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Economic feasibility of sugar and ethanol production in Brazil under alternative future prices outlook

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ABSTRACT

Brazil has a key role in the global market for sugar and ethanol, but its future role depends on the industry's financial viability, which has been affected by low and variable prices, credit shortages, and policies that affect price of substitutes like gasoline. Our objective was to assess the financial viability of Brazil's sugar and ethanol industries under alternative future price outlooks for the 10-year period through 2022. A Monte Carlo simulation model was developed in order to evaluate the economic performance of a representative sugar mill in São Paulo State, Brazil. The economic feasibility study was conducted using four different price scenarios forecasted by FAPRI-ISU, OECD-FAO, USDA and World Bank. The model starts each year with a stochastic annual sugarcane yield and area harvested. Monthly production is simulated for white sugar, very high polarization (VHP) sugar, anhydrous and hydrated ethanol based on stochastic monthly sugar cane production. In the next section, the cost section, total costs are simulated for cane production and processing into products, and are used with simulated revenues to calculate net cash income, annual cash flows, balance sheet components and profitability measured in terms of net present value (NPV) and rate of return on equity (ROE). The results showed a high probability of success for a sugar mill if the OECD-FAO, USDA and World Bank price forecasts were to prevail. Under these price forecasts the NPV and ROE show a zero probability of values less than zero. The FAPRI price scenario presented a small probability of negatives values for NPV and ROE, and indicated the largest relative risk for these two variables. These results help to better understand the outlook for the Brazilian sugar and ethanol industry over the next 10 years. The Brazilian sugar and ethanol industry will continue to experience a high degree of risk and uncertainty from production, macroeconomic variables, demand, costs of production and market price. As a result, the industry will likely see considerable risk in rates of return, net cash income, and ending cash; however, there is a high probability that the industry will be profitable.

1. Introduction

Brazil has a key role in the global market for sugar and ethanol. According to the values presented by UNICA (2013), in the 2010/2011 harvest the country was responsible for 50% of global sugar exports and was the world's second largest producer of ethanol. The largest share of Brazilian sugar in 2012–2013 was allocated to the foreign market, with exports of 27.5 million tons and domestic consumption of 10.4 million tons. Ethanol production is mostly for the domestic market, where 25.5 billion liters were consumed, compared with 1.9 billion liters exported. In 2010–2011, the combined sugar and ethanol industry revenues totaled more than US$ 50 billion.

Nevertheless, the Brazilian sugar industry has faced some difficulties in recent years. For the 2007/08 and 2008/09 harvests, the sector operated with negative returns due to the low prices of sugar and ethanol. Moreover, the global financial crisis, which started in 2008, reduced availability of credit from banks. At that time much of the sector came with high levels of debt due to new investments, especially in new areas of cane sugar production and an expansion in the number of new mills. This combination of negative margins and tight credit, in a sector that has been funded by credit, led to a strong reduction in the rate of renewal of sugar cane plantings, thus raising the average age of sugar cane in the fields and changing cultural practices. These impacts were reflected in the following seasons, where the industry had falling agricultural productivity and subsequent increases in costs (Meneghin et al., 2013).

Another important difficulty faced by the sector in Brazil is policies related to gasoline prices, because gasoline is a direct substitute for ethanol. Gasoline prices (set by the government) were kept low from 2006 to 2013 to reduce inflation. This reduced ethanol prices, demand,

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profitability and investments in new ethanol plants (Farina et al., 2013). According to these authors, the number of new plants installed annually, which reached 30 units in 2008, began to decline gradually and in the coming years there are no indications that this trend will change.

Due to these difficulties, the Brazilian government has recently introduced measures to stimulate the sector, including the reduction of taxes for the production of sugar and ethanol. Two other measures were directed specifically to the ethanol market. First, it increased the mandatory amount of ethanol to be blended into gasoline back to 25% beginning in May 2013. Second, after keeping gasoline prices unchanged since 2006 to check inflation, it raised them by 7%, a move that improves the competiveness of ethanol against gasoline at the pump.

However, some uncertainties remain about the profitability of the Brazilian sugar and ethanol industry in the coming years. Those uncertainties affecting the operation of the sugar mill and ethanol plants in Brazil, important generators of jobs and taxes, and also the decision of new investments. As a result, producers and consumers in the global market may also be affected by decisions taken in this context. The objective of the present work is to project the viability of the industry under alternative future price outlooks. A Monte Carlo simulation model was developed to evaluate the economic performance of a representative sugar mill in São Paulo state, Brazil. The economic feasibility study was conducted using four different price scenarios forecasted by FAPRI-ISU, OECD-FAO, USDA, and World Bank. This method to study economic feasibility of biofuel industries has been used by Richardson et al. (2007), Outlaw et al. (2007) and Palma et al. (2011), and others.

