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An Empirical Investigation of the Impact of Gasoline Prices on Grocery Shopping Behavior

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Report Summary

In 2008, a U.S. household earning a median income spent 11.5% on gas—up from 4.6% in 2003. While it is known that consumers adjust their grocery expenditures when faced with rising gas prices, there is little systematic research on the topic.

This study offers a comprehensive analysis of the impact of gas price on consumers' grocery shopping behavior. The authors quantify the impact on a household's total purchase volume and dollar spending, and examine which of several potential avenues consumers use to save money on grocery shopping—shifting their shopping from one retail format to another; shifting from national brands to private labels, from regular-priced products to promotional purchases, and from higher-priced national brands to lower-priced ones.

Using a home-scan panel of approximately 1,000 U.S. consumers, the study tracks shopping trips and purchases in 297 major product categories across retail formats including grocery stores, drugstores, mass merchandisers, and warehouse clubs from January 2006 to October 2008. Gasoline prices varied widely during the period, from a minimum of $2.13 to a maximum of $4.30 per gallon, according to data from the Department of Energy Information Administration.

Study findings

The authors find that for every dollar increase in gas price per gallon, the average consumer reduces shopping frequency by approximately 7.5% and total expenditure by about 4.4%. Households make these cuts despite the fact that they are eating out and traveling away from home less (and thus, are presumably eating at home more).

The authors also document a substantial shift in spending *away* from grocery, drug, and traditional mass stores *toward* supercenters and warehouse clubs.

For a 100% increase in gas price, the share of the average household's expenditure spent at drug stores, grocery stores, and mass merchant stores decreases by 2%, 7%, and 6% respectively. In contrast, the share at supercenters and warehouse clubs increases by 41% and 24% respectively. Translated to share points, a 100% increase in gas price results in grocery stores losing about 4.1 market share points on average, and supercenters and warehouse clubs gaining about 2.4 market share points each. This shift occurs even though consumers must typically travel farther to shop at a supercenter or warehouse club. Apparently, consumers look not just for lower prices but also for single-stop shopping.

Interestingly, among those who buy promoted name brands, the share of top-tier brands increases—an average of 6 share points for a 100% increase in gas prices at the expense of bottom-tier brands. In other words, consumers who stick to national brands don't compromise quality but do seek out deals to get more value for their money.

Managerial implications

Both manufacturers and retailers must find ways to make their offerings more attractive to consumers as gas price increases cut into monthly household budgets.

For manufacturers, these findings suggest that they should balance their focus on large supercenters and club stores with greater support and trade deals for their traditional retail partners. If they want to keep the grocery store and drugstore format competitive, they may need to offer more promotional funds to those channels, while engaging the supercenter and club channels with larger-size, lower-unit price SKUs.

Manufacturers should recognize that promotions work and should use them to keep their customers from switching to private label. In addition, they should resist the temptation to extend their well-known brands into the low price–low quality space. Unless they can preserve margins at the substantially lower price needed to combat private labels, they may find that the lower-tier introductions are not effective in retaining customers and may hurt the equity of their top-tier brands.

For their part, traditional retailers must recognize that the advantage of location convenience is not sufficient in tough economic times. Given the increased leverage of supercenters and club stores, retailers need to differentiate themselves on deeper product assortment and frequent promotions.

Further, this analysis suggests that increasing promotions is a more effective way for traditional retail formats to try to retain their customers' share of wallet than lowering regular prices. Retailers must realize that private label, while important, should not be over-emphasized at the expense of attractively merchandised name brands. Unless private-label marketing is accompanied by credible quality improvements, the emphasis may not be effective. A robust private label with attractive promotions on national brands is more likely to be effective.

In conclusion, these findings confirm the importance of incorporating the effects of rising gas prices explicitly into consumer shopping behavior models, especially as gas prices continue to exhibit substantial variance. It should also be noted that the study looks at the short-term impact of rising gas prices; future research should investigate whether these shopping behavior changes persist over the longer term.

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Seven in 10 Americans say the country's energy situation is having a major impact on the U.S. economy. More than half say it is causing them financial hardship, while 6 in 10 report cutting back on their discretionary spending as a result of higher gasoline and energy prices.

Gallup News Service (2006)

Introduction

As a result of increasing gas prices in recent years, a U.S. household earning a median income spent 11.5% of that income on gasoline in July 2008, up from 4.6% five years prior. (Wall Street Journal 2008a). Prior research shows that gasoline demand is fairly inelastic, with estimates of short-run demand price elasticity averaging between -0.3 and -0.5 (Archibald and Gillingham 1980; Brons et al. 2008; Greening et al. 1995), and Gicheva, Hastings, and Villas-Boas (2007) reporting that "gasoline expenditures increase one for one with gasoline prices". Although consumers may want to change their driving habits and buy more fuel efficient cars (Willenborg and Pitts 1977), changes in "committed" consumption like car fuel use or mortgage payments (Chetty and Szeidl 2007) are not feasible in the short term. Thus, when the price of gas increases sharply but income does not increase concomitantly, consumers have less disposable income, feel significant financial hardship, become more price conscious, and try to find ways to reduce discretionary spending in other areas (Du and Kamakura 2008; Estelami, Lehmann, and Holden 2001; Gallup News Service 2006; Washington Post 2008).

Fast moving consumer packaged goods (hereafter referred to as grocery products) individually cost little relative to overall income. However, after housing and transportation, they form the largest percentage of the U.S. household's annual expenditures. For instance, expenditure on food at home for the average household was 5.6% of total income after taxes in 2007, exceeding other expense categories like apparel, entertainment, and healthcare (Consumer Expenditure Survey 2007, hereafter CES).[1] Further, grocery shopping is done frequently,

generally more than once a week, so there is plenty of opportunity to make adjustments in purchases. Therefore, expenditures on grocery products provide a substantial and flexible means to adjust spending in response to unexpected changes in discretionary income.

Although Gallup polls and other consumer surveys report that consumers are clipping more coupons and looking for deals (Nielsen 2009), downgrading from expensive brands to cheaper ones and to private label (Wall Street Journal 2008b), and buying more from discount retailers (Business Week 2008), there is little systematic research on the impact of gas prices on consumers' shopping behavior. One exception is a working paper by Gicheva, Hastings, and Villas-Boas (2007) who find from CES data that expenditures on food-away-from home decrease by 56% and expenditures on food purchased at grocery stores increase slightly with a 100% increase in gas price. Gicheva et al. (2007) also use sales data in four food categories from a California grocery chain to show that consumers substitute away from regular shelf-price products and towards promotional items in order to save money on overall grocery expenditures.

The objective of our research is to provide a comprehensive analysis of the impact of gas price on consumers' grocery shopping behavior. We not only quantify the impact on a household's total purchase volume and dollar spending, but we also examine which of several potential avenues consumers use to save money on grocery shopping – shifting their shopping from one retail format to another; shifting from national brands to private labels, from regular priced products to promotional purchases and from higher priced national brands to lower priced ones; and consuming less of certain product categories to make up for increased expenditure on others. Such an analysis is important not only for researchers and policy makers but also for manufacturers and retailers who must determine the best way to respond to, and perhaps pre-empt, changes in shopping behavior.

We conduct our analysis using a household panel dataset provided by Information Resources Inc. (IRI). The dataset captures complete grocery shopping information across multiple retail formats of approximately 1000 panelists from a major U.S. metropolitan area. The data are from January 2006 to October 2008 and panelists' purchases span almost 300 product categories. We supplement these data with gas prices in the same metropolitan area obtained from the Department of Energy Information Administration website. Several unique features of these data make them especially useful for our research. First, we cover not just a few product categories but the entire set of CPG products purchased by consumers. Second, we cover not only the traditional grocery and drug store channels but also regular and supercenter stores of mass merchants (including Wal-Mart), and warehouse clubs. Third, there was substantial variation in gas prices during the period of our data.

Our work is not only the first to conduct a comprehensive analysis of the impact of gas price on grocery shopping behavior, it also complements the larger body of marketing research on the impact of macro-economic factors. For instance, one stream of research studies the effect of business cycles and consumer confidence on sales of durable goods (e.g., Allenby, Jen, and Leone 1996; Deleersnyder et al. 2004; Kumar, Leone, and Gaskins 1995) and private labels (Lamey et al. 2007). Another stream examines the effectiveness of increasing advertising and other "pro-active" marketing activities during a recession (e.g., Frankenberger and Graham 2003; Srinivasan, Rangaswamy, and Lilien 2005; Tellis and Tellis 2009). However, this research is typically done at an aggregate level, with industry, firm or product category level sales data. But, change in consumer behavior is at the root of why these macroeconomic variables affect sales and firm performance. It is therefore insightful to conduct a more disaggregate analysis

(Deleersnyder et al. 2004) and understand how consumers react to changes in macro-economic factors (Grewal, Levy and Kumar 2009).

We organize the remainder of this article as follows. In the next section, we present the conceptual framework for our model and analysis, drawing on relevant literature wherever possible. Next, we discuss our data and methodology. Following this, we present our empirical results, and, finally, the implications of our findings for researchers and managers.

Conceptual Framework

Overview

Figure 1 depicts our conceptual framework. Gas prices affect consumers' perception of financial hardship and therefore their motivation to save money on grocery shopping. In addition to gas prices, which are of central interest in our research, demographic variables like income and household size also influence perception of financial hardship and motivation to save. So do the prices and promotional offerings of the stores where they shop.

Consumers who want to save on grocery shopping can do so by adjusting how much they buy (purchase volume), how often they buy, and how much they spend on their purchases (expenditure). Further, they can reduce their total grocery expenditure by changing where they buy and what types of brands and categories they buy. They may shift their purchases from higher priced retail formats like drug and grocery stores to discount formats like mass merchants, supercenters, and warehouse clubs. They may shift from national brands to lower priced private labels, and they may buy more on promotion to get better value. They may shift from higher priced national brands to lower priced ones. And, finally they may buy fewer specialty and discretionary categories though they cannot cut consumption of staples, especially food staples.

Figure 2 translates this conceptual framework into our model by identifying the specific endogenous and exogenous variables we examine. There are two sets of endogenous variables, on the right hand side of the figure. One set relates to the household's total grocery shopping and the other to how the household allocates its spending among retail formats, brands, and categories. The exogenous variables are listed on the left hand side of the figure and include, apart from gas price, household demographic variables, the distance to the store, and the price and promotion indices for the store (Appendix 1 contains variable definitions). Since increasing gas prices are likely to cause greater financial hardship for households with lower incomes and larger families, and the direct cost of gas consumption will be greater when the household has to travel a greater distance for shopping, we allow for interactions of distance and demographic variables with gas price. We discuss our expectations about the effect of gas price and other key variables on the various endogenous variables below. These expectations are summarized in Table 1.

Effects of gas price on overall shopping

Shopping trips. On one hand, the direct effect of higher gas price should be to reduce driving and therefore gas consumption as much as possible. This implies a negative effect of gas price on number of shopping trips. On the other hand, however, multiple trips allow consumers to search for and make better use of promotions, thus saving money (Gauri, Sudhir, and Talukdar 2008; Putrevu and Ratchford 1997; Urbany, Dickson, and Kalapurakal 1996). Gauri, Sudhir, and Talukdar (2008) find that households can obtain savings of up to 68% if they engage in search either temporal (over time) or spatial (across stores) search, and can increase those savings to 76% if they search across both stores and time. Thus, it is unclear whether gas prices will have a negative or positive effect on the number of shopping trips for the average household.

Total purchase volume. As noted in the introduction, grocery products are an expense category where consumers can adjust spending patterns to offset the budgetary shortfall caused by increasing gasoline price. The lower disposable income resulting from higher gas price puts pressure on consumers to buy and consume less. However, since consumers are also trying to save money by eating more at home than in restaurants (Gicheva et al. 2007), and spending more time at home (New York Times 2008), there is a positive substitution effect for food products (i.e., as gasoline price goes up, more food related items are purchased for in-home use to substitute for restaurant consumption). Across all grocery products however, we expect a negative effect of gas prices on total purchase volume.

Total dollar spending. Even if consumers are unable to reduce total consumption significantly, they can use a variety of strategies, which we discuss next, to reduce their total expenditure. We expect a negative effect of gas price on total grocery spending.

Effect of gas price on retail format choice

There is considerable, though not complete, overlap in the product categories carried by different store formats, making it feasible for consumers to shift their spending from one format to another (Luchs, Inman and Shankar 2007). Grocery and drug stores tend to locate in convenient places offering personalized service and the former offer deeper assortments than other formats. On the other hand mass merchants, supercenters, and warehouse clubs offer one-stop convenience and lower prices at the expense of service and convenient locations.[2] The difference in price levels should lead consumers to shift purchases away from grocery and drug formats towards discount formats.

