PBTC 03-7

International Agricultural Trade and Policy Center

ETHANOL FROM SUGAR: THE CASE OF HIDDEN SUGAR SUBSIDIES IN BRAZIL

By

Andrew Schmitz, Troy G. Schmitz, and James L. Seale, Jr.

PBTC 03-7 July 2003

POLICY BRIEF SERIES

UNIVERSITY OF FLORIDA

Institute of Food and Agricultural Sciences

INTERNATIONAL AGRICULTURAL TRADE AND POLICY CENTER

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Andrew Schmitz, Troy G. Schmitz, and James L. Seale, Jr.
University of Florida, Gainesville, Florida
Arizona State University, Mesa, Arizona
University of Florida, Gainesville, Florida

INTRODUCTION

Brazil is the world's largest producer of sugarcane, the world's largest exporter of sugar, and the world's third largest consumer of sugar. Brazil produces sugarcane-refined sugar for human use as well as anhydrous and hydrous alcohol, which are used mainly as a blend when converting alcohol to domestically consumed gasoline. Over 50 percent of Brazil's sugarcane production is converted into fuel for automobile use.

The Brazilian government affects Brazil's sugarcane market through its alcohol fuel program. The government sets the blend ratio for blending alcohol with gasoline. At the FAO Conference in Africa in October 2002, one of the authors was repeatedly asked whether Brazil's fuel policy provided a hidden subsidy to Brazilian sugarcane farmers (Schmitz, Seale, and Schmitz 2002). The answer is yes. Changes in the ethanol program and increasing blend ratios transfer more than 100 million dollars annually in the form of hidden subsidies. However, the effects of these subsidies on world market prices are much different than in the case of price supports–deficiency payment type schemes. In the case of Brazil, the fuel policy can result in an increase in world sugar prices, whereas prices would fall under alternative-type direct subsidies. Cases may exist where world prices decrease as a result of Brazil's fuel policy even though sugarcane production increases and producer welfare increases.

THE BRAZILIAN SUGAR-ALCOHOL INDUSTRY

Brazilian sugarcane has three major uses: refined sugar, anhydrous alcohol, and hydrous alcohol. Anhydrous alcohol is used as a blend with gasoline as mandated by the Brazilian government, and hydrous alcohol is used as fuel for vehicles that are powered 100 percent by alcohol.

Part of the reason for the substantial increase in anhydrous alcohol production in Brazil is due to the phenomenal increase in the yield of ethanol from sugarcane. In 1999, roughly 5,500 liters were produced per hectare, whereas in 1975, per-hectare yield was only approximately 2,000 liters (Figure 1). This represents almost a three-fold increase in the efficiency of ethanol production per year. Brazil placed import tariffs and export taxes on sugar to ensure that alcohol-production targets were met (Schmitz, Seale and Buzzanell, 2002). The Brazilian National Alcohol Program (PROALCOOL) was created in 1975 in response to the 1973 oil crisis. Under this program, the Institute of Sugar and Alcohol (IAA) purchased anhydrous alcohol at an equivalency rate of 44 liters of alcohol per 60-kilogram bag of sugar while Petrobas, the state owned oil company, controlled ethanol distribution. Credit guarantees and low fixed-interest-rate subsidies were also provided for the construction of distilleries and autonomous plants built adjacent to sugar mills.

Ethanol production is still regulated by government decree. Each year, a Presidential Decree sets an alcohol-to-gasoline blend-ratio range for the percentage of ethanol that must be used in Brazilian gasoline.

