IMPACT OF THE GASOLINE PRICE CONTROL ON SUGARCANE MILLS IN BRAZIL

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Overview
This paper presents an integrated assessment of sugarcane mills considering sales of ethanol, sugar and bioelectricity to evaluate the impact of the gasoline price control on the sugar cane industry. Brazil is the main producer of sugarcane in the world, the number one exporter of sugar and second of ethanol. In addition to these two products, sugarcane mills have added bioelectricity as a third business opportunity to their portfolio. This study uses OptValue, a software developed by PSR, to evaluate investments in sugarcane mills and cogeneration. Its main conclusion was that the gasoline price freeze policy and the fuels tax exemption of 2012 (enacted by Presidential Decree No. 7764) diminished the average internal rate of return (IRR) of a sugarcane mill by ten pp. This reduction in the IRR is particularly sensitive to the mill's portfolio. In addition, our findings showed that the consideration of bioelectricity makes project IRR less volatile, decreasing in this way sugarcane mills investors perceived risks.

Keywords – Ethanol; Cogeneration; Gasoline price control; Portfolio and risk management.

1. Introduction
Brazil is the world's leading producer of sugarcane, the largest exporter of sugar and second of ethanol. Last year, Brazil produced 532 million tons of sugarcane, of which 57% was used to produce ethanol (28.4 billion liters) and 43% to produce sugar (35.5 million tons). The annual revenue of the sector amounts to US$ 70 billion with a total of 369 sugarcane mills in 2015. Brazil has historically been known for its sugar production, but it was only after the *Pro-alcohol*, a subsidy-oriented program to develop ethanol from sugarcane, and the two oil shocks of 1973 and 1979, that ethanol started to form a significant portion of the mills' production. These factors, together with the introduction of flex fuel cars in 2003, implied in a great increase of ethanol production – from 0.8 billion in 1973 to 28 billion liters in 2015.

A third business opportunity for sugarcane mills is bioelectricity. As a byproduct of the ethanol-sugar production process, sugarcane biomass can be used for electricity cogeneration. Although most sugarcane mills already use cogeneration for their own consumption, only a few export their surplus to the grid. In 2004 Brazil's market model created electricity auctions, which allowed sugarcane's surplus energy production to be contracted on long-term basis. As the ethanol sector was facing a *boom* at that time, and considering that there are few long-term contracts in the sugar and ethanol industries, the long-term contracts offered by the electricity auctions could – besides ensuring an increasing in project profitability - stimulate the creation of *receivables* funds, and increase the producer's range of financing options, contributing in this way to new investments in ethanol mills. Furthermore, the electricity contract brings a stable revenue in local currency which protects the producer against sudden oscillations in the export market prices (typically, sugar and more recently ethanol), as well as exchange rate fluctuations, such as the strengthening of the R$ against the US$. These factors contributed to the increase in bioelectricity exported to the grid, which was heavily discussed after the 2004 reform of the Brazilian electricity sector. In 2014, bioelectricity accounted for 8% of the total installed capacity of the grid (EPE, 2015).

Even though bioelectricity and ethanol hold high potential, the sector as a whole has faced a serious crisis for the past three to four years. In 2012, no biomass plant won an energy auction, and since then 24% of the mills in operation have requested a judicial settlement, and 11 went officially bankrupt in 2015 alone, with bank debts amounting to R$ 8 billion[1] (Valor, 2016).

The main objective of this study is to evaluate one of the main causes of the sector's crisis - the gasoline price control. As a final goal, this paper aims to contribute to the evaluation of public policies for further improvement on their implementations.

The remainder of the paper is organized as follows: **section 2** presents OptValue, the software used for this study, **section 3** explains further the issue of gasoline price control and presents the methodology applied, in **section 4** and **5** the economic evaluation is carried out for the expected and realized ethanol price, respectively. The last section concludes our findings.

[1] Approximately US$ 2 billion (considering a conversion rate of 4 BRL/USD).

2. OptValue

In order to account the impacts of the gasoline price freeze and the tax fuel exemption of 2012-2015, we used OptValue, a software developed by PSR,[2] developed for the financial evaluation of generation projects, considering investment costs, revenues from energy sales, bank loans, taxes, among others. For sugarcane mills, the software has an add-in, in which it is possible to do an integrated evaluation of the project, including besides power generation, ethanol and sugar production, sugarcane acquisition cost and other variables related to the agricultural production. The model allows for the seasonality of sugarcane production, and it is also possible to provide the production profile of the mill. Other inputs, such as annual processing capacity or carbon price, may also be introduced.

