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Price Advertising by Manufacturers and Dealers

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The central prediction of the current paper is that manufacturer price advertising may be a less effective tool for influencing demand than retailer price advertising. We manipulate the source of a price advertisement in an experiment run on a sample of pickup truck owners. Manufacturer price advertising leads to lower indicators of potential demand than dealer price advertising, even among consumers who are experienced with the brand. An econometric analysis of pickup truck sales, price, and advertising data shows that this effect is large enough to detect in market data. Manufacturer and dealer price advertising both increase the demand intercept and the responsiveness of demand to price, but the effects of dealer price advertising are larger. Although dealer price advertising is more effective than manufacturer price advertising, manufacturer price advertising may still be useful to reduce channel conflict.

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1. Introduction

Two types of information are commonly communicated through advertising: brand information and price information (Kaul and Wittink 1995). "Price advertising" is defined as commercial messages that primarily communicate product price (Mela et al. 1997, Jedidi et al. 1999). It is usually delivered through local media due to geographic variation in prices. "Brand advertising" is defined as commercial messages that primarily communicate brand positioning and unique brand attributes. It is typified by manufacturers' use of national media.

A comprehensive database of television and newspaper advertisements was investigated to determine the prevalence of brand advertising and price advertising by manufacturers and retailers. Advertisements were inspected within each of the 22 product categories studied by papers cited in Kaul and Wittink's (1995) meta-analysis of price advertising (Table 1).[1] Manufacturer brand advertising was prevalent in *all* categories, whereas manufacturer price advertising was found in 64% of categories. However, although retailer price advertising was prevalent in *all* categories, retailer brand advertising for manufacturer products was found in *none* of the categories.[2]

These observations about price advertising raise several important questions. Do price advertisements from the manufacturer have the same influence on demand as price advertisements from the distribution channel? If not, how do their effects differ? Which type of price advertising is more effective in influencing consumer demand?

A large literature on persuasion knowledge (Friestad and Wright 1994) and attribution theory (Folkes 1988) implies that price advertising may evoke consumers' attributional processes to interpret and evaluate the underlying motives of the persuasion attempts (Campbell 1999, Campbell and Kirmani 2000, Jain et al. 2000, Settle and Golden 1974, Smith and Hunt 1978, Sparkman and Locander 1980). On one hand, consumers may attribute the advertised discount offer

[1] Table 1 only includes product categories with independent resellers.

[2] Retailer advertising of manufacturer brands cannot be ruled out completely; some manufacturers' cooperative advertising programs require that retailers communicate differentiating messages about the manufacturer's product. Still, retailer brand advertising seems to be rare.

Table 1 Prevalence of Advertising by Type

Product category	Manufacturer brand advertising	Manufacturer price advertising	Dealer brand advertising	Dealer price advertising
Yogurt	Y	Y	N	Y
Confectionary/ candy bars	Y	Y	N	Y
Ground coffee	Y	Y	N	Y
Soft drinks	Y	Y	N	Y
Frozen waffles	Y	Y	N	Y
Ready-to-eat cereals	Y	Y	N	Y
Sparkling wine	Y	Y	N	Y
Aluminum foil	Y	Y	N	Y
Hair spray	Y	N	N	Y
Detergents	Y	Y	N	Y
Insecticides	Y	N	N	Y
Deodorants	Y	N	N	Y
Suntan lotions	Y	Y	N	Y
Liquid household cleansers	Y	Y	N	Y
Bath tissue	Y	Y	N	Y
Ketchup	Y	N	N	Y
Disposable diapers	Y	N	N	Y
Cat litter	Y	N	N	Y
Dry dog food	Y	Y	N	Y
Cigarettes	Y	N	N	Y
Electric shavers	Y	N	N	Y
Television sets	Y	Y	N	Y
Proportion "yes" (%)	100	64	0	100

Note. Product categories studied by papers cited in Kaul and Wittink's (1995) meta-analysis are included, except three undisclosed CPG product categories and categories that used franchisees or vertically integrated retailers to distribute goods (e.g., gasoline, banks, airlines, law firms).

to inferior product quality. Price discounts have been found to lower perceived product quality in many different contexts, as reviewed by Rao and Monroe (1989). On the other hand, consumers may infer that the motivation of a sales promotion delivered through price advertising is to push out excess inventory (Lichtenstein et al. 1989, Burton et al. 1994). Therefore, the low-quality inference may lead consumers to stay away from the advertised product, but the excess-inventory inference may indicate favorable timing to make a purchase (Raghubir et al. 2004).

