Integration in Gasoline and Ethanol Markets in Brazil over Time and Space under the Flex-fuel Technology

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Executive Summary

This paper studies integration in the gasoline and ethanol markets in Brazil, a large country with a consolidated biofuel market, where currently most of the light-duty vehicles can use indifferently either ethanol or gasoline at any proportion. In particular, this research aims to further our understanding of the extent of spatial integration in those markets after the introduction of the flex-fuel car technology. The idea of spatial market integration has often been examined by investigating the validity of the Law of One Price. In this study, we assess it by testing whether price discrepancies are stationary.

This paper offers two distinguishing features with respect to the existing literature. First, we study the interaction between gasoline and ethanol prices at the state level by adapting the Pesaran (2007) pairwise procedure to the study of market integration. The idea underlying the pairwise procedure is that given a sample of prices, unit root tests are conducted on all possible price differentials, so that the total number of stationary differentials can be determined. Bearing in mind that Brazil is a federation that consists of 27 states, a pairwise analysis of 27 gasoline price series and 27 ethanol price series, that is 54 price series, yields a total of 1,431 possible price differentials that can be computed. Consequently, the application of this modelling strategy not only allows us to study the possibility of spatial integration within the gasoline and ethanol markets, but also between them.

The second novelty of our modelling strategy is that once the number of stationary price differentials is determined, in a subsequent stage of the analysis we employ information from geographical and economic variables to explain differences in the speed of convergence towards long-run equilibrium across the pairwise price differentials. More specifically, in the event of regional shocks to gasoline or ethanol prices, we explicitly consider the role of distance between states insofar as the possibility that the speed of adjustment towards long-run equilibrium is fastest between contiguous as opposed to more distant or non-contiguous states. In doing this, we also explore the role played by variables such as population density, real per-capita GDP, gas stations density, sugarcane mills density and gasoline and ethanol tax regimes at the state level in influencing the speed of adjustment of price differentials.

We present four important findings. Firstly, more than half of the fuel price differentials are stationary, which reveals the importance of accounting for spatial effects in the analysis. Second, half-life for gasoline price differentials is shorter than that for hydrous ethanol, which can be due to the larger pipeline network and infrastructure to transport gasoline, while ethanol is mostly dependent on road transportation. Thirdly, distance and the differentials in the sugarcane mills density and in taxes play a role in determining the speed of adjustment of price differentials. Indeed, for distance there is evidence that the longer the distance between two states, the slower the speed of adjustment back to equilibrium. As to the differentials in the number of sugarcane ethanol mills density and in taxes, both variables have a positive effect on the half-life, with the magnitude of the effect being much smaller in the former than in the latter. This means that the larger the differential between tax rates, that is between states and/or between ethanol and gasoline, the slower the speed of price adjustment. Lastly, compared to price differentials that involve gasoline and ethanol prices, adjustment is quicker for

price differentials that only involve ethanol prices, and even quicker for those that involve gasoline prices alone.