How Much E85 Can Be Consumed in the United States?

by Bruce A. Babcock and Sebastien Pouliot

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The Environmental Protection Agency is poised to release its draft rule for mandated volumes of biofuels for 2014. Earlier this year, EPA indicated that it understood that a limited demand for biofuels, particularly for ethanol, conflicts with the scheduled mandated volumes written in the law. To date, mandates for ethanol have been met with a gasoline blend that contains no more than 10 percent ethanol, referred to as E10. However, mandated volumes for ethanol are scheduled to exceed 10 percent of total gasoline consumption so new marketing channels will need to be developed to meet expanded mandates. Thus, the so-called E10 blend wall presents a real challenge to EPA.

The question we address here is the potential demand for ethanol in excess of the E10 blend wall through E85 consumption. E85 is a blend of motor fuel that contains on average about 75 percent ethanol and 25 percent gasoline.[1] E85 is the most likely channel in the next few years to distribute ethanol in excess of the E10 blend wall because it moves a greater amount of ethanol per volume of motor fuel than alternatives.

Because ethanol contains about two-thirds the energy of gasoline, one gallon of E85 yields about 77 percent of the energy as one gallon of E10. Thus, on a cost-per-mile-driven basis, E85 is equivalent to E10 only if its price is 23 percent below the price of E10. The cost per mile driven is not the only attribute that motivates motorists to select one fuel over another—motorists may prefer a motor fuel that contains more ethanol because they wish to support farmers and the ethanol industry. In contrast, some motorists may discount E85 because it requires more frequent fueling.

Three key factors currently limit the consumption of E85. First, only cars labeled as flex vehicles can run on E85. Data on vehicle registrations in the United States show that as of January 2013, there were about 14.6 million flex vehicles on the road, with the greatest concentrations in Texas, the Midwest, and on the East coast. Given continued sales of flex vehicles, we estimate that there are currently at least 16 million (out of the 244 million total passenger vehicles) in the United States.

The second limiting factor is the number and location of gas stations selling E85. Currently, about 2,500 fuel stations, mostly in the Midwest, have at least one pump to dispense E85—a small fraction of the 115,000 or so fuel stations that sell gasoline. Few pumps are located in other areas with large concentration of flex vehicles. For instance, there are currently only 81 fuel stations in Texas that offer E85, but Texas has more than 1.6 million flex vehicles. The lack of E85 stations along with a mismatch between the location of the existing stations and the location of flex vehicles severely limits E85 sales.

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[1] The findings reported here are taken from two papers previously published:
Babcock, B.A., and S. Pouliot. 2013. "Price It and They Will Buy: How E85 Can Break the Blend Wall." Policy Brief (13-PB-11), Center for Agriculture and Rural Development, Iowa State University.
Babcock, B.A., and S. Pouliot. 2013. "Impact of Sales Constraints and Entry on E85 Demand." Policy Brief (13-PB-12), Center for Agriculture and Rural Development, Iowa State University

