



Analyzing light fuel demand elasticities in Brazil using cointegration techniques



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ABSTRACT

This study is intended to assess the sensitivity of demand for light fuels in Brazil to changes in prices and income, considering the unique characteristics of the Brazilian fleet, the lack of convergence across studies available for the domestic market and its importance in discussions on climate change and national security, among others. For this purpose, the short- and long-term price and income elasticities of light fuel demand were estimated using cointegration techniques, based on an empirical model that incorporates the unique features of the internal market. Despite the characteristics of the Brazilian fleet, the results showed that the elasticities found for the national market are similar to those seen in other countries. The conceptual framework and empirical analysis that were used also allowed for a better understanding of the differences between the results of studies on demand for gasoline, ethanol or natural gas in Brazil and those found in the international literature, providing key players in the sector with crucial information for designing public policies and business strategies.

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1. Introduction

The price and income elasticities of fuel demand have been extensively studied in the literature, as they lay the groundwork for discussions on the energy security of nations, on GHG emission control measures, and on the macroeconomic policy adopted by countries, among others. Drollas (1984), Dahl and Sterner (1991), Espey (1998), Goodwin et al. (2004), and Graham and Glaister (2004) compiled hundreds of papers assessing the sensitivity of demand to changes in these economic variables.

Within this field, the Brazilian market for light fuels¹ deserves special mention, as it has a unique characteristic not seen anywhere else in the world. Apart from gasoline-only vehicles, the country has a large number of hydrous ethanol-fueled vehicles and a growing fleet of vehicles that can run on more than one fuel.

Launched in March 2003, flex-fuel vehicles have secured a strong foothold in the domestic market by allowing consumers to use gasoline, ethanol or any mixture of both, offering them a unique opportunity to fill their cars with the fuel that best suits their interest. According to

Anfavea (2016), in 2015 sales of flex-fuel vehicles hit the mark of 2.2 million units, accounting for 94.1% of all new vehicles sold in the country (see Fig. 1).

In addition to dual-fuel vehicles, the Brazilian light-vehicle² fleet has seen an increasing share of flex-fuel motorcycles, which accounted for 47.9% of domestic sales in 2015, and about two million gasoline, ethanol or flex-fuel vehicles converted to run on compressed natural gas as an alternative fuel (ABRACICLO, 2016 IBP, 2015). Fig. 2 shows the number of vehicles converted to run on CNG.

This unique characteristic has led to several studies on fuel demand in Brazil. Studies published in the international literature include those carried out by Santos (2013), Salvo and Huse (2013), Freitas and Kaneko (2011), and Alves and Bueno (2003). Additionally, Burnquist and Bacchi (2002), Roppa (2005), Nappo (2007), Schunemann (2007), Silva et al. (2009), Farina et al. (2010), Serigati et al. (2010), Fernandes et al. (2012), Diehl (2012), Cardoso and Bittencourt (2013), and Orellano et al. (2013) also conducted studies on this subject that were published in national magazines and journals and presented at congresses.

Overall, these studies sought to assess the impact of flex-fuel technology on this sector and of the decision of owners of vehicles that can run on more than one fuel to select one of them for use. None of

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¹ In this study, the term light fuel refers to fuels used by vehicles with Otto-cycle engines (thermodynamic cycle associated with the operation of spark-ignition internal combustion engines).

² In this paper, the term "light-vehicle fleet" is used to characterize cars, light trucks and motorcycles equipped with Otto cycle engines.

