



Global Development and Environment Institute
Tufts University

Sweetening the Pot

Implicit Subsidies to Corn Sweeteners and the U.S. Obesity Epidemic

By Alicia Harvie and Timothy A. Wise*

Pigs, chickens and steers aren't the only ones in the United States getting fat off a diet of cheap corn. So are many Americans, according to some analysts, and corn sweeteners are alleged to be the culprits. The annual per-capita consumption of caloric sweeteners has increased by 40 pounds in the last 40 years, and high fructose corn syrup (HFCS) accounts for 81% of the 83 additional calories the average American consumes each day from sweeteners alone.¹ Has cheap corn caused an HFCS boom and contributed to the obesity epidemic?

Perhaps the most prominent writer on the subject is consumer advocate Michael Pollan, who charges U.S. farm policy with a central role in America's expanding waistline, citing the abundance of cheap corn sweeteners in our food. Some recent academic studies question the validity of the charge, suggesting the link is tenuous at best.²

GDAE adds to this discussion by estimating how much cheaper HFCS, a critical ingredient in the American diet, was from 1997-2005 because corn prices fell below corn's cost of production. In examining the economics behind the claim, our findings suggest that while Pollan might be overstating the causal link, U.S. farm policy is doing American diets no favor. We find that U.S. farm policy effectively lowered corn prices and HFCS production costs, offering HFCS producers an implicit subsidy of \$243 million a year, a savings of \$2.2 billion over the nine-year period, and over \$4 billion since 1986. For soda bottlers, the main consumers of HFCS and among those most heavily implicated in public health concerns, the savings amounted to nearly \$100 million per year, \$873 million over the nine-year period, and nearly \$1.7 billion since the wholesale adoption of HFCS by the soda industry in the mid-eighties.

While this may not have reduced soda prices to an extent that would account for rising consumption, there is little doubt U.S. agricultural policies have indirectly subsidized a sector that may be contributing to health problems.

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The Public Health Claims

Increasingly the voices of health and consumer advocates such as Michael Pollan indict the U.S. agricultural system for its role in shaping the modern American diet. In his most recent *New York Times Magazine* piece, "Farmer in Chief," Pollan outlines a connection between U.S. farm policies and the rise of chronic diseases linked to diet, such as heart disease, stroke, Type 2 diabetes and cancer. The argument goes something like this: Government policies have made corn cheap; cheap corn became cheap HFCS; Americans now ingest HFCS in unprecedented quantities from their super-sized sodas and sweet snacks; and our healthcare expenditures have bloated, in turn.³

His claims are more fleshed out in a 2002 *New York Times* article "When a Crop Becomes King," where he blasted the 2002 Farm Bill for subsidizing corn producers to the tune of \$4 billion in a time of surplus. Pollan also implicated those who stood to profit: corn processors, "factory farms" and soft drink and snack manufacturers who rely on cheap corn. Above all, he pointed his finger at HFCS:

"Nearly 10 percent of the calories Americans consume now come from corn sweeteners; the figure is 20 percent for many children....It's probably no coincidence that the wholesale switch to corn sweeteners in the 1980's marks the beginning of the epidemic of obesity and Type 2 diabetes in this country. Sweetness became so cheap that soft drink makers, rather than lower their prices, super-sized their serving portions and marketing budgets. Thousands of new sweetened snack foods hit the market, and the amount of fructose in our diets soared."⁴

There's no mistaking his charge: Cheap corn sweeteners, fed by U.S. farm policies, have fattened and sickened our nation. But, is it true? Are we *literally* getting fat off cheap corn sweeteners?