However, Bell, Ho, and Tang (1998) show that consumers consider the sum of fixed (e.g., traveling to and from the store) and variable (product prices and quantities in the basket)

costs of shopping in making their store choice. Similarly, Bhatnagar and Ratchford (2004) argue that format choice is a function of consumers' costs of travel, inventory holding etc., and also of consumption rates and product perishability. These costs vary between the three discount formats. The mass format has an advantage over the other two on price and location but the smaller assortment of categories limits one-stop shopping. The warehouse club format generally requires the consumer to drive further and also invest a larger sum of money in buying bulk, but many warehouse clubs now also sell gas at significantly lower than market prices (DailyFinance.com 2009), thus encouraging consumers to make the trip. Supercenters have the dual advantage of low price and one-stop shopping. Overall, therefore, we expect gas price to have the most negative effect on grocery and drug formats, and the most positive effect on supercenter formats, with warehouse clubs and mass merchants falling somewhere in-between.

Effect of gas price on brand and promotion choice

National brands are sold at retail prices that are 20%-30% higher than private labels (Ailawadi and Harlam 2004) and penetration of private label has increased substantially in the past decade with most retailers offering private label products in a wide range of categories (Kumar and Steenkamp 2007). This makes shifting from national brands to private labels a relatively easy way for household to save money on their grocery shopping.

Value conscious consumers can also save money by searching out promotions (Ailawadi, Neslin, and Gedenk 2001). Given the significant savings from promotions, we expect that increasing gas prices will encourage consumers to shift a larger share of their total spending from regular priced products to promotional purchases. Since retailers offer promotions not just on national brands but also on private labels (Ailawadi et al. 2008; Sethuraman 2009), we expect a positive effect of gas prices on promotional purchases of both national brands and private label, a

negative effect on regular priced purchases of national brands, and a positive effect on regular priced purchases of private label.

Effect of gas price on national brand price tier share

Despite private label's price advantage, national brands still have a unit market share of over 75% across CPG categories (PLMA 2009), supporting Sethuraman's (2000) finding that consumers are willing to pay a significant premium for national brands even in the face of a private label of equivalent quality. Consumers can save money by switching from higher price tier to lower price tier national brands even if they are not willing to switch to private label. This suggests a positive effect of gas price on lower tier brand share and a negative effect on top tier brand share. Indeed, this possibility has led companies like Procter & Gamble to test lower priced "basic" versions of their top tier brands (Wall Street Journal 2009).

However, the literature on asymmetric price and context effects shows that consumers of lower tier national brands are more likely to switch to private label while top tier national brands are more insulated (Blattberg and Wisniewski 1989; Geyskens, Gielens, and Gijsbrecht 2009; Pauwels and Srinivasan 2004; Sethuraman et al. 1999). Thus, when increasing gas prices lead financially constrained consumers to shift their purchases to private label in categories where they consider the private label to be acceptable, the remaining national brand purchases are more likely to be of top tier national brands. Overall, therefore, we don't expect gas price to affect the share of middle tier brands but cannot predict the effect on share of top and bottom tier brands among national brand purchases.

Effect of gas price on product category share

A squeeze on discretionary spending due to higher gas price may also cause share shifts across various types of categories. Some product categories are staple necessities while the

consumption of others is discretionary and therefore may have more room for adjustment. Consistent with this, price elasticities vary significantly across categories (Bijmolt, van Heerde, and Pieters 2005; Narasimhan, Neslin, and Sen 1996; Tellis 1988).

The Food Marketing Institute (see also Dhar, Hoch, and Kumar 2001) classifies categories into four broad groups on the basis of their penetration and purchase frequency. High penetration-high frequency categories are "staples" that are regularly used by most consumers (e.g., milk, juices, snack products, household paper and cleaners), while low penetration-high frequency ones are "niche" categories that are not used by everybody, but are necessities for those who do use them (e.g., pet food, baby products, cigarettes, diet and nutrition products). High penetration-low frequency categories are commonly used but "storable" (e.g., batteries, light bulbs and other household items, condiments, canned meat). Finally, low penetration-low frequency categories are "specialty" products used by fewer people that are either storable or infrequently used (OTC medications and other health products, fragrances, cosmetics, specialty food products).[3]

We expect the consumption of staples and niche categories to be less elastic with respect to gas prices. Indeed, their share of total expenditure may increase since consumers are spending more time at home and eating in more (Gicheva, Hastings, and Villas-Boas 2007). To the extent that consumers have flexibility in the purchase timing of storable categories, we expect to see lower expenditure on this group when gas price is high. Finally, the effect of gas price on the share of the specialty group is unclear since it includes necessities like medications as well as hedonic, discretionary products like cosmetics. Households are less able to reduce consumption of the former but more able to reduce consumption of the latter. Overall, therefore we expect gas

price to have a negative effect on the share of storable categories, and a positive effect on the share of staples and niche products.

Effects of demographic variables

Demographic variables have been shown to be related to a variety of consumer shopping behaviors such as price search, promotion use, private label proneness, and retail format choice (e.g., Ailawadi, Neslin, and Gedenk 2001; Blattberg et al. 1978; Fox, Montgomery, and Lodish 2004; Luchs, Inman, and Shankar 2007; Urbany, Dickson, and Kalapurakal 1996). The mechanisms by which demographics are expected to affect these behaviors are generally financial, time, and space constraints. For example, income and household size may drive financial constraints, employment status may drive time constraints, and renting versus home ownership may drive space constraints. Thus, demographic variables may have a main effect on the various aspects of purchase behavior that we study in this paper. For instance, lower income and larger households are more likely to be financially constrained and therefore engage in more of the savings behaviors discussed above (e.g., smaller supermarket and drug store shares, greater private label and promotion shares, smaller top tier national brand share). In addition, demographics may interact with gas prices, since financially constrained households are likely to be more sensitive to increasing gas prices.

However, the effects of demographics on shopping behavior have not been found to be particularly strong or consistent (Bucklin and Lattin 1992; Chintagunta and Gupta 1994; Fox, Montgomery, and Lodish 2004). Therefore, we follow Ailawadi, Neslin, and Gedenk (2001) and Fox, Montgomery, and Lodish (2004) in including demographics to account for consumer differences (heterogeneity) but do not develop explicit hypotheses about their effects.

Effects of remaining variables

We expect distance traveled for shopping to have a negative effect on shopping frequency as well as total purchases and spending as households whose driving expense increases with gas price try to conserve both on driving and the amount they spend. For the same reason, we expect distance to have a negative effect on regular priced and top tier brands and a positive effect on promotional and bottom tier brands. Further, distance is a key factor in store choice (e.g., Ailawadi, Pauwels, and Steenkamp 2008; Fox, Montgomery, and Lodish 2004), so we expect that the farther a household has to travel to reach a particular retail format, the lower the share of that format. Finally, we don't see any reason why distance should affect the allocation between different category types.

Basic economic theory predicts that, as prices increase or promotions decrease, households should reduce purchases and spending. In addition, as prices increase, households should conserve spending by shopping less frequently, but as promotions increase, we expect households to shop more frequently because they need to engage in spatial as well as temporal search to make use of promotions (Gauri, Sudhir, and Talukdar 2008).

Further, as prices of specific alternatives increase, or promotions decrease, households should reduce their share of spending on that alternative. However, differences in regular price levels between alternatives (e.g., between supermarkets and supercenters, or between national brands and private labels, or between top and bottom tier national brands) are generally much greater than variation in regular price over time within an alternative. The former clearly play a major role in consumers' preferences for the various alternatives, and, as we will discuss subsequently, we capture these preference differences (unobserved preference heterogeneity) separately in our model. Beyond these cross-alternative differences, we expect the effect of

regular price to be weak (e.g., Fox, Montgomery, and Lodish 2004). Indeed, the estimated effect may even be positive if price sensitivity is weak — consumers may not change purchase amounts but the dollar value of those purchase amounts goes up. In contrast, retailers promote different products every week so there is plenty of variation in promotions within an alternative over time. Therefore, we expect the effect of promotion to be strong even after capturing preference heterogeneity.

Data

We use a recent IRI panel data set from a major metropolitan area for this study. The data capture household-level shopping and spending across stores and formats, including all items or SKUs bought by panel members in 297 categories. The 1,009 panel members made purchases over 147 weeks between 2006 and 2008. Eliminating a few households for whom information on distance to stores was not available left 967 households in our empirical analysis. For each household, we also obtained information on key demographic variables including household income, household size, age, employment status, and home ownership. Finally, we obtained gasoline prices in the metropolitan area over the same period from the Department of Energy Information Administration website.[4]

Descriptive statistics of household variables are provided in Table 2. Definitions of these and all other variables computed for our analysis are provided in the Appendix 1. The average annual household income in our sample is $63,853, average household size is 2.7, and average age of the household head is 56 years. 87% of the households own their home, and 35% are dual income households where both household heads work full-time. The average age and income of our sample are somewhat higher than the average U.S. grocery shopping household (McTaggart and Heller 2005).

Our unit of analysis is a household and month (e.g., Fox, Montgomery, and Lodish 2004). The average household spends $381 per month across 8.4 shopping trips. The mean basket size is 13.6 SKUs with a relatively large standard deviation of 12.7. The largest basket contains 71 SKUs and the smallest basket contains only one. Note that total purchase volume is also measured in dollars. This is because the vastly different units across categories (e.g., pounds, gallons, square feet, etc.) cannot be aggregated in a meaningful way. To obtain total purchase volume in a month, we multiply the purchase volume of each category by its average price per unit volume in the initialization period, and sum this across categories (see Appendix 1 for formula). The initialization period is the first two months. Thus, variation in this variable occurs only due to volume changes, not price changes, so we can assess the impact of gas price on purchase volume by modeling variation in this variable.

Table 3 provides an overview of the five retail formats in our data. As expected, mass merchandisers, supercenters, and club stores have lower prices compared to grocery and drugstores. Drug stores promote the most and are located closest to households, whereas club stores and supercenters promote the least and are located farthest away from households. And, consumers make more trips to and spend much more in grocery stores than the other formats. Table 4 summarizes how households allocate their total spending across formats, brands, promotions, and category types.

Figure 3 depicts the monthly price of regular unleaded gasoline in the metropolitan area during the period of our analysis. Gasoline price varied widely during the period of our data, ranging from a minimum of $2.13 per gallon to a maximum of $4.30 per gallon. In Figure 4, we plot the monthly averages of three key variables – number of trips, total spending and total purchase volume – over the same period. As the Figures suggest, there is an association between

gas price and overall shopping behavior -- the correlation of gas price with these three variables is -0.55, -0.38, and -0.46 respectively. We systematically model this association next.

Method

Following the conceptual model in Figure 2, we include as explanatory variables gas price, the household's distance to store, the price and promotion indices of the store, six demographic variables reflecting income, household size, age, employment, and home ownership, as well as interactions of the distance and demographic variables with gas price. In addition, we include the household's average value of the dependent variable in an initialization period (first two months) to control for unobserved heterogeneity in households' needs and preferences.