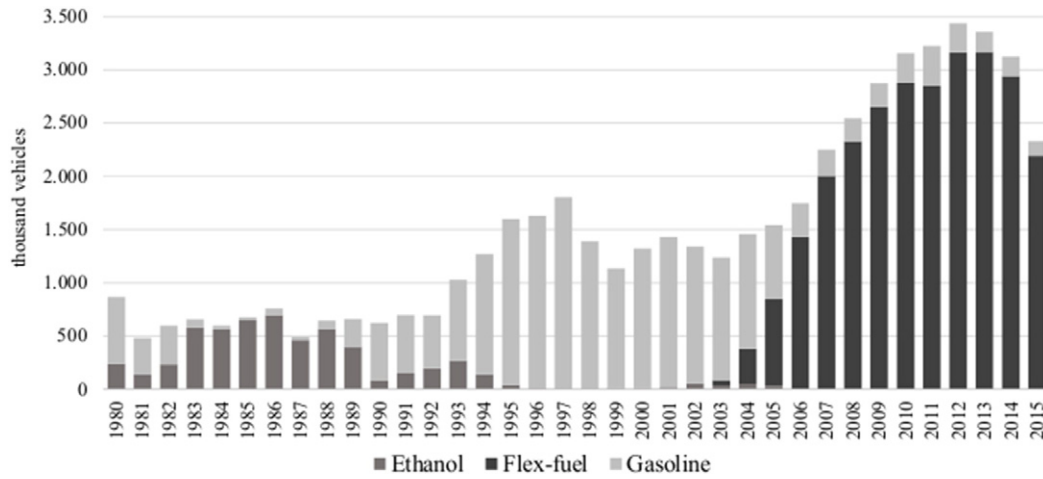


Fig. 1. Sales of light vehicles in the Brazilian market, by type of fuel. Source: ANFAVEA (2016).

the studies, however, focused on assessing the behavior of demand for energy by the light-vehicle fleet.

Therefore, while they provide relevant information for understanding the level of substitution between different fuels, the results available have limitations for one to understand the amount of kilometers demanded for private transportation purposes, reflected in total light fuel consumption in the country (total energy of all hydrous ethanol, C gasoline and natural gas volumes consumed).

Furthermore, when analyzing demand for each type of fuel individually, these studies found very different price and income elasticities from those estimated by studies carried out in other countries. In the case of price, for example, while the international literature indicates an inelastic demand, studies focused on the domestic market found elasticities of up to -8.47 for hydrous ethanol and -1.19 for gasoline.

The lack of information on the behavior of demand for light fuels and differences between the results reported in studies conducted in the Brazilian market and those available in the international literature justify the analysis proposed in this paper, which focuses on estimating price and income elasticities of energy demand for light fuels in Brazil.

The suggested approach consists in recognizing the specific characteristics of the domestic market with the aim of assessing whether or not the discrepancies between domestic and international studies can be explained by the different behavior of Brazilian consumers.

Apart from contributing to the literature on the topic, developing a better understanding of the behavior of demand for private transportation is particularly relevant to the sector's public and private players.

Analyzing the sensitivity of fuel demand in Brazil is crucial not only to support discussions on environmental, fiscal and economic issues, but also to define scenarios for analyzing the evolution of the national transportation matrix in light of the recent changes in the Brazilian economy and of forecasts that the country will likely import increasing volumes of gasoline to meet domestic demand in coming years (EPE, 2015).

To achieve its objective, this paper was organized as follows: after this introduction, Section 2 sets out the theoretical framework and the structure of the proposed model. Section 3 provides details about the estimation strategy and variables adopted, while Section 4 describes the empirical specification of the model. Finally, the results, discussion and conclusions of the study are presented in Sections 5 and 6, respectively.

2. Literature review and structure of the model

At the international level, analyses of fuel demand have usually been based on specifications that include income and price as the main – and in most cases the only – variables influencing consumption (Dahl and Sterner, 1991).

In these analyses, gasoline is used to represent overall energy consumption by the fleet and estimate the price and income elasticities of demand for private transportation, as in other countries gasoline is the only fuel on which light vehicles can run.

In the Brazilian market, however, using a single fuel (gasoline, ethanol or natural gas) has implications for the analysis of demand for

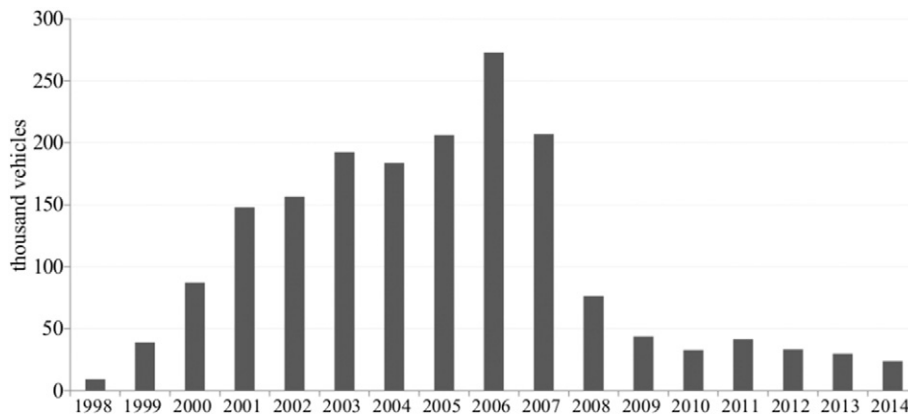


Fig. 2. Number of vehicles converted to use CNG as an alternative fuel. Source: CBIE (2016) and IBP (2015).

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