IS PREMIUM GASOLINE THE TARGET MARKET FOR METHANOL?

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ABSTRACT

A survey of vehicle owners was conducted in New York State and California to explore the market potential of methanol. Data on premium gasoline purchase behavior and willingness to pay for cleaner fuels and more power were collected. We found that drivers are willing to pay slightly more for cleaner fuels than for more power or more octane, although we do not interpret this to mean that when confronted at a fuel pump with two fuels, one cleaner but more expensive than the other, that a motorist would select the more expensive cleaner-burning fuel. Rather, motorists are willing to pay more, but only if everyone is paying more.

We found that income is not an important predictor of cleaner fuels, suggesting that environmental concerns cut across socio-economic groups. As expected, income is an important variable for explaining premium (high octane) gasoline purchase behavior, and even more important in explaining demand for more power. Consumer decicions are also sensitive to the type of car they drive (fuel injection, number of cylinders) and fuel prices. Gender and to some extent, respondents' domicile are significant variables in certain cases. We conclude that current premium gasoline buyers are likely to be the core group of buyers of methanol vehicles and fuels.

INTRODUCTION

This paper is an exploration of the potential demand for methanol fuel in the household vehicle market. We conducted a survey of vehicle owners in New York State and California to analyze the demand for premium gasoline, as well as for important attributes associated with methanol fuel. We collected data on actual behavior and stated preferences.

We focussed on premium gasoline because it is the closest analogy in the marketplace to methanol fuel, in the sense that both fuels have high octane ratings and high prices. Although they also have dissimilar attributes, the analogy is useful in that methanol will have to be perceived and priced as a premium fuel, as is the case with high octane premium gasoline currently, to gain significant market penetration.

According to this premium fuel analogy, we can expect a large number of people to be willing to purchase methanol if it is perceived to be a superior fuel, even if it is more expensive than regular gasoline.

Because the demand for premium gasoline is not perfectly analogous to the future demand for methanol, we supplemented data on premium gasoline choice behavior with a mixture of hypothetical choice questions aimed at understanding demand for two attributes of methanol fuel that are significantly different from those of premium gasoline: less polluting emissions and greater engine power. A third attribute that distinguishes methanol from gasoline (if fuel tank size is unchanged) is greater refueling frequency (see Sperling and Kurani, 1987; Sperling and Kitamura, 1986).

The overall objective of this study was to explore the willingness of consumers to pay for methanol fuel and to analyze differences across population groups.

BACKGROUND

The principal motive for introducing methanol as a transportation fuel is its emission characteristics; the relatively low reactivity of the emissions means that in those areas with a relatively high ratio of nitrogen oxide to hydrocarbons in the atmosphere, the combustion of methanol instead of conventional gasoline will result in significant reductions in urban ozone concentrations.

Methanol has two other important attributes that, from a consumer perspective, distinguish it from gasoline: it provides about 10% greater power than gasoline in a comparably-sized engine; and, because methanol has only half the energy content per unit of volume of gasoline, methanol vehicles must be refueled roughly twice as often (or outfitted with larger fuel tanks). Methanol has other distinctive attributes, but they are either relatively unimportant in the vehicle and fuel purchase decision, or they cannot be readily characterized as a clear advantage or disadvantage.

Premium gasoline is distinguished from regular gasoline primarily by its higher octane rating and higher price. Gasoline suppliers sometimes put special additives in premium gasoline to keep the very narrow passages in modern fuel injectors clean, but these detergent additives are increasingly being put in regular gasoline as well (Consumer Reports, 1990).

In recent years, regular unleaded gasoline in the US had an octane rating ((R+M)/2) of 87, while premium grades generally had ratings of 91 or 92. In the late 1980s, gasoline marketers began selling a mid-grade premium gasoline with ratings of 88 to 90, first on the east coast, and later elsewere, to take advantage of what they saw as a greater willingness of consumers to pay extra for a premium gasoline.

Virtually all of the premium gasoline sold in the US since the early 1980s has been unleaded. Premium gasoline sales steadily increased from 13% of the total gasoline market in 1983 to 29% in 1989 (EIA, 1989). The price differential between premium and regular unleaded gasoline increased from 6 cents per gallon in 1983 to 13 cents in 1989 (EIA, 1990).