The third factor limiting E85 sales is that until recently, E85 has been priced at a level that increased driver's fuel costs. Thus, only real lovers of ethanol have filled their tanks with the fuel. The extent of fuel price disadvantage with E85 is shown in Figure 1 for Minnesota. The dots show price ratios for individual fuel stations and the line shows the average price ratio at a given date. If that ratio equals 0.77, then E85 and gasoline are priced such that they are equivalent on a cost per mile basis; but if the ratio is greater than 0.77, then E85 costs more per mile than gasoline. Since 2000, the average price of E85 has been well above the price needed for drivers to break even on a cost per mile basis.
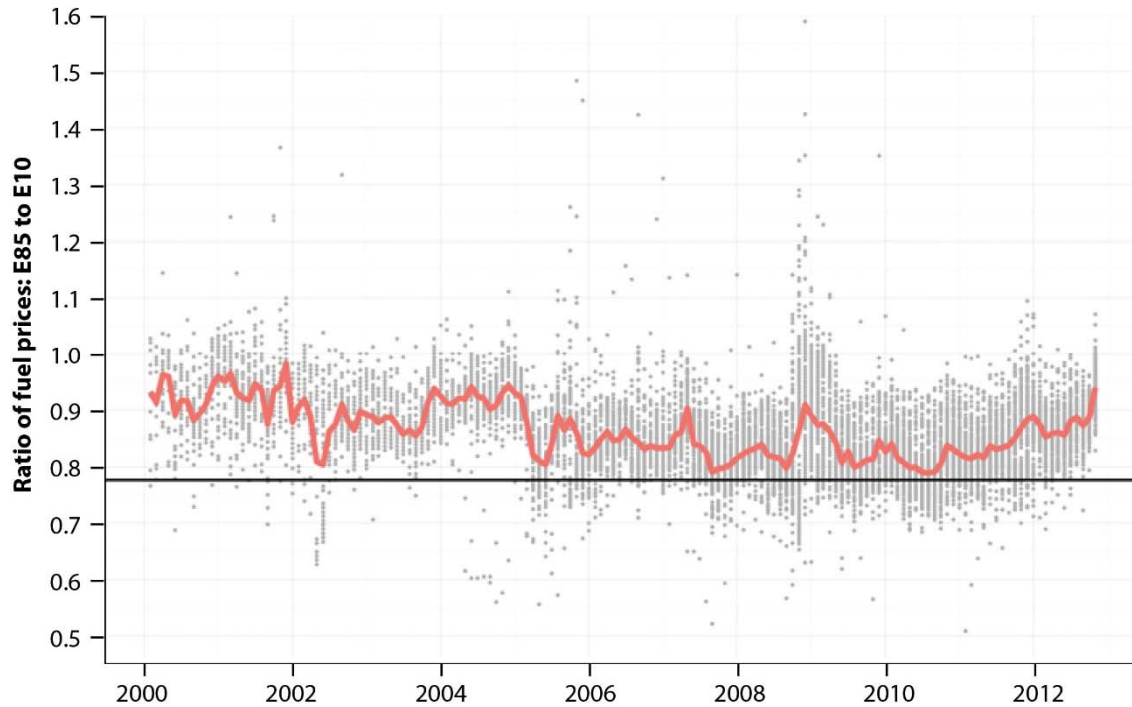
Figure 1. Ratio of E85 to E10 fuel prices in Minnesota

To measure the potential consumption of E85, we calculated the demand for E85 accounting for motorists' preferences for ethanol and gasoline, the geographic location of flex vehicles, the geographic location of E85 pumps and possible capacity limits of individual fuel stations to sell the fuel. Figure 2 below shows the quantity of ethanol in E85 on the horizontal axis and the ratio of the price of E85 to the price of E10 on the vertical axis.

3   *CARD*
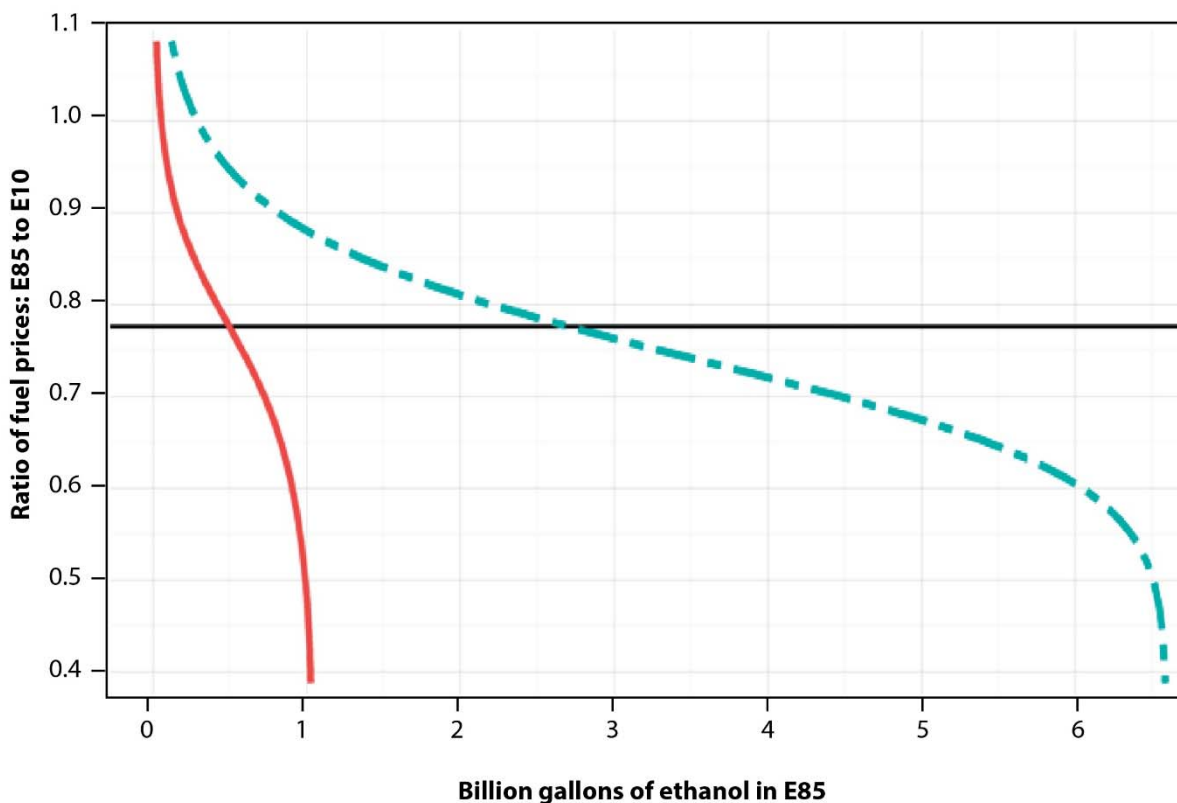
Figure 2. Consumption of Ethanol in E85