We hypothesize that consumers' inferences might depend on which channel member communicates the price advertisement. More specifically, manufacturer price advertising may lead to a greater negative quality inference than retailer price advertising because the manufacturer is more directly responsible for the product's quality. Conversely, retailer price advertising may be more likely to generate sales than manufacturer price advertising because retailers are more directly responsible for managing inventory. This is not to say that manufacturer price advertising is ineffective in an absolute sense, just that it may be less effective than retailer price advertising at influencing demand for the product. This is the central prediction of the current paper.

This central prediction that manufacturer price advertising is less effective than retailer price advertising is tested, using both experimental studies and econometric analysis, in the context of the market for pickup trucks. This product category was chosen because of its importance; it was more heavily advertised than any other in 2007. Automobile manufacturers spent about \$6 billion on truck advertising, including more than \$2 billion on price advertising. Dealers associations spent an additional \$3 billion on price advertising. About 1 out of every 12 U.S. broadcast television commercials (in any product category) advertised a pickup truck in 2007.[3]

We manipulate the source of a price advertisement in an experiment run on a sample of pickup truck owners. The experiment confirms the paper's central prediction, showing that consumers who received a price advertisement from a truck manufacturer indicated lower potential demand than consumers who received a price advertisement from a dealers association. An econometric analysis of market data on pickup truck sales and advertising also confirms the central prediction, showing that dealer price advertising is more effective than manufacturer price advertising and establishing that the difference is large enough to detect in market data.

The current paper seeks to make three contributions. First, the experiments described in the next section are the first to manipulate the channel member as the source (i.e., perceived sender) of a price advertising message. Prior work implies that the character or spokesperson appearing within an ad may alter the prestige of the advertised product (Fuchs 1964), influence the credibility of the message (Gottlieb and Sarel 1991), and change attitudes within subgroups of targeted consumers (Brumbaugh 2002). However, we do not know of any previous studies showing that price advertisements effects depend on which channel member sent the ad.

Second, we contribute to a large literature on estimating consumer demand for automobiles.[4] To the best

[3] *Source*: Kantar Media advertising spending database.

[4] In the recent literature, Sudhir (2001) examined competitive pricing behavior in different segments of the U.S. auto market and found that automakers price more aggressively in the entry-level segment and less aggressively in the larger car segment. Busse et al. (2006) found that "customer cash" results in larger pass-through than "dealer cash" since customer cash is directly revealed to the consumer. Dasgupta et al. (2007) showed that consumers are more likely to lease vehicles with high expected maintenance costs and to buy cars that are seen as more reliable. Bucklin et al. (2008) developed a method to evaluate the impact of dealer distribution intensity on consumers' new car choices. Busse et al. (2010) found that employee discount pricing promotions offered by automotive manufacturers led to simultaneous increases in prices and sales by cannibalizing demand from future periods. Albuquerque and Bronnenberg (2012) proposed a framework to estimate dealer costs and predicted the impact of a recession on dealer exit and post-exit automobile prices.

of our knowledge, only three studies of automotive demand included advertising data. Kwoka (1993) estimated returns to product redesigns and advertising, finding that redesigns' effects on sales last longer than advertising's effects. Srinivasan et al. (2009) found that investors' profit expectations respond to automakers' marketing strategies, with auto quality and advertising interacting positively to increase stock prices while price promotions reduced stock prices. Barroso and Llobet (2012) found that the omission of advertising data biases automotive demand estimates. The current paper adds to this literature by showing how sales respond differentially to three types of advertising. We also find that truck advertising effects take place over a two-week horizon with no discernible contemporaneous effect. These econometric results are explored in the third section.

Finally, the current paper has implications for research on manufacturer–retailer interactions. Prior work has focused on the balance of power between manufacturers and retailers in setting the wholesale price and dividing channel profits between the two parties (Kadiyali et al. 2000, Sudhir 2001, Villas-Boas and Zhao 2005, Draganska et al. 2010). As we discuss in the final section, the findings in the current paper may offer a rationale for further channel coordination in price advertising budgets and the design of price advertising messages, as well as future research in channel design.

2. Experimental Evidence

Perhaps surprisingly, no previous paper has directly manipulated the channel member as the sender of a price advertisement. It is expected that manufacturer price advertising will result in lower potential demand than retailer price advertising for two reasons. The manufacturer is more immediately responsible for the product's quality than the retailer, so a price promotion will harm perceived quality more when it is advertised by the manufacturer than when it comes from the retailer. In addition, the retailer is more immediately responsible for setting prices to manage inventory. Therefore, a price promotion communicated by the retailer is more likely to be attributed to temporary conditions indicating a favorable time to make a purchase.