It is widely believed by oil and auto industry analysts that people are buying premium gasoline beyond what their vehicles need. In other words, consumer perceptions of the benefits of premium gasoline may not match the reality of those benefits. The major auto manufacturers insist that virtually all their cars will run well on regular gasoline. The only systematic test of octane needs are those conducted annually by the Coordinating Research Council (1989). Those studies tend to overstate octane requirements; if knocking is detected in a car, then that car is determined to need a higher octane, even though automotive engineers note that small amounts of knocking and pinging do not hurt the engine. In fact, an engine is considered to be operating most efficiently when it knocks on hills and during accelaration.

Even so, using its more conservative approach, CRC determined that 73% of new cars needed up to 87 octane in 1985; 82% in 1986; 73% in 1987; and 88% in 1988. Taking into account octane "creep" in aging cars, CRC estimated that 15-16% of all cars in 1987 and 1988 required greater than 90 octane. Since sales of gasoline rated at over 90 octane accounted for 23.5% of sales in 1988, one concludes that at least one third of all premium gasoline sales are unneeded. Using a less conservative approach than that of CRC would lead to much higher estimates of "unneeded" gasoline sales. We explore this demand for premium gasoline through our survey later in the paper with the intent of determining whether buyers of premium gasoline would be interested in methanol.

RESEARCH APPROACH

In late February 1989, 5000 questionaires were mailed to randomly-selected owners of registered automobiles in New York State and California. Of the 5000 individuals sampled, 1876 usable surveys were returned. Another 505 were returned as "undeliverable", 11 were returned from diesel owners, and 6 were returned blank and without comment. Therefore the final response rate is 42%. The returned questionnaires were weighted heavily toward males (approximately 69%), as are automobile registrations.

The Contingent Valuation Method (CVM) was selected for this study to derive estimates of what consumers are willing to pay for premium gasoline and selected attributes of methanol fuel that differ from gasoline. CVM is widely accepted as a method of generating willingness-to-pay (WTP) functions for a wide variety of market and non-market goods, including environmental benefits (see Hanemann, 1984; and Loomis, 1988).

The basic premise of CVM is that a respondents bid how much they are willing to pay for a particular good under specified market conditions using a designated payment technique. In our questionnnaire, respondents could choose from eight different bid amounts, ranging from $0.02 up to $0.45 per gallon extra, for lower emissions, higher octane, and more power.

To analyze demand for methanol, we identified three indicators that are treated as distinct dependent variables: 1) willingness to pay for premium gasoline, 2) willingness to pay for cleaner fuel, and 3) willingness to pay for extra power.

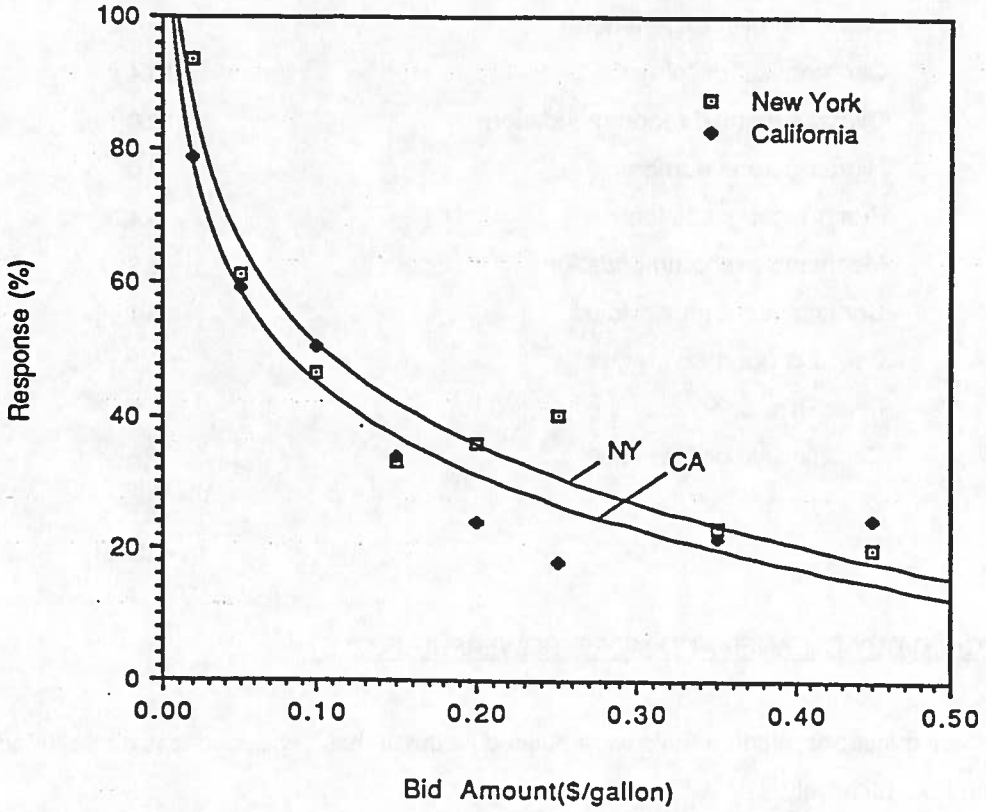
From the survey, twenty independent explanatory variables were specified and grouped into the following three subgroups: socioeconomic, demographic and other personal attributes; vehicle characteristics which may affect a driver's choice of fuels; and behavioral and attitudinal attributes with respect to fuel purchases.