Few have examined this link in great detail, an exception being researchers at the Institute for Agriculture and Trade Policy (IATP), who maintain that the relative cheapness of less-healthy foods means consumers are more likely to make unhealthy choices in the marketplace. They cite one study where reducing the vending machine prices of low-fat snacks by 10%, 25% and 50% increased their sales by 9%, 39% and 93%, respectively. When prices were raised back, consumption declined substantially. More pertinent here, they offer that even if the low wholesale prices of HFCS constitute only a nominal share in the total manufacturing and distribution costs of retail foods, they still help manufacturers set retail prices below those of otherwise-competitive, healthier alternatives.⁵

Not so Fast

John Beghin and Helen Jensen of Iowa State's Center for Agricultural and Rural Development (CARD) reach a different conclusion. In a recent paper, they acknowledge the problematic role of sweeteners in the American diet and recognize that subsidies for corn producers handed a "moderate subsidy" to corn users who purchased it for less than its opportunity cost. They acknowledge that the low price of corn sweeteners contributed to their use in foods, particularly in sodas. However, they caution that the link between HFCS-heavy food prices and corn prices is smaller than assumed.

Using an economic model of the elasticity between corn and retail food prices, they estimate that a 20% subsidy for corn users in 1975 would have decreased food prices by 1.8%. In recent years, as raw materials have come to represent a smaller share of our more highly processed diets, a 20% corn subsidy would translate into a mere 0.3% decrease in retail food prices and a 0.15% increase in the quantity of food items consumed.

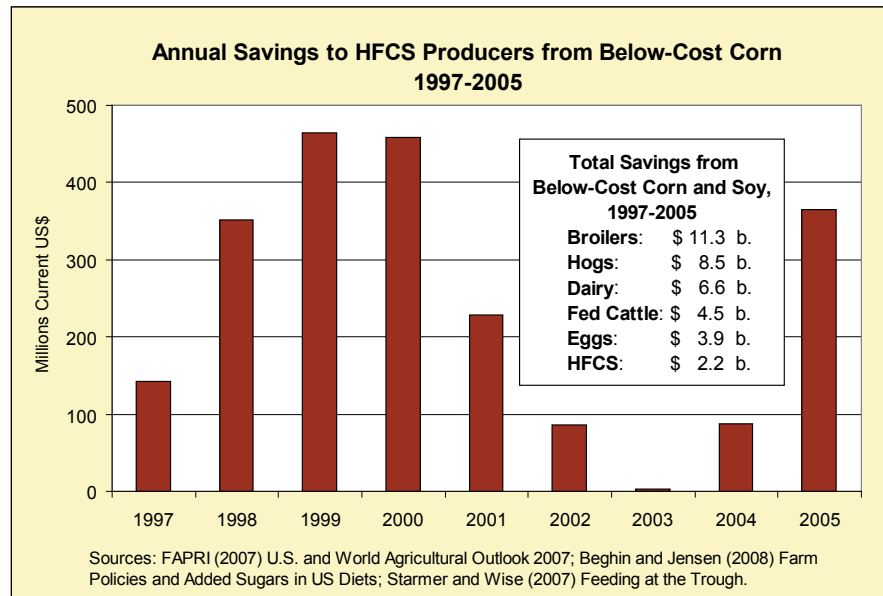
This is true in part because corn's influence on food prices decreases as it moves through the supply chain. For sweetener-intensive sectors like soft drinks or baked goods, the share of sweeteners in the unit price of retail food is small, and it has fallen dramatically since 1975 as retail foods have become more highly processed. Today, HFCS represents just 3.5% of the total cost of soft drink manufacturing as measured by the value of shipments. Meanwhile, the corn content of HFCS represents only 1.6% of this value.⁶ Thus, the impact of corn prices on the final retail price of a food product is not as high as one might think. The Iowa State researchers conclude that policies influencing corn prices can have at most a nominal impact on the retail prices consumers face at the super-market.⁷

To further refute the causal link between a country's farm policies and obesity, they point to international data, which indicate conflicting trends in sugar policy and obesity rates among developed nations. Australia and the United States both have high and rising obesity rates, but opposite sugar policies. Sugar is the major sweetener consumed in Australia, not HFCS, and there are essentially no distortions in its program. The United Kingdom and France have the same sugar policy and similar consumer prices, but different sugar consumption patterns and health outcomes (namely, higher sugar consumption and obesity prevalence in the UK). Meanwhile, Japan has extremely high sugar prices, declining per-capita sugar consumption and low obesity rates. Hence they find no clear link between a country's sugar policies and its health outcomes.

So what of Pollan's claims given the cogent evidence above?

