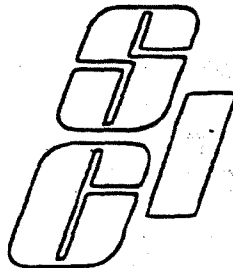


AN ANALYSIS OF THE FACTORS  
LEADING TO THE USE OF LEADED GASOLINE  
IN AUTOMOBILES REQUIRING  
UNLEADED GASOLINE

EPA CONTRACT  
68-01-3866 - Mod 1

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SOBOTKA & COMPANY, INC.

and  
Market Facts Incorporated

This report was furnished to the Environmental Protection Agency by Sobotka & Co., Inc. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.

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## EXECUTIVE SUMMARY

In a survey of owners of automobiles requiring catalytic converters 6% of the respondents reported that they use leaded gasoline to fuel their vehicles; 77% reported that they use only unleaded gasoline. Another 17% gave ambiguous or inconsistent information about their fuel purchases. The nature of their responses makes it appear possible or even probable that they had used leaded fuel in their automobiles at least two times. Thus, it appears that at least 6% but no more than 23% of automobiles with catalytic converters are operated with converters that may be inoperative because two tankfuls of leaded gasoline may be sufficient to render the converter inoperative.

If the price differential between leaded and unleaded gasoline is eliminated, the percent of switching to leaded for use in vehicles requiring unleaded will decline to about 6% from a current estimated level of roughly 15%.<sup>1</sup> In order to eliminate all switching without compulsion or inspection, it would be necessary to improve people's perception of the

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<sup>1</sup> The 15% estimate is based on a survey separate from the one whose results are described in the previous paragraph and is consistent with those results. These estimates reflect use of leaded two or more times in vehicles requiring unleaded. Estimates of about 10% based on service station observation, appears lower. But not all switching is consistent. Therefore, service station observations understate the percent of vehicles requiring unleaded that have been fueled with leaded two or more times.

quality of unleaded gasoline because a significant fraction of purchasers report that they believe that unleaded gasoline leads to automobile performance inferior to that obtainable with the use of leaded gasoline.

It is likely that switching will increase if current price differentials and quality perceptions are maintained because there is considerable dissatisfaction with the unleaded product among those who now use it consistently. The introduction of premium unleaded grades is likely to cause a small reduction in switching and may increase the use of unleaded gasoline in vehicles in which it is not required.

No investigation was made of the determinants of the use of unleaded gasoline in automobiles without catalytic converters. Changes in gasoline qualities and prices would probably affect the demand for unleaded gasoline for use in these vehicles.

## CHAPTER I

### INTRODUCTION

#### A. Background and Objectives

This study was commissioned by the Environmental Protection Agency (EPA) in response to a concern over the apparent widespread use of leaded gasoline in vehicles requiring unleaded fuel. It has been estimated that as much as 10 percent of the gasoline purchased for such vehicles is leaded.<sup>1</sup> Since two tankfuls of leaded gasoline used in a car equipped with a catalytic converter will render the converter inoperative, this fuel switching (the use of leaded gasoline in a vehicle requiring unleaded) adds substantially to air pollution.

The objectives of the study are to:

1. Determine the scope of and the casual factors leading to the use of leaded gasoline in vehicles designed for unleaded gasoline,
2. Analyze the importance of automobile users' perceptions about price differentials, absolute price levels and other key variables contributing to switching, and
3. Estimate the extent to which switching might be reduced by changes in gasoline price differentials or other measures.

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<sup>1</sup> EPA estimate. Note that more than 10% of vehicles requiring unleaded fuel are likely to have been fueled with leaded gasoline two or more times even though some do not use leaded consistently.

B. Conduct of the Study

The results presented in this report are based on a mail survey conducted through the facilities of Market Facts' Consumer Mail Panels. This facility consists of some 65,000 households broadly representative of the continental United States population who have agreed to participate in mail surveys from time to time.

The survey reported here was restricted to households known to have post-1974 vehicles in family use. Of 2,600 questionnaires mailed out, 1,500 were returned and 1,266<sup>1</sup> were analyzed. An additional mailing was made to a different sample of comparable households in order to obtain an independent estimate of switching by use of a "Sensitive Question" technique.<sup>2</sup>

The analysis was restricted to vehicles known to require a catalytic converter. Hence none of the study's results are directly usable for inferences about the use of unleaded gasoline in vehicles not equipped with catalytic converters.

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<sup>1</sup>Pick-ups, vans, and recreational vehicles were excluded because of difficulties in ascertaining the catalytic converter requirement.

<sup>2</sup>A mailing was made to 1000 households asking for information about the most recent model year automobile in the household. Responses were received from about 800 households of which 307 reported about a post-1974 automobile which required a catalytic converter.

CHAPTER II  
OUTLINE AND SUMMARY OF THE FINDINGS

A. The Scope of Fuel Switching

This section is a description of the methods used to estimate the extent of fuel switching and to define switchers (6%), non-switchers (77%) and possible switchers (17%).

It is estimated that about 15% of the post-1974 car owners are now using or have used leaded gasoline in cars that require unleaded gasoline.

B. Characteristics of Fuel Switchers

This section shows the variation of switching with respect to such variables as:

1. Geographic location,
2. Degree of urbanization,
3. Demographics -- age, education and income,
4. Car purchase and use, and
5. Fuel purchase conditions such as attendant vs. self-service, and cash vs. credit card use.

Switching is found to be more prevalent in the Pacific region than in the East, in rural than in metropolitan areas and among the younger, middle income, better educated segment of the population who are most likely to be economy conscious sophisticated buyers.



### C. Some Possible Causes of Switching

This section explores the following factors as possible causes of switching:

1. Possible unavailability of unleaded gasoline,
2. Price level and unleaded-leaded price differential,
3. Gasoline performance, and
4. Perceived car problems.

Possible unavailability of unleaded gasoline is found to be a negligible factor in switching. These findings do show sufficient discontent with the performance of unleaded gasoline to identify this as a probable cause of some switching. Price differentials between unleaded and leaded are identified as a probable cause of switching.

### D. Trade-Off Analysis

This section uses market simulations based on the Trade-Off Analysis method to study the probable effect on switching of:

1. Varying unleaded-leaded gasoline price differentials,
2. Improving the gasoline buyers' perceptions of the performance of unleaded gasoline, and
3. Introducing a premium grade unleaded gasoline with varying price configurations.

7.

The results suggest that eliminating the price differential and improving the quality, or consumers' perceptions of the quality, of unleaded gasoline should greatly reduce, and almost completely eliminate, fuel switching. The introduction of an unleaded premium would cause only a slight direct reduction in switching given a small price differential between unleaded and leaded regular grades. However, there does appear to be considerable interest in such a product among current users of unleaded gasoline. This suggests that it may stem further growth in switching in the long run by providing a more satisfactory alternative to unleaded regular.

CHAPTER III  
FINDINGS AND METHODOLOGY

A. The Scope of Fuel Switching

In this section we estimate the extent of fuel switching. We also describe the method used to classify respondents according to the likelihood of their having used two or more tankfuls of leaded gasoline in their post-1974 cars. The classification is based on their responses to questions about their last and previous gasoline purchases for those cars.

The principal obstacles to estimating the extent of fuel switching and to identifying those who have switched are:

1. Reluctance to admit to fuel switching on the part of those respondents who may feel that it is socially undesirable and possibly illegal, and
2. Confusion about the distinction between leaded and unleaded gasoline and about grades and types of gasoline generally purchased.