Hypothesis 1 (H1). *Subjects exposed to retailer price advertising should indicate greater potential demand than subjects exposed to manufacturer price advertising.*

Consistent with this central prediction, if consumers think the manufacturer is the sender of the price advertisement they were exposed to, it should result in lower potential demand than if they believe the retailer is the sender of the price advertisement. This leads to a second hypothesis.

Hypothesis 2 (H2). *Subjects who perceive the retailer as the source of the price ad should indicate greater potential demand than subjects who perceive the manufacturer as the source of the price ad.*

Hypothesis 1 tests the effect of exposure on potential demand and is identified by random assignment within an experimental design. Hypothesis 2 tests the effect of source perception on potential demand and is identified by consumers' self-reported source perceptions.

2.1. Method

2.1.1. Stimuli. To create the stimuli, a manufacturer price advertisement was modified so that its sender was either Ford (a pickup truck manufacturer) or the Texas Ford Dealers Association. In the manufacturer source condition, the audio of the commercial was replaced with a clip in which a researcher recited the script from the original ad while a Ford commercial song played in the background. This ensured that the narrator's voice and background music were kept constant across the two price advertisements in the experiment.

Three changes were made to manipulate the sender of the advertisement. First, subjects and pronouns referring to the sender in the script were appropriately modified. Second, the geographic frame of reference was changed from the national market to the Texas market. Third, the onscreen logo and call to action were changed appropriately to show that the commercial came from the Texas Ford Dealers Association rather than from Ford. These three elements are nearly universal in dealers associations' price advertisements for pickup trucks, and represent the complete set of price advertisement attributes that commonly differ between manufacturers and dealers associations.

Figure 1 provides download links to watch the two commercials, complete scripts, and pictures of the logos in the closing seconds of the two price advertisements.[5] In sum, this manipulation was rather subtle. 87% of the words and 90% of the video frames are identical between the two stimuli.

A pretest with 147 subjects indicated that the manipulation was effective. Each person was randomly assigned to watch one of the two price advertisements and then answered a multiple choice question about whom they thought had paid for the advertisement: (a) Ford, (b) the Texas Ford Dealers Association, (c) other, or (d) do not know/not sure; 75% of the subjects who watched the manufacturer source stimulus

[5] The number of stimuli was limited because subject recruitment was relatively costly and slow. The price content of the ad was not modified but the list price of a Ford truck did not change much between the time when the ad originally aired and when the experiment was conducted.

Figure 1 Price Advertisement Stimuli

Manufacturer attribution Dealers association attribution

Notes. (Left) Original manufacturer price advertisement (emphasis added): "Since **we** introduced the Ford family plan, hundreds of thousands of **Americans** have joined in on the savings. Now **we're extending the plan until** September 6. Get employee pricing on F-Series, **America's best selling truck**, including F-150, the highest ranked light-duty full-size pickup in initial quality by J.D. Power and Associates. Now get a Built Ford Tough F-150 for just $15,270. That's over $6,000 in savings on a new F-150. No hassles, no gimmicks. **Visit your local Ford store today**!" (http://www.youtube.com/watch?v=i2zmiJ1HgWg, posted by "LinliXu," September 5, 2010). (Right) Revised price advertisement script with revisions indicated by added emphasis: "Since **Ford** introduced the Ford family plan, hundreds of thousands of **Texans** have joined in on the savings. Now **it's been extended until** September 6. Get employee pricing on F-Series, **Texas' best selling truck**, including F-150, the highest ranked light-duty full-size pickup in initial quality by J.D. Power and Associates. Now get a Built Ford Tough F-150 for just $15,270. That's over $6,000 in savings on a new F-150. No hassles, no gimmicks. **Visit your Texas Ford Dealer today**!" (http://www.youtube.com/watch?v=ICxHNOteVgs, posted by "LinliXu," September 5, 2010).

chose option (a) and 74% of the subjects who watched the dealer source stimulus chose option (b). Both figures are different from 50% at the 99% confidence level, confirming that the sender manipulation of the price advertisement is valid.

2.1.2. Subject Pool. The survey link was posted on eight Internet forums devoted to pickup trucks. It was also advertised on Facebook, targeting users whose profiles indicated that they like pickup trucks or major pickup truck brands; 337 truck enthusiasts completed the experiment, taking an average of about three minutes each.

2.1.3. Experimental Design. The first page of the online survey presented each subject with a manufacturer brand advertisement, followed by a price advertisement. All subjects saw the same brand ad but were then randomly assigned with equal probability to see either the manufacturer price ad or the dealer price ad. The brand ad was used to ensure that all subjects had at least some minimal knowledge about Ford's brand positioning. Of all subjects, 94% stayed on the page for at least 90 seconds or clicked at least twice (the minimum number of clicks needed to view both advertisements), verifying that they were exposed to the stimuli.