With per-capita consumption weighing in at 43 pounds per year, it is worth retracing how HFCS came to be America's sweetener of choice.⁸ In the 1970s and 1980s, HFCS burst into the sweetener industry as it replaced sugar, most prominently in carbonated beverages, but also in baked goods and other foods. As a liquid, HFCS is easier to work with than sugar, and six times sweeter. It also prolongs shelf life and resists freezer burn.⁹ From 1980, the year when Coca-Cola first used HFCS in its sodas, to 1999, per capita consumption of HFCS grew by a staggering 235%.¹⁰ Today, HFCS represents more than 40% of the caloric sweeteners added to foods and beverages, and is the only sweetener added to soft drinks in the United States.¹¹ Each year, about 500 million bushels, or 5%, of the U.S. corn crop is used to produce HFCS.¹²

In the 1970s, HFCS's competitive advantage over sugar derived partly from R&D expenditures in the corn wet milling process. However, corn sweeteners have also benefited from the U.S. sugar program, which includes prohibitive trade restrictions and production allotments. With a high price floor for sugar and below-cost corn underwriting liquid HFCS, sugar cannot be price-competitive with HFCS. Data from 1963-2005 show real corn prices falling more than twice as fast as real sugar prices.¹³ As such, manufacturers have historically been able to purchase HFCS at prices 20% to 70% less than sugar prices. A 1983 *Fortune* magazine article estimated that Coca-Cola gained a cost advantage of \$70 million annually over Pepsi when it switched from sugar to HFCS.¹⁴



The Implicit Subsidy to HFCS

More recently, HFCS producers – and all other large-scale consumers of U.S. row crops such as corn and soybeans – have benefited from federal policies, particularly from the 1996 Farm Bill, which ended production controls in federal commodity programs and helped usher in a period of overproduction and low prices. In previous publications, GDAE estimated that corn and soybeans were priced 23% and 15% below their average production costs, respectively, in the nine-year period following the 1996 Farm Bill, 1997-2005. As a consequence, industrial hog, broiler, egg, dairy, and cattle operations enjoyed savings of nearly \$35 billion thanks to below-cost corn and soybeans purchased for their feed.¹⁵

Using a similar methodology, we estimate that wet millers who refine HFCS were able to save on HFCS production from corn priced 27% below its cost from 1997-2005.¹⁶ Using Beghin and Jensen's own estimate that corn value represents 44% of HFCS production costs, we find that the wet milling industry spent \$18.4 billion in HFCS production costs over the 1997-2005 period and that corn accounted for \$8.1 billion of that total.¹⁷

However, if corn had been priced to reflect its true cost, HFCS production costs would have increased by 11.8%, translating to \$243 million dollars more in annual costs. **Hence, over that same 1997-2005 period, wet millers who purchased corn below its cost of production saved \$2.19 billion in HFCS production.**

What are the implications for soda-makers? If corn had been priced at its true cost, HFCS-55 prices (the major sweetener for soft drinks) would have been an estimated 8.8% higher, a figure consistent with Beghin and Jensen's study.¹⁸ ERS data indicates that in 2002, 8 billion pounds of HFCS were used in soft drinks, with a value of over \$1.1 billion.¹⁹ If corn were priced at its true cost, then, soda makers would have spent \$97 million more in production costs that year alone. **Multiplied out over the nine-year period of our study, that would come to \$873 million in savings to soda-makers from below-cost corn.**

In reality, this period reflects a more pronounced phase of a longer trend in below-cost commodity prices. GDAE has previously estimated that corn was priced 17% below its cost of production on average during the eleven years preceding the 1996 Farm Bill, 1986-1996. From this, we can roughly estimate that HFCS manufacturers saved \$180 million annually and \$1.98 billion in total during this period. Soda makers, in turn, would have saved nearly \$72 million annually, or \$790 million from 1986, the year after HFCS was fully adopted by the soda industry, to 1996.²⁰

Adding this rough estimate of the implicit subsidy to HFCS from 1986-96 to the more detailed estimate for 1997-2005, we get estimated savings to HFCS producers from below-cost corn of more than \$4 billion for the twenty-year period. Estimated savings for soda makers since the wholesale adoption of HFCS in the mid-eighties are \$1.7 billion.