To circumvent the first of these obstacles, reluctance to admit switching, Market Facts mailed a brief questionnaire to a sample of car owning households (independent of the one used in the buying survey) with cars requiring catalytic converters. This questionnaire employed a

"Sensitive Question" technique that enabled the respondent to supply information useful in estimating the extent of fuel switching without revealing whether the respondent had actually switched fuels.

The essential portion of the questionnaire used for this purpose follows:

Step one -- Remove the coin attached to this questionnaire and flip it --

Step two -- If the coin comes up

Heads -- Answer Question #1 only  
Tails -- Answer Question #2 only

but do not indicate which question you are answering.

- | <p>1. Was your mother born in the month of April? RECORD ANSWER IN THE APPROPRIATE BOX TO THE RIGHT.</p> <p>2. I have used leaded gasoline in this car two or more times since I have been driving it. RECORD ANSWER IN THE APPROPRIATE BOX TO THE RIGHT.</p> | <table border="1"> <tr> <th colspan="2">ANSWER BOX</th> </tr> <tr> <td>Yes</td> <td><input type="checkbox"/></td> </tr> <tr> <td>No</td> <td><input type="checkbox"/></td> </tr> </table> | ANSWER BOX |  | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|---|---|------------|--|-----|--------------------------|----|--------------------------|
| ANSWER BOX  |   |            |  |     |                          |    |                          |
| Yes   | <input type="checkbox"/>  |            |  |     |                          |    |                          |
| No  | <input type="checkbox"/>  |            |  |     |                          |    |                          |

Based on the responses to this question, it was estimated that 13.7% of the post-1974 car owning panel households are fuel switchers.<sup>1</sup>

<sup>1</sup>The formula for calculating the "yes" responses to the "sensitive" question is

$$\frac{1}{2} S + \frac{1}{2} M = Y$$

where S is the percent answering "yes" to the sensitive question, M is the percent of females born in April (8.3%) and Y is the total percent answering "yes" in the box (11%). The lower and upper 90% confidence limits for the 13.7% estimate are 5.9% and 21.5%

The classification of respondents according to the likelihood of their having switched fuels was based on the following information about the last gasoline purchase for their post-1974 car:

1. Responses to direct questions as to whether they purchased unleaded or leaded gasoline, and
2. Responses to two other questions which might or might not be consistent with their response to the direct question: what grade they bought (open-ended response) and the relative price of the gasoline they bought (whether it was the lowest or highest price, a price in between, or the only gasoline available at the station).

On the basis of this information, respondents were classified according to their reported last purchase of gasoline as follows:

	Reported	
	<u>Leaded</u>	<u>Unleaded</u>
<u>TOTAL</u>	<u>6%</u>	<u>94%</u>
Definite	5	77
Probable	1	4
Doubtful	-	11
Inconsistent	*	2

\*Less than 0.5%.

Previous purchases (other than the most recent) were also studied. The respondents who reported buying unleaded were asked whether they had ever bought leaded gasoline and, if so, the relative frequency of their use of leaded and unleaded. Those who reported a purchase of leaded gasoline the last time they bought gasoline were asked similar questions about previous purchases of unleaded.

On the basis of their last and their previous purchases, respondents were classified as follows:

Switchers (definite)	6%
Probable switchers	4
Possible switchers	13
Non-switchers (definite)	<u>77</u>
	100%

For most of the analysis of the findings, we make comparisons among three groups:

Switchers (definite)	6%
Probable and possible switchers	17
Non-switchers	<u>77</u>
	100%

## B. The Characteristics of Switchers

This section describes the characteristics of switchers. The principal findings are displayed in the table on the following page and further details are shown in Appendix A.

As might be expected, fuel switching is more prevalent in rural areas where there are likely to be more "do-it-yourselfers" who find it easy to modify the tank openings.

Fuel switching is by no means restricted to lower income groups. It is more prevalent among relatively young, middle income, educated people who are more sophisticated buyers than the poor, and are more price conscious than the very affluent.

Since self-serve avoids the involvement of an attendant as an accomplice in fuel switching, it is not surprising that switching is more prevalent among self-serve gasoline buyers.

### Characteristics of Switchers

Compared to the average, switching is:

Higher In:

The Pacific coast region (120)

Rural areas (120A)

Lower In:

The East

Metropolitan areas

Higher Among:

25-44 year olds (127)

Middle income groups  
(\$17.5-\$24.9K) (125)

College graduates (121)

Males<sup>1</sup> (121)

Used car buyers ( 4)

Those with cars driven  
15-49.9K miles ( 4A)

Self serve buyers ( 20)

Cash buyers ( 21)

Lower Among:

45 + year olds

Low and very high income  
groups (\$25K and up)

High school graduates or  
less educated

Females

New car buyers

Those with cars driven  
less than 15K miles

Attendant serve buyers

Oil company credit card  
buyers

Notes:

- 1) There were no definite switchers in New Jersey, where state law provides for an annual inspection of emissions. (119)
- 2) Definite switchers have more cars per household than do other groups. (1)

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<sup>1</sup>Definite switchers only.

( ) Numbers in parentheses refer to page number in Appendix A.



### C. Possible Causes of Fuel Switching

In this section, we explore the findings of the survey with a view to isolating the possible causes of fuel switching. In particular, we examine the relation between fuel switchers and each of these factors:

1. Unavailability of unleaded gasoline,
2. Price level,
3. The unleaded vs. leaded price differential,
4. The perceived performance of gasoline,
5. Problems with car performance in relation to use of leaded vs. unleaded gasoline.

While the results are not conclusive, they do point to two factors as the principal causes of switching: the price differential between unleaded and leaded gasoline, and a perception of unleaded gasoline as inferior in performance.

#### 1. Unavailability of Unleaded Gasoline

Very few respondents (6%) reported that the regular grade of unleaded gasoline was unavailable at the station where they last bought gasoline. One may safely rule out unavailability as a significant factor in fuel switching except, possibly, for some occasional purchases in an emergency situation.

The following table shows responses used in evaluating this factor:

<u>Grade and Type</u>	Percent of Respondents Reporting Grade and Type:		
	<u>Not Available</u>	<u>Available</u>	<u>No Answer</u>
Regular unleaded	6%	82%	12%
Premium unleaded <sup>1</sup>	39	32	29
Regular leaded	3	77	20
Premium leaded	14	57	29
Number of respondents		(1,266)	

## 2. Price Level

The impact of price level was examined in two ways:

- a. In terms of the reported price of regular leaded gasoline at the station where the respondent made his/her last gasoline purchase, and

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<sup>1</sup>In view of the fact that very few brands currently sell a premium unleaded gasoline we might have expected many more than 39% of the respondents to report its unavailability at the station. This finding suggests that some respondents may think that some (or perhaps all) brands of unleaded gasoline are of "premium" grade, possibly because of its price differential over regular leaded.

b. In terms of the perceived base price.

This was defined to respondents as:

"The price per gallon of the least expensive grade of gasoline that might be available in your area at a station carrying a brand that you would consider using."

The results of both of these analyses are inconclusive in establishing a causal relation between fuel switching and price level. Fuel switchers and non-switchers report no significant difference in the average perceived price of leaded regular gasoline at the station where they made their last gasoline purchase as illustrated below:

	<u>Definite and Probable Switchers</u>	<u>Non- Switchers</u>
Mean reported price of leaded regular in cents per gallon (cpg)	60.6 cpg	60.5 cpg

The following table shows that fuel switching may be slightly more prevalent in areas where gasoline prices are low than where they are high:<sup>1</sup>

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<sup>1</sup>This finding that switchers are more prevalent in areas of perceived low regular leaded prices may reflect the greater use of self-service (at a lower price) by switchers than by non-switchers.

