1985

The Efficiency of Producing Alcohol for Energy in Brazil: Comment

Jonathan B. Wight
University of Richmond, jwight@richmond.edu

Recommended Citation
Wight, Jonathan. "The Efficiency of Producing Alcohol for Energy in Brazil: Comment." *Economic Development and Cultural Change* 33, no. 4 (1985): 851-56. doi:0013-0079/85/3304-0047$01.00.

The Efficiency of Producing Alcohol for Energy in Brazil: Comment

In a 1982 issue of this journal, Michael Barzelay and Scott R. Pearson examined the social costs and benefits of producing ethanol motor fuel in Brazil.[1] They conclude that ethanol fuel was economically infeasible in 1981 and will remain so unless petroleum prices rise dramatically in the future. We seek first to call attention to some problems in their data and second to suggest that their analysis include broader considerations. Quite different conclusions could result.

Ethanol Costs of Production Data

Barzelay and Pearson base their analysis on the published production costs of COPERSUCAR, the prominent and respected sugar mill cooperative in São Paulo and Paraná.[2] Without question, COPERSUCAR has the most complete data-reporting network on sugar costs in Brazil. But what should be questioned is whether its data are appropriate for Barzelay and Pearson's purposes. Two points are noteworthy:

First, COPERSUCAR, in addition to being a first-class agricultural research institute, represents the political interests of its sugar mill owners. A key lobbying effort arises before each harvest when the federal government sets official prices for sugarcane, sugar, and ethanol. Clearly, it is in the interests of the cooperative to promote high prices for its outputs of sugar and ethanol, and it thus annually publishes its expected costs well in advance of the pricing decision. Barzelay and Pearson correctly note this fact and reduce COPERSUCAR's reported costs by 20% "to compensate for the suspected overestimation of the published data" (p. 135). It is unclear how the authors arrive at the 20% figure, and the issue of ethanol efficiency appears rather sensitive to this parameter (see n. 9 below).[3]

Second, the cooperative's membership, and hence its survey, is made up almost exclusively of sugar mills and their annexed distil-

0013–0079/85/3304–0047$01.00

TABLE 1

National Alcohol Program: Projects Approved by CENAL, 1975–81

	Type of Distillery			
	Annexed		Autonomous	
Region	*N*	Additional Capacity (millions of liters/year)	*N*	Additional Capacity (millions of liters/year)
North-Northeast	61	884.9	63	1,710.8
Central-South	122	2,374.6	144	3,135.0
Total	183	3,259.5	207	4,845.8

Source.—CENAL (May 1981).

leries.[4] The alcohol being produced is largely anhydrous ethanol, which is 99.6% water-free and suitable for mixing with gasoline in conventional motors. As table 1 shows, however, over 50% of the ethanol projects approved by the Executive National Alcohol Commission (CENAL) during 1975–81 were autonomous distilleries largely producing hydrated ethanol.[5] Hydrated ethanol contains up to 6% water and may be burned directly in motors designed for its use. It is cheaper to produce than anhydrous because it provides more volume and does not require an expensive benzine "stripping" to remove the final percentages of water. COPERSUCAR itself estimates that in annexed distilleries hydrated ethanol is 4.5% cheaper to produce than anhydrous.[6] For this reason and others, Barzelay and Pearson's analysis of social profitability for 1980–81 needs refining.

Social Profitability, 1980–81

Using their data, I recalculated social profitability in 1980–81, accounting for differences between anhydrous and hydrated ethanol. Their "base case" cost of US$0.24 per liter of ethanol is assumed to refer to anhydrous ethanol because their original cost estimates were for this fuel, and the text mentions adjustments in this cost relating only to higher petroleum prices.[7] One may calculate conservatively that the cost of hydrated ethanol is therefore $0.23 per liter (4.5% below anhydrous costs).

As the authors correctly note, anhydrous ethanol may replace gasoline on a one-for-one basis when mixed with gasoline (up to 30%). Hydrated ethanol, on the other hand, does not substitute one-for-one when burned directly, because 20% more is necessary to provide the same mileage as gasoline. At a 1981 world price of petroleum at $34 per barrel, the per-liter price of gasoline is $0.24 in real terms. Thus the

TABLE 2
SOCIAL COSTS AND RETURNS, 1980–81

	Type of Ethanol	
	Anhydrous	Hydrated
Costs	.24	.23
Returns	.24	.20
Net losses	.00	.03

NOTE.—Figures in US$ per liter.

social value of anhydrous ethanol (substituted volume for volume for gasoline) is \$0.24. The social value of hydrated ethanol (substituted at a rate of 1.2 to 1.0) is \$0.20.[8]

The recalculated social costs and returns in 1980–81 are quite different from those reported by Barzelay and Pearson (see table 2). The anhydrous ethanol production was indeed viable in 1980–81, and the net social loss in hydrated ethanol was almost one-half that reported in the original article.[9]

The conclusion that hydrated ethanol is not economical is borne out by other research.[10] However, though Barzelay and Pearson note some of the beneficial externalities arising from hydrated ethanol production, they are arguably not the most important.