Public Health Implications

There remains the question of whether this impacted American diets during that period. In the United States, HFCS consumption patterns are closely tied to soft drink consumption, both of which correlate with obesity rates. Sweetener consumption is up 20% since 1970, and 65% of that is accounted for by HFCS in soda consumption, which continues to dwarf the consumption of all other non-alcoholic beverages.²¹

The sheer quantity of HFCS consumed would be bad enough for the American waistline, but there is also research suggesting HFCS is metabolized differently from other sugars in the body. Pollan cites a University of Minnesota study finding that diets high in fructose elevate triglyceride levels in men shortly after eating; this has been linked to a higher risk of obesity

and heart disease.²² However, the impact of HFCS consumption on obesity is still a hotly debated topic in scientific literature. While there is some evidence that HFCS is metabolized differently, other studies have found no real difference.²³ More recently, entirely different public health concerns have been raised by reports indicating the presence of mercury in HFCS and HFCS-containing products, the consequences of which are unclear.²⁴ There is little disagreement, however, that the volume of sweetener consumed, if not its inherent qualities, has impacted the health of Americans.

Conclusion: They're both right

Michael Pollan is right that cheap corn has helped underwrite the rise of HFCS and contributed to alarming increases in sweetener consumption, but he may overstate the causal link between cheap corn and worsening diets. U.S. agricultural policies may have driven the shift from sugar to HFCS, but the soda-led increase in sweetener consumption may well have happened anyway. CARD researchers, for their part, are correct to point out the overstatement; HFCS just isn't a large enough share of consumer prices to be the primary cause of overconsumption. But their study in no way undercuts the argument that cheap corn – and U.S. agricultural policies – have contributed to bad diets. (Their correlations on national sugar policies and obesity are interesting, but seem inconclusive at best.)

GDAE's findings suggest that U.S. farm policy certainly doesn't help the situation. While they may not have caused the obesity epidemic by making corn cheap, U.S. agricultural policies raised the price of sugar and decreased the price of corn. Together, this drove the price of corn below its production costs, shifted the sweetener industry over to HFCS, made HFCS artificially cheap, and served as an implicit subsidy to those using HFCS in large quantities, notably soft drink makers. With HFCS producers receiving implicit subsidies to the tune of \$243 million a year, one can certainly question if this is a worthy outcome of U.S. farm policy.

¹ Beghin, J. C., Jensen, Helen H. (2008). Farm Policies and Added Sugars in US Diets. Ames, Iowa, Center for Agricultural and Rural Development (CARD), Iowa State University.

² Ibid.

³ Pollan, M. (2008). Farmer in Chief. *New York Times Magazine*. October 9, 2008

⁴ Pollan, M. (2002). When a Crop Becomes King. *The New York Times*. New York, New York. July 19, 2002.

⁵ Muller, M., Schoonover, Heather, Wallinga MD, David (2007). Considering the Contribution of U.S. Food and Agricultural Policy to the Obesity Epidemic: Overview and Opportunities. Institute for Agriculture and Trade Policy. Minneapolis, MN.

⁶ The value of shipments refers to the net selling value of all products shipped within a particular industry. Census Bureau (2004). Economic Census, Manufacturing Reports, Industry Series, 1992, 1997 and 2002. US Department of Commerce, Census Bureau.

⁷ Beghin and Jensen (2008).

⁸ Erickson, A. (2004). "The U.S. HFCS industry: A strong foundation = A strong future." *International Sugar Journal* 106(1268): 422-425.

⁹ Schoonover, H., Muller, Mark (2006). Food without Thought: How U.S. Farm Policy Contributes to Obesity. Institute for Agriculture and Trade Policy. Minneapolis, MN.

¹⁰ See data from USDA ERS (2008) High fructose corn syrup: estimated number of per capita calories consumed daily, by calendar year, and discussion in Haley, S., Ali, Mir (2007). Sugar Backgrounder. *Outlook Report*. Washington, D.C., USDA Economic Research Service.