<u>Base Price (cpg)</u>	<u>Percent Switching (Includes Probable Switchers)</u>
50-54¢	9%
56¢	10
59¢	10
61¢	12
64¢	9
67¢	7
70¢	3
No answer	11

### 3. The Unleaded vs. Leaded Price Differential

The following analysis of the relation between switching and the price differential between unleaded and leaded gasoline is not inconsistent with the hypothesis that high price differentials cause some switching. (The price differential hypothesis is explored in depth by a different approach in Section D.) The data is shown in the following table:

<u>Price Difference (cpg) Unleaded Minus Leaded</u>	<u>Percent Switching (Definite Switchers Only .)</u>
0 - 2¢	4
3 - 5¢	6
6 - 7¢	4
8¢ or more	8
No answer	8

#### 4. The Perceived Performance of Gasoline

Respondents were asked which of the four grades and types of gasoline would give the best and which would give the worst performance in their car. The following table shows how many of them rated each of the grades and types best for the group as a whole and for each of the switcher groups. Note that, except for the switchers, more than four out of five rated one of the unleaded grades best. As might be expected, nine out of ten switchers rated leaded grades best.

#### Percent Rating Type and Grade Best

<u>Type and Grade</u>	<u>Total</u>	<u>Switchers</u>	<u>Possible Switchers</u>	<u>Non-Switchers</u>
<u>Unleaded</u>	<u>82%</u>	<u>7%</u>	<u>88%</u>	<u>87%</u>
Regular	44	4	55	46
Premium	38	3	33	41
<u>Leaded</u>	<u>11%</u>	<u>86%</u>	<u>5%</u>	<u>6%</u>
Regular	5	53	3	2
Premium	6	33	2	4
No answer	<u>7%</u>	<u>7%</u>	<u>7%</u>	<u>7%</u>
Number of respondents	(1,266)	(72)	(217)	(977)

The following table shows how many of the respondents rated each of the four types and grades of gasoline poorest in performance. Note that one out of four respondents was reluctant to single out any one type and grade as poorest.

Another one out of four rated one of the unleaded grades (predominantly the regular grade) as poorest. In the switcher group, two out of three singled out an unleaded grade as poorest. Even among the non-switchers, who use only unleaded gasoline, one out of five rated an unleaded grade as poorest. These results point to dissatisfaction with performance as a probable cause of past switching and a possible cause of more switching in the future.

Percent Naming Types and Grade as Poorest

<u>Type and Grade</u>	<u>Total</u>	<u>Switchers</u>	<u>Possible Switchers</u>	<u>Non-Switchers</u>
<u>Unleaded</u>	<u>23%</u>	<u>62%</u>	<u>22%</u>	<u>20%</u>
Regular	20	51	19	18
Premium	3	11	3	2
<u>Leaded</u>	<u>53%</u>	<u>16%</u>	<u>51%</u>	<u>56%</u>
Regular	47	10	44	51
Premium	6	6	7	5
No answer	<u>24%</u>	<u>22%</u>	<u>26%</u>	<u>24%</u>
Number of respondents	(1,266)	(72)	(217)	(977)

The preceding analysis suggests that fuel switching could be reduced by:

- a. Improving the performance<sup>1</sup> of unleaded gasoline, and consumers' perceptions of its performance
- b. Introducing a premium unleaded gasoline.

<sup>1</sup>The term "performance" was not further defined for the respondents. As we shall see later, it is likely that different respondents used different criteria of gasoline performance. One may safely assume, however, that rating a grade or type of gasoline as likely to give the poorest performance is a valid indication of the perceived quality of the product.

Both of these possibilities are analyzed in relation to price differentials in Section D of this report.

5. Problems With Car Performance in Relation to The Use of Leaded Vs. Unleaded Gasoline

In order to explore which aspects of gasoline performance might be causally related to switching, comparisons were made as to the relative incidence of specific problems between switchers and non-switchers. While the results do not definitively pin-point any specific car problems as a cause of switching, they are consistent with the belief that the lower octane rating of unleaded gasoline is a source of dissatisfaction among its users.

Consistent users of unleaded gasoline (non-switchers) are more likely than leaded gasoline users (switchers) to have problems with knocking and "hesitation," lag in expected power when accelerating or going uphill, as illustrated in the following table:

<u>Car Problem Encountered</u>	<u>Percent Reporting Problem</u>	
	<u>Switchers</u>	<u>Non-Switchers</u>
<u>Knocking</u>	<u>27%</u>	<u>30%</u>
Had any problem	27	30
Had a severe problem	7	7
<u>Hesitation</u>	<u>33</u>	<u>39</u>
Had any problem	33	39
Had a severe problem	3	8
Number of respondents	(72)	(977)

On the other hand, leaded gasoline users are more likely to have encountered problems with run-on (or dieseling) and rough idling. The data is shown below:

<u>Car Problems Encountered</u>	<u>Percent Reporting Problem</u>	
	<u>Switchers</u>	<u>Non-Switchers</u>
<u>Run-On</u>		
Had any problems	38%	30%
Had a severe problem	9	6
<u>Rough Idling</u>		
Had any problem	44	31
Had a severe problem	5	4
Number of respondents	(72)	(977)

There were no appreciable differences between switchers and non-switchers with respect to the reported incidence or degree of severity of problems with stalling, hard starting, or lack of pep.

An important aspect of car performance for most car owners is mileage, the number of miles per gallon. Here, the leaded gasoline users seem to have a definite advantage. Switchers report getting an average of 2.1 miles per gallon more than consistent users of unleaded gasoline. Again, a table illustrates the data:

<u>Average Miles per Gallon</u>	<u>Switchers</u>	<u>Non-Switchers</u>
City driving	18.0 mpg	15.2 mpg
Highway driving	21.6 mpg	19.6 mpg
Overall	19.3 mpg	17.2 mpg



The better mileage reported by the switchers may be a function of the cars they own or of their driving habits rather than of the gasoline they use.

D. Trade-Off Analysis

1. The Effect of Price Differential

In the previous section of this report we explored gasoline buyers' previous buying behavior and perceptions in order to find clues as to the probable causes of fuel switching. In this section, we use the method of Trade-Off Analysis<sup>1</sup> to predict how buyers would respond to various product offerings, such as, premium and regular grades of unleaded and leaded gasoline at various price differentials.

The data used in this analysis was obtained by asking respondents to choose one of two products in each of 38 product pairs in which the products differ with respect to two attributes (for example, type/grade and price), but are assumed to be identical in all other respects. From these 38 choices, one can infer how a buyer would choose one gasoline among a bundle of gasoline products that may differ with respect to:

- a. Type and grade,
- b. Price,
- c. Self-service vs. attendant service, and
- d. Method of payment: cash only vs. credit  
or cash

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<sup>1</sup>See Appendix C for a description of the method.

The products are assumed to be identical in all other respects. These inferences make it possible to simulate various situations where the gasoline buyer would have to choose among several grades and types of gasoline each at its own price (or price differential) but assumed to be the same in all other respects. In a typical application, we consider a scenario such as:

- |               |  |
|---------------|--|
| Product One   | - Regular leaded gasoline at the base price <sup>1</sup>                     |
| Product Two   | - Regular unleaded gasoline at 2 cents per gallon (cpg) above the base price |
| Product Three | - Premium leaded gasoline at 6 cpg above the base price                      |

The Trade-Off model predicts the fraction of buyers who would choose each product. We might then, for example, consider several scenarios where the price differential of Product Two is changed, all other variables remaining fixed, in order to explore the effect of a price change on the preference for leaded over unleaded gasoline, that is, on the percent who might switch.