After viewing both ads, the subjects were asked to indicate their agreement on a 1 to 10 scale with each of five statements on the second page:

"Ford trucks have high quality."
"Ford trucks are a good value."
"Ford trucks are tough."
"I would test drive a Ford truck."
"I would consider buying a Ford truck."

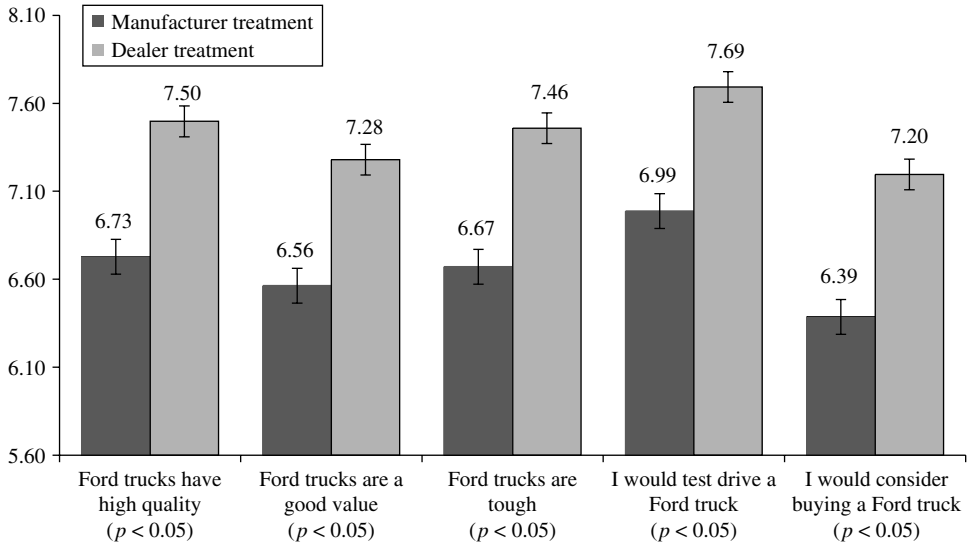
The first and third statements are direct and indirect measures of truck quality perceptions. The second statement is used to distinguish between the effects of price advertising on perceived quality and value. The final two statements elicit subjects' behavioral intentions. Subjects' responses on perceived quality, value, and behavioral intentions have repeatedly been found to correlate well with actual purchases made outside of the lab (Klein and Lansing 1955, Tobin 1959, Juster 1966, Clawson 1971, Fishbein and Ajzen 1975, Kalwani and Silk 1982, Morwitz and Schmittlein 1992). Because the high price of pickup trucks precludes measuring subjects' actual purchase behavior in an experimental setting, we follow prior work in relying on these measures to indicate subjects' purchase intentions. We refer to the group of five questions as "indicators of potential demand."

Subjects were then asked whom they thought had paid for the brand advertisement and, separately, who they thought had paid for the price advertisement, using the same multiple choice question as the pretest. Finally, each subject indicated all truck brands he or she had owned.

2.2. Experimental Findings

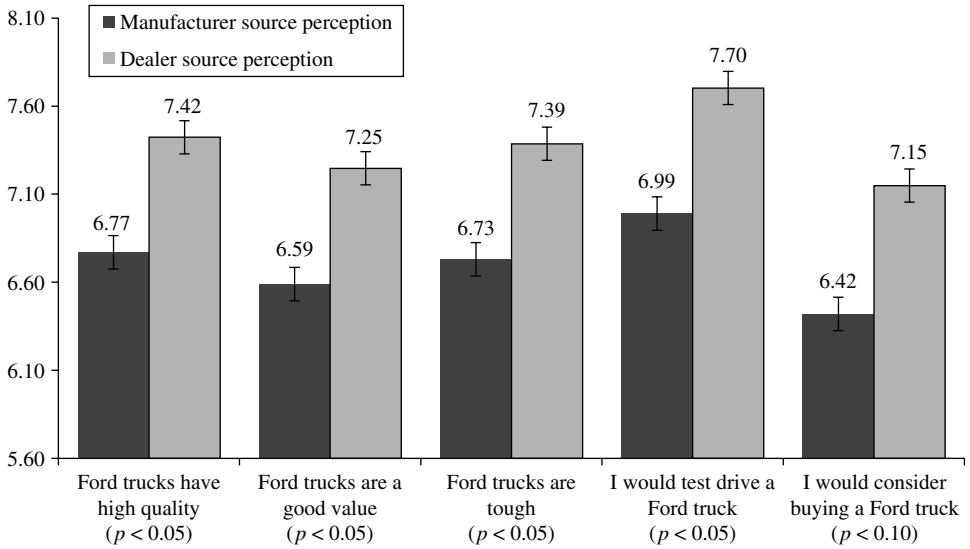
Figure 2 shows that subjects exposed to the dealer price advertisement gave higher ratings on all five indicators of potential demand than those who were exposed to manufacturer price advertising. All five indicators are significantly different between the two groups at the 95% confidence level, providing strong support for H1.