WHO BUYS PREMIUM GASOLINE, AND WHY?

As shown in Figure 1, we found that residents' domicile was correlated with willingness to pay for premium gasoline; that is, New Yorkers are more likely to purchase premium gasoline than Californians. This finding about differences between California and New York drivers is consistent with sales data that showed higher market penetration by premium gasoline sales in New York.

Gender is also strongly related to willingness to pay for premium gasoline. Everything else being equal, men are willing to pay only about 68% as much extra for premium gasoline as women. Perhaps female drivers perceive that spending a little more for fuel is justified by their belief that the car is less likely to break down if it is operating on premium fuel.

FIG.1 Willingness to Pay for Unleaded Premium



To understand why people buy premium gasoline, we presented respondents with a list of reasons for buying premium gasoline and asked them to select the reason that was most important to them. As indicated in Table 1, almost 40% of premium users checked the response that the most important reason for using premium gasoline was that "based on my own experience my car runs better on a higher-grade unleaded." An additional 16% cited the most important reason as being the car knocks or pings. Less than 5% cited the reason as being their car runs poorly on regular gasoline. These responses support the presumption that a large proportion of drivers are willing to pay $0.10-0.15 per gallon more for a premium fuel, even if the measurable (or perceived) benefits are minimal.

Table 1: Reason for Purchasing Premium

Based on own experience	39.1
Car "knocks" or "pings"	16.4
Owner's manual recommendation	12.0
Higher octane number	9.0
Prefer higer grade fuel	5.4
Mechanic's recommendation	5.2
Contains detergent additive	5.1
Car runs poorly on regular	4.8
Friend's suggestion	1.6
Car "diesels" or "runs-on"	1.5
	100.0%
	(n = 1085)

WHO WOULD BUY CLEANER AND MORE "POWERFUL" FUELS?

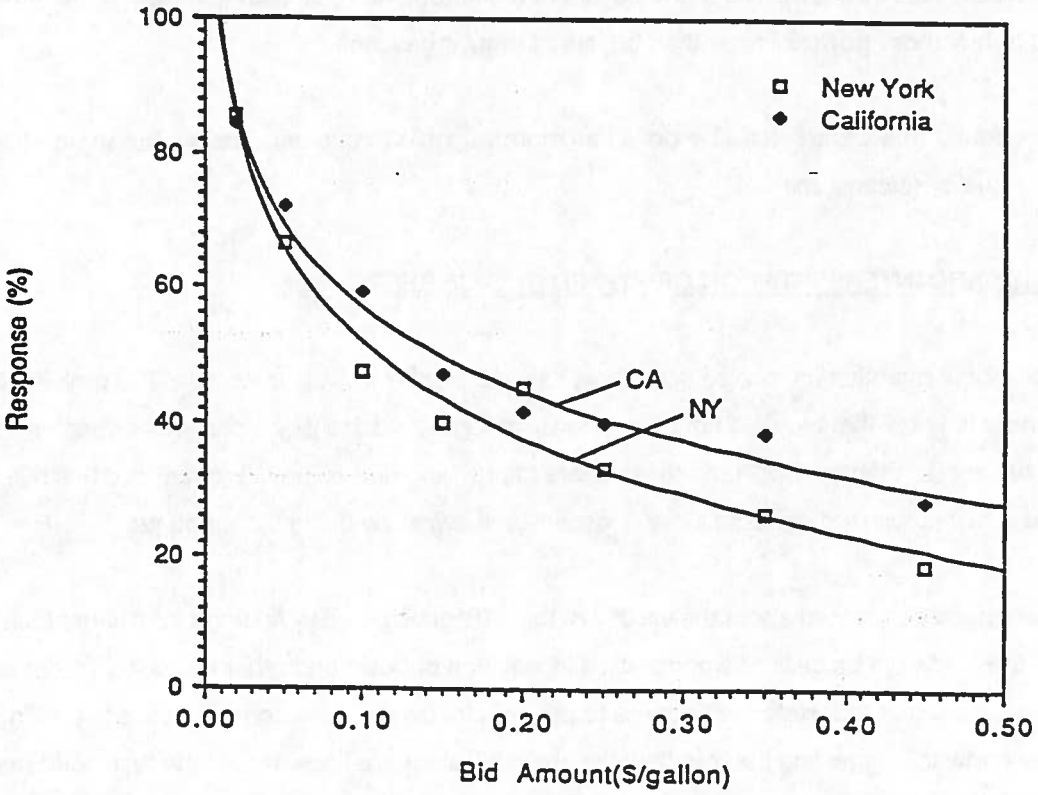
In the survey questions, cleaner fuels were defined as those that "produced less air pollution." "Less" was not defined quantitatively.