Total trips, purchase volume, and dollar spending

The first three endogenous variables relate to the household's total monthly shopping – number of trips, total purchase volume, and total dollar spending. Model specifications for each are listed in the equations below.

$$\begin{aligned} Numtrips_{ht} = {} & \beta_1^1 + \beta_2^1 Gasprice_t + \beta_3^1 Dist_h + \beta_4^1 Price_{ht} + \beta_5^1 Promo_{ht} + \beta_6^1 L\log income_h + \beta_7^1 Hhsize_h + \\ & \beta_8^1 Hhage_h + \beta_9^1 Noemp_h + \beta_{10}^1 Dualemp_h + \beta_{11}^1 Rent_h + \beta_{12}^1 Gasprice_t \cdot Dist_h + \\ & \beta_{13}^1 Gasprice_t \cdot L\log income_h + \beta_{14}^1 Gasprice_t \cdot Hhsize_h + \beta_{15}^1 Gasprice_t \cdot Hhage_h + \\ & \beta_{16}^1 Gasprice_t \cdot Noemp_h + \beta_{17}^1 Gasprice_t \cdot Dualemp_h + \beta_{18}^1 Gasprice_t \cdot Rent_h + \beta_{19}^1 Numtrips_{h0} + \varepsilon_{ht}^1, \end{aligned}$$

$$\begin{aligned} Dolspend_{ht} = {} & \beta_1^2 + \beta_2^2 Gasprice_t + \beta_3^2 Dist_h + \beta_4^2 Price_{ht} + \beta_5^2 Promo_{ht} + \beta_6^2 L\log income_h + \beta_7^2 Hhsize_h + \\ & \beta_8^2 Hhage_h + \beta_9^2 Noemp_h + \beta_{10}^2 Dualemp_h + \beta_{11}^2 Rent_h + \beta_{12}^2 Gasprice_t \cdot Dist_h + \\ & \beta_{13}^2 Gasprice_t \cdot L\log income_h + \beta_{14}^2 Gasprice_t \cdot Hhsize_h + \beta_{15}^2 Gasprice_t \cdot Hhage_h + \\ & \beta_{16}^2 Gasprice_t \cdot Noemp_h + \beta_{17}^2 Gasprice_t \cdot Dualemp_h + \beta_{18}^2 Gasprice_t \cdot Rent_h + \beta_{19}^2 Dolspend_{h0} + \varepsilon_{ht}^2, \end{aligned}$$

$$
\begin{aligned}
Purvol_{ht} \;=\; & \beta_1^3 + \beta_2^3 Gasprice_t + \beta_3^3 Dist_h + \beta_4^3 Price_{ht} + \beta_5^3 Promo_{ht} + \beta_6^3 L\log income_h + \beta_7^3 Hhsize_h + \\
& \beta_8^3 Hhage_h + \beta_9^3 Noemp_h + \beta_{10}^3 Dualemp_h + \beta_{11}^3 Rent_h + \beta_{12}^3 Gasprice_t \cdot Dist_h + \\
& \beta_{13}^3 Gasprice_t \cdot L\log income_h + \beta_{14}^3 Gasprice_t \cdot Hhsize_h + \beta_{15}^3 Gasprice_t \cdot Hhage_h + \\
& \beta_{16}^3 Gasprice_t \cdot Noemp_h + \beta_{17}^3 Gasprice_t \cdot Dualemp_h + \beta_{18}^3 Gasprice_t \cdot Rent_h + \beta_{19}^3 Purvol_{h0} + \varepsilon_{ht}^3,
\end{aligned}
$$

(1)

where:

$Numtrips_{ht}$ = Number of shopping trips made by household *h* in month *t*

$Dolspend_{ht}$ = Total grocery spending in dollars by household *h* in month *t*

$Purvol_{ht}$ = Total purchase volume by household *h* in month *t* measured in constant dollars

$Gasprice_t$ = Average price per gallon of regular gas in month *t*

$Dist_h$ = Weighted average distance of household *h* to the closest store of each format

$Price_{ht}$ = Weighted average price index facing household *h* in month *t*

$Promo_{ht}$ = Weighted average promotion index facing household *h* in month *t*

$Logincome_h$ = Logarithm of income for household *h*

$Hhsize_h$ = Size of household *h*

$Hhage_h$ = Age of the older household head in household *h*

$Dualemp_h$ = Dummy variable equal to 1 if both household heads in household *h* are employed

$Noemp_h$ = Dummy variable equal to 1 if both heads of household in household *h* are unemployed or retired

$Rent_h$ = Dummy variable equal to 1 if household *h* rents rather than owns their residence

$Numtrips_{h0}$ = Average number of trips per month by household *h* in initialization period

$Purvol_{h0}$ = Average purchase volume per month by household *h* in initialization period

$Dolspend_{h0}$ = Average dollar spending per month by household *h* in initialization period.

We estimate the three models using Seemingly Unrelated Regression to account for correlated errors.

Expenditure allocation models

The remaining endogenous variables measure households' allocation of expenditures across formats, brands, and categories. Thus, we need to specify several share models. We use a differential effects MNL (multinomial logit) attraction model in each case (Cooper and Nakanishi 1982; Nakanishi and Cooper 1988). The general form of the attraction model is:

$$S_{hjt} = \frac{A_{hjt}}{\sum_{m=1}^{J} A_{hmt}} \tag{2}$$

$$\text{where } A_{hjt} = \exp\left(\alpha_j + \sum_{k=1}^{K} \beta_{kj} X_{hkt} + \sum_{l=1}^{L} \theta_{lj} Z_{hljt} + \varepsilon_{hjt} \right) \tag{3}$$

The subscript *j* refers to an alternative (e.g. one of five formats) and subscripts *h* and *t* refer to household and month as before. There are two groups of explanatory variables in the model. One group has K variables denoted by X_{hkt} and comprises variables like gas price, demographics, and their interactions, that do not vary across alternatives. The other group has L variables denoted by Z_{hljt} and comprises variables like distance, price, and promotion that can be alternative-specific. The differential effects specification allows an explanatory variable to have a different effect on each alternative. This is reflected in the *j* subscript for coefficients of all explanatory variables.[5] The model can be transformed to a linear form as shown below. Derivation of the transformed equation follows Cooper and Nakanishi (1988) and is available in the Appendix 2.

$$\log\left(\frac{S_{hjt}}{\tilde{S}_{ht}}\right) = \sum_{m=2}^{J} \alpha_m \left[I\{m = j\} - \frac{1}{J} \right] + \sum_{k=1}^{K} \beta_{kj}^{*} X_{hkt} + \sum_{l=1}^{L} \sum_{m=1}^{J} \theta_{lm} Z_{hlmt} \left[I\{m = j\} - \frac{1}{J} \right] + \varepsilon_{hjt}^{*} \tag{4}$$

where:

S_{hjt} = Household *h*'s share of expenditure during month *t* in alternative *j*.

$\tilde{S}_{ht}$ = Geometric mean share of expenditures for household *h* during month *t* across all *J* alternatives.

α_j = Constant term for alternative *j*.

$$\beta_{kj}^{*} = \beta_{kj} - \bar{\beta}_k, \text{where } \bar{\beta}_k = \frac{1}{J}\sum_{m=1}^{J}\beta_{km}$$

$$\varepsilon_{hjt}^{*} = \varepsilon_{hjt} - \overline{\varepsilon_{ht}}, \text{where } \overline{\varepsilon_{ht}} = \frac{1}{J}\sum_{m=1}^{J}\varepsilon_{hmt}$$

This general specification is applied to each of our share models as follows. Since the error in attraction models can be heteroskedastic, we compute heteroskedasticity-robust standard errors (White 1980) for all models.

Retail format share. The first attraction model is for retail format share and has five alternatives – grocery, drug, mass merchant, supercenter, and warehouse club format. The alternative-specific variables in the model (Z_{hlmt}) are distance from the household's residence to the closest store of the format, the interaction of distance with gas price, weighted average price and promotion indices of the format, and the household's share of expenditure in the format during the initialization period. The other explanatory variables (X_{hkt}) are gas price, the six demographic variables and their interactions with gas price.

Brand and promotion share. The second attraction model has four alternatives – regular priced national brands, promotional national brands, regular priced private label, and promotional private label. The only alternative-specific explanatory variables in this model are the household's share of expenditures on each alternative during the initialization period. All the other explanatory variables are non-alternative specific. Apart from gas price, demographics and distance, they include private label price and promotion indices and national brand price and

promotion indices. Note that this specification allows full flexibility in estimating the effects of both national brand and private label prices and promotions on shares of the four alternatives.

National brand tier share. The third attraction model is for the household's allocation of its national brand purchases across price tiers and has three alternatives – top tier, middle tier, and bottom tier national brands. The alternative-specific explanatory variables in this model include the household's share of initialization period national brand purchases in each of the three price tiers, and the price and promotion indices for each tier. The non-alternative specific variables include gas price, demographics, distance, and their interactions with gas price.

Category type share. The fourth and final attraction model is for types of categories and has four alternatives: staple, niche, storable discretionary, and specialty categories. As in the previous model, the alternative-specific variables here are initialization period shares and price and promotion indices of each category type, and the non-alternative-specific variables are gas price, demographics, distance, and their interactions with gas price.

Results

In this section, we report estimates of all the above models. We make four overall points before reporting individual model results. First, appropriate price and promotion indices for each model are computed using household-specific weights as shown in the Appendix 1. Similarly, the distance variable is computed using household-specific weights where needed. Second, gas price and all continuous variables that interact with it (distance and demographic variables) are mean-centered so we can interpret the coefficient of the gas price variable as the effect on the dependent variable when the latter variables are at their mean values. Third, in all models, the initialization variables that capture household heterogeneity in preferences are highly significant and positive, thus confirming that preferences are relatively stable and heterogeneity is captured

well. Fourth, the price and promotion variables may be endogenous if there are common factors that drive both gas prices and grocery prices or due to strategic retailer pricing in anticipation of demand effects of gas price. To control for this, we repeated all our analyses using one and two month lags of the price and promotion variables as instruments for current period values of those variables. There is no evidence of serial correlation in our models, so the lags are valid instruments. Since there was no substantive difference in results, we do not report the instrumental variable estimates here but details are available upon request.

Overall shopping model results

Table 5 presents the estimates of our SUR model for number of shopping trips, total purchase volume, and total expenditure.

Number of shopping trips. The first column of Table 5 contains model estimates for number of shopping trips. The coefficient of gas price is negative and significant. Thus the average single-income household significantly reduces the number of shopping trips it makes per month as gas price increases. Comparing the magnitude of the coefficient (-.63) with the average number of monthly trips in the data (8.4) shows that, for a $1 increase in gas price, the number of trips decreases by 7.5% on average. The interaction terms are largely insignificant suggesting that the gas price effect is fairly homogenous across demographic groups. One exception is that larger households reduce their shopping trips more as gas price increases.

Households with older and non-working household heads make more trips, presumably because they have fewer time constraints. Low income households make more trips, perhaps because financial constraints encourage them to engage in more search. Note that these main effects of demographic variables are significant over and above the cross-sectional heterogeneity

captured by the initialization variable. Finally, distance, price, and promotion have the expected signs – shopping frequency decreases with distance and price and increases with promotion.

Monthly spending. The second column of Table 5 reports model estimates for monthly spending. As we expected, gas price has a significantly negative effect on monthly spending. A $1 increase in gas price reduces the monthly expenditure of the average household by almost $17, a 4.4% decrease from the average. This decrease may seem small at first glance, but it is important to realize that households make these cuts despite the fact that they are eating out and traveling away from home less (Gicheva, Hastings, and Villas-Boas 2007). The effect of gas price on total spending is fairly consistent across households as evidenced by the fact that most of the interaction terms are not significant. The two exceptions are income and household size. We find that larger households reduce their spending more with gas price increases, perhaps because their disposable income is spread across more members, making them more sensitive to gas price. Surprisingly, higher income households reduce their spending more with gas price hikes. This may be because higher income households do not cut their spending away from home as much, so that the positive substitution effect is smaller for them.

Some demographic variables also have significant main effects. Higher income and larger households both spend more, the ability to spend being higher for the former and requirements being higher for the latter. Renters spend less than home owners and households with older heads also spend more. Finally, distance and price have expected signs but the promotion coefficient is not significant, perhaps because promotions do allow consumers to buy more but the promotional price discount reduces the dollar amount of purchases.

Monthly purchase volume. Column 3 of Table 5 reports model estimates for monthly purchase volume. Here again, we find the expected negative effect of gas price. Comparing the

coefficient of -37.7 with the mean value of the dependent variable shows that a $1 increase in gas price results in a decrease of almost 11% in purchase volume. The other effects largely mirror those for total spending so we do not repeat them.

Expenditure allocation model results

Effect on retail format. The results of the format share model, summarized in Table 6, support our expectation that higher gasoline prices shift share from drug and grocery formats to supercenters and club stores. However, we find that regular mass format stores also lose share as gas price increases. In order to provide a sense for the magnitude of the effect, which is not directly interpretable in the linearized attraction model, we computed the elasticity with respect to gas price for each format (the expression for elasticity is provided in the Appendix 2). We find that, for a 100% increase in gas price, the share of the average household's expenditure spent at drug stores, grocery stores, and mass merchant stores decreases by 2%, 7%, and 6% respectively. In contrast, the share at supercenters and warehouse clubs increases by 41% and 24% respectively. With the high average share of grocery stores (see Table 4), a 7% decline translates to a loss of approximately 4.1 share points. In comparison, the low average share of supercenters and warehouse clubs means that these formats gain approximately 2.4 share points each.

There are only a few significant interaction terms -- higher income people are less likely to shift away from grocery stores and to mass merchants as gas price increases; larger households are more likely to switch to supercenters, and retired/unemployed households are more likely to switch to drugstores. Other than that, the gas price effect is fairly uniform across demographic groups.