Figure 2 **Average Indicators of Potential Demand by Treatment**



Note. The error bars represent the standard errors of the mean.

Figure 3 **Average Indicators of Potential Demand by Source Perception**



Note. The error bars represent the standard errors of the mean.

The point estimate of the effect is appreciable, about 0.75 on a 10-point scale.

Figure 3 shows that subjects who perceived the source of the price advertisement to be the dealers association reported higher indicators of potential demand than subjects who perceived the source to be the manufacturer.[6] This difference is significant at the 95% confidence level for quality, value, toughness and willingness to test drive, and significant at the 90% confidence level for willingness to consider purchase. Thus, the results provide strong evidence supporting H2.[7]

One would expect the intersection of source and perceived source to have significant differences in indicators of potential demand. This was true; subjects exposed to the dealer source ad who stated that they perceived the dealer as the source indicated higher

[6] We also looked at the effect of perceived source on indicators of potential demand within each treatment condition. The results were directionally consistent with H2 on all five indicators within both conditions; none of the differences were statistically significant perhaps because relatively few people misperceived the sender within each of the two conditions.

[7] The mean effects in Figures 2 and 3 are equivalent, perhaps because most subjects correctly identified the source of the price advertisement, leading to substantial overlap in the treatment conditions used to test the two hypotheses.

potential demand than subjects exposed to the manufacturer source ad who stated that they perceived the manufacturer as the source. Mean differences between the two groups ranged from 1.15 to 1.20.

2.3. Discussion

The experiment confirms our central prediction that manufacturer price advertising leads to lower indicators of potential demand than dealer price advertising.

The findings of Lichtenstein et al. (1989) and Burton et al. (1994) can be used to understand the mechanism producing the experimental results. These authors exposed consumers to dealer price advertisements and asked them to rate the value offered by the discount as well as why they thought the dealer would offer the discounted price. On one hand, many subjects attributed the price discount to dealers' attempts to sell out their inventory and therefore rated the offers as being a good value. They believed that the promotion offered opportunities to save money or save time and effort in their decision making, generating a positive *economic effect* and increasing their demand for the product. On the other hand, some consumers inferred negative information about the product from the price discount. The subjects who attributed the sales promotion to product-related reasons such as "there must be something wrong with the product" experienced a negative *information effect*, depressing their demand for the product. The final effect of the sales promotion is the sum of the positive economic effect and the negative information effect.

This can explain the experimental results above when we relate the two effects to the strategic roles that manufacturers and dealers play in delivering the product to the consumer. Dealers are more directly responsible for using price to manage inventory, so the dealer price advertising may be attributed to dealers' attempts to sell out their inventory, leading to more positive economic effects than manufacturer price advertising. On the other hand, the manufacturer is more directly responsible for the product's quality than the dealer is, so manufacturer price advertising may lead to more negative information effects than dealer price advertising. Therefore, the net effect of manufacturer price advertising on potential demand is lower than the net effect of dealer price advertising.

It is worthwhile to note that because of the cost of enrolling truck owners in the study, we did not measure the indicators of potential demand in the absence of any price advertising stimulus. The experimental evidence supports the central prediction that manufacturer price advertising is less effective than retailer price advertising, but it does not offer any absolute statement about the efficacy of manufacturer price advertising. Next, we describe two additional analyses conducted to test alternative explanations for these experimental findings.

2.4. Robustness Check: Geographic Frame of Reference

The geographic frame of reference was not manipulated independently from the perceived sender in the above-reported conditions because dealer price advertisements always use a local frame of reference whereas manufacturer price ads always use a national frame of reference. Still, it leaves unanswered the question of whether geographic frame of reference could reproduce the effect of price advertisement source on indicators of potential demand in the absence of the sender manipulation.

To answer this question, we isolated the source perception effect by holding the geographic frames of reference constant between the manufacturer's price ad and the dealer's price ad. We created a third stimulus by modifying the manufacturer price ad to reference the same local market (Texas) as the dealer's price ad stimulus. The ad was otherwise unchanged. Eighty-eight current and past truck owners were assigned to watch the ad and asked to answer the same questions described in §2.1. 74% of the participants correctly identified the source to be the manufacturer (Ford).

