler indicated that this phenomenon was present in the gasoline price adjustment mechanisms in Germany in the 1970s; however, because the market became more competitive and robust in the 1980s, price adjustments began exhibiting the "rockets and feathers" phenomenon). Accordingly, the present study also focused on exploring whether the "rockets and feathers" phenomenon is prevalent in gasoline price adjustments in developing countries.

Third, in international markets, crude oil trading is priced in US dollars. For small open economies that do not use US dollars as the trading currency, exchange rate fluctuations influence the crude oil purchase cost and thereby influence the adjustment of gasoline prices. In addition, these small open economies must prepare adequate exchange reserves to maintain international trade. Specifically, trade-oriented small open economies that do not use the US dollar as their trading currency might have unique gasoline pricing models.

Taiwan is categorized as a trade-oriented small open economy that does not use the US dollar as the trading currency. The retail gasoline market in Taiwan primarily comprises two types of participants consisted of two integrated petroleum companies (i.e., the Chinese Petroleum Corporation (CPC) and Formosa Petrochemical Corporation (FPCC)) and numerous independent downstream retailers. CPC and FPCC provide branded petroleum products and recommended retail prices to downstream retailers. CPC is a state-owned enterprise (belonging to the Taiwanese Ministry of Economic Affairs) that monopolized the domestic petroleum market before 2000. In 1996, Taiwan permitted private vendors to refine and import/export petrochemical products; subsequently, the privately owned FPCC entered the Taiwanese petroleum market in 2000. This changed Taiwan's gasoline wholesale market into a duopolistic industry (Wu et al., 2011). Currently, CPC leads the domestic petroleum product market (approximately 77% of gasoline stations sell CPC petroleum products). However, CPC must cooperate with government price stabilization policies when setting prices for CPC products (Huang and Chao, 2012). Although FPCC can use market mechanisms to set prices, FPCC typically follows the pricing strategy set by CPC because of market share considerations. In other words, adjustment patterns for Taiwan's retail gasoline price are complex because of the unique domestic market structure.

We use the average weekly data for the period between June 2002 and December 2013, and divided gasoline retail prices into CPC list prices, FPCC list prices, average list prices, and pump prices. The objectives and contributions of this study are described as follows. First, we considered the characteristics of structural breaks in the data to construct a unit root model with relatively greater testing power to precisely determine the unit root behavior in the price variables (Narayan and Liu, 2015). This study simplified and set the price variables to have an endogenous structure break during the sample period and determined that the unit root null hypothesis can be rejected for all price variables. Therefore, oil price, exchange rate, and four retail prices were all empirically considered as stationary series. Previous studies have neglected the characteristics of structural break in such variables and thus have incorrectly determined the unit root behavior in the variables; moreover, adopting a cointegration analysis to construct an asymmetric ECM is unnecessary. We recommend using an asymmetric autoregressive distributed lag model (asymmetric ADL) to simulate the dynamic adjustment of retail prices and to estimate positive and negative shocks of oil prices and exchange rates on retail gasoline prices in Taiwan.

Second, test results on price asymmetry and cumulative adjustment functions showed that retail gasoline prices in Taiwan exhibited price asymmetry in oil-price and exchange-rate shocks as well as rapid and excessive responses to cost reductions. The adjustments of Taiwan's retail gasoline price do not indicate the presence of the "rockets and feathers" phenomenon, which can be seen in most industrialized countries; instead, the adjustment corresponds with the "politico-economic asymmetry" phenomenon. The gasoline industry is in imperfect competition; however, a lack of comprehensive market mechanisms in addition to price interference by governments in developing countries might have caused the adjustment of retail gasoline prices to differ from those reported in numerous previous studies. Accordingly, relatively great importance must be attached to the role of governments when investigating developing or emerging countries.

Third, exchange rates are crucial to Taiwan, which is a small trade-oriented and open economy. As proposed by numerous scholars (see,