The main effects of demographics provide a view of consumers' format preferences that makes sense for the most part. Higher income households are more likely to shop at warehouse clubs and supercenters versus the other three formats, perhaps because they can afford to buy in bulk. This is consistent with Inman et al. (2004) who find that affluence has a positive effect on share of grocery and club stores and a negative effect on share of mass merchandiser and drug stores. Larger households are more likely than smaller ones to shop at mass stores. The older the household head the more the likelihood of shopping at a drug store, perhaps because they frequent drug stores for medications anyway. Single employment households are more likely than non-working or dual employment households to shop at supercenters and warehouse clubs, perhaps because they are less financially constrained than the former and can buy in bulk, and they are less time-constrained than the latter so they can travel farther for their shopping. Finally, renters are more likely than homeowners to favor drug stores and less likely to favor warehouse clubs, presumably because they are space constrained.

Consistent with expectations, the farther a household is from a format, the less they shop there. The price effect is mixed, consistent with Fox, Montgomery, and Lodish's (2004) finding that price has only a weak effect on format choice. As noted previously, the few positive price effects may reflect the fact that consumers don't change their purchases much so higher prices increase the dollar amount of those purchases. In contrast, the promotion effect is generally positive. This is consistent with the notion of indirect store switching due to promotions (Bucklin and Lattin 1992). In other words, if households visit multiple formats, they may not directly switch from one format to another, but they may buy products in a different format than their usual if they see them on promotion during a shopping trip.

Effect on national brand and promotion share. Table 7 summarizes the results of the national brand and promotion share model. It shows that higher gasoline prices shift share from the regular priced items to the promotional items of both national and private label brands. Again, we computed the elasticity with respect to gas price for each alternative. We find that, for a 100% increase in gas price, the share of the average household's expenditure spent on regular priced items prices decreases by 10% and 4% respectively for national and private label items, while the share of expenditure on promotional items of national and private label brands increases by 39% and 30% respectively. This translates to a loss of about 6.5 share points by regular price national brands and a gain of about 6.4 share points by promoted national brands. The shift for private label is much smaller, at less than 1 share point. Thus, we see much more movement towards promoted national brands than towards private label as gas prices increase.

There are several significant main effects of demographic variables and some significant interactions. As the vast literature on private labels would predict, higher income people are more likely to buy national brands than private labels. They also shift more towards promoted national brands as gas price increases. Larger households, who may have to juggle time and financial constraints, are more likely to buy regular priced private labels, and less likely to use promotions (Ailawadi, Neslin, and Gedenk 2001). They shift even more towards private label as gas price increases. Households where neither head is employed buy fewer regular priced national brands and more promoted national brands, likely because they are financially constrained but have the time to search out deals. They shift more towards private label as gas price increases, perhaps because search is now more expensive and the everyday low price of private label is attractive. The effect of dual employment households is counter-intuitive. They are more likely to buy promoted national brands, but as gas price increases, they seem to shift

more to regular price national brands. Finally, renters buy more private labels, perhaps because their space constraints preclude promotion-induced stockpiling and this behavior does not change significantly as gas price increases.

Contrary to our expectations, distance has a positive effect on national brand purchases and a negative effect on private label purchases. Perhaps consumers travel farther for good values on their preferred national brands but not for relatively less differentiated private labels. The "own" effects of price and promotion variables have expected signs. As the national brand (private label) price index increases, the share of regular priced national brands (private label) goes down and the share of promoted national brands (private label) increases. Similarly, as the national brand (private label) promotion index increases, the share of regular priced national brands (private label) goes down and the share of promoted national brand (private label) increases. "Cross" effects are partially consistent with prior research on asymmetric price effects (Blattberg and Wisnewski 1989; Sethuraman, Srinivasan, and Kim 1999). When private label price increases, regular price national brands gain share but when national brand price increases, private label does not gain share. The cross promotion effects, however, are different. Private label promotions hurt regular priced national brand just as national brand promotions hurt regular price private label. But, both sets of promotions increase the share of promoted products of both national brands and private labels, probably by encouraging people to engage in deal-searching.

Effect on national brand tier share. The results of the national brand price tier share model, summarized in Table 8, reveal that higher gasoline prices shift share from bottom tier national brands to top tier national brands. The effect of gasoline price increase on the middle tier national brands is insignificant. Elasticity computation shows that, for a 100% increase in gas price, the share of the average household's national brand expenditure spent on bottom tier

brands decreases by 19% (translating to almost 6 share points), while the share of expenditure on middle and top tier national brands increases by 9% and 39% respectively (translating to approximately 3 and 6 share points respectively). Only two of the interaction terms are significant showing that the gas price effect is quite uniform across demographic groups.

The main effects of demographic variables have sensible signs. Lower income, larger, non-working households buy more bottom tier brands and fewer top tier brands, probably because they are more likely to feel financially constrained. Interestingly, households who must travel farther to shop buy more bottom tier brands and fewer top tier brands, and so do dual employment households. Finally, the promotion index is strongly positive for all three tiers, confirming that promotions attract consumers. As in the format share model, the effect of the price index is weak, showing that, like format choice, national brand tier choice is also not strongly driven by ongoing variations in regular price within the tier.

Effect on category type share. The results of the category type share model, summarized in Table 9, reveal that higher gasoline prices shift share from specialty categories to staples, whereas the other two category groups are relatively unaffected. Thus, our hypothesis that storable categories would be more affected by gas prices is not supported. Elasticity computations show that the magnitude of the share shift that does occur is fairly small. For a 100% increase in gas price, the share of the average household's expenditure spent on staples increases by 4% (translating to a little over 3 share points), while the share of expenditure on specialty categories decreases by 24% (about 1.8 share points). Further, there are very few significant interactions, so this effect is consistent across most demographic groups. One exception is that larger and non-working households are less likely to reduce the share of expenditure they devote to specialty products.

Finally, the price variable has mixed effects as we expected, and the insignificance of the distance variable is also consistent with our expectations. In contrast, the promotion effect is positive for all except specialty categories. Households make purchases in multiple categories so, even if they don't directly switch from one category type to another, they are more likely to buy a category if they happen to see it promoted during a shopping trip. The key findings and implications are summarized in Table 10.

Discussion

Macro-economic factors such energy/gas prices, consumer confidence, and business cycles have major effects on consumer behavior and therefore on firm performance. Our research provides a comprehensive consumer-level analysis of how and how much consumers change their shopping behavior in response to one important macro-economic variable – gas prices. On one hand, it complements aggregate research on the impact of macro-factors and, on the other hand, it builds on the large body of research on consumer grocery shopping behavior, which examines a host of variables like price, promotions, assortment, and competitive factors, but generally does not incorporate macro-economic factors. We summarize our key findings and their implications below.

An increase in gas prices significantly reduces shopping frequency, purchase volume and dollar spending. This is an important finding for at least two reasons. First, while prior research has established a strong effect of macro-economic factors such as recessions and lower consumer confidence on sales of durable goods, CPG products are deemed more habitual and necessary, less conducive to purchase postponement, and hence less vulnerable (Deleersnyder et al. 2004; Katona 1975). Second, there is evidence that consumers travel less and eat at home more as gas prices go up (Gicheva et al. 2007), so there is a positive substitution effect that should increase grocery spending. Despite these phenomena, we see a substantial reduction in overall purchases

and dollar spending. It is possible that grocery spending may be less sensitive to broader indicators of macro-economic health and attitudes (e.g., recessions and consumer sentiment) than it is to gas prices because gas prices directly affect a household's monthly budget while broader factors may not. Future research should examine these differences.

Traditional supermarkets lose 7% of their share to supercenters and warehouse clubs for a $1 increase in gas price. Interestingly, traditional mass stores do not benefit, though their supercenter stores do – consumers look not just for lower prices but also for single-stop shopping. Further, our analysis suggests that increasing promotions is a more effective way for traditional retail formats to try to retain their customers' share of wallet than lowering regular prices. Manufacturers too must consider the shift in consumer choice as they negotiate prices and trade deals with the different formats. If they want to keep the supermarket and drugstore format competitive, they may need to offer more promotional funds to those channels, while engaging the supercenter and club channels with larger size, lower-unit price SKUs.

We recognize, of course, that other factors such as service and convenience (Berry, Seiders and Grewal 2002; Seiders, Voss, Grewal, and Godfrey 2005) influence consumers' format and store choice. To the extent that these factors are stable, our model controls for them through the initialization variable. However, future research should examine whether the influence of these factors changes as the macro-economic environment changes.

Promotions are an effective retention tool as gas prices increase. Our analysis shows a much greater shift towards promoted products than towards everyday low priced private labels as gas price increases. While it is certainly the case that private label sales operate counter-cyclically with the business cycle (e.g., Lamey et al. 2007; Hoch and Banerji 1993), we find that, in the face of financial constraints induced by rising gas prices, consumers are much more likely

to look for special deals and promotions to save money instead of making large shifts towards private label. Despite the attention in the business press to growing private label sales, the dollar market share gain reported for private label reported during 2008 is about 0.7 percentage points (Palmer 2009), basically in line with what we find in our data.

The implications of this finding are important. Market share of the standard tier of "low price acceptable quality" private labels may be plateauing in the U.S. Retailers should realize that continuing to further emphasize private label at the expense of national brands, unless it is accompanied by credible quality improvements (Ailawadi, Pauwels, and Steenkamp 2008) and strong marketing and differentiation (Wal-Mart's relaunch of the Great Value private label) , may not attract additional consumers in great numbers, even in tough economic times. Balancing a robust private label with attractive promotions on national brands is more likely to be effective. And, manufacturers should realize that hunkering down in tough times by allowing prices to rise and cutting promotions will lead to substantial share losses (see also evidence and impact of price increases in tough times in Deleersnyder et al. 2004). Further, given prior findings with respect to the asymmetry of consumer shifts (Lamey et al. 2007), consumers lost in tough times may not return when financial constraints are eased.

Top tier brands are not the most vulnerable as gas prices increase. Indeed, we find that, among those who continue to purchase national brands, the share of top tier brands increases at the expense of bottom tier brands. This is consistent with the literature on context effects – private labels are much more likely to take share away from bottom tier brands than from top tier ones. Thus, manufacturers should tread carefully when it comes to introducing lower-prices extensions of their top-tier brands. Unless they can significantly cut their costs and preserve margins at the substantially lower price which is needed to combat private labels, they may find

that the lower tier introductions are not effective in retaining customers and may end up hurting the equity of their top-tier brands. It will be interesting to evaluate the impact of the "basic" versions of national brands that are being introduced by companies such as P&G.

The gas price effect is fairly uniform across demographic groups. Our model specification allows for heterogeneity in the effect of gas price across several demographic groups. For the most part, these effects are not significant, showing that the response to increasing gas price is not dramatically different across demographic groups. The two demographic variables that appear to matter most are household size and income. The role of household size is largely consistent with the notion that larger households are more likely to be constrained both by time and by budget. Therefore, the negative effect of gas price on shopping frequency and monthly spending is more pronounced for larger households. The need to balance time and budget also explains why they are more likely to switch to private labels than to national brand promotions. The role of income is less intuitive. We find that higher income households reduce their monthly spending and purchase volume more as gas price increases. Additional research is needed to shed light on why this occurs. Perhaps these households are "over shoppers" who become more careful as gas prices increase; or perhaps they don't cut their traveling and eating away from home as much as lower income people so there is no positive substitution effect.

In conclusion, the significant effect of gas price that we document in this paper makes it important to incorporate this factor explicitly into consumer shopping behavior models, especially when gas price exhibits substantial variance. Of course, our study looks at the short term impact, but it is equally important to understand whether the shopping behavior changes that consumers make when gas price increases persist over the longer term. For instance, Lamey

et al. (2007) show that private label sales go up in bad economic times but don't drop off as much in upturns. Further, it is important to understand the extent to which shopping behavior changes are driven by psychological factors versus the direct budgetary constraints imposed by higher gas prices. We hope our work stimulates further research in this important domain.

Appendix 1: Variable Definitions

Gas Price$_t$: Average price per gallon of regular gas in month *t* in the panel market.

Top tier national brands: Brands whose average regular price is in the top third of the national brand price distribution.

Middle tier national brands: Brands whose average regular price is in the middle third of the national brand price distribution

Bottom tier national brands: Brands whose average regular price is in the bottom third of the national brand price distribution.

Staple categories: Categories whose penetration and purchase frequency in the initialization period are both above the median.

Niche categories: Categories whose penetration is below the median and purchase frequency is above the median.

Storable categories: Categories whose penetration is above the median and purchase frequency is below the median.

Specialty categories: Categories whose penetration and purchase frequency are below the median.

Log Income$_h$: Logarithm of annual income of household *h*.

Household Size$_h$: Number of people residing in household *h*.

Household Head Age$_h$: Age of older head of household *h*.