Figure 4 shows that subjects who perceived the dealers association as the sender of the price advertisement again rated Ford trucks higher on all five indicators of potential demand than subjects who perceived the manufacturer as the sender of the price advertisement. This difference is significant at the 95% confidence level for value and willingness to test drive, and significant at the 90% confidence level for quality, toughness, and willingness to consider purchase. This result shows that there is a direct effect of the perceived source of the price advertisement on indicators of potential demand, independent of the geographic frame of reference.

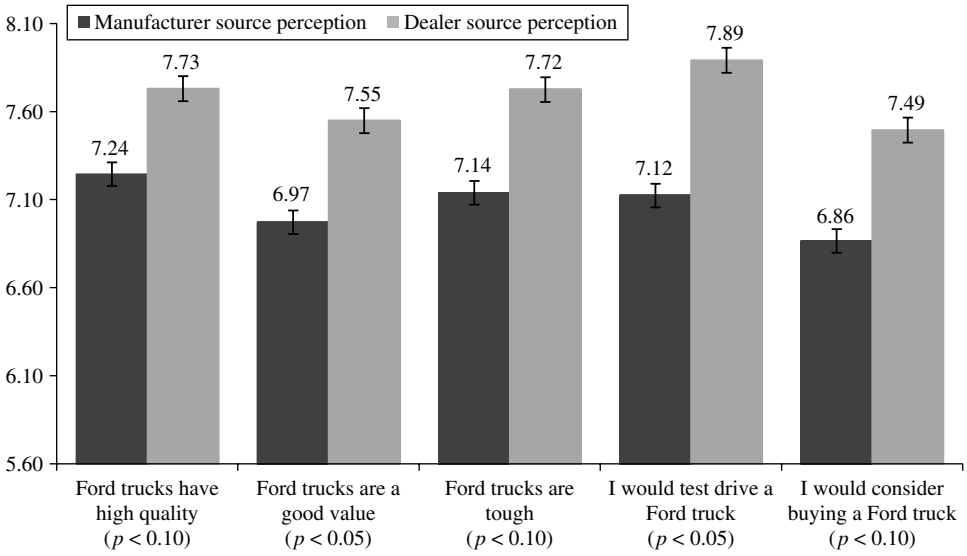
2.5. Robustness Check and Moderation Analysis: Prior Ford Ownership

Subjects who owned Ford trucks may have higher potential demand for Ford trucks, and may therefore be more likely to perceive price advertisements for Ford trucks to come from the dealers association rather than the manufacturer. This would not affect the evidence for H1 since identification of the exposure effect depends solely on random assignment. However, it could lead to a spurious positive correlation between dealer source perception and potential demand.

Of the subjects, 63% indicated having owned a Ford truck. They rated Ford trucks significantly higher on all five indicators of potential demand than those who had never owned a Ford truck. However, prior Ford owners and non–Ford owners showed no significant differences in their source perceptions. The same proportion of Ford owners (77%) and non–Ford owners (77%) receiving the dealer source treatment perceived the dealers association as the source.

The experimental manipulation confirms H1 even when we restrict the sample to Ford owners. That is,

Figure 4 **Average Indicators of Potential Demand by Source Perception Holding Geographic Frames of Reference Constant**



Note. The error bars represent the standard errors of the mean.

Ford owners exposed to the dealer price advertisement rated the truck higher on all five indicators of potential demand than Ford owners exposed to the manufacturer price advertisement. Differences in the first two measures were significant at the 90% confidence level, and the last three were significant at the 95% confidence level. It appears that prior Ford ownership did not affect the relative impact of the perceived source on potential demand.

Finally, following Baron and Kenny (1986), we tested whether prior Ford ownership moderates the source perception effects (H2) of price advertising on indicators of potential demand. In other words, prior Ford ownership might reduce the differences between the effects of manufacturer price advertising and the effects of dealer pricing advertising. Figure 5 shows no evidence that Ford ownership moderates the effects of source perception on any of the five indicators of potential demand ($p > 0.38$ for all five indicators). Similarly, no evidence was found that prior Ford ownership moderates the treatment effects (H1).

2.6. Summary

The experimental findings show that (a) consumers are generally able to correctly identify the sender of a price advertisement and (b) manufacturer price advertising leads to lower indicators of potential demand than dealer price advertising, even among experienced consumers. Next, we investigate whether these effects can be detected in market data.