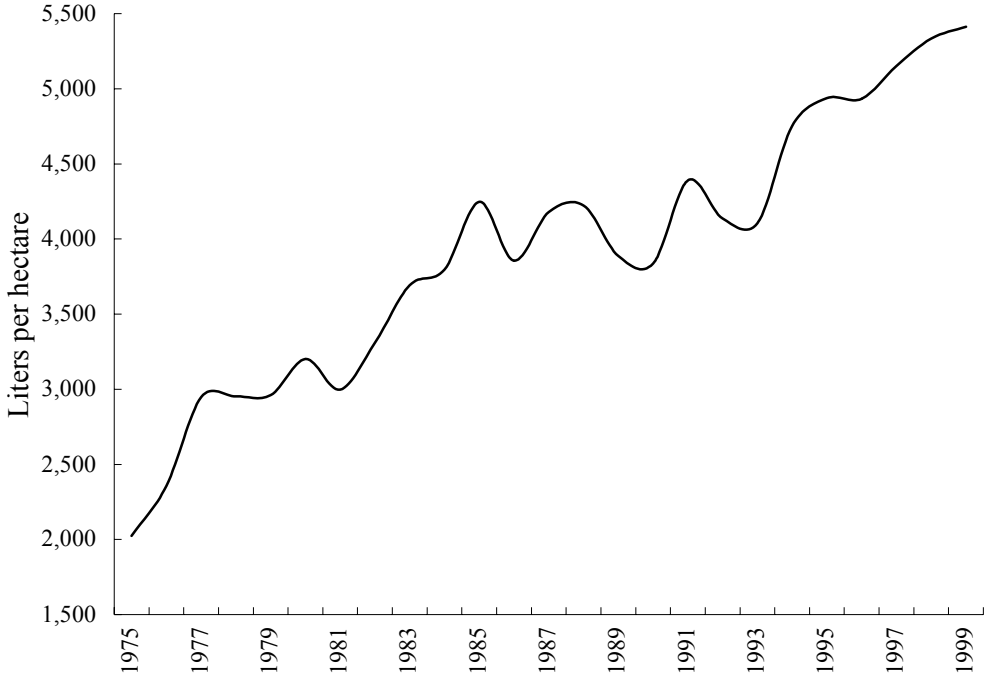

Figure 1. Ethanol yield from sugarcane in Brazil, 1975–1999 (Schmitz, Seale, and Buzzanell, 2002).

Both the domestic sugar and ethanol markets are protected from competition from other low-cost exporters. A common external tariff of 20 percent on sugar imports and 30 percent on imports of ethanol was put in place in 2001.

BLEND RATIOS AND BRAZILIAN SUGARCANE MARKETS

The Brazilian government sets the portion of anhydrous alcohol that is used in gas-powered vehicles. This "blend ratio" is adjusted from time-to-time by government decree. For example, the blend ratio was 25 percent in 1970 and then dropped to 11 percent by 1976; it increased to 22 percent in 1985, and then decreased to 13 percent by 1990; and it reached as high as 25 percent in June 2002, and then decreased to 20 percent in January 2003.

Using the 1998 to 2001 three-year average as a benchmark, based on actual data regarding the blend ratio, supply, and demand over a range of plausible assumptions regarding the shape of the supply and demand curves, empirical results show that the three-year weighted weekly average of blend ratios from 1998 and 2001 was approximately 22 percent.

Based on the data, two sets of simulations were performed to obtain empirical results for the impact of a change in the blend ratio over a typical marketing year. The first set simulated an increase in the blend ratio from 22 to 24 percent, reflecting what actually occurred at one point

during 2002. The second set simulated a decrease in the blend ratio from 22 to 20 percent, reflecting what was announced in January 2003.

Increase in the Blend Ratio

The empirical results associated with an increase in the blend ratio from 22 to 24 percent are summarized below (Table 1). The amount of cane used for anhydrous alcohol production rose by between 8.9 and 18.2 million metric tons (mmt), an increase of between 12 and 24.7 percent.

Table 1: Increase in blend ratio for anhydrous alcohol used in gasoline from 22% to 24%.

	Low Sensitivity		**Medium Sensitivity**		**High Sensitivity**	
	Absolute Difference*	Percentage Difference	Absolute Difference*	Percentage Difference	Absolute Difference*	Percentage Difference
Cane Price Received by Farmers ($/MT)	$0.31	3.2%	$0.20	2.1%	$0.12	1.3%
World Sugar Price ($/MT)	$2.30	1.3%	$1.47	0.8%	$0.92	0.5%
Cane Used for Domestic Sugar (mmt)	-1.1	-1.6%	-1.4	-2.1%	-1.7	-2.6%
Cane Used for Anhydrous Alcohol (mmt)	8.9	12.0%	11.9	16.1%	18.2	24.7%
Cane Used for Hydrous Alcohol (mmt)	-1.4	-1.6%	-1.8	-2.1%	-2.3	-2.6%
Cane Exported as Sugar to ROW (mmt)	-1.7	-2.6%	-2.6	-4.1%	-6.6	-10.3%
Total Cane Consumption (mmt)	6.4	2.8%	8.7	3.8%	14.2	6.2%
Total Cane Production (mmt)	4.7	1.6%	6.1	2.1%	7.6	2.6%
Sugar Consumer Surplus	-$20	-3.2%	-$13	-4.1%	-$8	-5.1%
Anhydrous Consumer Surplus	$180	25.5%	$123	34.9%	$98	55.5%
Hydrous Consumer Surplus	-$27	-3.2%	-$17	-4.1%	-$11	-5.1%
Aggregate Domestic Consumer Surplus	$133	6.0%	$93	8.5%	$79	14.4%
Domestic Producer Surplus	$91	4.2%	$58	4.1%	$37	5.0%
Aggregate Domestic Welfare	$224	5.2%	$151	6.0%	$116	9.1%
ROW Sugar Processor Surplus	-$20	-5.0%	-$12	-8.0%	-$8	-19.4%

*Measures an increase in the blend ratio from 22 to 24 percent over the benchmark period (1998-2001). [All prices were converted to U.S. dollars for ease of comparison only; all welfare results are in millions of U.S. dollars.
Low Sensitivity results use initial values of demand elasticity = -0.5, supply elasticity = 0.5, and excess demand elasticity = -2.0
Medium Sensitivity Results use initial values of demand elasticity = -1.0, supply elasticity = 1.0, and excess demand elasticity = -5.0
High Sensitivity Results use initial values of demand elasticity = -2.0, supply elasticity = 2.0, and excess demand elasticity = -20

In addition, the surplus accruing to sugarcane producers increases from between $37 million and $91 million (U.S. dollars) annually. Finally, aggregate welfare in the Brazilian sugar sector increases between $116 million and $224 million (U.S. dollars). Of course, this latter number does not include the losses accruing to crude-oil producers, crude-oil importers, etc. On

the other hand, it does not include the gains accruing to Brazilian society in general, due to the fact that ethanol has been shown to be more environmentally friendly than gasoline made from crude oil. In other words, Brazilian sugarcane producers would receive a subsidy of between $79 million and $133 million (U.S. dollars) per year if the blend ratio for anhydrous alcohol used in gasoline were increased from 22 to 24 percent.