Dual Employment$_h$: Dummy variable = 1 if both heads of household *h* are employed, 0 otherwise.

Non-Working$_h$: Dummy variable = 1 if both heads of household *h* are retired or unemployed, 0 otherwise.

Rent$_h$: Dummy variable =1 if household *h* rents their residence, 0 otherwise.

Purchase Volume$_{ht}$: $\sum_{c=1}^{C} q_{htc}\, price_{t_0 c}$

q_{htc}: Total equivalent units of category *c* purchased by household *h* in month *t.*

t_0 : Initialization period (the first two months of the data).

$price_{t_0 c}$: Average price per equivalent unit of category *c* in initialization period.

Price Index$_{ht}$ (for overall shopping models): $\sum_{c=1}^{C} \frac{price_{htc}}{price_{ht_0c}} cs_{ht_0c}$

$price_{htc}$: Weighted average price per equivalent unit across all SKUs of category *c* for household *h* in month *t*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

cs_{ht_0c}: Total spending on category *c* as a percentage of the total spending by household *h* in the initialization period.

Promotion Index$_{ht}$ (for overall shopping models): $\sum_{c=1}^{C} promo_{htc} cs_{ht_0c}$

$promo_{htc}$: Weighted average of promotion dummy variable (=1 if there is any type of promotion in month *t* for a given SKU) across all SKUs of category *c*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

Price Index$_{hjt}$ (for retail format share models, where *j* stands for retail format):

$$\sum_{c=1}^{C} \frac{price_{hjtc}}{price_{ht_0c}} cs_{hjt_0c}$$

$price_{hjtc}$: Weighted average price per equivalent unit across all SKUs of category *c* in alternative *j* for household *h* in month *t*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

cs_{hjt_0c}: Total spending on category *c* as a percentage of the total spending in alternative *j* by household *h* in month *t*.

Promotion Index$_{hjt}$ (for retail format share models, where *j* stands for retail format):

$$\sum_{c=1}^{C} promo_{hjtc} cs_{hjt_0c}$$

$promo_{hjtc}$: Weighted average of promotion dummy variable (=1 if there is any type of promotion in month *t* for a given SKU) across all SKUs of category *c* in alternative *j*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

Price Index$_{hjt}$ (for brand and promotion share model / national brand tier share model, where *j* stands for one of the brand and promotion types / national brand tiers*)*:

$$\sum_{c=1}^{C} \frac{price_{hjtc}}{price_{ht_0c}} cs_{ht_0c}$$

$price_{hjtc}$: Weighted average price per equivalent unit across all SKUs in alternative *j* of category *c* for household h in month *t*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

Promotion Index$_{hjt}$ (for brand and promotion share model / national brand tier share model, where *j* stands for one of the brand and promotion types / national brand tiers):

$$\sum_{c=1}^{C} promo_{hjtc} cs_{ht_0c}$$

$promo_{hjtc}$: Weighted average of promotion dummy variable (=1 if there is any type of promotion in month *t* for a given SKU) across all SKUs in alternative *j* of category *c*, where weights are the SKU's share of the household's total purchases of the category in the initialization period.

Price Index$_{hjt}$ (for category type share model, where *j* stands for one of the category types*)*:

$$\sum_{c \in C_j} \frac{price_{htc}}{price_{ht_0c}} cs_{ht_0c}^{C_j}$$

C_j: a set that contains all categories within category type *j*.

$cs_{ht_0c}^{C_j}$: Total spending on category *c* as a percentage of the total spending in category type *j* by household *h* in the initialization period.

Promotion Index$_{hjt}$ (for category type share model, where *j* stands for one of the category types):

$$\sum_{c \in C_j} promo_{htc} cs_{ht_0c}^{C_j}$$

$dist_{hj}$ (for format share model): $\sum_{n=1}^{N} dist_{hjn} nfs_{hjnt_0}$

$dist_{hjn}$: Distance from the closest store of retailer *n* in format *j* to household *h*.

nfs_{hjnt_0}: Share of total spending at retailer *n* by household *h* in initialization period within format *j*.

Distance$_h$ (for all except format share model): $\sum_{j=1}^{J} dist_{hj}\, fs_{hjt_0}$

fs_{hjt_0}: Share of total spending by household *h* in initialization period at retail format *j*.

Appendix 2: Estimating the Differential Effect Attraction Model

In this section, we derive the specification of the differential effect market share attraction model. Let *j* denote an alternative, e.g., a particular retail format in the format choice model (*j=1,…,F*), let *t* denote time, and let *h* denote household. We write the attractiveness of an alternative and the corresponding market share as:

$$A_{hjt} = \exp\left(\alpha_j + \sum_{k=1}^{K} \beta_{kj} X_{hkt} + \sum_{l=1}^{L} \theta_{lj} Z_{hljt} + \varepsilon_{hjt} \right) \qquad \text{(WA1)}$$

$$S_{hjt} = \frac{A_{hjt}}{\sum_{m=1}^{J} A_{hmt}} \qquad \text{(WA2)}$$

where α_j is the alternative specific intercept, and X_{hkt} and Z_{hljt} are both exogenous variables determining the attractiveness of alternative *j* at time *t* for household *h*.

X_{hkt} contain exogenous variables that are common across alternatives (such as gasoline price and household demographics). Z_{hljt} contain exogenous variables that differ across alternatives (such as price and promotion).

Note that the corresponding coefficients β_{kj} and θ_{lj} contain subscript *j*, reflecting the fact that this is a differential effect model.

To derive an estimable version, we first take log of equation (WA2) (for simplicity of exposition, we omit the household and the time subscripts):

$$\log\left(S_j\right) = \left(\alpha_j + \sum_{k=1}^{K} \beta_{kj} X_k + \sum_{l=1}^{L} \theta_{lj} Z_{lj} + \varepsilon_j \right) - \log\left(\sum_{m=1}^{J} A_{mt} \right) \qquad \text{(WA3)}$$

Sum up equation (WA3) for all alternatives, and divide both sides of the equation by *J*:

$$\log\left(\tilde{S}\right) = \frac{1}{J}\sum_{j=1}^{J}\left(\alpha_j + \sum_{k=1}^{K}\beta_{kj}X_k + \sum_{l=1}^{L}\theta_{lj}Z_{lj} + \varepsilon_j\right) - \log\left(\sum_{m=1}^{J}A_{mt}\right) \qquad \text{(WA4)}$$

where $\tilde{S} = \sqrt[J]{\prod_{j=1}^{J} S_j}$. Subtract equation (WA4) from equation (WA3), we get:

$$\log\left(\frac{S_j}{\tilde{S}}\right) = \alpha_j^* + \sum_{k=1}^{K}\beta_{kj}^* X_k + \sum_{l=1}^{L}\sum_{m=1}^{J}\theta_{lm}Z_{lm}\left(I\{m=j\} - \frac{1}{J}\right) + \varepsilon_j^* \qquad \text{(WA5)}$$

where $\bar{\alpha} = \frac{1}{J}\sum_{m=1}^{J}\alpha_m, \bar{\varepsilon} = \frac{1}{J}\sum_{m=1}^{J}\varepsilon_m, \bar{\beta}_k = \frac{1}{J}\sum_{m=1}^{J}\beta_{km}, \alpha_j^* = \alpha_j - \bar{\alpha}, \varepsilon_j^* = \varepsilon_j - \bar{\varepsilon}, \beta_{kj}^* = \beta_{kj} - \bar{\beta}_k$. We set α_1 to zero for identification. Therefore, we can rewrite α_j^* as: $\alpha_j^* = \sum_{m=2}^{J}\alpha_m\left[I\{m=j\} - \frac{1}{J}\right]$.

Rearranging terms, we can rewrite equation (WA5) as:

$$\log\left(\frac{S_j}{\tilde{S}}\right) = \sum_{m=2}^{J}\alpha_m\left[I\{m=j\} - \frac{1}{J}\right] + \sum_{k=1}^{K}\beta_{kj}^* X_k + \sum_{l=1}^{L}\sum_{m=1}^{J}\theta_{lm}Z_{lm}\left(I\{m=j\} - \frac{1}{J}\right) + \varepsilon_j^* \text{(WA6)}$$

This equation can then be estimated directly with linear regression techniques.

The price elasticity of the market share of alternative *j* with respect to X_{hkt} is given by:

$$E^j\left(X_k\right) = \frac{\partial S_j}{\partial X_k}\frac{X_k}{S_j} = \left(\beta_{kj}^* - \sum_{m=1}^{J}S_m\beta_{km}^*\right)X_k \qquad \text{(WA7)}$$

Similarly, the price elasticity with respect to Z_{lm} is given by:

$$E^j\left(Z_{lm}\right) = \frac{\partial S_j}{\partial Z_{lm}}\frac{Z_{lm}}{S_j} = \left(I\{m=j\} - S_m\right)\theta_{lm}Z_{lm} \qquad \text{(WA8)}$$

Notes

1. "The Current Employment Statistics program is a monthly survey conducted by State employment security agencies in cooperation with the Bureau of Labor Statistics. The survey provides employment, hours and earnings estimates based on payroll records of business establishments." Source: http://www.bls.gov/ces/cesprog.htm (accessed December 10, 2009).
2. We distinguish between traditional mass stores that have less square-footage and carry a smaller assortment of categories, and the larger supercenter format whose assortment is broader and includes perishable food products.
3. Dhar, Hoch, and Kumar (2001) label the latter two groups of categories as "variety enhancers" and "fill-ins" since their nomenclature refers to the role of the category for the retailer. Our interest here is in the role of the category for consumers.
4. Gasoline prices are available for regular, midgrade, and premium fuel grades. We use regular gasoline prices.
5. Not only is the differential effects specification more flexible, it is necessary when some or all explanatory variables do not vary across alternatives. See Neslin, Rhoads, and Wolfson (2009) for a recent application.

References

Ailawadi, Kusum and Bari Harlam (2004), "An Empirical Analysis of the Determinants of Retail Margins: The Role of Store Brand Share," *Journal of Marketing*, 68(1), 147-166.

----, Koen Pauwels, and J.B. Steenkamp (2008), "Private Label Use and Store Loyalty," *Journal of Marketing*, 72(6), 19-30.

----, Scott Neslin, and Karen Gedenk (2001), "Pursuing the Value Conscious Consumer: Store Brands Versus National Brand Promotions," *Journal of Marketing,* 65(1), 71-89.

Allenby, Gregory, L. Jen, and Robert Leone (1996), "Economic Trends and Being Trendy: The Influence of Consumer Confidence on Retail Fashion Sales," *Journal of Business and Economic Statistics*, 14(1), 103-111.

Archibald, R. and R. Gillingham (1980), "An Analysis of the Short-run Consumer Demand for Gasoline Using Household Survey Data," *Review of Economics and Statistics*, 62, 622-628.

Bell, David R., Teck-Hua Ho, and Christopher S. Tang (1998), "Determining Where to Shop: Fixed and Variable Costs of Shopping," *Journal of Marketing Research*, 35 (August), 352–69.

Berry, Leonard L., Kathleen Seiders, and Dhruv Grewal (2002), "Understanding Service Convenience," *Journal of Marketing*, 66 (July), 1-17.

Bhatnagar, Amit and Brian T. Ratchford (2004). "A Model of Retail Format Competition for Non-Durable Goods," *International Journal of Research in Marketing*, 21: 39-59.

Bijmolt, Tammo, Harald van Heerde, and Rik G.M. Pieters (2005), "New Empirical Generalizations on the Determinants of Price Elasticity," *Journal of Marketing Research*, 42 (May), 141-156.

Blattberg, Robert C., Thomas Buesing, Peter Peacock and Subrata Sen (1978), "Identifying the Deal Prone Segment," *Journal of Marketing Research*, 15 (August), 369-377.

----, and Kenneth J. Wisniewski (1989), "Price-induced Patterns of Competition," *Marketing Science*, 8, 291–309.

Brons, Martjin, Peter Nijkamp, Eric Pels, and Piet Rietveld (2008), "A Meta-Analysis of the Price Elasticity of Gasoline Demand: A SUR Approach," *Energy Economics*, 30(5), 2105-2122.

Bucklin, Randolph E., and James M. Lattin (1992), "A Model of Product Category Competition Among Grocery Retailers," *Journal of Retailing*, 68 (3)), 271-293.

Business Week (2008), "Grocers: A Shift Toward Thrift", August 14. (http://www.businessweek.com/print/magazine/content/08_34/b4097072834121.htm)

Chetty, R. and A. Szeidl (2007), "Consumption Commitments and Risk Preferences," *Quarterly Journal of Economics*, 122(2), 831-877.