1 This has been defined as: "The price per gallon of the least expensive grade of gasoline that might be available in your area at a station carrying a brand that you would consider using."

Before discussing the results of several such sets of simulations, it should be kept in mind that they would be applicable only to gasoline bought for a car required by EPA regulations to use only unleaded fuel. Moreover, respondents have been alerted to keep in mind that "... to use leaded gas in your car might require changes in the tank opening to accommodate the wider nozzle used at pumps that have leaded gas."

The following table shows the results of varying the price differential of unleaded regular gasoline from 0 to 8 cents per gallon above the base price (by 2 cpg intervals) in a market where the buyer has to choose among these products: (1) leaded at the base price, (2) unleaded regular at 0, 2, 4, 6, 8 cpg above base, (3) leaded premium at 6¢ above base.

<u>Unleaded Price Differential (cpg above base)</u>	<u>Percent Choosing Leaded</u>
0¢	6%
2¢	11
4¢	15
6¢	31
8¢	69

These results show that an elimination of the price differential between unleaded and leaded gasoline would reduce fuel switching to about 6%. An increase to 6 cpg from the current average differential of 4 cpg would double the current switching rate.

A further increase to 8 cpg would increase switching to the point where more than two-thirds of the gasoline purchased for cars requiring unleaded would be leaded. Note that while a reduction in the price differential would reduce the amount of switching, one could not expect it to be completely eliminated even if the differential were to be reduced to zero.

## 2. The Effect of Gasoline Performance

The existence of a hard core of switching that would remain even at a zero price differential should not be surprising in light of earlier findings that show substantial dissatisfaction with the performance of unleaded gasoline among switchers and considerable discontent with its performance among non-switchers.

In order to explore the impact of performance we repeat the same price simulations among those who rated the performance of unleaded regular gasoline as the best of the four types and grades considered.

The results of the simulations displayed in the following table indicate that among this group, the amount of switching is somewhat reduced at current and higher price differentials and reduced to 2 percent at the zero differential -- one-third of that for the population as a whole.

<u>Unleaded Price Differential (cpg above base)</u>	<u>Among All Buyers Requiring Unleaded</u>	<u>Among Those Rating Unleaded Best In Performance</u>
0¢	6%	2%
2¢	11	4
4¢	15	7
6¢	31	22
8¢	56	66

The appearance of 2 percent (or indeed of any) switching at price parity between leaded and unleaded gasoline among those who consider unleaded gasoline to be superior in performance may seem paradoxical since one would expect everybody to choose the better of two products at the same price. However, one should bear in mind that the phrase "best performance" may not have exactly the same meaning for all people. For example, some people may think that unleaded gasoline delivers more power than leaded but that it has a deleterious effect on the engine; others may not consider "best performance" to include better mileage.

### 3. The Impact of Premium Unleaded Gasoline

The findings of the study suggest a strong interest in a premium unleaded gasoline and at least one major oil company has announced the forthcoming introduction of such a product. The following simulations of a market with four products -- two leaded and two unleaded grades --

indicate that the introduction of unleaded premium would have some but not a substantial impact at the lower price differential levels (unleaded regular vs. leaded regular) that were examined. They might have a substantial impact in reducing switching at higher price differential levels.

The conditions of the simulation are:

- a. Regular leaded at base price; premium leaded at base + 6 cpg.
- b. The unleaded grades at the seven price differential levels shown in the following table:

Unleaded price Differentials (cpg above base)		Percent Choosing Leaded Gasoline	
		With Premium Unleaded Available	With No Premium Unleaded Available
<u>Regular</u>	<u>Premium</u>		
0¢	2¢	5%	6%
0¢	4¢	5	6
2¢	4¢	8	11
2¢	6¢	9	11
4¢	6¢	11	15
4¢	8¢	12	15
6¢	8¢	14	31

Note that at the current average 4 cpg differential between leaded regular and unleaded regular, the introduction of an unleaded premium at 4 cpg above unleaded regular would reduce switching from 15% to 12%. If the differential between

premium and regular unleaded is reduced to 2 cpg, the switching rate is not affected very much. It is reduced by only one percentage point

Unleaded Price Differential (cpg above base)		Percent Choosing Each Type/Grade			
<u>Regular</u>	<u>Premium</u>	<u>Leaded</u>		<u>Unleaded</u>	
		<u>Regular</u>	<u>Premium</u>	<u>Regular</u>	<u>Premium</u>
0¢	2¢	5%	*%	67%	28%
0¢	4¢	5	*	76	19
2¢	4¢	8	*	42	50
2¢	6¢	9	*	72	19
4¢	6¢	11	*	54	35
4¢	8¢	11	1	72	16
6¢	8¢	13	1	59	27

\* Less than 0.5%.

The table above suggests that while decreasing the differential between unleaded regular and premium from 4 cpg to 2 cpg would have only a small effect on the degree of switching, it would greatly increase the purchase of premium unleaded among unleaded users. This increase should deter further switching by increasing user satisfaction with a presumably superior unleaded fuel.

APPENDIX B  
THE QUESTIONNAIRES



# CONSUMER MAIL PANELS

323 SOUTH FRANKLIN STREET - CHICAGO, ILLINOIS 60606



(9309)

Dear Panel Member,

Today I would like your help in a study about gasoline. I've been asked to find out how people decide what gasoline to use in their cars. To determine which member of your household should answer my questions please answer questions A, B and C. Record the "qualified household member's" relationship in Qu. C. If you are that person continue answering the remaining questions. If another member is the "qualified household member, please ask that person to begin with the introduction before Question D below.

Cordially,

*Marie*

- A. How many cars are there in your household? Please include any passenger car, station wagon, van, or pick-up that is maintained by anyone in your household and available for personal or family use by one or more family members.

Number of Cars In Your Household: \_\_\_\_\_

(13)

- B. I am interested in finding out about recent model year cars, 1975, 1976, 1977 and 1978. If there is more than one such car in your household, this questionnaire is to be filled out for the most recent model year car. For example, if your household had a 1976 model year car and a 1977 model year car, you would choose the 1977 model year car. If there is more than one car of the most recent model year, for example, two 1977 model year cars, please choose the one that is used the most often.

On the line below, for the most recent model year car, please write in the make, series, model year, body style, number of cylinders and number of miles the car has been driven.

Make	Series	Year	Body Style	Number of Cylinders	Number of Miles Car Has Been Driven
Example: (Ford)	(Granada)	(1977)	(2 door Sedan)	(6)	(12,500)
_____	_____	_____	_____	_____	_____
		14 15 16 17 18 19 20		(21)	(22-27)

- C. The person who is most likely to buy the gasoline for the car you described in Question B is:

Male Head of Household. . . . ☐  
 Female Head of Household. . . ☐  
 Other Male . . . . . ☐  
 Other Female . . . . . ☐

(28)

Please have the person who is most likely to buy the gasoline for the car you described in Question B fill out the rest of this questionnaire.

To the "qualified household member":

I am asking you to tell me about your gasoline purchases only as they apply to the particular car, pickup or van described in Question B. As you answer please consider your gasoline purchases for only that vehicle even if you are also the principal gasoline purchaser for other household vehicles.