Decrease in the Blend Ratio

With a decrease in the ratio of anhydrous alcohol used in gasoline from 22 to 20 percent, the surplus accruing to sugarcane producers decreases by between $36 million and $90 million (U.S. dollars) annually (Table 2). Finally, aggregate welfare in the Brazilian sugar sector decreases by between $93 million and $201 million (U.S. dollars) annually.

Table 2: Decrease in blend ratio for anhydrous alcohol used in Gasoline from 22% to 20%.

	Low Sensitivity		**Medium Sensitivity**		**High Sensitivity**	
	Absolute Difference*	Percentage Difference	Absolute Difference*	Percentage Difference	Absolute Difference*	Percentage Difference
Cane Price Received by Farmers ($/MT)	-$0.31	-3.2%	-$0.20	-2.1%	-$0.12	-1.3%
World Sugar Price ($/MT)	-$2.30	-1.3%	-$1.47	-0.8%	-$0.92	-0.5%
Cane Used for Domestic Sugar (mmt)	1.1	1.6%	1.4	2.1%	1.7	2.6%
Cane Used for Anhydrous Alcohol (mmt)	-8.9	-12.0%	-11.9	-16.1%	-18.2	-24.7%
Cane Used for Hydrous Alcohol (mmt)	1.4	1.6%	1.8	2.1%	2.3	2.6%
Cane Exported as Sugar to ROW (mmt)	1.7	2.6%	2.6	4.1%	6.6	10.3%
Total Cane Consumption (mmt)	-6.4	-2.8%	-8.7	-3.8%	-14.2	-6.2%
Total Cane Production (mmt)	-4.7	-1.6%	-6.1	-2.1%	-7.6	-2.6%
Sugar Consumer Surplus	$21	3.2%	$13	4.2%	$8	5.2%
Anhydrous Consumer Surplus	-$160	-22.6%	-$105	-29.7%	-$77	-43.3%
Hydrous Consumer Surplus	$28	3.2%	$18	4.2%	$11	5.2%
Aggregate Domestic Consumer Surplus	-$112	-5.1%	-$74	-6.7%	-$57	-10.4%
Domestic Producer Surplus	-$90	-4.2%	-$57	-4.0%	-$36	-4.9%
Aggregate Domestic Welfare	-$201	-4.6%	-$131	-5.2%	-$93	-7.3%
ROW Sugar Processor Surplus	$20	5.2%	$13	8.3%	$8	21.5%

*Measures a decrease in the blend ratio from 22 to 20 percent over the benchmark period (1998-20001). [All prices were converted to U.S. dollars for ease of comparison only; all welfare results are in millions of U.S. dollars.]
Low Sensitivity Results use initial values of demand elasticity = -0.5, supply elasticity = 0.5, and excess demand elasticity = -2.0.
Medium Sensitivity Results use initial values of demand elasticity = -1.0, supply elasticity = 1.0, and excess demand elasticity = -5.0.
High Sensitivity Results use initial values of demand elasticity = -2.0, supply elasticity = 2.0, and excess demand elasticity = -20.

CONCLUSIONS

Brazilian sugarcane producers receive indirect subsidies through Brazil's fuel-alcohol program. If Brazilian sugarcane producers are risk neutral, an increase in the blend ratio from 22 to 24 percent will raise the domestic price of sugarcane by between 1.3 and 3.2 percent. Brazilian sugarcane producers would benefit from these price increases. Brazilian producers would receive between $37 million and $91 million (U.S. dollars) annually in indirect sugarcane subsidies from an increase in the blend ratio. Some advocates who promote the production and use of fuel alcohol in Brazil foresee the development of a substantial fuel-alcohol-export market. In 2002, only about 0.5 to 1.0 billion liters of ethanol were exported annually. To help promote the trade globalization of ethanol, Brazil is providing information on the economics and technological aspects of ethanol production and trade worldwide.

If Brazilian sugarcane producers are risk averse, there will be a supply response to Brazilian fuel policy. In this case, the size of producer subsidies is larger than in the absence of risk aversion effects. Specifically, if the Brazilian government dictates an increase in the alcohol/gas blend ratio, both the demand and supply curves for Brazilian sugarcane will shift outward to the right. World sugar prices can fall due to an increase in the blend ratio making the Government policy trade distorting.

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