Chintagunta, Pradeep, and Sunil Gupta (1994), "On Using Demographic Variables to Determine Segment Membership in Logit Mixture Models," *Journal of Marketing Research*, 31(February), 128-139.

Consumer Expenditure Survey (2007), http://www.bls.gov/cex/csxstnd.htm#2007

Cooper, Lee G., and Masao Nakanishi (1988), *Market-Share Analysis*, Norwell, MA: Kluwer Publishers.

DailyFinance.com (2009), "Cheap gas burns away BJ's Wholesale Club's profits," Aug 19. (http://www.dailyfinance.com/2009/08/19/cheap-gas-burns-away-bjs-wholesale-clubs-profits/).

Deleersnyder, Barbara, Marnik Dekimpe, Miklos Sarvary, and Philip Parker (2004), "Weathering Tight Economic Times: The Sales Evolution of Consumer Durables Over the Business Cycle," *Quantitative Marketing and Economics*, 2, 347-383.

Dhar, Sanjay K., Stephen J. Hoch, and Nanda Kumar (2001), "Effective category management depends on the role of the category," *Journal of Retailing*, 77(2), 165-84.

Du, Rex and Wagner Kamakura (2008), "Where Did All That Money Go? Understanding How Consumers Allocate Their Consumption Budget," *Journal of Marketing*, 72 (November), 109–131.

Estelami, H., D.R. Lehmann, and A.C. Holden (2001), "Macro-Economic Determinants of Consumer Price Knowledge: A Meta-Analysis of Four Decades of Research," *International Journal of Research in Marketing*, 18(4), 341–355.

Fox, Edward J., Alan L. Montgomery, and Leonard M. Lodish (2004), "Consumer Shopping and Spending across Retail Formats," *Journal of Business*, 77 (2), S25-S60.

Frankenberger, Kristina, and Roger Graham (2003), "Should Firms Increase Advertising Expenditures During Recessions?" *Marketing Science Institute*, Report No. 03-115, Cambridge, MA.

Gallup News Service (2006), "High Gas Prices Causing Consumer Spending Cuts," May 24. (http://www.gallup.com/poll/22918/high-gas-prices-causing-consumer-spending-cuts.aspx).

Gauri, Dinesh, K. Sudhir, and Debabrata Talukdar (2008), "The Temporal and Spatial Dimensions of Price Search: Insights from Matching Household Survey and Purchase Data," *Journal of Marketing Research*, 45 (2), 226–40.

Geyskens, Inge, Katrijn Gielens, and Els Gijsbrecht (2009), "Proliferating Private-Label Portfolios: How Introducing Economy and Premium Private Labels Influences Brand Choice," *Journal of Marketing Research*, forthcoming.

Gicheva, Dora, Justine Hastings, and Sofia Villas-Boas (2007), "Revisiting the Income Effect: Gasoline Prices and Grocery Purchases," NBER Working Paper No. 13614.

Greening, L.A., T.J. Hann, J.P. Formby, and D.C. Cheng (1995), "Use of Region, Life-cycle and Role Variables in the Short-run Estimation of the Demand for Gasoline and Miles Traveled," *Applied Economics*, 27, 643-656.

Grewal, Dhruv, Michael Levy and V. Kumar (2009), "Customer Experience Management in Retailing: An Organizing Framework," *Journal of Retailing*, 85 (1), 1-14.

Hoch, Stephen, and Shumeet Banerji (1993), "When do Private Labels Succeed?" *Sloan Management Review*, 34 (Summer), 57-67.

Inman J. Jeffrey, Venkatesh Shankar, and Rosellina Ferraro (2004), "The Roles of Channel-Category Associations and Geo-demographics in Channel Patronage," *Journal of Marketing*, 68 (2), 51–71.

Katona, G. (1975), *Psychological Economics*, New York: Elsevier Scientific Publishing Co.

Kumar, Nirmalya, and Jan-Benedict E.M. Steenkamp (2007), *Private Label Strategy*, Cambridge, MA: Harvard Business School Press.

Kumar, V., Robert Leone, and John Gaskins (1995), "Aggregate and Disaggregate Sector Forecasting Using Consumer Confidence Measures," *International Journal of Forecasting*, 11(3), 361-377.

Lamey, Lien, Barbar Deleersnyder, Marnik Dekimpe, and J.B.E.M. Steenkamp (2007), "How Business Cycles Contribute to Private-Label Success: Evidence from the United States and Europe," *Journal of Marketing*, 71(January), 1-15.

Luchs, Ryan, J, Jeffrey Inman, and Venkatesh Shankar (2007), "Channel Blurring: A Study of Cross-Retail Format Shopping Among U.S. Households," *University of Pittsburgh Working Paper*.

McTaggart, Jenny, and Walter Heller (2005), "Forces of Change," *Progressive Grocer*, 84 (6), 48-59.

Nakanishi, Masao, and Lee G. Cooper (1982), "Simplified Estimation Procedures for MCI Models", *Marketing Science*, 1 (3), 314-321.

Narasimhan, Chakravarthi, Scott Neslin, and Subrata Sen (1996), "Promotional Elasticities and Category Characteristics", *Journal of Marketing*, Vol. 60 (April), 17-30

Neslin, Scott, Edward Rhoads, and Paul Wolfson (2009), "A Model and Empirical Analysis of Patient Compliance and Persistence in Pharmaceuticals," *Tuck School Working Paper*.

New York Times (2008), "Teeth Gritted, Drivers Adjust to $4 Gasoline" May 24. (http://travel.nytimes.com/2008/05/24/business/24gas.html).

Nielsen (2009), Nielsen Homescan Gas Impact Study. (http://en-us.nielsen.com/main/insights/consumer_insight/april_2009/gas_prices_consumers).

Palmer, Alex (2009), "Private Label Growing Rapidly," *Brandweek*, Sept 22.

PLMA (2009), "PLMA Yearbook Documents Private Label Sales Surge of More Than 105," http://www.plma.com/pressupdate/pressupdate.asp#ID39.

Pauwels, Koen and Shuba Srinivasan (2004), "Who Benefits from Store Brand Entry?" *Marketing Science*, 23 (Summer), 364-390.

Putrevu, Sanjay and Brian T. Ratchford (1997), "A Model of Search Behavior with an Application to Grocery Shopping," *Journal of Retailing*, 73 (4), 463-486.

Seiders, Kathleen, Glenn B. Voss, Dhruv Grewal, and Andrea L. Godfrey (2005), "Do Satisfied

Customers Buy More? Examining Moderating Influences in a Retailing Context," *Journal of Marketing*, 69 (October), 26-43.

Sethuraman, Raj (2000), "What Makes Consumers Pay More for National Brands Than for Store Brands: Image or Quality," *Marketing Science Institute*, Report No. 00-110.

---- (2009), "Assessing the External Validity of Analytical Results from National Brand and Store Brand Competition Models," *Marketing Science*, Vol. 28, No. 4, 759-781.

----, V. Srinivasan, and Doyle Kim (1999), "Asymmetric and Neighborhood Cross-Price Effects: Some Empirical Generalizations, *Marketing Science,* 18(1) 23–41.

Srinivasan, Raji, Arvind Rangaswamy, and Gary Lilien (2005), "Turning Adversity into Advantage: Does Proactive Marketing During a Recession Pay Off?" *International Journal of Research in Marketing*, 22(June), 109-125.

Tellis, Gerard J. (1988), "The Price Elasticity of Selective Demand: A Meta-Analysis of Econometric Models of Sales," *Journal of Marketing Research*, 25, 331–341.

----, and Kethan Tellis (2009), "A Survey of Research on Advertising in a Recession," *Marketing Science Institute*, Special Report 09-205, Cambridge, MA.

Urbany, Joel E., Peter R. Dickson and Rosemary Kalapurakal (1996), "Price Search in the Retail Grocery Market," *Journal of Marketing*, 60 (April), 91-104.

Wall Street Journal (2008a), "Income vs. Gas Prices, an Update," August 4. (http://blogs.wsj.com/economics/2008/08/04/income-vs-gas-prices-an-update/)

Wall Street Journal (2008b), "Private-Label Goods Make Gains in Tough Economy", May 21. (http://online.wsj.com/article/SB121134284454709965.html)

Wall Street Journal (2009), "Tide Turns 'Basic' for P&G in Slump," August 6. (http://online.wsj.com/article/SB124946926161107433.html)

Washington Post (2008), "Burdened by the Weight of Inflation", May 14. (http://www.washingtonpost.com/wp-dyn/content/article/2008/05/13/AR2008051303120_2.html?sid=ST2008051400066)

White, Hal (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica*, Vol. 50, 483-499.

Willenborg, John F. and Robert E. Pitts (1977), "Gasoline Prices: Their Effect on Consumer Behavior and Attitudes," *Journal of Marketing*, 41 (1), 24-31.

Table 1: Summary of Expectations

Dependent Variable	Expected effect on Dependent Variable of			
	Gas Price	Distance	Price[a]	Promotion
Overall Shopping Behavior				
Number of shopping trips	?	-	-	+
Total spending	-	-	-	+
Total purchase volume	-	-	-	+
Allocation across formats				
Drug store share	-	-	-	+
Grocery store share	-	-	-	+
Mass merchant share	+	-	-	+
Supercenter share	+	-	-	+
Club warehouse share	+	-	-	+
Allocation across brands and promotion				
Regular price national brand share	-	-	-	+
Promoted national brand share	+	+	-	+
Regular price private label share	+	+	-	+
Promoted private label share	+	+	-	+
Allocation across national brand tiers				
Top tier share	?	-	-	+
Middle tier share	0	0	-	+
Bottom tier share	?	+	-	+
Allocation across category types				
Staples share	+	0	-	+
Niche share	+	0	-	+
Storables share	-	0	-	+
Specialty share	?	0	-	+

[a] We expect the price effects to be weak as discussed in the text

Table 2: Descriptive Statistics of Panel

Variable	*Mean*	*Std Dev*	*Minimum*	*Maximum*
Monthly Trips (n)	8.36	5.06	1	44
Monthly Spending ($)	381.82	248.11	100.10	870.87
Monthly Purchase Volume ($)	351.07	412.44	94.08	752.29
Basket Size (No. of items)	13.56	12.67	1	71
HH Income ($)	63853	32982	5000	117500
HH Size (n)	2.72	1.35	1	6
HH Head Age (years)	56.23	10.21	30	70
Dual Income HH (%)	35.06			
Non-Working HH (%)	26.16			
Home Owner HH (%)	86.56			

Table 3: Descriptive Statistics of Retail Formats

Variable	*Mean and (Standard Deviation) for*				
	Drug	*Grocery*	*Mass Merchandiser*	*Supercenter*	*Warehouse Club*
Price Index	1.09	1.08	.91	.88	.86
	(.04)	(.06)	(.04)	(.03)	(.05)
Promotion Index	.12	.19	.07	.04	.05
	(.01)	(.01)	(.01)	(.01)	(.01)
Monthly Trips (n)	1.24	4.91	1.30	.40	.51
	(1.87)	(3.58)	(1.79)	(1.10)	(1.03)
Monthly Spending ($)	26.19	220.58	64.78	23.12	47.15
	(51.62)	(178.14)	(110.09)	(70.90)	(108.5)
Distance to Households (miles)	1.20	3.32	3.60	12.03	5.43
	(1.39)	(4.82)	(2.52)	(5.64)	(3.49)

Table 4: Descriptive Statistics of Spending Allocation

Alternative	*Mean Share (%)*	*Standard Deviation of Share*
Share across formats		
Drug	8.51	15.06
Grocery	59.43	29.94
Mass Merchandiser	15.90	21.77
Supercenter	5.89	16.47
Warehouse Club	10.27	20.34
Share across products		
Regular Price National Brands	65.05	17.85
Promoted National Brands	16.53	14.15
Regular Price Private Label	16.07	13.20
Promoted Private Label	2.34	3.97
Share across national brand tiers		
Top Price Tier	15.36	10.51
Middle Price Tier	35.28	13.61
Bottom Price Tier	49.36	17.37
Share across category types		
Staple	77.32	12.35
Niche	5.29	8.15
Storable	10.01	7.12
Specialty	7.38	7.59

Table 5: Overall Shopping Behavior Models

Variable	*No. of Trips*	*Total Spending*	*Total Purchase Volume*
Intercept	2.51***	215.40***	345.74***
	(10.18)	(15.75)	(12.88)
Gas Price	-0.63***	-16.95***	-37.70***
	(-8.90)	(-4.29)	(-4.82)
Distance	-.07***	-1.87***	-1.65*
	(-8.54)	(-4.05)	(-1.80)
Price	-.54**	-86.57***	-172.04***
	(-2.03)	(-5.89)	(-5.87)
Promotion	.64**	22.73	31.92
	(2.11)	(1.35)	(.96)
Log Income	-.13***	13.15***	-.15
	(-3.05)	(5.66)	(-.03)
Household Size	.03	10.54***	22.61***
	(1.30)	(9.44)	(10.35)
Household Head Age	.03***	.44***	1.57***
	(8.93)	(2.79)	(5.02)
Non-Working Dummy	.29***	-1.93	-1.24
	(4.34)	(-.52)	(-.17)
Dual Employment Dummy	-.05	1.89	-2.10
	(-.95)	(.62)	(-.35)
Rent Dummy	-.07	-11.95***	11.68
	(-.89)	(-2.86)	(1.41)
Gas Price X Distance	-.02	-.21	-1.26
	(-1.33)	(-.26)	(-.79)
Gas Price X Log Income	-.03	-13.40***	-21.55***
	(-.42)	(-3.22)	(-2.62)
Gas Price X HH Size	-.11***	-6.12***	-2.52
	(-3.15)	(-3.08)	(-.64)
Gas Price X HH Age	.01	.44	.68
	(.99)	(1.54)	(1.20)
Gas Price X Non-working	.12	-8.26	18.20
	(.95)	(-1.22)	(1.36)
Gas Price X Dual employment	.02	4.13	17.72
	(.18)	(.74)	(1.61)
Gas Price X Rent	-.05	-.85	-5.28
	(-.35)	(-.11)	(-.35)
Initialization Period Dependent Variable	.72***	.67***	.48***
	(180.91)	(130.11)	(52.82)
R^2	.40		
N	73578		

Note: *** p<.01, ** p<.05, * p<.10. t-statistics in parentheses are computed using robust standard errors.

