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Are retail prices of ethanol, gasoline and natural gas in the midwest cointegrated? An asymmetric threshold cointegration analysis

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ABSTRACT

This paper examines whether there is a long run equilibrium relationship, and the short run dynamic adjustment of such a relationship between the retail prices of selected transportation fuels in the Midwest. The study uses monthly data for the period October 2006 to December 2013. The analysis involves the nonlinear Threshold Autoregressive (TAR) and the Momentum Threshold Autoregressive (M-TAR) models of threshold cointegration, and the Momentum Threshold Vector Error Correction Models (M-TVECM), after pretesting for nonlinearities. The empirical results provide an unambiguous evidence of cointegration and asymmetric adjustments to the long run equilibrium relationship following deviations from the empirically estimated thresholds. There is robust empirical evidence of bi-directional Granger causality. There is empirical evidence that shocks to ethanol have lasting effects on gasoline prices than a corresponding shock to gasoline on ethanol prices. The empirical results have huge policy implications for the current debate on the future of the Renewable Fuel Standards (RFS) mandate in the United States.

1. Introduction

There are two perspectives in the literature on factors influencing prices of transportation fuels, particularly, gasoline. Some argue that changes in gasoline prices are determined by market

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fundamentals. Others point to the market power of OPEC, and speculation resulting from increases in oil derivatives trading. Related to this is the issue of the effect of policies enacted to promote the production of renewable fuels in general, and ethanol in particular, in the United States (U.S.A.) on the environment, food prices, and prices of gasoline. This paper does not address the issues related to the environment and food prices, but gasoline. The issues interrogated in this paper align with the market fundamentals argument, but differs from previous studies by expanding the argument to include the effects of the ethanol and natural gas industries on gasoline prices.

The surge in ethanol production in the U.S.A. has been the result of deliberate policy actions. These policy actions include the Renewable Fuels Standard (RFS) requirement, the import tariff on imported ethanol, and the blenders' tax credit. The RFS mandates how much ethanol and other biofuels be blended with transportation fuel. The Energy Information Administration (EIA) of the U.S. Department of Energy had projected in their annual energy review (Annual Energy Review, 2008) that domestic gasoline demand would increase to about 150 billion gallons by 2013 and 170 billion gallons by 2020. The RFS, enacted in 2005 and amended in 2007, was motivated by the desire to meet the expected domestic fuel consumption needs. However, a lot has changed since. The annual energy outlook of the EIA (Annual Energy Outlook, 2014) projects that total consumption of petroleum and other liquids will increase from 35 quadrillion British Thermal Units (BTU) in 2013 to 37 quadrillion BTU in 2018, but will decrease to approximately 36 quadrillion BTU by 2025, representing a 4% decrease in projected consumption levels.

The observation that the demand for gasoline is lagging behind projected consumption levels has put the intended goal of the RFS under the spotlight. In the first half of 2013, cumulatively, three different bills were introduced in the congress of the U.S.A., two in the House of Representatives and one in the Senate to repeal or at least amend the RFS. The effort eventually failed, but it appears the war is not over. In addition, and driven in part by the changes in fuel consumption forecasts, in November 2013, the Environmental Protection Agency (EPA, 2013) of the U.S.A. proposed to lower the RFS requirement for the year 2014. The EPA proposal reduces the RFS mandate from the initial mandate of 18.15 billion gallons of ethanol and biodiesel for blending into gasoline to 15.21 billion gallons, representing a 16 percent reduction. Compared to the 2013 RFS requirement of 16.55 billion gallons, this represents an 8 percent reduction. The 16.55 billion gallons in 2013 consists of approximately 14 billion gallons of corn-based ethanol, and about 2.55 billion gallons of advanced biofuel. As of April 2014, the proposed changes by the EPA are still under review. However, the full implication of this change is still unknown.

Coincidentally, U.S. total consumption of domestically produced biofuels is projected to increase from 1.30 quadrillion BTU in 2013 to 1.58 quadrillion BTU by 2025, representing a 22% increase. This increase is driven in part, by policies enacted to promote the production of biofuels. U.S. domestic natural gas consumption increased from 25.6 quadrillion BTU in 2012 to 26.22 quadrillion Btu in 2013 and is projected to reach 28.87 quadrillion Btu in 2025, representing a 10% increase over the 2013 levels. The increased demand for natural gas is driven in part, by growing demand in the industrial sector, and advances in the automobile industry. The implications of these statistics are that the U.S. energy landscape is changing very fast and biofuels and natural gas will be assuming important roles in the economy. Currently ethanol and gasoline are complements; partly because of the legislation on blending, but can also be substitutes, while natural gas is a substitute for gasoline and ethanol as transportation fuel. Nevertheless, the overall implications of any adverse change in the RFS policy are not too obvious yet. Understanding the full implications of any change in policy first requires investigating the long and short run relationships between all the prices.

Some researchers and policy makers believe that expansions in ethanol production will lead to declining gasoline prices. Proponents of this view include Du and Hayes (2012), who reported that from January 2000 to December 2011, expansion in ethanol production reduced gasoline prices by $0.29 per gallon, on average, in the U.S.A. In the Midwest, wholesale prices of gasoline decreased by $0.45 per gallon. O'Brien and Woolverton (2009) observed that from January 2006 to June 2006, on the average, a 10% increase in Midwest gasoline prices leads to a 6.59% increase in the price of ethanol in Iowa. However, Knittel and Smith (2012) argue that the effects of ethanol production on gasoline prices are statistically insignificant and therefore the argument that increases in ethanol production will lead to reduced gasoline prices is untenable.