¹¹ Bray, G. A., Nielsen, Samara Joy, Popkin, Barry M. (2004). "Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity." *The American Journal of Clinical Nutrition* 79: 537-43.

¹² FAPRI (2007). U.S. and World Agricultural Outlook 2007. Food and Agricultural Policy Research Institute. Ames, IA, Iowa State University.

¹³ Beghin and Jensen (2008).

¹⁴ Warner, M. (2006). A Sweetener With a Bad Rap. *The New York Times*. New York, New York. July 2, 2006.

¹⁵ See Starmer and Wise, "Feeding at the Trough: Industrial Livestock Firms Saved \$35 Billion From Low Feed Prices." *GDAE Policy Brief No. 07-03*, December 2007: <http://www.ase.tufts.edu/gdae/Pubs/rp/PB07-03FeedingAtTroughDec07.pdf> and Starmer and Wise, "Living High on the Hog: Factory Farms, Federal Policy, and the Structural Transformation of Swine Production," *GDAE Working Paper No. 07-04*, December 2007: <http://www.ase.tufts.edu/gdae/Pubs/wp/07-04LivingHighOnHog.pdf>.

¹⁶ The estimate is adjusted to align with FAPRI HFCS production and price data.

¹⁷ A source at USDA shared with us an estimate of HFCS processing costs for wet millers. Adding in corn purchase expenses, we approximate a total cost of \$247.32 per metric ton to produce HFCS. We use historical HFCS supply and production data to estimate industry-wide costs during the 1997-2005 time period, provided by FAPRI (2007). Corn's total share of HFCS production costs is taken from Beghin and Jensen (2008).

¹⁸ Interestingly, Beghin and Jensen's study notes the following: "Historically, large distortions in the sugar market induced a search for a cheaper sweetener, which was found in HFCS. Cheaper corn made HFCS slightly cheaper, as a 20% user subsidy for corn is equivalent to an 8% subsidy on the unit cost of HFCS."

¹⁹ Haley, S., Ali, Mir. (2007). *Sugar Backgrounder*. USDA Economic Research Service.

²⁰ See Starmer, Witteman, and Wise, "Feeding the Factory Farm: Implicit Subsidies to the Broiler Chicken Industry." GDAE Working Paper No. 06-03, June 2006: <http://www.ase.tufts.edu/gdae/Pubs/wp/06-03BroilerGains.pdf>. Given that corn was priced 17% below its cost of production from 1986-1996 and 23% below its cost of production from 1997-2005, we estimate the savings to HFCS manufacturers and soda-makers from 1986-1996 are 74% of the savings during the latter period.

²¹ Beghin and Jensen (2008).

²² Pollan, M. (2002).

²³ Anderson, G. H. (2007). "Much ado about high-fructose corn syrup in beverages: the meat of the matter." *The American Journal of Clinical Nutrition* 86: 1577-8.; Bray, G. A., Nielsen, Samara Joy, Popkin, Barry M. (2004). "Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity." *The American Journal of Clinical Nutrition* 79: 537-43.; Elliott, S. S., Kleim, Nancy L., Stern, Judith S., Teff, Karen, Havel, Peter J. (2002). "Fructose, weight gain, and the insulin resistance syndrome." *American Journal of Agricultural Economics* 76: 911-922.; Melanson, K., Zukley, L., Lowndes, J., Nguyen, V., Angelopoulos, T.J., Rippe, J.M. (2007). "Effects of high-fructose corn syrup and sucrose consumption on circulating glucose, insulin, leptin, and ghrelin and on appetite in normal-weight women." *Nutrition* 23(2): 103-12.

²⁴ Dufault R, LeBlanc B, Schnoll R, et al. (2009) "Mercury from chlor-alkali plants: measured concentrations in product sugar." *Environmental Health*. 8(2).; Wallinga M.D., D., Sorensen, Janelle, Mottl, Pooja, Yablon M.D., Brian. (2009). Not So Sweet: Missing Mercury and High Fructose Corn Syrup. Institute for Agriculture and Trade Policy. Minneapolis, Minnesota.

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