The simulations for this paper use a base model for a sugarcane mill with four different configurations: (i) ethanol production, (ii) ethanol and cogeneration, (iii) ethanol and sugar production, (iv) ethanol, sugar and cogeneration. The following inputs were used for the different specifications:

Table 1 – Optvalue's inputs

	Ethanol	Ethanol and Cogeneration	Ethanol and Sugar	Ethanol, Sugar and Cogeneration
Base date of currency	Jan-16	Jan-16	Jan-16	Jan-16
Initial date of contract	Jan-18	Jan-18	Jan-18	Jan-18
Duration of the contract (months)	x	240	x	240
Kind of contract	x	availability	x	availability
Bid price (R$/MWh)	X	180	X	180
Installed capacity for the grid (MW)	x	54	x	54
Available power to the grid (MW)	x	46.5	x	46.5
Firm energy to the grid (average MW)	x	23.3	x	23.3
Industrial investment (R$)	298	298	416	416
Cogeneration ivestment (R$)	0	180	0	180
Financing term (years)	20	20	20	20
Financing Interest rate (% per year)	10%	10%	10%	10%
Equity (%)	30	30	30	30
Mill Processing capacity (M ton of cane/year)	2.5	2.5	2.5	2.5
Cane x Sugar (kg/ton of cane)	0	0	70	70
Cane x Ethanol (l/ton of cane)	82	82	41	41
Cane x Power to the grid (kWh/ton of cane)	0	81	0	81
Number of reference days	200	200	200	200
Sugarcane price (R$/ton)	55	55	55	55
Cogeneration O&M cost (R$/kW - year)	x	50	x	50
Ethanol or Sugar O&M cost (R$/l or R$/kg)	0.18	0.18	0.18	0.18

The next section analyses the gasoline price freeze and tax fuel exemption issues, key aspects of this study.

[2] See www.psr-inc.com.

3. Gasoline price control

Since 1999, Brazil has adopted an inflation target regime of 4.5% with two pp up or down. In order to curb inflation that was continuously exceeding its target, the federal government has passed Decree No. 7764, which exempted taxes on fuels (called CIDE). Indeed, this policy, combined with the gasoline price freeze had the aim to help control inflation, as gasoline prices alone account for almost 4% of the Brazilian consumer price index (IPCA).

The following graph compares the national price of gasoline with the international price of crude oil. Prior to 2012, both prices followed similar trajectories. The split that happened after the policy of controlling gasoline prices is striking. Indeed, the national gasoline price followed a decreasing pattern whereas the international oil price increased (at least before the steep fall of oil prices that took place in the end of the year of 2014). It was only after 2015, when Decree No. 7764 and the gasoline price freeze policy were repealed, that these two series started to follow the same path again.

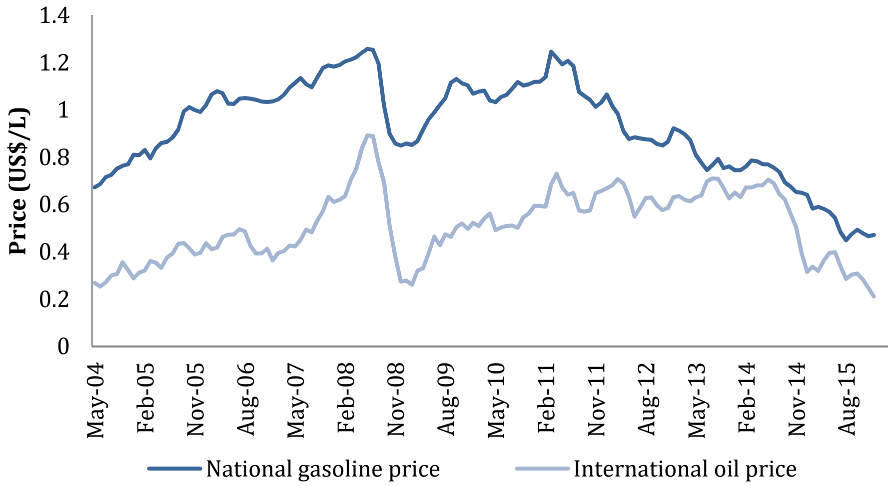

Figure 1 - National gasoline price versus international oil price.

