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Symmetric or asymmetric oil prices? A meta-analysis approach

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HIGHLIGHTS

- I study asymmetries in the price gasoline industry through a meta-analysis regression.
- The asymmetries are produced mainly in the retail market.
- The asymmetries are less frequent when we analyze recent cases.
- There may be some degree of publication bias.
- The level of competition may explain the patterns of asymmetry.

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ABSTRACT

The analysis of price asymmetries in the gasoline market is one of the most widely studied in energy economics. However, the great variation in the outcomes reported makes the drawing of any definitive conclusions difficult. Given this situation, a meta-analysis serves as an excellent tool to discover which characteristics of the various markets analyzed, and which specific features of these studies, might account for these differences. In adopting such an approach, this paper shows how the particular segment of the industry analyzed, the characteristics of the data, the years under review, the type of publication and the introduction of control variables might explain this heterogeneity in results. The paper concludes on these grounds that increased competition may significantly reduce the possibility of occurrence of asymmetric behavior. These results should be taken into consideration therefore in future studies of asymmetries in the oil industry.

1. Introduction

How the oil market works and, in particular, the pricing strategies that companies adopt have been widely analyzed. Within these studies, one element that has received a great deal of attention is the possible existence of asymmetries in the gasoline market. More specifically, there is a vast body of literature that aims to determine whether the prices in a given segment (primarily, the wholesale or retail) of the oil market respond symmetrically or asymmetrically to movements in the prices of its main input (primarily, the petrol or gasoline and diesel wholesale prices). Many papers have examined empirically whether the prices of petroleum products incorporate cost increases more rapidly than they do for decreases, with no unanimous outcomes.

Price asymmetry is not exclusive to the oil market and has received attention from numerous authors in many markets. As noted by Peltzman (2000), there is a perception among consumers that there are asymmetries in the way costs are absorbed by the final prices in many markets. This perception is particularly important in the case of the oil market because there exists a high level of consumption, a high frequency of consumption and greater price transparency than that found in other markets. It is common for consumers to attribute these possible asymmetries to uncompetitive behavior in the markets and even to the presence of collusion, although Borenstein et al. (1997) show that there are many reasons that might account for asymmetries when firms compete in the market.

Despite the attention that this topic has attracted, empirical findings regarding the existence of asymmetries in fuel prices are mixed. The use of different methodologies, models, frequencies and periods of data, applied to a range of different countries, may underlie this heterogeneity in results. Some of the papers published in this area stress the importance of specific factors in obtaining a particular outcome. For example, Kirchgässner and Kübler (1992) obtained conflicting results for the decades of the 1970s and 1980s, while in the analysis undertaken by Bettendorf et al. (2003), the result depended on the day of the week data

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prices were collected. As such, the results would seem to be affected by the specific characteristics of the market and by those of the paper itself. The application of a meta-analysis is therefore of great interest in determining the existence of systematic patterns associated with the obtaining of one result or another. Surprisingly, this methodology has not been applied to an analysis of asymmetries in oil prices, especially considering that meta-analyses have been applied on numerous occasions in the energy industry. Good examples include Espey (1998) and Brons et al. (2008), who analyze the elasticities of demand for gasoline; Sundqvist (2004), who studies negative externalities in electricity production; Koetse et al. (2008), who examine elasticity in capital-energy substitution; and finally Kuik et al. (2009), who focus their interest on the costs of greenhouse gas mitigation policies. However, this methodology has not been applied to oil prices.

The only application of this methodology to asymmetric oil prices has been undertaken by Frey and Maneras (2007), although their study does not focus solely on the fuel market. The authors, in fact, analyze a group of industries: food, agriculture and fuel. The aim of this paper therefore is to try to fill this gap and to explain the heterogeneity and sensitivity of empirical results.