Your help on this survey is very important and, of course, I appreciate it very much.

D. Was the car described in Question B bought new, used, or is it leased?

- New . . . . . ☐ 1  
 Used . . . . . ☐ 2 (29)  
 Leased . . . . . ☐ 3  
 Other (specify) \_\_\_\_\_ ☐

E. How long have you been using this car?

- 6 months or less . . . . . ☐ 1  
 More than 6 months . . . . . ☐ 2 (30)

F. About how many miles per gallon do you generally get with this car? (Please round your estimate to the nearest whole number.)

- In city . . . . .   MPG (31-32)  
 On highway . . . . .   MPG (33-34)  
 Over-all, on the average . . . . .   MPG (35-36)

G. About how frequently do you buy gasoline for this car?

- Two or more times a week . . . . . ☐ 1  
 Once a week . . . . . ☐ 2  
 Once every ten days . . . . . ☐ 3  
 Twice a month . . . . . ☐ 4 (37)  
 Once a month . . . . . ☐ 5  
 Less than once a month . . . . . ☐ 6

Questions 1-6 are about the last time you bought gasoline for this car -- the one described in Question B. Throughout the questionnaire I will be talking about unleaded and leaded gas. In your part of the country unleaded gas may be called "lead-free" or "no lead". Leaded gas is gasoline containing lead.

1. About how long ago did you last buy gasoline for this car?

- Within the past 2 or 3 days . . . . . ☐ 1  
 4-7 days ago . . . . . ☐ 2  
 1-2 weeks ago . . . . . ☐ 3 (38)  
 More than 2 weeks but within the past month . . . . . ☐ 4  
 More than one month ago . . . . . ☐ 5

2a. What type of service did you get at the station?

- Self-service . . . . . ☐ 1  
 Attendant service . . . . . ☐ 2 (39)

2b. How did you pay for your purchase?

- Cash . . . . . ☐ 1  
 Oil company credit card . . . . . ☐ 2 (40)  
 Bank or other credit card . . . . . ☐ 3

3a. What brand of gasoline did you buy at that time?

41   42

3b. What grade of gasoline did you buy at that time?

43   44

- 3c. Most gas stations sell only 2 or 3 grades of gasoline. When you bought gasoline the last time, did you buy:

The lowest price gasoline at the station . . . ☐1  
 The highest price gasoline at the station . . . ☐2  
 The gasoline at a price in between (if  
 the station had 3 grades) . . . . . ☐3

(45)

- 3d. And what was the cost per gallon of the gasoline you bought? (Please round to the nearest cent)

¢ per gallon

(46-47)

- 3e. Was the gasoline you got at that time unleaded (that is, no lead or lead-free) or was it gasoline containing lead (that is, leaded)?

Unleaded (no lead or lead-free) . . ☐1

Contained lead (leaded) . . ☐2

(48)

PLEASE ANSWER THESE QUESTIONS IF YOU BOUGHT UNLEADED (NO LEAD OR LEAD-FREE) GASOLINE LAST TIME.

PLEASE ANSWER THESE QUESTIONS IF YOU BOUGHT LEADED GASOLINE (i.e., CONTAINING LEAD) LAST TIME.

- 4a. Have you ever bought leaded gasoline for this car?

Yes . . . ☐1 (49)  
 No . . . ☐2 → (SKIP TO QU. 6a)

- 5a. Have you ever bought unleaded gasoline for this car?

Yes . . . ☐1 (52)  
 No . . . ☐2 → (SKIP TO QU. 6a)

- 4b. Why did you buy leaded gas? (Please "X" only one box.)

Only type available at station . . ☐1  
 Costs less . . . . . ☐2  
 Performs better . . . . . ☐3  
 Recommended by car  
 manufacturer . . . . . ☐4  
 Other (Please describe) (50)

- 5b. Why did you buy unleaded gas? (Please "X" only one box.)

Only type available at station . . ☐1  
 Costs less . . . . . ☐2  
 Performs better . . . . . ☐3  
 Recommended by car  
 manufacturer . . . . . ☐4  
 Other (Please describe) (53)

- 4c. Which type of gasoline do you buy most frequently for this car?

Unleaded . . . . . ☐1  
 Leaded . . . . . ☐2 (51)  
 Both equally . . . . . ☐3

- 5c. Which type of gasoline do you buy most frequently for this car?

Unleaded . . . . . ☐1  
 Leaded . . . . . ☐2 (54)  
 Both equally . . . . . ☐3

- 6a. Of the grades and types of gas listed below, which do you think would give the best performance for your car? ("X" one box in Column A.)
- 6b. Of the grades and types of gas listed below, which would give the poorest performance for your car? ("X" one box in Column B.)
- 6c. Below are listed some grades and types of gasoline that may be available in your area -- only two or three of these are likely to be available at any one gas station. In Column C, please "X" either the "Yes" or the "No" box to indicate whether or not you think that the grade and type was available at the station where you last bought gasoline for this car.
- 6d. In Column D, please write in your best recollection of the price per gallon of each grade and type that was available at that station. (Please give me the pump price including taxes to the nearest cent.)

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	
	Best Performance	Poorest Performance	Available At Station? No Yes	Pump Price ¢ Per Gallon	
Regular leaded. . . .	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1 <input type="checkbox"/> 2 →	<input type="text"/> ¢/gal.	(57-59)
Regular unleaded . .	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 1 <input type="checkbox"/> 2 →	<input type="text"/> ¢/gal.	(60-62)
Premium leaded. . .	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 1 <input type="checkbox"/> 2 →	<input type="text"/> ¢/gal.	(63-65)
Premium unleaded . .	<input type="checkbox"/> 4 (55)	<input type="checkbox"/> 4 (56)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 →	<input type="text"/> ¢/gal.	(66-68)

- 6e. At most stations, regular leaded gasoline is the lowest priced grade and type of gasoline at the station. Even if you can't recall the prices of all the grades and types of gasoline at the station of your last purchase, how much more do you think you would have to pay for regular unleaded than for the leaded gas at that station?

¢ per gallon more for unleaded gas than for leaded gas

(69-70)

(71-78 open) 79-80

Card 2  
(Dup. 1-12)

Questions 7 and 8 are about problems you might have had with this car and what, if anything, you did about them.

- 7a. Below is a list of problems that a person driving a car over a period of time might notice. Next to each of these problems, please "X" the appropriate box in Column A to indicate whether or not you've ever had that problem with this car.
- 7b. For each problem you've had with this car, please "X" the box in Column B that best describes how severe this problem was.

Problems A Car Might Have	A Ever Had Problem		B How Severe?		
	No	Yes	Slight	Severe	
		<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	
Hard starting .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(13-14)
Rough idle .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(15-16)
Stalling .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(17-18)
Hesitation (lag in expected power when accelerating or going uphill) .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(19-20)
Knock or ping when accelerating or going uphill .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(21-22)
Engine run-on -- engine continues to run after ignition is turned off. ....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(23-24)
Poor mileage .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(25-26)
Engine lacks pep. ....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(27-28)
Other engine problems (Describe) .....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	(29-30)
	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 2	31 32 (33-34)

LOOK UP AT QU. 7a. IF YOU HAVE MARKED A "NO" FOR EVERY PROBLEM LISTED ABOVE SKIP TO QU. 10a.

- 8a. Of all the problems you have had as described in Qu. 7a, think about the most recent one. Have you ever had any work done to correct that problem? Please do not count routine things such as oil changes or lubes. Do count anything involving an adjustment or part change whether done by you or a mechanic.