In addition, gasoline and ethanol prices are cointegrated and driven by a single common trend (J. Myers et al., 2014), as is suggested by the following graph.

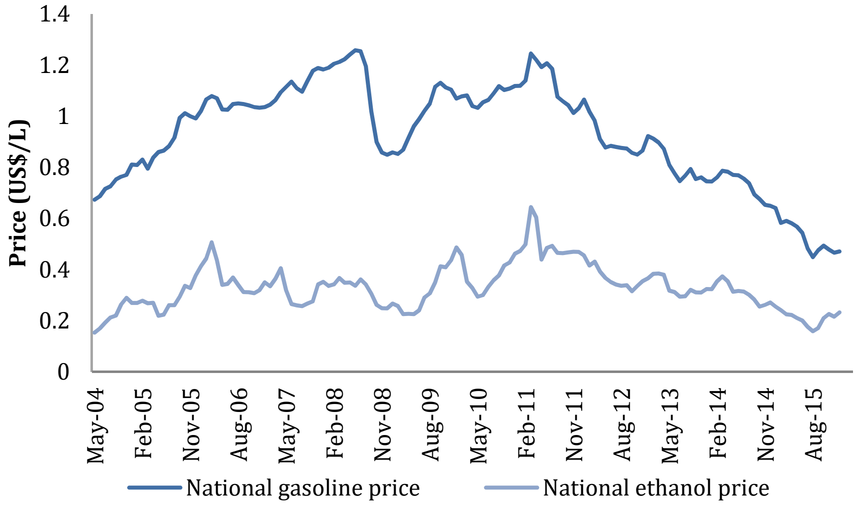

Figure 2 - National gasoline price versus national ethanol price.

As the calorific value of ethanol is only 70% of that of gasoline, ethanol is only competitive with gasoline if its price is at least 30% cheaper. This relation, between ethanol and gasoline prices, is observed in the next graph. The 2007-2008 period was especially favorable for ethanol in contrast to the 2011-2015 period, when ethanol lost its competitiveness.[3] As a result of this, total ethanol share in the automotive fuel consumption (Otto cycle) dropped from 54% in 2009 to 36% in 2012.

[3] 2011 was a particularly bad year for the sugarcane harvest, which explains why ethanol was more expensive and the coefficient observed between ethanol and gasoline prices was over 0.7.

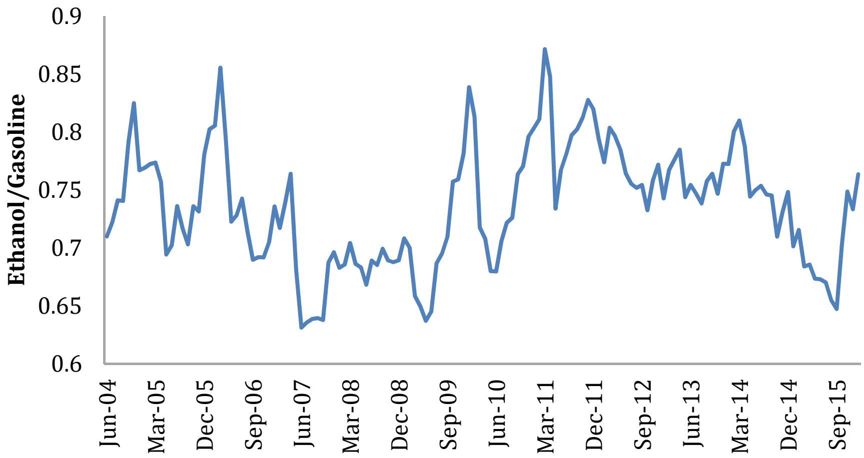

Figure 3 – Ratio between ethanol's and gasoline's price.

In order to evaluate in a quantitative way, the impact of the gasoline price control on sugarcane mills, we constructed a historical series, from 2003 to 2015, for what would be the equilibrium ethanol price if gasoline were not frozen. This series is based on international crude oil data, taking into account refining cost, distribution and commercialization cost for gasoline, exchange rate, and the relative efficiency of ethanol with respect to gasoline for Otto cycle engine (70%). This is considered as the expected price for ethanol and is used as control.

The following graph displays the two series for ethanol price (in current R$). The observed and expected (control) prices for ethanol fluctuate in tandem until the end of 2011, when they start to divert. Hence, the gasoline price control pushed down the competitive ethanol prices to considerably low levels.