Externalities

Proálcool is the Brazilian National Alcohol Program. Although many of its social objectives have not been realized,[11] key strategic and economic goals are closer to fulfillment as a result of ethanol production.

National Energy Security

Brazil imported about 80% of the petroleum it needed in 1980, and 79% of these imports came from the Middle East.[12] The first strategic benefits of ethanol were realized sooner than expected when war broke out between Iran and Iraq in September 1980. Virtually overnight, 40% of petroleum imports were cut off. A difficult period ensued, but by raising the proportion of alcohol in gasoline to 30%, instituting conservation measures, and making spot purchases of petroleum, a major economic and political crisis was averted. This year ethanol is expected to substitute 37% for gasoline, according to official projections.[13]

Emphasizing production of export crops such as sugar or soybeans—instead of ethanol—to earn foreign exchange would have had disastrous results for Brazil because of the world recession and overproduction.[14] Thus ethanol continues to provide a cushion of domestic liquid fuel, which contributes to national energy security.[15]

Promotion of Consumer and Capital Goods Industries and Exports

Proálcool was instrumental in maintaining automotive sales at approximately one million units per year during 1975–80, according to planning minister Delfim Neto.[16] Consumer acceptance of all-ethanol cars has increased dramatically with the elimination of starting and corrosion problems found in earlier models. Demand has also depended on financial considerations (lower taxes on ethanol fuel and improved engine efficiency) as well as on considerations of future gasoline versus ethanol supplies. Whereas total automobile sales fell to 700,000 units in 1982, ethanol cars in mid-1983 accounted for 80% of total sales.[17]

Proálcool has also stimulated capital goods production. With few exceptions, the 300 distillery projects built or in progress utilize grinding mills, distillation columns, pumps, tanks, cranes, furnaces, conveyors, generators, and other equipment manufactured in Brazil. The expertise gained in ethanol capital goods production and the chemical process has enabled Brazil to become an exporter of such equipment to developing countries, including Indonesia, the Philippines, Costa Rica, and Paraguay.[18]

Although a breakdown of distillery equipment exports alone was not available, total Brazilian exports of furnaces, mechanical instruments, and machines grew 25% from 1979 to 1982. Export earnings in 1982 amounted to US$1.2 billion.[19]

Conclusion

A recalculation of ethanol costs and benefits and the inclusion of beneficial externalities favorably alters the conclusions to be drawn about Proálcool in 1981. More recently, petroleum prices have fallen; so presumably have the real costs of producing ethanol (measured by the opportunity cost of resources that would otherwise be idle because of the world sugar glut). Proálcool is providing stable and increased rural employment at a time when sugar prospects are bleak for the short and long term (see n. 14). Even a net loss in hydrated ethanol production, as noted above, must be considered in the light of national strategic and economic interests.

Certainly any alternative energy program is risky: the potential payoff depends on events or situations that are largely unforeseeable and uncontrollable (e.g., stability within OPEC and the Middle East over the next 5 years). Under these circumstances, ethanol acts beneficially as a small insurance policy for promoting continued industrial and rural development. That there may be a price to pay for this "insurance" does not necessarily invalidate the program.[20]

JONATHAN WIGHT

University of Richmond

Notes

1. Michael Barzelay and Scott R. Pearson, "The Efficiency of Producing Alcohol for Energy in Brazil," *Economic Development and Cultural Change* 31 (October 1982): 131–44. All subsequent references to this article will be parenthetical in text.

2. The proper name is Cooperativa Central dos Produtores de Açucar e Álcool do Estado de São Paulo.

3. According to Barzelay and Pearson, COPERSUCAR officials claim that their data reflect the costs of mills that are "only somewhat less efficient than average" (p. 135), but they offer no substantive details.

4. Interview with COPERSUCAR officials, May 1981.

5. The original project goals called for the production of 10.7 billion liters of ethanol by 1985: 6.1 billion liters hydrated, 3.1 billion liters anhydrous, and 1.5 billion liters as chemical feedstock.