Figure 2 shows two ethanol consumption lines that describe how much ethanol can be consumed in E85 for various ratios of E85 to E10 prices. The dashed line is calculated assuming that E85 is as widely distributed in the United States as E10. Thus, the dashed line shows how the number of flex vehicles on the road limits the potential consumption of E85. If E85 and E10 are priced at parity, that is when the ratio of fuel cost per mile equals 0.77, then this line shows that the consumption of ethanol through E85 approaches 3 billion gallons. When E85 is discounted by 10 percent, consumption increases to about 4 billion gallons of ethanol.

The second line in Figure 2 accounts for the additional cost and inconvenience of trying to find an existing station that sells E85. In addition, this line assumes that no station can sell more than 45,000 gallons of E85 per month. Thus, the second line presents an estimate that accounts for limits on both the number of flex vehicles and the ease with which drivers of flex vehicles can find an E85 station. If the prices of E85 and E10 are at parity, fuel stations that currently offer E85 can move about 500 million gallons of ethanol through E85. With a 10 percent discount on E85, consumption increases to about 750 million gallons of ethanol. The maximum amount of ethanol that can be sold in E85 if discounted heavily enough is about one billion gallons.

At a given price ratio, the horizontal distance between the two lines in Figure 1 shows how much current distribution capacity limits the volume of E85 that can be sold. The

difference in volumes highlights that the bottleneck in marketing E85 ethanol is in the number of fuel stations that offer E85 rather than the number of flex vehicles on the road. In fact, if the number of fuel station offering E85 was to double, the volume of E85 sold if priced at parity with E10 would about double.

Table 1 translates the price ratio in Figure 2 into a pump price for E85 and a RIN price. With an E10 pump price of $3.75 per gallon, fuel cost parity corresponds to an E85 pump price of $2.89 per gallon. A 50 cent drop in the E10 prices decreases parity price of E85 by 39 cents to $2.50 per gallon. The RIN prices that would allow E85 to be priced at the indicated levels are calculated by fixing the cost of producing ethanol at $1.75 per gallon and then calculating what wholesale ethanol price would be needed to be able to price E85 at an indicated level. To achieve a 20 percent reduction in fuel cost per mile requires a RIN price of $0.65 per gallon when the E10 price is $3.75 per gallon, or a RIN price of $1.06 per gallon when the E10 price is $3.25 per gallon. Table 1 allows calculation of what it would take in terms of E85 prices and RIN prices to achieve the consumption levels shown in Figure 2.

If consumption of ethanol in the United States is to move significantly beyond the E10 blend wall then consumption of E85 must increase. There were enough flex vehicles on the road at the end of 2012 to consume about three billion gallons of ethanol if E85 were priced at parity with E10 on a fuel cost per mile basis. However, because of a limited number of stations, this fuel price ratio would result in 500 million gallons of ethanol sold as E85. An additional fuel cost discount of 10 percent would increase ethanol consumption by about 250 million gallons. Consumption beyond these levels will require a substantial increase in the number of stations that offer E85. Whether investment in E85 fueling infrastructure actually occurs depends on whether EPA sets biofuel mandates at levels that can be met only by increasing the amount of ethanol that is sold in E85.

Table 1. Translating Fuel Cost Ratios into E85 Pump Prices and RIN Prices

Fuel Cost Ratio	E10 Price = $3.75/gal		E10 Price = $3.25/gal	
	E85 Pump Price	RIN Price	E85 Pump Price	RIN Price
	$/gal			
1.2	3.47	0.00	3.00	0.00
1.1	3.18	0.00	2.75	0.06
1.0	2.89	0.00	2.50	0.40
0.9	2.60	0.27	2.25	0.73
0.8	2.31	0.65	2.00	1.06
0.7	2.02	1.04	1.75	1.40
0.6	1.73	1.42	1.50	1.73

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