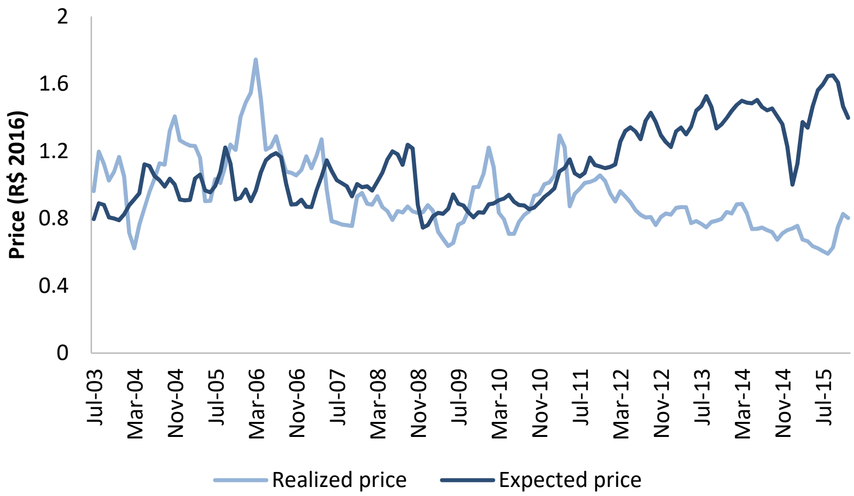

Figure 4 – Realized versus Expected ethanol's price.

In order to take into account future uncertainties, scenarios for both the expected (control) and observed ethanol prices were generated, based on the historical series. Next section describes the economic evaluation carried out with the expected ethanol price.

4. Economic evaluation - expected ethanol price

Considering the expected ethanol price, the sugarcane mill is profitable under the four configurations, thus explaining the great increase of ethanol production and cogeneration in the past. Besides, both sugar and bioelectricity production contribute to the increasing of the IRR expected value with respect to the case where only ethanol is considered. Furthermore, the addition of bioelectricity contributes to the increasing of the IRR not only for the ethanol case but also for the ethanol and sugar case, as can be seen in the table below.

Table 2 – Average IRR for the expected ethanol price

	Ethanol	Ethanol and Cogeneration	Ethanol and Sugar	Ethanol, Sugar and Cogeneration
Expected	13.1%	15.5%	17.6%	18.1%

Figure 5 shows the IRR distribution for the same case. As expected, project IRR is very sensitive to ethanol price when only ethanol is considered. As a result, IRR is much more volatile in this case. Next, we consider cogeneration together with ethanol. Despite its smaller participation in plant revenue (15%), cogeneration project IRR has become more stable as shown in the figure, due to long-term contracts offered by the electricity auctions.

When sugar is considered together with ethanol, ethanol participation in plant revenue decreases and, as a consequence, project IRR has also become more stable. Finally, when bioelectricity is added to the sugar and ethanol portfolio, total project revenue became even more stable and as a consequence IRR much less volatile.

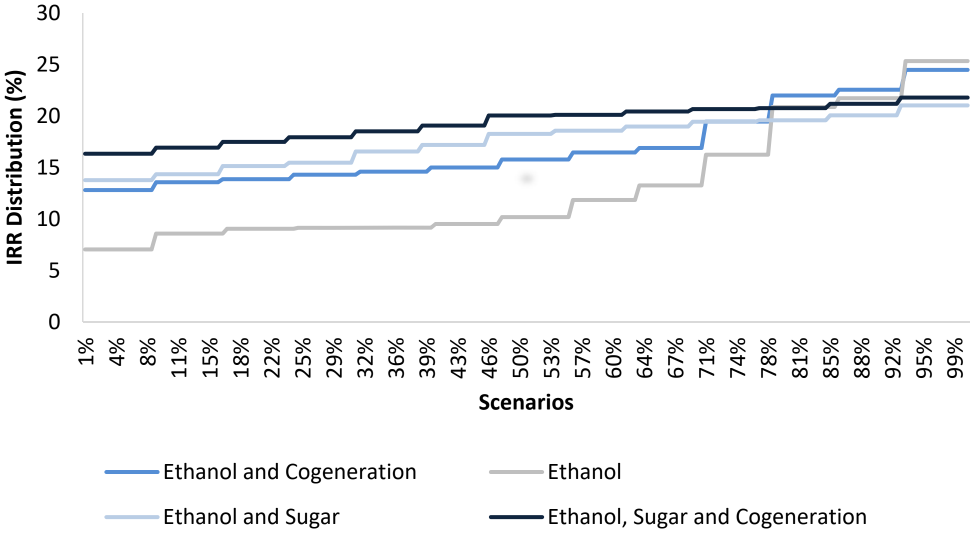

Figure 5 – IRR distribution for stakeholders under the four configurations of a sugarcane mill.