2. Data and methods

The sugarcane model, SUCROSIM, is a Monte Carlo simulation model to simulate the annual production, marketing, and financial activities of a commercial sugar mill and ethanol plant in Brazil. The model uses data from many different sources to simulate a ten year planning horizon. Risk faced by a sugar mill and ethanol plants in Brazil are explicitly included in the model by using probability distributions to simulate random values for prices, yields, costs, rates of inflation, and asset values. Mean annual forecasted prices come from projections by OECD-FAO, FAPRI, USDA, and World Bank. A schematic of the model is presented in Fig. 1.

The schematic in Fig. 1 shows that the model starts each year with a stochastic annual sugarcane yield and area harvested, defined by the user. Monthly production (boxes 1 through 7) is simulated for white sugar, VHP sugar, anhydrous and hydrated ethanol based on stochastic monthly sugar cane production. All the ethanol is produced from sugar cane juice and molasses. In the next section, the cost section (boxes 8 through 15), total cost is simulated for cane production and production of each output. The third section starts with the annual total cost and annual total receipts to simulate net cash income and calculates annual cash flows, using boxes (16 through 28). The last section in the model simulates the balance sheet and calculates net present value and rate of return on equity (boxes 29 through 38).

The SUCROSIM model was programmed in Microsoft Excel using the Simetar© add-in, following a general architecture for Monte Carlo simulation modeling used by Richardson et al. (2007), Outlaw et al. (2007) and Palma et al. (2011). This methodology provides numerous options for analyzing different scenarios without re-programming the model.

2.1. Overview of model equations

This section of the paper presents an overview of the model. See Appendix A for a detailed description of the equations in the model. The model starts each year by simulating stochastic values for annual cane yield and monthly total recoverable sugar (ATR) content. These variables are stochastic in the model because they are greatly dependent on weather during the growing season which is out of the control of the sugar mills.

For cane yield, the climate of São Paulo State enables sugar cane plantation in two periods known as “one-year cane” and “1.5-year cane”. The one-year cane, planted in September–October, grows most rapidly between November and April, with growth slowing after that due to weather conditions, and is harvested within 11 to 14 months.

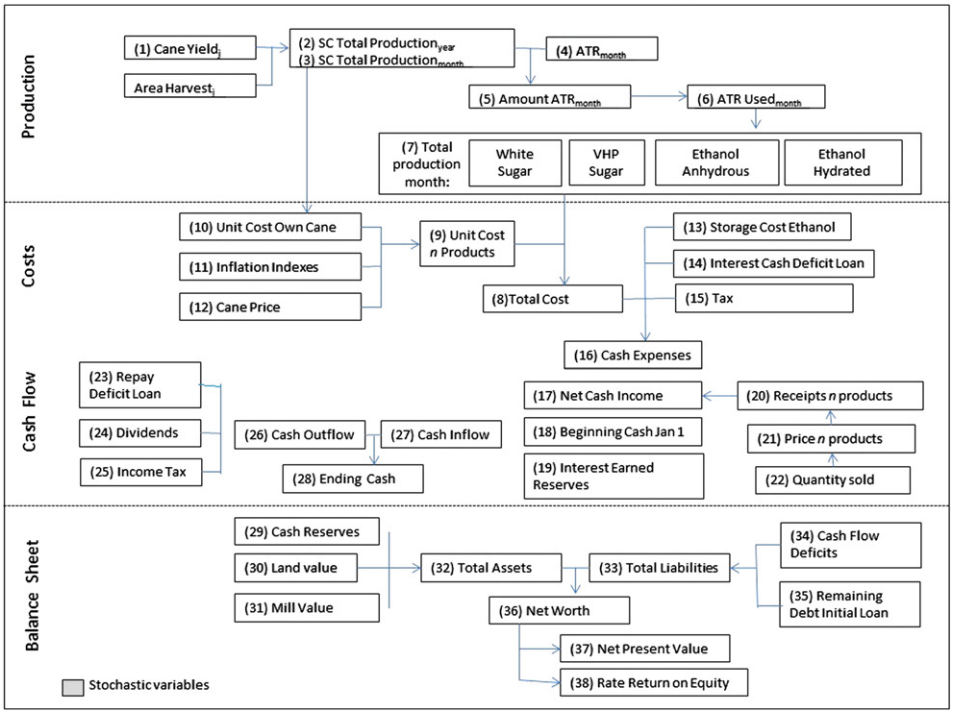

Fig. 1. Schematic of SUCROSIM model.