The Influence of Production of Ethanol into Sugar-Cane Prices in Brazil

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ABSTRACT

Biofuel has come up as an important alternative to diversifying the global energy matrix, with economic, social, and environmental impact. Currently, Brazil is the main supplier and one of the top consumers of biofuels in the world, and has prioritized the use of soy as a raw-material for the biofuel industry, as well as the sugar-cane for producing ethanol; both industries use more than 8 million hectares of cropped land and employ over 1 million people per year. On the other hand, ethanol has raised discussion since some evidence point to a causality relationship between biofuels and agricultural commodities prices. In this research we can see that the production of ethanol shows a causal flow (short time) on the price of sugar-cane and that the causal flow in the opposite direction is of a much lesser magnitude, evidently due to the ethanol plant production cycle, i.e., the insertion of new ethanol plant for producing into the production cycle has a large impact only after a relatively long time (in this research 3 years), which explains the short-term inelasticity.

INTRODUCTION

Bioenergy has come up as an important alternative to diversifying the energy matrix in the world, where nations have tried to decrease their oil and oil derivatives dependence. Furthermore, the use of biofuels has generated several economic, social, and environmental advantages, since it can generate both employment and rent, it can decrease greenhouse gases emission, and it can also increase a country’s currency value in productive countries, both by exporting product and by reducing oil imports (Cavalheiro, 2014).

Brazil is the number one user of biofuel when considering the total consumed by vehicles in the national freight, and it comes in as number two, considering volume, after the United States. It is also the largest ethanol exporter in the world. This performance reflects the weather conditions and the technology developed by companies and institutions in the country. This segment accounted for, in 2012, the production on 27.78 million cubic meters of ethanol and biodiesel in Brazil (Cavalheiro, 2014).

On the other hand, ethanol has raised discussion since some evidence point to a causality relationship between biofuels and agricultural commodities prices (Zhang et al., 2009; Zhang et al., 2010). Considering this context, we established the following research problem: the total production of Brazilian ethanol cause variation to price paid to Brazilian producers of sugar-cane? According to Yang et al. (2008), we are facing the first food crisis of the 21st century. The prices of food are concerning consumers all around the world, in developed countries (e.g., Low & Isserman, 2008; O'Brien & Woolverton, 2008; De La Torre et al., 2006; Clemmitt, 2009), and especially in developing countries. The world prices increase affect millions of poor people, and contribute for inflation (YANG et al., 2008). Especially, we point out the increase of the international soy price, and soybean oil, according to the IPEADATA (2015), it has increased 369% over 40 years, whereas, according to OECD (2015), the average inflation of food in countries belonging to the Organization for Economic Cooperation and Development, for this same period, was 256%.

In their research, Yang et al. (2008) comment that the increase of the price of soy was greatly due to the increase of the price of oil, and the increase of...
demand regarding biofuels. On the other hand, Mitchell (2008) comments that, despite all the differences in approach, many studies recognize that the biofuel production has been a determining factor for the increase of food cost. Lipsky (2008) points out that the International Monetary Fund – IMF estimates that the increase of demand for biofuel responded for 70% of the increase of corn prices and 40% of soy. On the other hand, Risso (2011) concluded that this recent increase of the cost of soy and its derivates is closely connected to the Yuan:US dollar ration, and especially connected to the Chinese economic growth.

The empirical evidence shows, on a short term basis that there is probably a causality relationship between biofuels and agricultural commodities (Senauer (2008), Zhang et al. (2009) and Zhang et al. (2010)), having a greater influence in the after-food-crisis period (2007/2008), as per Kristoufek et al. (2012). However, results show that there is no long-term relationship. According to Wetzstein and Wetzstein (2011), the economic theory suggests that in not centralized and competitive markets, prices are restored for their long-term equilibrium trends after any shock in the agricultural prices due to an increase of demand for biofuel or other shocks (ZHANG et al., 2009 e ZHANG et al. 2010).

As an example, using an economical world market model, the rapid growth of biofuels will trigger a significant increase of cultivated land taken away from pasture and forests (Hertel et al., 2010). Besides, according to the authors, second and third generation biofuels have the potential of changing the bio-mass production in marginal agricultural land, thus reducing the impact of biofuel on the cost of food.

Considering the importance of this topic in the international context, we have yet to consider the importance of understanding of the relationship of cause-effect of production of ethanol and the price paid to sugar-cane producers because in this industry, as several strengths operate in this system: social demands due to the increase of food cost, economic demands due to the importance that the main raw material (sugar-cane) has in Brazilian exports, as well as political demands due to the need of decreasing the oil dependency in the country’s energetic matrix.