Yes ... ☐1  
No .... ☐2 (SKIP TO QU. 9a) (35)

- 8b. To what extent was the problem corrected?

Not at all ..... ☐1  
Somewhat. .... ☐2  
Completely. .... ☐3 (36)

- 9a. Have you ever changed the brand, type, or grade of gas in order to correct a problem with this car?

Yes ... ☐1  
No .... ☐2 (SKIP TO QU. 10a) (37)

- 9b. The last time you changed brand, grade or type of gas, to what extent was the problem corrected as a result of this change?

Not at all ..... ☐1  
Somewhat. .... ☐2  
Completely. .... ☐3 (38)

- 10a. Since you've been driving this car, have you ever been advised or influenced by any person or anything you saw or heard to change the brand, type, or grade of gasoline you use in the car?

Yes ... ☐1  
No .... ☐2 (SKIP TO QU. 11a) (39)

- 10b. What brand, type or grade were you advised to switch to?

BRAND (Please specify name on the line below)	GRADE AND TYPE					40 41
	Leaded Regular	Unleaded Regular	Leaded Premium	Unleaded Premium	Other	
.....	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	(42)

- 10c. Who gave you that advice?

New car dealer ..... ☐1  
Garage mechanic. .... ☐2  
Service station ..... ☐3  
Friend or relative ..... ☐4  
Advertising. .... ☐5  
Other (Describe) ..... ☐ (43)

- 11a. Since you've been driving this car, when was the last time, if ever, you switched the brand, grade or type of gasoline you put in it?

Never . . . . . ☐ 1 → (SKIP TO QU. 12)  
 More than 6 months ago . . . ☐ 2  
 Past six months . . . . . ☐ 3

(45)

- 11b. What reason or reasons made you switch brand, grade or type of gasoline?

_____	46		47
_____	48		49
Any others? _____	50		51
_____	52		53

- 11c. Please think of the last time you switched the brand, type, or grade of gasoline you were using in this car. On the lines below, write in the brand and check the type and grade of gasoline you were using in this car before switching, and write in the brand and check the type and grade you are now using. (Please ignore any listed grades or types which may not be available in your area.)

Brand Name	GRADE AND TYPE					
	Leaded Regular	Unleaded Regular	Leaded Premium	Unleaded Premium	Other	
Before Switching:						54 <input type="checkbox"/> <input type="checkbox"/> 55
_____	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	(56)
Brand Name						
After Switching:						57 <input type="checkbox"/> <input type="checkbox"/> 58
_____	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	(59)

The next section of this questionnaire deals with some of the factors that go into your decisions as to what gasoline to buy and where to buy it. In particular, I'm interested in your choice of the grade of gasoline, the brand, the type of service at the station, and the method of payment you prefer (cash or credit card), and the price. Please remember that in your part of the country unleaded gas may be called "lead-free" or "no lead". Leaded gas is gasoline containing lead.

12. Below is a list of six types and grades of gasoline that might be available to you at service stations in your area -- although any one station is not likely to have more than two or three of these grades today. The premium grade generally has a higher octane rating than regular. Some brands carry a grade that is intermediate between the usual regular and premium grades. Whether you've had any experience with all the grades or not, I'd like to know what grades you think you would prefer to put in your car if they were all equally available to you all other things being equal -- in other words, if all six grades were available at the same price, in the same place, etc.

I would like you to rank each of the six grades of gasoline in the order of your preference. As you are ranking them, please keep in mind that to use leaded gas in your car might require changes in the tank opening to accommodate the wider nozzle used at pumps that have leaded gas.

Now, in Column 12 below, please put a "1" in the box next to the grade you would prefer to put in your car if you could choose from all six grades. Then put a "2" in the box next to the grade that would be your second choice if you could not have your first choice. Please continue until you have shown your preference for each of the six grades. When you are done, there will be a number from 1 to 6 in each box to show your rank order of preference for each of the six grades. Please do not give me any ties (for example, do not put a "3" in two different boxes to show your 3rd rank order preference) or leave any boxes blank.

Grade of Gasoline	Col. 12		
	Rank Order of Preference (1 = most preferred to 6 = least preferred)		
Regular leaded . . . . .	<input type="checkbox"/>		(60)
Regular unleaded . . . . .	<input type="checkbox"/>		(61)
Intermediate leaded . . . . .	<input type="checkbox"/>		(62)
Intermediate unleaded . . . . .	<input type="checkbox"/>		(63)
Premium leaded . . . . .	<input type="checkbox"/>		(64)
Premium unleaded . . . . .	<input type="checkbox"/>		(65)

Next, I'd like to know your preference for type of service and method of payment. (Price, brand and grade being equal.

- 13a. Would you prefer attendant service or self-service?

Attendant service . . . . . ☐1  
Self-service . . . . . ☐2

(66)

- 13b. Would you prefer to buy gasoline at a station that accepts cash only or accepts either cash or a credit card?

Accepts cash only . . . . . ☐1  
Accepts either a credit card or cash . . . . ☐2

(67)

14. In considering the price of various options such as brand, grade, gasoline type, service type and payment method I'll ask you to compare the price with a base price. This is the price per gallon of the least expensive grade of gasoline that might be available in your area at a station carrying a brand you would consider using. Generally, in most places, the least expensive grade is regular leaded. This varies from one area to another and even from one station to another in the same area. Which of the prices below do you think is closest to the base price in your area -- that is, the price per gallon of the least expensive grade of gasoline that you can buy in your area at a station that carries a brand you would consider using.

50¢ per gallon . . ☐1  
54¢ per gallon . . ☐2  
56¢ per gallon . . ☐3  
59¢ per gallon . . ☐4  
61¢ per gallon . . ☐5  
64¢ per gallon . . ☐6  
67¢ per gallon . . ☐7  
70¢ per gallon . . ☐8

(68)

(69-78 open)

79 ☒ 80

15. In order to get a better idea of your preferences for different gasoline choices, I'm going to ask you about various combinations of factors such as brand, price, grade, type of gasoline, type of service and payment method.

Listed below are several pairings that will give you a choice between two different factors, but are similar to each other in all other respects.

Please read both factors carefully and decide which you would prefer. If you prefer the factor on the left the most, then please draw a circle around the "L" next to that factor; but if you prefer the factor on the right the most, then draw your circle around the "R" next to that factor.

#### EXAMPLE

-----	
You Pay The Base Price	You Pay 2¢ Above The Base Price
&	&
Attendant Service	Self-Service
-----	
Self-Service	Attendant Service
&	&
You Pay 8¢ Above The Base Price	You Pay 2¢ Above The Base Price
-----	

Now would you please read each of the following pairs of factors carefully. For each pair, circle either the "L" or the "R" to show which you prefer. Sometimes you might not like either of the pairs of factors. In those cases, circle the "L" or the "R" to show which one you dislike the least. Although some may seem similar, none are exactly the same and I need your answer for each one. Some may involve choices which you may not have available to you. In such cases, choose the pair of factors based on what you would do if the choices were available to you.

The following pairings are alike in all respects except for the two factors below:

GRADE AND TYPE OF GAS

&

TYPE OF SERVICE

Please circle either "L" or "R" to indicate your preference for the pairs below.