6. Julio Maria Martins Borges (of COPERSUCAR), "Desenvolvimento econômico, política, energética e álcool," *Proceedings of the Fourth International Symposium on Alcohol Fuels Technology*, Guarujá, Brazil, October 1980, p. 759. The 4.5% estimate may understate the true cost differences, because it appears to account only for volume and not for production cost differences. In addition, autonomous distilleries also produce a by-product of potential value: about one-half the dried sugarcane stalks (*bagasse*) will be surplus and may be burned for rural electrification, or the fiber will be used in paper manufacture. Annexed distilleries generally run out of *bagasse* and must supplement with more expensive fuels such as wood and coal. In their defense, Barzelay and Pearson might argue that annexed distilleries benefit from economies of scale and scope in joint production with sugar. These advantages do not accrue to autonomous distilleries and may counterbalance the cost differences between anhydrous and hydrated fuel.

7. This "base case" cost includes a shadow exchange rate.

8. There are several apparent inconsistencies in the original article regarding social profitability in 1980–81. First, the numbers in the text for ethanol value do not match up with the numbers in the corresponding table 5 (pp. 142–43). Second, when calculating the hydrated ethanol value, the authors multiply the gasoline price by 0.80. The correct parameter is 0.83, because 1.0 liters of gasoline yields the same mileage as 1.2 liters of hydrated ethanol. Thus, 1.0 liter hydrated ethanol = 0.83 liters gasoline.

9. This loss would be further reduced to $0.01 per liter, assuming, e.g., that the overestimation in cost data was 25% rather than 20%. The "reported COPERSUCAR cost" of anhydrous ethanol is $0.30. Because hydrated ethanol costs 4.5% less, hydrated ethanol's reported cost is slightly less than $0.29. If these costs are overvalued by 25% rather than 20%, the base cost of ethanol would be $0.21 per liter: (.30) (.955) (.75) = .21.

10. See Borges; Alan Poole, "A Working Paper on Ethanol and Methanol as Alternatives for Petroleum Substitution in Brazil," mimeographed (São Paulo: Institute of Physics, 1979); Jonathan B. Wight, "Economies and Diseconomies of Scale in Ethanol Fuel Production: The Experience in Brazil" (Ph.D. diss., Vanderbilt University, 1982).

11. The alcohol program had ambitious social objectives for rural areas, such as more balanced interregional growth, improved opportunities for small farmers, and the creation of rural industrial employment to reduce migration to cities. Proálcool will create about 30,000 jobs in distilleries and 270,000 jobs in agriculture, according to Borges. Still, Barzelay and Pearson correctly note that "most of the incremental alcohol production has taken place on large plantation-mill-distillery complexes in the relatively wealthy central-south" (p.

132) and much of this new alcohol production has displaced food crops, esp. in São Paulo. (For further discussion, see Eli Roberto Pelin, "The Impact of Brazil's Proálcool on Land Prices and Crop Substitutions," *Proceedings of the Fourth International Symposium on Alcohol Fuels Technology*, Guarujá, Brazil, October 1980, pp. 831–38.)

12. Ministry of Energy and Mines, *Balanço energético nacional*, 1983, p. 10; IMF, Direction of Trade Statistics Yearbook (Washington, D.C.: IMF, 1984), pp. 100–102.

13. "Brazilian Energy Model," Ministry of Energy and Mines, Version 2 (May 1981).

14. World sugar prices fell from $276/ton to $136/ton during 1982, largely as a consequence of European sugar beet subsidies, competition from corn sweeteners, and the world recession. Brazil's sugar export earnings consequently fell 51%, while those for soybeans fell 34%. Coffee earnings, by contrast, rose 15% because of the coffee cartel. Figures are from *Conjuntura econômica* 37 (February 1983): 162.

15. Ethanol is by no means a panacea for the energy problem, as Barzelay and Pearson note when discussing the diesel fuel bottleneck. In addition, Proálcool may exacerbate problems in land distribution, food production, and by-product pollution.

16. Quoted in "Delfim: Proálcool é fator inflationário," *O Estado de São Paulo* (November 27, 1980).

17. "One Million Alcohol Cars," *Brazil Energy* 4 (May 25, 1983): 5.

18. Although France, the United States, and Germany are the technological leaders in ethanol production methods, the Brazilians provide proven and simple technology to countries with little skilled labor.

19. "Os novos horizontes da exportação," *Exame*, special ed. (May 1983), pp. 51–54, esp. 52.

20. One could argue, as the World Bank does, that this "insurance premium" be paid by a tax on imported petroleum.