5. Economic evaluation - observed ethanol price

This section analyses the impact of the gasoline price control for the four configurations of the sugarcane mill. Figure 6 presents the IRR distribution in this case, which is consistently lower than the one for the expected ethanol price. As was already observed, the IRR of a sugarcane mil is sensitive to its portfolio, thus flattening for a more diversified production.
Indeed, the IRR associated with a sugarcane mill that produces both ethanol and sugar and sells its power surplus to the grid shows a much more stable behavior under different scenarios.

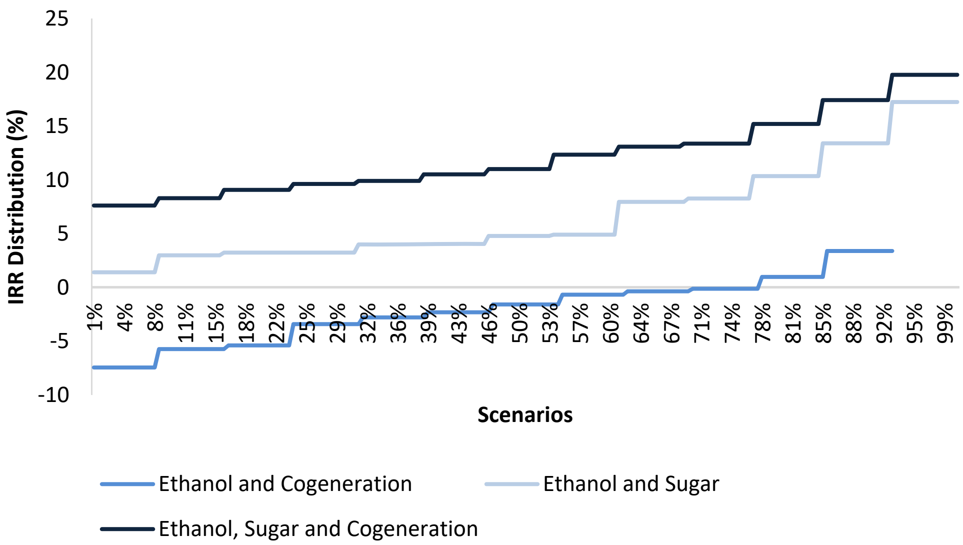

Figure 6 – IRR distribution for stakeholders under ethanol's realized price for the four configurations of a sugarcane mill.

Comparing the two scenarios we find that the average IRR for the stakeholder is persistently lower with the observed ethanol price. Indeed, there is a mean difference of ten pp between the expected and observed cases. However, the gap between the IRRs gets smaller as the sugarcane mill becomes more diversified.[4]

[4] The "x" on the table means that the procedure that computes the IRR did not converge. This is due to the much lower plant revenue as compared to its investment and O&M costs.

Table 3 – Average IRR for stakeholders under expected and realized price of ethanol

	Ethanol	Ethanol and Cogeneration	Ethanol and Sugar	Ethanol, Sugar and Cogeneration
Expected	13.1%	15.5%	17.6%	18.1%
Realized	x	-3.4%	6.7%	11.1%

6. Conclusion

Although Brazil is the top producer of sugarcane in the world, there is still great potential to be explored. During the past decade, bioelectricity was introduced as an extra product of sugarcane mills, increasing the mills' revenue and helping to diversify their portfolios, thus decreasing perceived risks. However, only a small fraction of mills export their surplus energy to the grid. This market, and the sector as a whole, was particularly affected during the sector crisis, mainly caused by the gasoline price control of 2012. This policy, adopted to curb inflation, was short term oriented and caused heavy losses to the sector. In order to evaluate its impact in a quantitative way, we used a module of OptValue developed to analyze cogeneration plants. The results show that the IRR for stakeholders was on average lower when the price of ethanol was forced down due to the gasoline price control. Finally, this study aimed to show the importance of the mills' portfolio in an integrated assessment of the policy adopted to exempt taxes on fuels and freeze gasoline prices. It contributes to policy evaluation methodology and helps to orient further policy that directly or indirectly affects this sector.

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