Card 3  
Dup.  
1-12

Intermediate Leaded Gas	(13)	Regular Leaded Gas
&	L OR R	&
Attendant Service		Self-Service
-----		
Self-Service	(14)	Attendant Service
&	L OR R	&
Intermediate <u>Unleaded</u> Gas		Premium <u>Unleaded</u> Gas
-----		
Self-Service	(15)	Attendant Service
&	L OR R	&
Premium Leaded Gas		Regular Leaded Gas
-----		
Premium Leaded Gas	(16)	Premium <u>Unleaded</u> Gas
&	L OR R	&
Attendant Service		Self-Service

The following pairings are alike in all respects except for the two factors below:

GRADE AND TYPE OF GAS

&

METHOD OF PAYMENT

Please circle either "L" or "R" to indicate your preference for the pairs below.

Intermediate Leaded Gas	(17)	Regular Leaded Gas
&	L OR R	&
Station Accepts Cash Only		Station Accepts Credit Card Or Cash
-----		
Station Accepts Credit Card Or Cash	(18)	Station Accepts Cash Only
&	L OR R	&
Regular <u>Unleaded</u> Gas		Regular Leaded Gas
-----		
Station Accepts Credit Card Or Cash	(19)	Station Accepts Cash Only.
&	L OR R	&
Intermediate <u>Unleaded</u> Gas		Regular <u>Unleaded</u> Gas
-----		
Premium <u>Unleaded</u> Gas	(20)	Premium Leaded Gas
&	L OR R	&
Station Accepts Cash Only		Station Accepts Credit Card Or Cash
-----		
Intermediate <u>Unleaded</u> Gas	(21)	Premium <u>Unleaded</u> Gas
&	L OR R	&
Station Accepts Cash Only		Station Accepts Credit Card Or Cash
-----		

The following pairings are alike in all respects except for the two factors below:

PRICE  
&  
TYPE OF SERVICE

Please circle either "L" or "R" to indicate your preference for the pairs below.

(22)

You Pay The Base Price  
&  
Self-Service

L OR R

You Pay 4¢ Above  
The Base Price  
&  
Attendant Service

(23)

Attendant Service  
&

L OR R

You Pay 8¢ Above  
The Base Price

Self-Service  
&

You Pay 6¢ Above  
The Base Price

The following pairings are alike in all respects except for the two factors below:

PRICE  
&  
METHOD OF PAYMENT

Please circle either "L" or "R" to indicate your preference for the pairs below.

(24)

You Pay The Base Price  
&  
Station Accepts Cash Only

L OR R

You Pay 2¢ Above  
The Base Price  
&  
Station Accepts Credit  
Card Or Cash

(25)

You Pay The Base Price  
&  
Station Accepts Cash Only

L OR R

You Pay 6¢ Above  
The Base Price  
&  
Station Accepts Credit  
Card Or Cash

(26)

Station Accepts Credit  
Card Or Cash  
&

L OR R

You Pay 8¢ Above  
The Base Price

Station Accepts Cash Only  
&

You Pay 4¢ Above  
The Base Price



The following pairings are alike in all respects except for the two factors below:

GRADE AND TYPE OF GAS  
&  
PRICE

Please circle either "L" or "R" to indicate your preference for the pairs below.

(27)	
Intermediate <u>Un</u> leaded Gas	Premium Leaded Gas
&	&
You Pay 8¢ Above The Base Price	You Pay 6¢ Above The Base Price
-----	
You Pay 6¢ Above The Base Price	You Pay 8¢ Above The Base Price
&	&
Premium <u>Un</u> leaded Gas	Premium Leaded Gas
-----	
You Pay 2¢ Above The Base Price	You Pay The Base Price
&	&
Premium <u>Un</u> leaded Gas	Intermediate <u>Un</u> leaded Gas
-----	
Regular <u>Un</u> leaded Gas	Intermediate Leaded Gas
&	&
You Pay 4¢ Above The Base Price	You Pay The Base Price
-----	
Regular <u>Un</u> leaded Gas	Regular Leaded Gas
&	&
You Pay 8¢ Above The Base Price	You Pay 4¢ Above The Base Price
-----	
You Pay 8¢ Above The Base Price	You Pay 4¢ Above The Base Price
&	&
Premium Leaded Gas	Intermediate Leaded Gas
-----	
You Pay 2¢ Above The Base Price	You Pay 6¢ Above The Base Price
&	&
Premium <u>Un</u> leaded Gas	Premium Leaded Gas
-----	
Intermediate <u>Un</u> leaded Gas	Regular <u>Un</u> leaded Gas
&	&
You Pay 8¢ Above The Base Price	You Pay 6¢ Above The Base Price
-----	

The following pairings are alike in all respects except for the two factors below:

GRADE AND TYPE OF GAS  
&  
PRICE

Please circle either "L" or "R" to indicate your preference for the pairs below.

(35)		
Regular Leaded Gas	L OR R	Intermediate Leaded Gas
&		&
You Pay 4¢ Above The Base Price		You Pay 2¢ Above The Base Price
(36)		
You Pay 4¢ Above The Base Price	L OR R	You Pay 8¢ Above The Base Price
&		&
Regular <u>Unleaded</u> Gas		Regular Leaded Gas
(37)		
You Pay 4¢ Above The Base Price	L OR R	You Pay 6¢ Above The Base Price
&		&
Intermediate <u>Unleaded</u> Gas		Intermediate Leaded Gas
(38)		
Premium <u>Unleaded</u> Gas	L OR R	Premium Leaded Gas
&		&
You Pay 6¢ Above The Base Price		You Pay 4¢ Above The Base Price
(39)		
Regular <u>Unleaded</u> Gas	L OR R	Regular Leaded Gas
&		&
You Pay 8¢ Above The Base Price		You Pay 6¢ Above The Base Price
(40)		
You Pay 6¢ Above The Base Price	L OR R	You Pay 8¢ Above The Base Price
&		&
Regular <u>Unleaded</u> Gas		Premium <u>Unleaded</u> Gas
(41)		
You Pay 6¢ Above The Base Price	L OR R	You Pay 8¢ Above The Base Price
&		&
Intermediate Leaded Gas		Premium Leaded Gas
(42)		
Intermediate Leaded Gas	L OR R	Intermediate <u>Unleaded</u> Gas
&		&
You Pay 8¢ Above The Base Price		You Pay 6¢ Above The Base Price

The following pairings are alike in all respects except for the two factors below:

GRADE AND TYPE OF GAS  
&  
PRICE

Please circle either "L" or "R" to indicate your preference for the pairs below.

Regular <u>Un</u> leaded Gas	(43)	Regular Leaded Gas
&	L OR R	&
You Pay 2¢ Above The Base Price		You Pay The Base Price
-----		
You Pay The Base Price	(44)	You Pay 2¢ Above The Base Price
&	L OR R	&
Regular <u>Un</u> leaded Gas		Regular Leaded Gas
-----		
You Pay The Base Price	(45)	You Pay 2¢ Above The Base Price
&	L OR R	&
Intermediate Leaded Gas		Premium <u>Un</u> leaded Gas
-----		
Regular <u>Un</u> leaded Gas	(46)	Intermediate <u>Un</u> leaded Gas
&	L OR R	&
You Pay The Base Price		You Pay 2¢ Above The Base Price
-----		
Intermediate Leaded Gas	(47)	Premium Leaded Gas
&	L OR R	&
You Pay The Base Price		You Pay 4¢ Above The Base Price
-----		
You Pay The Base Price	(48)	You Pay 2¢ Above The Base Price
&	L OR R	&
Premium <u>Un</u> leaded Gas		Premium Leaded Gas
-----		
You Pay 2¢ Above The Base Price	(49)	You Pay 4¢ Above The Base Price
&	L OR R	&
Intermediate <u>Un</u> leaded Gas		Premium <u>Un</u> leaded Gas
-----		
Intermediate <u>Un</u> leaded Gas	(50)	Intermediate Leaded Gas
&	L OR R	&
You Pay 4¢ Above The Base Price		You Pay 2¢ Above The Base Price
-----		

# CONSUMER MAIL PANELS

323 SOUTH FRANKLIN STREET • CHICAGO, ILLINOIS 60606

(9324)



PLEASE READ THE QUESTIONNAIRE BEFORE DETACHING THE COIN.