3. Econometric Evidence

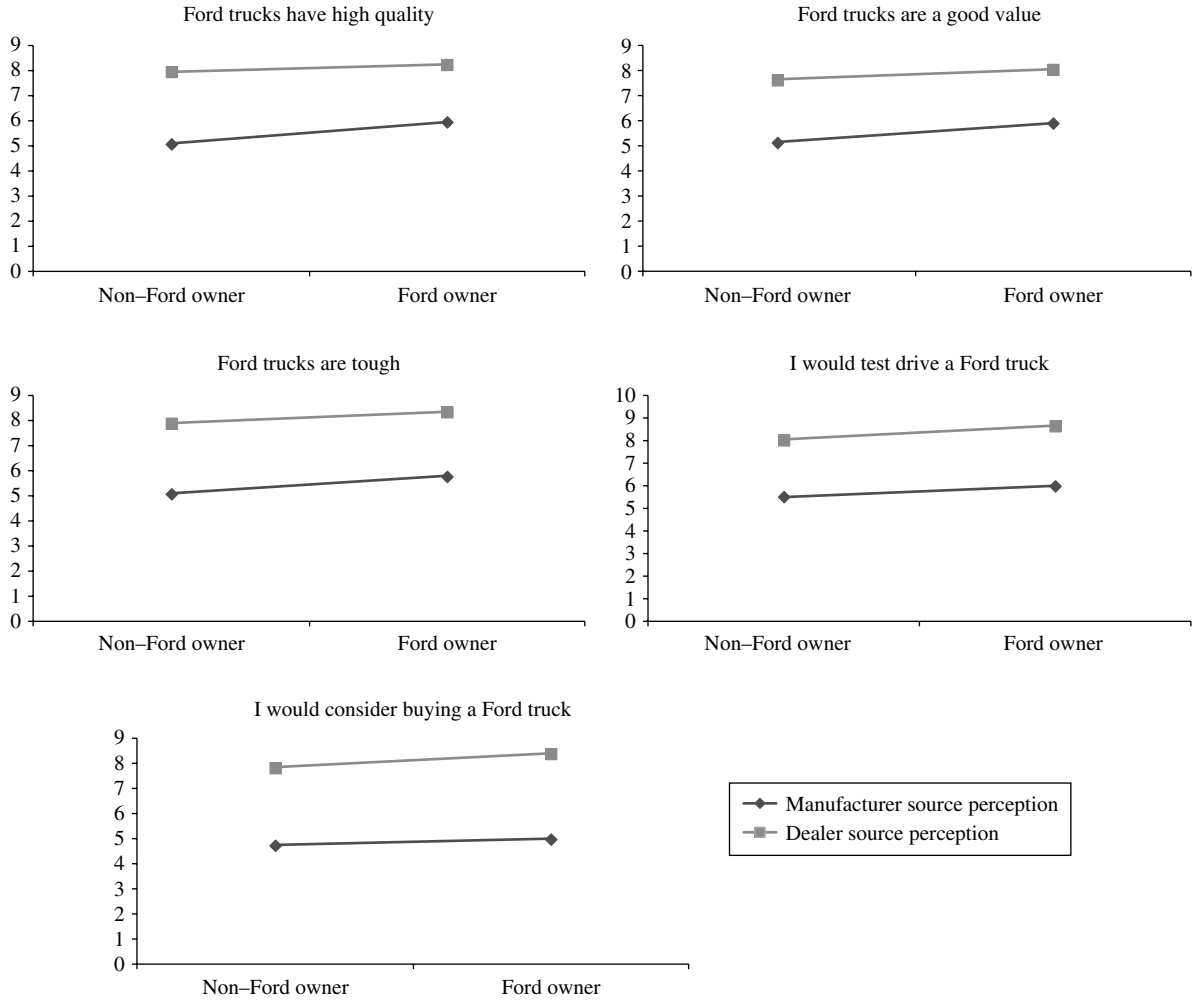
This section explores the external validity of the experimental findings using market data from the full-size pickup truck category. Manufacturers spend about $2 billion to advertise pickup truck prices annually. Dealers associations spend an additional $3 billion on price advertising.

Unlike the typical manufacturer-retailer structure in consumer-packaged goods industries, automotive manufacturers fund and organize dealers associations. Dealerships are not required to join dealers associations but nearly all of them do (Murry 2014). Typically, manufacturers contribute a fixed percentage of the invoice price of each car or truck sold at the wholesale price to pay for advertising done by the dealers association. Dealers association advertising is used to standardize and communicate local price promotions. Although dealers association advertising is funded by manufacturers, dealers associations are free to choose their own advertising strategies. However, analyses in §3.6 show that price advertising by manufacturers and dealers associations exhibit similar price messages and targeting.

3.1. Transaction Data

The econometric analysis combines two data sets. The first is transaction data on the sales of full-size pickup trucks in the Los Angeles metropolitan area collected by the Power Information Network, a division of J.D. Power and Associates. Each observation includes the transaction date, type (lease, finance, or cash), transaction pricing terms (e.g., down payment, rebate, APR, etc.), vehicle characteristics (make, model, model-year, options), an anonymous dealership number, customer gender, and customer zip code. The sample includes six trucks—Chevrolet Avalanche, Ford F-Series, Dodge Ram, Chevrolet Silverado, Toyota Tundra, and

Figure 5 Prior Ford Ownership on Source Perception Effects



GMC Sierra—that accounted for 87% of category sales between July 2001 and April 2005.

