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The taxation effect on gasoline price asymmetry nexus: Evidence from both sides of the Atlantic ☆

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HIGHLIGHTS

- We examine the possible causes of gasoline price asymmetry across the globe.
- We investigate the effect of taxation on the retail gasoline price adjustments.
- There is a symmetric gasoline price response in the EU wholesale level.
- Less competitive gasoline markets exhibit price asymmetry.
- The oligopolistic structure of the gasoline markets inflates price asymmetry.

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ABSTRACT

This paper explores the degree of competition in various gasoline markets and infers possible causes of price asymmetry across the globe. For this purpose we use the Dynamic Ordinary Least Square method in order to estimate price asymmetry in twelve European countries and the United States for a sample of weekly observations which spans the period from June 1996 to August 2011. The results indicate the common perception that less competitive gasoline markets exhibit price asymmetry, while highly competitive gasoline markets follow a symmetric price adjustment path. Finally, the inclusion of taxes (VAT and excise tax) into retail gasoline prices, supports the existence of price asymmetry in many European countries.

1. Introduction

Oil prices are often characterized by high volatility (Bettendorf et al., 2003; Kapetanios and Tzavalis, 2010; Fafaliou and Polemis, 2012; Fotis and Polemis, 2012; Polemis and Fotis, 2013). Due to this price volatility, consumers have become more reluctant to the oil companies' price setting behaviour. In other words they tend to believe that the oil companies adjust the retail gasoline price more quickly to cost increases than to cost decreases. The phenomenon whereby prices tend to adjust differently depending on their direction is known as price asymmetry (Bettendorf et al., 2003).

Many researchers and academic scholars have investigated the existence of price asymmetry in the oil markets (Frey and Manera, 2007).[1] Borenstein et al. (1997) use semimonthly prices from 1986 to 1992 in order to estimate a lag adjustment model of price asymmetry by employing two stage least squares. The empirical results indicate that retail prices respond more quickly to increases than to decreases in crude oil prices. The authors have proposed tacit collusion[2], consumer search costs, changes in inventories and crude oil price volatility as possible sources of price asymmetries.

Radchenko and Shapiro (2011) employ Engle–Granger methodology in order to examine asymmetric price movements in the

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[1] Related empirical studies are, *inter alia*, those of Douglas (2010), Deck and Wilson (2008, 2008),Galeotti et al. (2003), Eckert (2002, 2003), Johansen (1992), Salas (2002), Godby et al. (2000), Asplund et al. (2000), Peltzman (2000), Balke et al. (1998), Reilly and Witt (1998), Duffy-Deno (1996), Shin (1994), Kirchgässner and Kübler (1992), Bacon (1991), Manning (1991), Karrenbrock (1991), Lanza (1991), Norman and Shin (1991).

[2] See also Borenstein (1991), Borenstein and Shepard (1992, 1996),Slade (1992), Garcia (2010), Valadkhani (2009), Verlinda (2008) and Eckert and West (2005).

U.S. retail gasoline market for the period 1991 to 2010. They claim that gasoline inventories and unanticipated shocks are possible causes of price asymmetry. On the other hand, Kuper (2012) indicates gasoline price history and gasoline storage costs as possible sources that affect price adjustment process. Lewis (2011) and Hofstretter and Tovar (2010) indicate search cost and government suggested retail price (*common knowledge reference price)*, as possible explanations of price asymmetry. The latter study explores the retail gasoline market of ten cities in Colombia and postulate that gasoline prices rise more slowly when costs are higher.

Clerides (2010) uses data from several European Union (EU) countries and reports significant variation in the adjustment mechanism across countries. Bermingham and O'Brien (2010) conclude that for both the Irish and UK fuel markets, there is no evidence to support the hypothesis that retail prices rise faster than they fall in response to changes in oil prices. Contin-Pilard et al. (2009) have popularized the *Political Economy Hypothesis*.

Deltas (2008) has shown that retail gasoline prices respond faster to wholesale price increases than to equivalent wholesale price decreases. The author elaborates monthly data from 1988 to 2002 and concludes that markets with high average retail-wholesale margins experience an asymmetric response. Yang and Ye (2008) have indicated that search and learning cost fluctuations may play a crucial role in the price adjustment process. Tappata (2009) has also indicated consumer search behavior and learning cost fluctuations as possible explanations of price asymmetry

The contribution of this paper is three-fold. First, it moves beyond the existing literature in that it uses a particularly extended data set covering thirteen developed countries. Second, it overcomes the problem of sample bias in the OLS estimates of the existing literature which in turn affects the tests for symmetry restriction. This is performed by the application of the Dynamic Ordinary Least Square (DOLS) method developed by Stock and Watson (1993). Third and most importantly, the paper investigates the effect of taxation (Value added and excise tax) on the retail gasoline price adjustments in which little attention has been paid by the previous studies.

The remainder of this paper is organized in the following way. Section 2 provides the data and the methodology employed, while Section 3 depicts the empirical results. Lastly, Section 4 concludes the paper, together with some policy implications.