In this context, we can see that the biofuel demand shall continue to rapidly increase, influenced by the crescent governmental support to cleaner energies. This increase will be induced especially for environmental and energy safety reasons. In the new policies scenario, that considers the public policies commitments and plans announces by the countries, including guaranties of reduction of greenhouse effect gases emission, and plans to ban subsidies for fossil fuels, the world consumption of biofuel will increase approximately from the current 1.1 million barrels / day (63.8 billion liters/year) to 4.4 mb/d (255.3 billion liters/year) in 2035 (MME, 2010).

Also according to MME (2010), biofuels will account for around 8% of the world consumption for transportation in 2035, a significant increase compared to 3% in 2009. It is estimated that the US and Brazil will continue to be the biggest world producers and consumers of biofuels. The USA will account for 38% of the world consumption of biofuels in 2035 (a decrease compared to the current 45%), whereas Brazil will account for 20% of the world consumption of biofuel in 2035. Given the importance of this topic, and in order to respond to the problem of this research, the following section presents the main methodological aspects used in this work.

MATERIALS AND METHODS

Employing yearly data from 1931-2014 (IPEADATA, 2015), a study of causality in the temporal relationship of Brazilian production of ethanol (exogenous variable) to prices paid to Brazilian production of sugar-cane (endogenous variable) deflected by IPCA (Brazilian consumer price index) was undertaken. An augmented Dickey-Fuller methodology (ADF) implementing a unit root test was employed to verify data series stationarity. Afterwards, we performed the Engle-Granger test to verify a co-integration in these series. To verify the possible existence of a causal flow in both series, we performed the causality Granger test on a yearly basis (1994-2014).

In order to verify the causes of that grown production of sugar-cane, we separated in growing productivity per area and growing of a number planted area (hectare). To separate both effects we use equations (1), (2) and (3):

\[ \Delta P = \Delta PPA + \Delta QA \]  
\[ \Delta PPA = (PPA_t - PPA_{t-1}) \times QA_{t-1} \]  
\[ \Delta QA = (QA_t - QA_{t-1}) \times PPA_{t-1} \]

where \( \Delta P \) is the variation of the production total in a year, \( \Delta PPA \) is the effect of variation in productivity per area and \( \Delta QA \) is the effect of variation of the quantity planted area.

RESULTS AND DISCUSSION

As quoted, Brazil is the largest ethanol producer and the largest exporter in the world. According to CONAB (2013) in 2013/2014 the total production of sugar was 40,973 millions of tonnes and 27,172 millions of tonnes of ethanol. On the other hand, according, the total production of harvest 2013/2014 of sugar-cane allocated to produces ethanol or alcohol represents 52% of total harvested in Brazil, suggesting an inflationary pressure on the price of Brazilian sugar. To test this hypothesis, we the
Granger causality test, but initially we test the cointegration between total of Brazilian production of ethanol and the deflated price paid to Brazilian producer of sugar-cane.

To assess if cointegration exists in both series, we initially tested each series’ stationarity. According to Gujarati (1992), stationarity is a necessary condition to performing Granger’s and other co-integration causality tests. The Augmented Dickey-Fuller statistic (Dickey & Fuller, 1979), was employed to test for the presence of a unit root in the series. Models including a constant, a trend and a lag (τ₁), a model including a lag and a constant (τ₂) and a model with no constant and no trend (τ₃) were tested (Table 1). The null hypothesis stating that both series are not stationary cannot be rejected; therefore, the Engle and Granger procedure can proceed (Table 4).

Table 1: Augmented Dickey-Fuller unit root test for the null hypothesis stating that deflated prices paid to Brazilian sugar-cane producers and total of Brazilian produced of ethanol.