Dear Panel Member,

This questionnaire is about the most recent model year car, station wagon, van or pick-up that is maintained by anyone in your household and is available for personal or family use by one or more family members. If there is more than one recent car of the same year, choose the one that is used most often.

On the line below, for the most recent model year car, please fill in the make, series, model year, body style, number of cylinders and number of miles the car has been driven.

	<u>Make</u>	<u>Series</u>	<u>Model Year</u>	<u>Body Style</u>	<u>Number of Cylinders</u>	<u>Number of Miles Car Has Been Driven</u>
Example:	(Ford)	(Granada)	(1977)	(2 door Sedan)	(6)	(12,500)
	_____	_____	_____	_____	_____	_____

The person who is most likely to buy the gasoline for the car described above is:

- Male Head of Household . . . . . ☐ 1  
Female Head of Household . . . . . ☐ 2  
Other Male . . . . . ☐ 3  
Other Female . . . . . ☐ 4

(14)

Please have the person who is most likely to buy the gasoline for this car fill out the rest of this questionnaire.

As far as you know does the manufacturer of the vehicle described above specify that only unleaded (that is, lead-free or no lead) gasoline be used in that vehicle?

Yes . . . ☐ 1      No . . . ☐ 2      Don't know . . . ☐ 3

(15)

No matter how you answered Question 2, please continue following these instructions. It's important that everybody cooperates. In this study, I'm interested in finding out how many people are actually using leaded gasoline (that is, gasoline that contains lead) even though their cars may require only unleaded (that is, lead-free or no lead) gasoline be used. However, I have found that many people are reluctant to tell me whether they do this or not. You can help us get this information without revealing what you yourself do by following the instructions on the other side.

3. There are two questions below with provisions for only one answer. You are to decide which question to answer by flipping a coin. If the coin comes up heads you should answer the first question<sup>a</sup> by "X"ing the appropriate box. If it comes up tails, you should ignore the first question and use the answer box -- Yes or No -- to answer the second question. Only you will know whether the answer you have given applies to Question #1 or Question #2.

If you follow these instructions exactly, I will never know which of the two questions you answered or whether you yourself use leaded gasoline in your car. But by combining your answers with those of other people, I will be able to figure out statistically how many people in the population have used leaded gasoline -- provided you have followed the instructions exactly. Remember --

Step one -- Remove the coin attached to this questionnaire and flip it --

Step two -- If the coin comes up

Heads - Answer Question #1 only

Tails - Answer Question #2 only

but do not indicate which question you are answering.

- |   |
|---|
| 1. Was your mother born in the month of April? RECORD ANSWER IN THE APPROPRIATE BOX TO THE RIGHT.   |
| 2. I have used leaded gasoline in this car two or more times since I have been driving it. RECORD ANSWER IN THE APPROPRIATE BOX TO THE RIGHT. |

ANSWER BOX
Yes <input type="checkbox"/>
No <input type="checkbox"/>

Please return the questionnaire as promptly as possible. The dime is yours for taking the few minutes to complete these questions.

Cordially,  
*Marie*

APPENDIX C  
THE METHOD OF TRADE-OFF ANALYSIS

## THE METHOD OF TRADE - OFF ANALYSIS

The method of Trade-off Analysis is designed to predict a consumer's preference among a bundle of products all of which have the same attributes to varying degrees or levels. In this study we consider consumer choices among gasoline purchases all defined in terms of the four attributes underlined below.

<u>Grade and Type of Gasoline</u>	<u>Price Differential over the Base Price (CPG)</u>	<u>Type of Service</u>	<u>Method of Payment</u>
Regular Leaded	0	Self-serve	Cash
Regular Unleaded	2		
	4	Atten-	
Intermediate Leaded	6	dant	
	8	serve	Cash or
Intermediate Unleaded			Credit
Premium Leaded			
Premium Unleaded			

For example, we may wish to predict how a consumer would choose among:

Purchase One - A regular grade of leaded gasoline at the base price with self-serve at a station accepting his credit card

Purchase Two - A regular grade of unleaded gasoline at 2 cpg above the base price at a credit card station with attendant service

Purchase Three - A premium grade of leaded gasoline at (cpg) above the base price at a credit card station with attendant service

Trade-off analysis makes it possible to predict his choice from any combination of the 120 (6x5x2x2) products (combinations of attribute levels) that can be configured from the attribute-level list displayed.

The three components of this method are: (1) a technique of data collection requiring a respondent to consider "trade-offs" among desirable alternatives: (2) a computational method which derives "utilities" accounting as nearly as possible for each respondent's choice behavior; and (3) a simple market simulation model which attempts to determine those characteristics of a product which will maximize its share of preference within any particular competitive context.

The trade-off questioning technique is demonstrated in pages 7-11 of the survey questionnaire (see Appendix B). The computational methods that may be used to derive the "utilities" are described in some detail in the accompanying articles. This method consists of first deriving "part-utilities" for each attribute level (for each respondent). The "utility" of any product (combination of attribute levels) is computed by multiplying the "part-utilities" associated with each of the attribute levels making up the product.

The part-utilities are determined by the requirement that they predict as closely as possible the 38 pair-wise choices expressed by the respondent. That is, if a respondent has expressed a preference for the left hand combination of attributes below over the right hand one, the product  $axb$  should be greater than the product  $cxd$  (where  $a, b, c, d$  are the part-utilities as shown below):

Leaded regular (a)	L or R	Unleaded regular (c)
at base price (b)		at 6cpg over base (d)

The 38 conditions of this kind imposed by the respondent's choices are sufficient to determine the 16 "part-utilities" (one for each attribute level) that describe the respondent's preference system. Given any set of products (attribute level combinations), the respondent should choose the product with the greatest "utility" as computed by



multiplying the "part-utilities" of the attribute levels associated with each product.

An example of how this method would be applied to predict a particular respondents' choice among the three purchases described above is illustrated below. This respondent would choose Purchase One, since its "utility" (83) is greater than either of the competitors' (23 or 17).

The simulation method used in this study consists of computing the number of respondents choosing each of the several products making up the "market".

#### PREDICTING INDIVIDUAL CHOICE

		Purchase #1	Purchase #2	Purchase #3
		Reg. Leaded @ Base	Reg. Unleaded @ Base + 2¢	Prem Leaded @ Base + 6¢
<u>Grade/Type</u>	<u>Part-Utilities</u>			
Regular Leaded	100	100		
Regular Unleaded	48		48	
Mid Leaded	90			
Mid Unleaded	47			
Premium Leaded	97			97
Premium Unleaded	47			
<u>Price Differential (CPG)</u>				
0	100	100		
2	48		48	
4	28			
6	18			18
8	8			
<u>Service Type</u>				
Self	83	83		
Attendant	100		100	100
<u>Payment Type</u>				
Cash or Credit	100	100	100	100
Cash only	58			
<b>UTILITIES</b>		<b>83</b>	<b>23</b>	<b>17</b>