2. Material and methods

2.1. Theoretical background

Following the specification of, *inter alia* Borenstein et al. (1997), Galeotti et al. (2003), Bettendorf et al. (2003), Hofstretter and Tovar (2010), Kuper (2012) and Polemis (2012), various unrestricted error-correction models (ECMs) are used to link the relevant variables. In order to investigate the adjustment path in the different relevant gasoline markets, we estimate two distinct asymmetric ECMs accounting for the wholesale and retail oil market segments, respectively. It is worth mentioning that in alignment with other similar studies, we focus on the examination of price and exchange rate asymmetries appeared only in the short-run. By taking into account the previous considerations, the basic (long-run) relationships are the following:

$$\mathrm{SPG}_{r,t} = \beta_0 + \beta_1 \mathrm{CR}_{r,t} + \beta_2 \mathrm{EXR}_{c,t} + \varepsilon_t \quad (1)$$

$$\mathrm{NRPG}_{c,t} = \beta_0 + \beta_1 \mathrm{SPG}_{r,t} + \varepsilon_t \quad (2)$$

The interpretation of the relevant variables comes as follows: NRPG measured in Euro/litre for EZ-11, pounds/litre for the UK and USD/gallon for the US, denotes the net price of gasoline (excluding taxes and duties), SPG is the Rotterdam gasoline spot price measured in USD/gallon. CR is the Brent spot price for Europe measured in USD/barrel[3], EXR is the exchange rate between U.S dollar and national currencies (euro for EZ-11 countries and pound for the UK, respectively) and ε_t stands for the error term. The reason for using EXR in the wholesale model is related with the fact that exchange rate may be a relevant source of asymmetry in non-US countries. More specifically, as stated by Galeotti et al. (2003), since crude oil is paid for in dollars whereas gasoline sells for different sums of national currencies, the exchange rate plays a significant, possibly asymmetric role.

The sample data contains weekly time series observations covering the period from June 1996 to August 2011. It is noteworthy that the specific sample period covers the years before and after the adoption of the euro (1999 for the 10 sample countries and 2001 for Greece). Moreover, our sample includes eleven European countries together with two major global oil "players" (such as the United Kingdom and the US).

Eqs. (1) and (2) represent the long-run relationships in the wholesale (Eq. (1))[4] and retail market, respectively (Eq. (2)).[5] The aforementioned equations as well as the ECMs are estimated by using DOLS. This method gives an asymptotically efficient estimator which eliminates the feedback in the cointegrating system (Stock and Watson, 1993, 2003). It involves augmenting the cointegrating regression with lags and leads so that the resulting cointegrating equation error term is orthogonal. Moreover, DOLS increases the efficiency and reduces the small sample bias relative to the OLS estimator, while DOLS generates asymptotically efficient estimates of the regression coefficients for variables that are cointegrated (Kaufmann and Laskowski, 2005). The main reason for using this method, is that although the OLS estimate of the cointegrating vector is superconsistent, it will contain a small-sample bias and the limiting distribution is non normal with a nonzero mean (Stock, 1987). A bias in the estimate for the cointegrating vector will thus affect the cointegrating residual. It is worth mentioning that most of the empirical studies devoted to this topic use the OLS method instead of DOLS (i.e. Clerides, 2010; Faber, 2009; Valadkhani, 2009; Kuper and Poghosyan, 2008). Therefore the relevant bias in the OLS estimates of the cointegrating relations affects the tests of the symmetry restriction. In order to overcome this problem we apply the DOLS method in our empirical models.

The asymmetry in the transmission of changes in input prices to output prices can be accommodated within a dynamic model. In order to allow for possible price and exchange rate asymmetries we built and estimate the ECM specifications in the wholesale (Eq. (3)) and retail market (Eq. (4)) following the existing literature (Galeotti et al. 2003; Grasso and Manera, 2007; Contin et al. 2001; Polemis, 2012):

$$\Delta \mathrm{SPG}_{r,t} = a_0 + \sum_{i=0}^{k} a_i^{+} \Delta \mathrm{CRP}_{r,t-i} + \sum_{i=0}^{l} a_i^{-} \Delta \mathrm{CRN}_{r,t-i} + \sum_{i=0}^{m} b_i^{+} \Delta \mathrm{EXRP}_{c,t-i} + \sum_{i=0}^{n} b_i^{-} \Delta \mathrm{EXRN}_{c,t-i} + \sum_{i=1}^{p} c_i \Delta \mathrm{SPG}_{r,t-i} + \lambda^{+} \mathrm{ECMP}_{t-1} + \lambda^{-} \mathrm{ECMN}_{t-1} + \varepsilon_t \quad (3)$$

[3] However, for the US, we used the weekly WTI spot price as traded on the New York Mercantile Exchange (NYMEX) for delivery at Cushing, Oklahoma.

[4] The subscripts r and c denote the geographic region {i=Europe, US} and the sample country respectively {n=Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain and UK}.

[5] The effect of taxation on output prices in the retail oil market segment is presented in Section 3.3.