<table>
<thead>
<tr>
<th>Total Lags</th>
<th>τ₁</th>
<th>τ₂</th>
<th>τ₃</th>
<th>Total Lags</th>
<th>τ₁</th>
<th>τ₂</th>
<th>τ₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol – Brazilian Production</td>
<td>0.635***</td>
<td>0.597***</td>
<td>0.602***</td>
<td>1</td>
<td>0.144*</td>
<td>-0.112*</td>
<td>-0.004*</td>
</tr>
<tr>
<td>2</td>
<td>0.638***</td>
<td>0.634***</td>
<td>0.633***</td>
<td>2</td>
<td>0.154*</td>
<td>-0.116*</td>
<td>-0.009</td>
</tr>
<tr>
<td>3</td>
<td>0.638***</td>
<td>0.674***</td>
<td>0.674***</td>
<td>3</td>
<td>0.225</td>
<td>0.052</td>
<td>-0.007</td>
</tr>
</tbody>
</table>

* indicates that the null hypothesis is rejected at a 10% significance
*** indicates that the null hypothesis is rejected at a 1% significance
Source: own data

The Engle-Granger test showed an adjusted $R^2$ of 0.14 (Table 2). The $p$-value of the $f$-test shows this to be significant at a 99% confidence ($p < 0.01$), indicating that the total of Brazilian of ethanol produced is co-integrated with deflated prices paid to Brazilian sugar-cane producers.

The Granger’s causality concept is independent of the existence of co-integration, although the latter is sufficient to ensure causality. According to Alexander (2001), co-integration is not essential in order to the exposure and offset relations, demonstrated by the Granger’s causality, to exist: it may be that the causal flows exist between time series because they have common features. However, the fact that there is co-integration between series can provide insights regarding the multivariate behavior of variables.

Table 2: Engle-Granger test for co-integration of deflated prices paid to Brazilian sugar-cane producers with the total fo Brazilian of ethanol produced, on a yearly basis (1994-2014).

| Source | Estimate | Standard deviation | $t$ value | $Pr(>|t|)$ |
|-------|----------|--------------------|-----------|-------------|
| (Intercept) | 3,623.37 | 16,855.40 | 0.22 | 0.83 |
| World production of milk | 2,287.36 | 1,284.81 | 1.78 | 0.09* |

* indicates that the null hypothesis is rejected at a 10% significance
Source: own data

Table 3: Granger’s causality test between total of total production of ethanol in Brazil and deflated price paid to Brazilian producers of sugar-cane, from 1994 to 2014.

| Lag (years) | $f$ test | $Pr(>|t|)$ | $f$ test | $Pr(>|t|)$ |
|------------|----------|------------|----------|------------|
| Total production of ethanol Granger-causes price paid to sugar-cane producers | 5.4173 | 0.03255* | 0.492 | 0.4911 |
| Price paid to sugar-cane producers Granger-causes Production of ethanol | 2.4163 | 0.12540 | 0.6692 | 0.5278 |
| 2 | 2.1710 | 0.17140 | 5.0274 | 0.0752** |
| 4 | 2.5988 | 0.11660 | 1.3608 | 0.3285 |
| 5 | 2.0468 | 0.22530 | 0.7508 | 0.6164 |

* significant at 5% level. ** significant at 10% level

The Granger’s causality test between total of production of Brazilian ethanol and the deflated prices paid to Brazilian sugar-cane producers, for the years 1994 to 2014, indicated that with a one year lag, a significant Granger causality. This indicates that a change in production of ethanol would significantly influence the prices paid to Brazilian sugar-cane producers, but take a little time to occur. Therefore, this evidence shows that, on a short term basis that there is probably a causality relationship between biofuels and agricultural commodities prices. This result corroborate, for example, with Senauer (2008), Zhang et al. (2009) and Zhang et al. (2010).

On the other hand, the price paid to producers Granger-causes the production of ethanol using 3 lags. This result suggests a temporal delay because the decision to insert a new ethanol plant producing in the production cycle will have an impact after a relatively long time (in this context: 3 years).

Conclusion:

In this work, we sought to empirically verify the cause-effect relation between the production of ethanol in Brazil and the deflated price paid to Brazilian producers of sugar-cane, from 1994 to 2014. Also, we tried to identify the causes of increase of the production of sugar-cane in this country.
The results from this work suggest the importance to the growth of the Brazilian sugar-cane production of new technologies and new methods for plantation and improving their productivity (the productivity per area was increased 96.3%) and mainly by increased new area to plantation: the total area to produces sugar-cane increased 2,115% in this period.

On the other hand, in this research we can see that the production of ethanol shows a causal flow (short time) on the price of sugar-cane and that the causal flow in the opposite direction is of a much lesser magnitude, evidently due to the ethanol plant production cycle, *i.e.*, the insertion of new ethanol plant for producing into the production cycle has a large impact only after a relatively long time (in this research 3 years), which explains the short-term inelasticity. The causal flow between production of ethanol in price paid to sugar-cane producers corroborate with the hypothesis that an inflationary pressure on the price of food (short time) when we decided to produces food versus fuel.

**REFERENCES**