All else being equal, we found that women were more willing to buy cleaner fuel than men and, as shown in Figure 2, that Californians were more willing to pay extra for cleaner fuel than New Yorkers, though not as much more as we had expected. In addition, those who typically purchased premium unleaded gasoline were also more willing to buy cleaner fuel.

A surprising finding, unlike the analysis of demand for premium gasoline, is that income is not related to willingness to pay for cleaner fuels. A partial explanation is that environmental concern indeed cuts across all socio-economic groups. A second more plausible explanation is that individuals are not being called upon to make actual cash payments, and therefore may overstate their willingness to pay, especially less affluent individuals.

Demand for cleaner fuel was found to be slightly less price elastic than demand for premium gasoline.

FIG. 2 Willingness to Pay for Cleaner Fuel



Several conclusions can be noted so far. First, income is not an important variable in predicting the purchase of cleaner fuels. Second, people value cleaner fuel more than octane rating (premium gasoline) and those who value cleaner fuel are somewhat less sensitive to higher prices than those willing to pay for premium gasoline. Third, female drivers are willing to spend more on cleaner fuels. Fourth, premium gasoline buyers in California seem to be more willing to pay for cleaner fuel than those in New York.

Because methanol potentially provides more power than an equivalent amount of gasoline energy, the willingness of consumers to pay for additional power may be a good indicator of future demand for methanol. We posed the following question in the survey: "Would you switch to a fuel that gave your car about 10% more power if it was priced higher than the gasoline you normally buy?"

Using a model similar to that for predicting demand for premium gasoline and cleaner fuel, we tested the ability of several variables to predict willingness to pay for more power. We found only three variables that were good predictors: higher income group was about 25% more willing to pay for extra power, mechanically inclined drivers were almost 1.8 times more likely to purchase more powerful fuels than

mechanically less inclined drivers, and buyers of higher octane (gasoline) fuel were seven times more willing to buy more powerful fuels than buyers of regular gasoline.

We also found that drivers perceive power as more valuable than octane rating, but slightly less valuable than air quality (cleaner fuel).

VALIDITY AND INTERPRETATION OF STATED CHOICE RESPONSES

The validity of hypothetical choice questions, as used in this study, is uncertain. The problem is that if respondents know that they will not be bound by an expression to pay a certain amount for a particular good or service, then they will tend to overstate their willingness to pay. We reduced this overstatement bias associated with willingness to pay questions somewhat by using bid amounts.

We were most concerned about the validity of the willingness-to- pay findings for cleaner fuels, since clean air will always be desired when treated in isolation of costs and other tradeoffs. To our surprise, however, we found that stated willingness to pay for cleaner fuel was comparable to the willingness to pay for extra power, suggesting that our findings are valid, since we know that in the real-world marketplace that the willingness to pay for power is large.

About 85% of respondents were willing to pay, relative to their current gasoline, an additional 2 cents per gallon for extra power and over 20% were willing to pay an additional 40 cents. We further found that, drivers were willing to pay even more for cleaner fuels. This willingness to pay for cleaner fuels does not mean, however, that when confronted at a fuel pump with two fuels, one cleaner but more expensive than the other, that a motorist would select the more expensive cleaner-burning fuel. For example, in 1970 when environmental conciousness was at its zenith in the U.S., most of the major oil companies began marketing low-lead or no-lead gasoline primarily on the basis of the air quality benefit of eliminating lead. The unleaded gasoline sold for only 1-4 cents per gallon more than leaded gasoline, and yet sales were less than 3% of gasoline sales in 1971 and did not exceed 5% until catalytic converters were widely introduced on vehicles in 1975 (Sperling and Dill, 1988).