Table 6: Format Share Model

Variable	*Drugstore*	*Grocery*	*Mass Merchandiser*	*Super Center*	*Warehouse Club*
Intercept		1.90***	.03	-0.27***	-.22***
	-	(9.33)	(.34)	(-3.73)	(-3.13)
Gas Price	-.04*	-.05***	-.05**	.10***	.04*
	(-1.69)	(-2.54)	(-2.03)	(4.45)	(1.91)
Distance	-.07***	-.02***	-.07***	-.04***	-.02***
	(-11.72)	(-10.10)	(-18.59)	(-23.70)	(-6.71)
Price	.08	-.04	0.25***	.02	.11*
	(1.28)	(-.21)	(2.70)	(.32)	(1.76)
Promotion	.45***	-.18	.91***	.59***	.08
	(3.48)	(-1.51)	(4.23)	(3.31)	(.32)
Log Income	-.22***	-.03**	-.04***	.05***	.24***
	(-16.56)	(-2.08)	(-2.62)	(3.84)	(18.20)
HH Size	-.02***	-.04***	.07***	-.01	.01
	(-3.97)	(-7.36)	(9.28)	(-.95)	(1.08)
HH head Age	.01***	-.00***	-.00***	-.00***	.00*
	(8.46)	(-3.67)	(-3.25)	(-3.24)	(1.84)
Non-working	.01	.08***	.05**	-.09***	-.05***
	(.48)	(4.42)	(2.16)	(-4.87)	(-2.67)
Dual Employment	-.02	.11***	.02	-.07***	-.04***
	(-1.12)	(7.23)	(1.01)	(-4.42)	(-2.54)
Rent	.14***	-.01	-.04	.07***	-.17***
	(5.96)	(-.34)	(-1.53)	(3.54)	(-8.43)
Gas Price X Distance	.00	-.02***	-.03***	.00	.00
	(.18)	(-4.25)	(-4.55)	(.15)	(.80)
Gas Price X Log Income	-.00	.05**	-.09***	.03	.02
	(-.03)	(2.15)	(-3.42)	(1.21)	(.71)
Gas Price X Hh Size	.01	-.03***	.00	.02**	-.00
	(.73)	(-2.67)	(.11)	(2.23)	(-.37)
Gas Price X Hhage	-.00	-.00	.00	-.00	.00
	(-.18)	(-.39)	(.64)	(-1.30)	(1.04)
Gas Price X Non-working	.11***	-.01	-.03	.02	-.09**
	(2.96)	(-.16)	(-.77)	(.45)	(-2.41)
Gas Price X Dual employment	.04	.00	-.01	.00	-.04
	(1.37)	(.03)	(-.17)	(.14)	(-1.21)
Gas Price X Rent	-.04	.01	-.03	.01	.05
	(-.87)	(.18)	(-.57)	(.13)	(1.53)
Share in Initialization Period	4.38***	2.07***	4.22***	5.00***	4.97***
	(52.97)	(58.58)	(84.23)	(62.98)	(81.93)
Adjusted R^2	.60				
N	122630				

Note: *** p<.01, ** p<.05, * p<.10. t-statistics in parentheses are computed using robust standard errors.

Table 7: Brand and Promotion Share Model

	National Brand Regular Price	*National Brand Discounted Price*	*Private Label Regular Price*	*Private Label Discounted Price*
Intercept		-2.15***	-1.31***	-3.18***
	-	(-52.19)	(-31.10)	(-86.40)
Gas Price	-.08***	.08***	-.06***	.05***
	(-6.43)	(4.61)	(-3.71)	(3.89)
Distance	.00***	.00**	-.00*	-.00***
	(2.59)	(1.97)	(-1.67)	(-3.28)
National Brand Price	-.00***	.01***	-.00***	.00
	(-4.01)	(4.98)	(-3.73)	(1.46)
National Brand	-.61***	.86***	-.49***	.25***
Promotion	(-13.70)	(13.24)	(-8.86)	(5.05)
Private Label Price	.00*	.00	-.01***	.00*
	(1.73)	(.16)	(-3.23)	(1.87)
Private Label Promotion	-.31***	.61***	-.53***	.23***
	(-8.15)	(10.68)	(-10.38)	(5.23)
Log Income	.04***	.02**	-.04***	-.03***
	(5.70)	(2.16)	(-4.12)	(-3.30)
HH Size	-.01***	-.01***	.04***	-.01***
	(-2.65)	(-2.93)	(8.48)	(-3.62)
HH head Age	-.00**	.00***	-.00***	.00
	(-1.93)	(2.61)	(-2.76)	(1.44)
Non-Working	-.06***	.05***	.02	-.00
	(-5.44)	(2.81)	(1.19)	(-.24)
Dual Employment	-.08***	.07***	.02	-.01
	(-9.20)	(5.42)	(1.42)	(-.73)
Rent	-.06***	-.03	.05***	.04***
	(-4.95)	(-1.39)	(3.16)	(2.60)
Gas Price X Distance	.01***	-.02***	.01***	-.01**
	(4.47)	(-3.86)	(3.64)	(-2.05)
Gas Price X Log Income	-.05***	.05***	.00	-.00
	(-3.72)	(2.65)	(.17)	(-.21)
Gas Price X HH Size	.01	-.03***	.02**	.00
	(1.34)	(-2.91)	(1.93)	(.34)
Gas Price X HH Age	-.00	-.00**	.00*	.00
	(-.23)	(-2.04)	(1.73)	(.96)
Gas Price X Non-working	-.01	-.03	.06**	-.02
	(-.33)	(-1.04)	(2.19)	(-.78)
Gas Price X Dual employ	.04***	-.05**	.03	-.02
	(2.44)	(-2.13)	(1.41)	(-.98)
Gas Price X Rent	-.00	.03	-.03	-.00
	(-.20)	(.87)	(-.82)	(-.03)
Share in Initial Period	1.43***	3.73***	3.57***	5.58***
	(39.06)	(59.96)	(65.66)	(20.62)
Adjusted R^2	.77			
N	97260			

Note: *** p<.01, ** p<.05, * p<.10. t-statistics in parentheses are computed using robust standard errors.

Table 8: National Brand Tier Share Model

	Bottom Tier	*Middle Tier*	*Top Tier*
Intercept		.58***	-.66***
	-	(13.41)	(-15.25)
Gas Price	-.09***	-.00	.09***
	(-8.00)	(-.16)	(7.96)
Distance	.01***	-.00	-.00***
	(3.46)	(-.18)	(-3.24)
Price	.04***	.00	.00
	(8.31)	(1.14)	(.77)
Promotion	.42***	1.04***	.51***
	(3.34)	(9.37)	(3.70)
Log Income	-.08***	.00	.07***
	(-10.61)	(.60)	(9.64)
HH Size	.05***	-.01***	-.04***
	(15.62)	(-4.28)	(-11.37)
HH head Age	.00	-.00**	.00
	(.87)	(-2.38)	(1.03)
Non-Working	.03***	.01	-.05
	(3.29)	(1.62)	(-4.57)
Dual Employment	.03***	.01	-.03***
	(3.37)	(1.12)	(-4.19)
Rent	-.03**	-.02	.04***
	(-1.95)	(-1.61)	(3.25)
Gas Price X Distance	.00**	.00**	-.01***
	(1.94)	(2.10)	(-3.43)
Gas Price X Log Income	-.00	.01	-.01
	(-.01)	(.84)	(-.68)
Gas Price X HH Size	.01**	-.01***	-.00
	(2.28)	(-2.74)	(-.03)
Gas Price X HH Age	.00	.00	-.00
	(.49)	(.84)	(-1.13)
Gas Price X Non-working	.00	-.00	-.00
	(.23)	(-.04)	(-.19)
Gas Price X Dual employment	-.00	.01	-.01
	(-.04)	(.76)	(-.57)
Gas Price X Rent	.01	.02	-.02
	(.32)	(.86)	(-.97)
Share in Initial Period	1.86***	-.10**	2.74***
	(43.83)	(-2.14)	(36.26)
Adjusted R^2	.57		
N	73554		

Note: *** p<.01, ** p<.05, * p<.1. t-statistics in parentheses are computed using robust standard errors.

Table 9: Category Type Share Model

	Staples	*Niche*	*Storable Discretionary*	*Specialty*
Intercept		-2.31***	-1.50***	-1.61***
	-	(-48.61)	(-30.57)	(-30.25)
Gas Price	.02*	.01	.02	-.07***
	(1.86)	(.60)	(1.52)	(-4.27)
Distance	-.00	-.00	-.00	.00
	(-1.02)	(-.70)	(-.36)	(1.55)
Price	.01**	.00	-.00***	.00
	(1.94)	(1.11)	(-2.98)	(.24)
Promotion	.34***	.26***	.12**	.00
	(3.56)	(5.19)	(2.23)	(.04)
Log Income	-.01*	.03***	-.00	-.02**
	(-1.66)	(3.08)	(-.18)	(-2.29)
HH Size	.00	-.01**	.02***	-.02***
	(.69)	(-2.35)	(6.22)	(-3.88)
HH head Age	-.00***	.00	-.00**	.01***
	(-5.10)	(1.48)	(-1.97)	(3.05)
Non-Working	.04***	-.07***	.08***	-.04***
	(3.58)	(-4.32)	(6.18)	(-2.48)
Dual Employment	.01	-.03***	.03***	-.03**
	(.84)	(-2.52)	(3.28)	(-2.32)
Rent	-.01	.00	-.02	.02
	(-.80)	(.13)	(-1.33)	(1.45)
Gas Price X Distance	-.00	.00	-.00	.00
	(-.35)	(.90)	(-.76)	(.31)
Gas Price X Log Income	.02*	-.01	.01	-.01
	(1.65)	(-.29)	(.44)	(-.78)
Gas Price X HH Size	.01	-.01	-.00	.02***
	(1.05)	(-1.22)	(-.58)	(2.48)
Gas Price X HH Age	-.00	.00	.00	-.00
	(-.25)	(1.52)	(.38)	(-1.52)
Gas Price X Non-working	.02	-.05*	-.01	.07**
	(.79)	(-1.65)	(-.57)	(2.41)
Gas Price X Dual employment	-.02	-.02	.00	.03
	(-1.22)	(-.59)	(.14)	(1.58)
Gas Price X Rent	.05**	-.11***	.04	.01
	(2.31)	(-3.02)	(1.47)	(.48)
Share in Initial Period	.71***	4.78***	2.23***	2.09***
	(17.16)	(58.03)	(25.94)	(25.43)
Adjusted R^2	.62			
N	92199			

Note: *** p<.01, ** p<.05, * p<.10. t-statistics in parentheses are computed using robust standard errors.

