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Are there multiple bubbles in the ethanol–gasoline price ratio of Brazil?

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ABSTRACT

This paper tests for the existence of bubbles in the ethanol–gasoline price ratio in Brazil from 2000 to 2012 using right-tailed ADF tests. Results suggest the existence of two bubbles: one which has already burst (during the re-election of President Lula); and one which has been ongoing since 2010, thus corroborating empirical and anecdotal evidence in the Brazilian sugarcane industry. Freezing gasoline prices not only depressed ethanol prices but also depressed investments in new sugarcane crops and distillation plants.

Contents

1. Introduction

This paper analyses the formation of bubbles in the ethanol–gasoline price ratio in Brazil, from 2000 to 2012. Since 2008, the Brazilian Government has artificially frozen gasoline prices to the end consumer while the price of ethanol has remained free from governmental controls. The annual inflation in Brazil of around 5–6%[1] combined with the transfer of increases in labour and distribution costs annually to ethanol prices explains why ethanol consumption tends to decay while gasoline consumption tends to increase. In Brazil, as part of a governmental policy for stimulating the consumption of bio fuels, consumers are told that ethanol is more economical for refuelling cars when the price ratio is below 0.70. [2]

The difficulty in testing for the presence of bubbles lies in modelling their explosivity and labelling their occurrence [1]. Traditional unit root [2,3,4] and co-integration tests [5,6] used to identify such bubbles may not discern their existence when they are periodically collapsing (see Evans [7]). To overcome this problem, Phillips, et al. [8] developed a recursive right-tailed Generalized Sup Augmented Dickey-Fuller (GSADF) testing procedure to detect and date stamp mildly explosive pricing behaviour. Such periods would

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[1] Brazilian Central Bank – http://www.bcb.gov.br/Pec/metas/TabelaMetaseResultados.pdf.

[2] Brazilian Oil Agency – http://www.anp.gov.br/?pg=57994&m=&t1=&t2=&t3=&t4=&ar=&ps=&1436268597572.

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then be labelled as bubbles. In General, bubbles burst when there are systematic departures from the fundamental price of an asset, which eventually collapses. From a technical point of view, the term "bubble" implies a mildly explosive departure from a unit root data generating process (DGP) (see [8,9]).

A number of studies on the Brazilian sugarcane industry addressing production and consumption related aspects have been carried out to date; examples include Goldemberg et al. [10], Walter et al. [11], Figueira et al. [12], Bastian-Pinto et al. [13], Barros et al. [14] and Wang et al. [15]. Moreover, other similar studies focus on US ethanol, such as Marzhoughi and Kennedy [16], Du and Hayes [17] and Anderson [18]. Thus, this paper innovates because it analyses the Brazilian Government pricing policy for gasoline as an eventual driver for the formation of a bubble in the ethanol–gasoline price ratio. In addition, this paper uses for the first time right-tailed ADF tests in order to do so. Such tests have shown a pronounced ability to detect exuberance in economic and financial activities [19]. Despite the early work of Diba and Grossman [20], which had focused on the utility of using right-tailed ADF tests to capture explosive behaviours typifying bubbles, it is only recently that Phillips et al. [21,8] have introduced this test with this aim. The objectives of this paper are to explain the complex behaviour of the ethanol–gasoline price ratio in Brazil in light of certain governmental actions. Although there are several papers studying ethanol demand and production in Brazil in recent years (e.g. [22,23]) none uses this kind of statistical tool to explain possible bubbles in its consumer-pricing behaviour, even though the method has been widely used to detect bubbles in financial and commodity markets since the method was first proposed. For a detailed review in this regard, see Phillips and Wu [24] and Caspi et al. [25] (Fig. 1).

The paper is structured as follows. After this introduction, the background on the sugarcane industry in Brazil is presented, discussing not only ethanol production in historical and present terms, but also their future perspectives. Later the methodology will explain the data and right-tailed ADF tests, followed by a discussion of the results and the conclusion.