We therefore interpret the high willingness to pay for cleaner fuels as a willingness to pay if the cost burden is shared by all. It is a texbook "free-rider" problem. One approach for transforming this high willingness to pay into a politically acceptable initiative might be to place a surcharge on dirtier fuels as a means of subsidizing cleaner fuels; it would be most acceptable if that surcharge was specifically targeted to supporting cleaner fuels and clean air, and not deposited in the general budget.

IMPLICATION FOR METHANOL

Our analysis of the premium gasoline market indicates that it is difficult to explain fully why premium gasoline purchases are so large and continuing to increase. The CRC field test surveys and our survey indicate that some vehicles do tend to operate better on premium gasoline -- with less pinging and knocking -- but much of the purchasing behavior is not explained by this fact.

We conclude that a large portion of the driver population has a vague sense, reinforced by gasoline advertising, that premium gasoline is somehow good for their vehicle. Given that gasoline costs are a relatively minor part of the total cost of owning and operating a vehicle, many owners apparently buy premium gasoline as a sort of insurance policy.

For methanol to gain significant market penetration, it also must be perceived as a premium fuel. Since methanol can legitimately be marketed as a high-octane, "cleaner" fuel, that provides more power, it could also be positioned as a premium fuel.

In exploring the potential (hypothetical) willingness to pay for methanol, we analyzed qualitatively and quantitatively those three attributes -- higher octane, cleaner burning, and more power -- in order to establish willingness to pay for each attribute. While these willingness-to-pay figures cannot be added together to arrive at one total figure for methanol, it is possible to gain some sense of the target market.

We define the target market for methanol as the set of people who are willing to pay more for the three attributes analyzed above. By pooling together drivers who favored all attributes at each bid amount in our survey, we found that, indeed, a significant proportion of drivers are willing to pay more for these three attributes.

Of drivers who were willing to pay 2 cents per gallon more for higher octane, 71% were also willing to pay 2 cents more for cleaner fuels and 2 cents more for extra power. Of those willing to pay 5 cents more for higher octane, 63% were also willing to pay 5 cents more for both cleaner fuels and for extra power. The comparable percentages of those willing to pay higher bid amounts for higher octane as well as the other two attributes varied from 57% to 45% in a decreasing pattern.

Overall, the target market, as defined above, is approximately 19% of the total sample. Most of this target market comprises premium gasoline users. The target market consists of 24%, 4% and 72% of regular, mid-grade and premium gasoline buyers respectively. Although regular unleaded buyers represented a

higher relative percentage than mid-grade buyers, mid-grade buyers favoring those three attributes was 12% of the total mid-grade respondents compared to only 8% of regular unleaded buyers. No matter how we define the target market premium gasoline users are likely to be the core group of methanol powered vehicles.

Moreover, the target market included more than half of those willing to pay more for extra power (52%, 367 out of 707) while it accounted for only 42% of the comparable group of air quality enthusiasts (367 out of 881). On average, income for the target market was higher than for the entire sample set ($58,000 vs $42,000). This target population included slightly more men than the total sample (75% vs 70%), drove slightly newer and bigger cars, but were just as likely to live in California as New York state.

The magnitude of the target market for methanol can be defined in different ways -- for instance, by including those who are willing to pay some large amount for any two of the three attributes -- but no matter how one defines the target market, it appears to be potentially large. And what is most attractive from a methanol marketing perspective is that there is a large overlap between people who place a high value on each of the three attributes, a finding that surprised us.

The estimates of market potential derived above, based on willingness to pay for positive attributes, should be seen as upper bounds. First, as indicated earlier, while we have confidence in the estimates of willingness to pay, all else being equal, the extra costs are probably larger than individuals would actually pay in actual transactions.

Second, the shorter driving range associated with methanol will shrink drivers' willingness to pay for the fuel. We asked a question regarding refueling: whether respondents would buy a new fuel that provides 10% more power and less air pollution, if it required twice as much refueling. If we subtract from the target market those who answered "no" to that question, then the size of the target market shrinks from 19% to 14% of the total sample.

Other factors -- such as safety and national interests -- could increase or decrease the market potential of methanol, but these factors are more tied to perceptions and social messages than quantifiable attributes; further research is needed to determine their importance of these factors in fuel and vehicle purchase decisions.

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