In contrast to the previous literature, this paper introduces a number of innovations. Firstly, as already noted, this is the first time that a meta-analysis methodology has been implemented specifically to examine asymmetries in the oil market. Secondly, the database used in this paper incorporates a broader set of studies than those used previously. This paper undertakes an unusually broad review of the empirical literature concerned with this issue, including not only articles published in scientific journals but also unpublished working papers and reports by government institutions. Thirdly, the paper includes a set of variables hitherto unused that enables further conclusions to be drawn regarding the relationship between the results of asymmetry and the market and the study's specific characteristics. The analysis of the oil market facilitates the introduction of more specific variables and hence the drawing of more precise conclusions.

This paper shows that certain characteristics of a study can have a significant impact on the results. The particular segment of the industry analyzed, the specific year under review, the number of years analyzed, the use of temporally disaggregated data and the type of publication that can account for the different results in the literature.

These results suggest that the level of competition may be a relevant factor to explain the presence of asymmetries. The more competitive segments of the industry are less likely to display asymmetric behavior. Similarly, the variable of the particular year under review could indicate that as markets have been liberalized and competition, which has increased asymmetry become less likely. A further relevant factor is the number of years analyzed in the paper: as the number of years increases, the probability of detecting asymmetry falls. This result would seem to indicate that asymmetries may be generated in only a specific and small number of years. The use of daily and city level data increases the probability of finding asymmetries, thus, data quality would seem to be a significant factor. The final factor of note is the type of publication itself. Reports of asymmetry are less frequent in energy journals than they are in all other publications, which suggests there may be some publication bias.

The paper is organized as follows. Following on from this introduction, Section 2 discusses in detail the data and the variables used in the econometric specifications, Section 3 reports the results obtained, and finally the conclusions are presented in Section 4.

2. Data and empirical approach

To configure the database all articles analyzing the existence of asymmetries in the oil market were collected through EconLit, while relevant working papers and reports were also obtained through the Google Scholar search engine. The search produced a set of 61 documents, but as the studies generally report more than one analysis, the final number of observations rose to 403.

Table 1 presents a brief summary of the papers included in the analysis and some of their characteristics.

Below a detailed description of the variables used in the econometric analysis is provided.

2.1. Dependent variable

As far as the dependent variable is concerned, a common element in all the approaches taken is the use of logit estimations in which the endogenous variables are dummy variables that take a value of 1 if the study reported the presence of asymmetry (or a certain type of asymmetry) and 0 otherwise. This empirical approach differs from that used by Frey and Manera (2007), who used the *F*-statistic to test the existence of asymmetry. This approach is not taken here because the number of studies that do not report information on the *F*-statistic is very high, which reduces the sample and could cause problems of sample selection. This problem therefore could very significantly bias the results. Indeed, Frey and Manera (2007) do in fact stress the limited number of papers that include this information:

> "Among the 70 papers cited in this survey, we select the contributions which provide complete information on the calculated *F*-statistic for price symmetry for a total of 29 articles and 462 observed *F* tests".

As such, the use of the *F*-statistic would reduce the sample to just over 40% of the papers, thereby generating a possible problem of sample selection. Therefore, it was deemed more appropriate to use a dummy as the dependent variable and not to limit the sample to a small subset of studies.

2.2. Moderator variables

In this subsection the set of moderator variables that account for the different results obtained in the asymmetric analysis are presented.

- Types of asymmetry discussed in the article. A set of dummy variables were used that take a value of one if the study analyzes the existence of a certain type of asymmetry and zero otherwise. Following Frey and Manera (2007), five types of asymmetry were included: COI (contemporaneous impact), DLE (distributed lag effect), CUI (cumulated impact), RT (reaction time), and EAP (equilibrium adjustment path)[1].
- Industry segment analyzed by the study. A set of dummy variables were introduced that take a value of one if the study analyzes the relationship with different segments of the oil industry and zero otherwise. Three segments were considered: segment 1, which takes a value of one if the paper analyzes the relationship between the price of crude and the spot price of refined gasoline in the international markets; segment 2, which takes a value of one if the paper analyzes the relationship between spot prices and the wholesale price or the

[1] Each model can analyze one or more types of asymmetry, and so they are not mutually exclusive categories.