2. Background on the sugarcane industry in Brazil

In Brazil, fuel ethanol is derived from sugarcane and is used pure or blended with gasoline in a mixture called gasohol (25% ethanol, 75% gasoline). A conjunction of factors including (i) Brazil's heavy reliance on fossil fuels; (ii) Brazilian government concerns about national sovereignty; and (iii) the low price of sugar, with the consequent possibility of bankruptcy by sugar industrialists, led Brazil to adopt subsidies and protection from alcohol imports in the mid-1970s [26]. There has been extensive research on Brazilian ethanol with a focus on history, economics and possible energy policy and environmental implications [10]. According to Blottnitz and Curran [27], the majority of these assessments focused on net energy and greenhouse gases, and despite differing assumptions and system boundaries, the following general lessons emerge: (i) make ethanol from sugar crops in tropical countries, but approach expansion of agricultural land usage with extreme caution; (ii) consider hydrolysing and fermenting lignocelluloses residues to ethanol; and (iii) the LCA results on grasses as feedstock are insufficient to draw conclusions. Although economic competitiveness is a very frequent argument against renewable energy [22], the economies of scale and technological advances achieved through the Brazilian experience with ethanol [10] lead to increased competitiveness of the ethanol alternative, thus reducing the gap with conventional fossil fuels [23].

The Brazilian sugarcane industry has experienced significant growth in recent decades. Indeed, the acceleration of investments in new ethanol plants, mainly from 2003, was driven by growth in

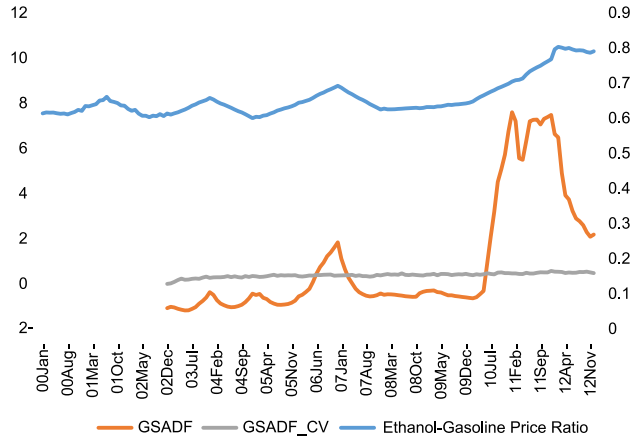

Fig. 1. GSADF statistics of the ethanol–gasoline price ratio. This graph shows the series of the ethanol–gasoline price ratio (blue) and its corresponding sequence of GSADF statistics (orange). The grey line represents the 5% GSADF critical values. The initial window size is set at 36 observations. The left-axis measures the values of the GSADF test statistic, while the right-scale measures the ethanol–gasoline price ratio. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article)

sugar demand in the international market, especially after the reform of the European policy for the product, and Brazil's increasing use of ethanol driven by the development of Flex Fuel vehicles. Moreover, Brazil saw increasing prospects of exporting the production to a growing number of countries that had chosen to add bio fuels to their energy matrixes – primarily United States and Europe – and to this end established a bio fuel policy in 2005. In response to such strong demand stimulus, the production of sugarcane has experienced a significant increase in the last decade, mainly in the period between cycles 2001/2002 and 2008/2009, year of the global economic crisis. In this interval, the sugarcane crop yield grew at a rate of 10.6% per year, reaching 573 million tons. The period from 2009/2010 until the 2012/2013 harvest saw a break with the pace previously witnessed and production declined 1% a year. After the global financial crisis of 2008, investments in the sugarcane sector ceased and the expansion of cultivated area was compromised, especially by the sharp tightening of credit, which had until then been abundant. As a result, most companies found themselves heavily indebted, a scenario that was only exacerbated by increased world supply of sugar. Nonetheless, the costs of production in Brazil rose [22] and, even with the recovery in prices of sugar and ethanol in the 2009/2010 harvest, the unfavourable financial situation of most companies was far from being resolved. The sector began to experience a strong movement of mergers and acquisitions while part of the milling sugarcane capacity increased to multinational companies, factors that significantly changed their profile. Furthermore, some of the companies that had made acquisitions of highly indebted groups were surprised by a sequence of harvests beset with serious weather problems. Added to the unfavourable scenario, the policy gap in gasoline prices practiced by the Brazilian Government in relation to the international market led to the deactivation and failure of a large number of plants. Since the 2008 crop, the industry lost sugarcane milling capacity of 48 million tons of cane in the interim between new units coming on line and others closing. More recently, the 2013 production was about 600 million tons in the South Central Region. Yield shortfalls caused by the reduction in dealings with sugar plantations and problems with aging crops, mechanisation and climate problems ameliorated only in the 2013/2014 harvest [28].

In a universe of 435 ethanol and sugar mills in Brazil, 44 closed in the last 5 seasons and 12 others may wind up operations in 2014/2015, thus wiping out 100,000 jobs. According to the Brazilian