Table 10: Summary of Key Findings and Implications

Variable of interest	Impact of gas price	Implications
Shopping expenditure	A $1 increase in gas price results in a 4.4% decrease in monthly shopping expenditure for the average consumer	Tough economic times lead to sales decreases not just for durable goods but also for fast-moving grocery products. Both manufacturers and retailers must find ways to make their offering more attractive to consumers as gas price increases cut into monthly household budgets.
Shopping frequency	A $1 increase in gas price results in a 7.5% decrease in monthly shopping frequency for the average consumer	Manufacturers of impulse products may be especially hurt as impulse purchase opportunities decrease. Consumers will stockpile so manufacturers and retailers may need to offer more frequent promotions to increase the opportunities for consumers to choose their offering.
Retail format choice	A 100% increase in gas price increases the average share of supercenters and warehouse clubs by 2.4 points each, mostly at the expense of supermarkets, whose share drops by an average of 4.1 points	This shift occurs despite the fact that a consumer must typically travel farther to shop at a supercenter or warehouse club. The advantage of location convenience is not sufficient for traditional retailers. They must differentiate themselves on deeper product assortment and frequent promotions. Manufacturers must balance an increased focus on supercenter and club formats with support in the form of special SKUs, trade allowances etc., for their traditional retail partners.
Promotion use	A 100% increase in gas price increases the average share of promoted national brands by 6.4 share points, mostly at the expense of regular price national brands. There is also a small shift from regular priced private label to promoted private label.	Promotions are an effective retention tool for manufacturers and retailers alike. As consumers find themselves financially constrained with increases in gas expenditure, they are more likely to use deals. This is despite the fact that they shop less frequently and therefore have fewer opportunities to look for deals.
National brands versus private label	Gas price increases cause only a small shift from national brands towards private label. Much of the shift occurs within national brands from regular to promotional purchases. Further, among purchasers of national brands, top tier brands gain an average of 6 share points for a 100% increase in gas price at the expense of bottom tier brands.	Consumers seem to react differently to gas price changes that hit immediately but may be short-term than they do to longer-term business cycles. Retailers should realize that continuing to further emphasize standard private label, unless it is accompanied by credible quality improvements and strong marketing, may not be effective. Balancing a robust private label with attractive promotions on national brands is more likely to be effective. And, manufacturers should realize that hunkering down in tough times by allowing prices to rise and cutting promotions will lead to substantial share losses. Manufacturers should also be careful in introducing lower-prices extensions of their top-tier brands. Unless they can preserve margins at the substantially lower price needed to combat private labels, they may find that the lower tier introductions are not effective in retaining customers and may hurt the equity of their top-tier brands.

FIGURE 1
CONCEPTUAL FRAMEWORK

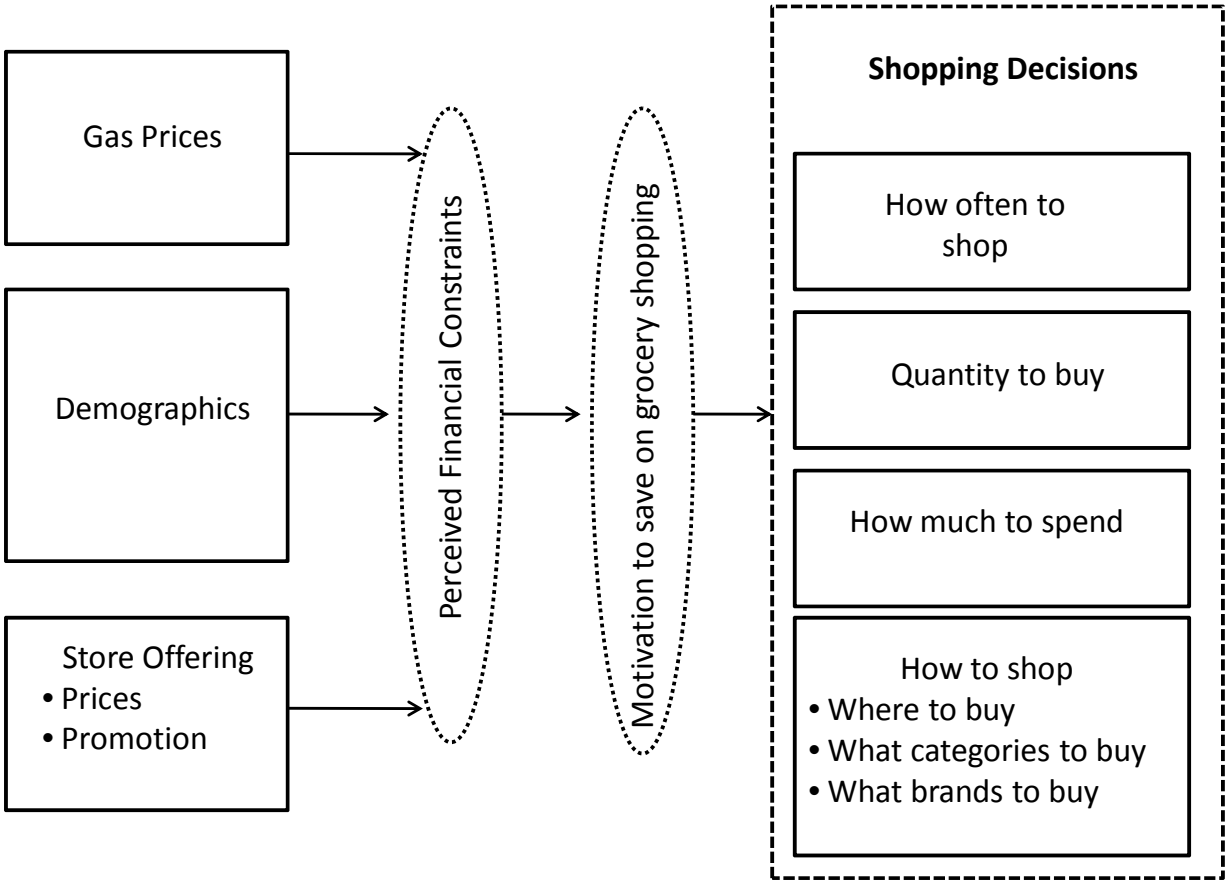

FIGURE 2
OUR MODEL

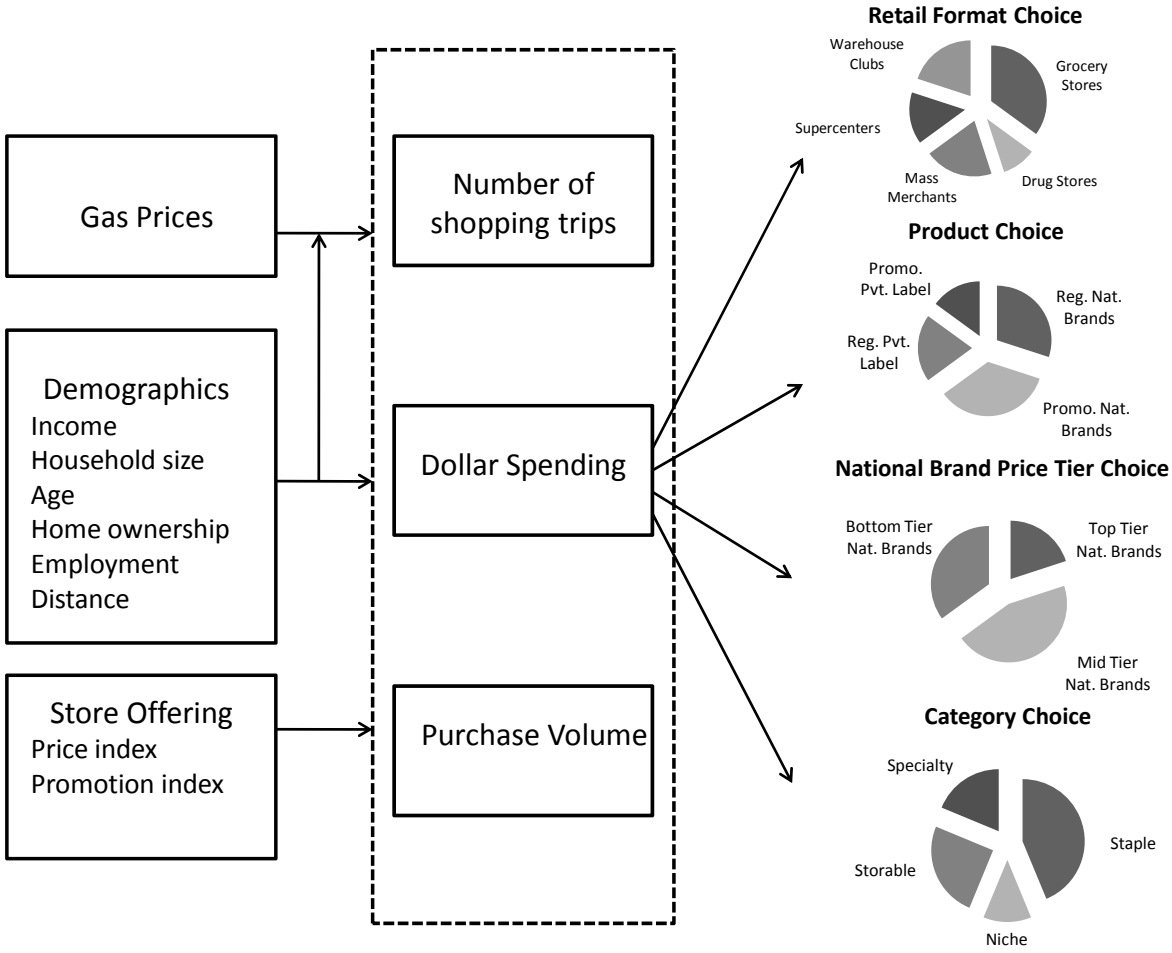

FIGURE 3
PRICE OF REGULAR UNLEADED GASOLINE IN METRO AREA (2006–2008)

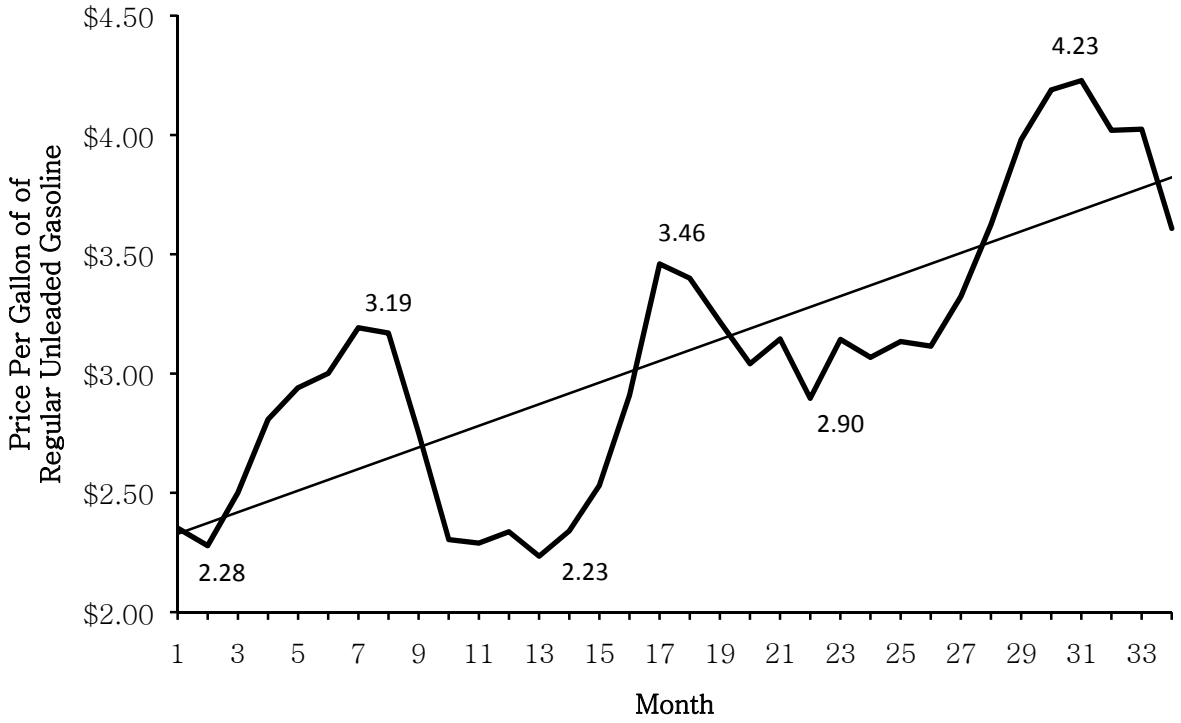

FIGURE 4
PLOT OF MONTHLY TRIPS, SPENDING AND PURCHASE VOLUME