Figure 6 shows the two leading trucks' market shares and average prices over the sample period. The market shares of Ford and Silverado had similar averages of 4.9% and 4.7%, respectively. However, these shares varied considerably over time; the standard deviation of Ford's market share was 1.5% whereas the standard deviation of Silverado's market share was 1.8%. Large weekly changes in market shares usually corresponded to sales promotions, major holidays and the release of new model-year units.

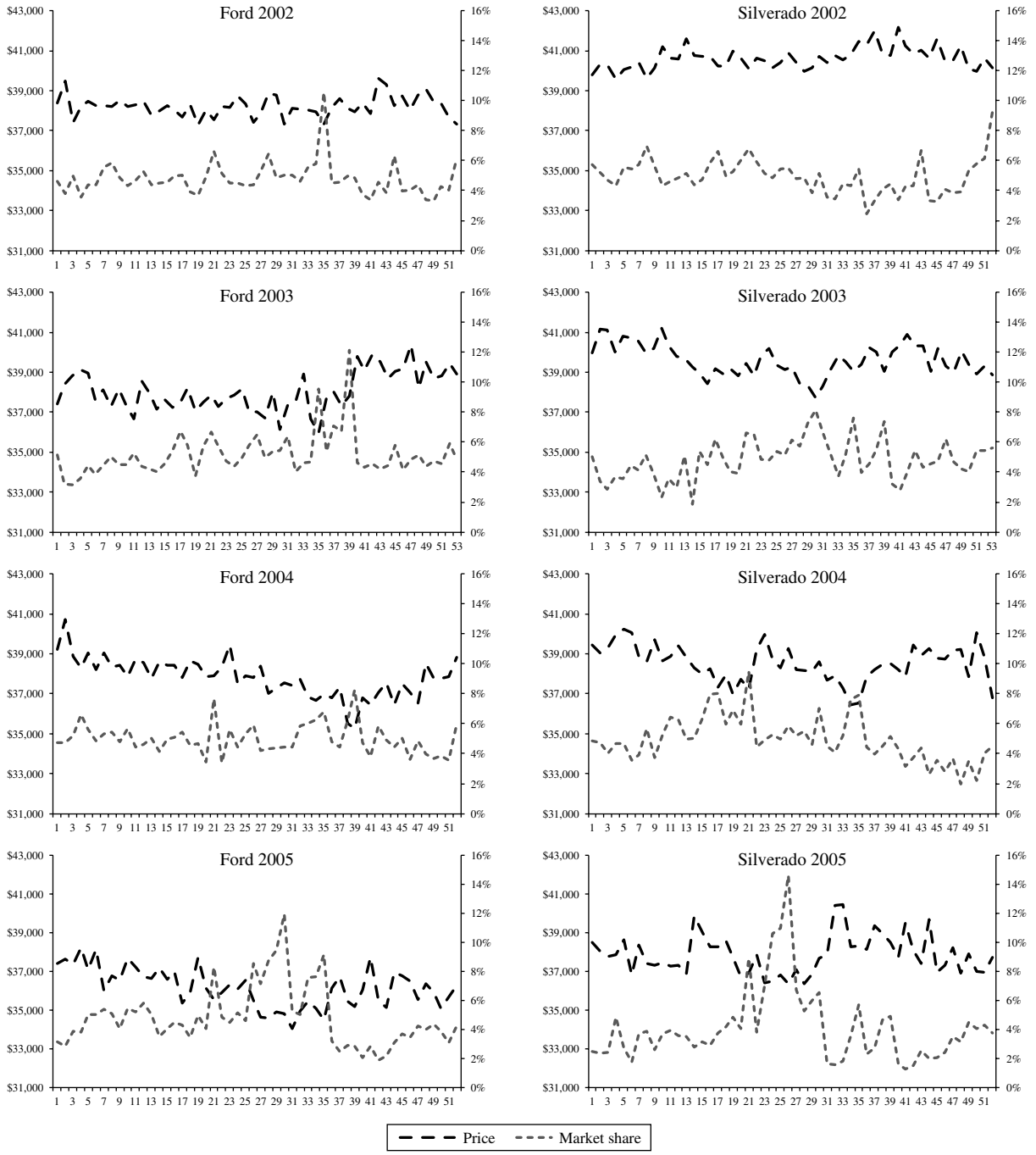
To understand the nature of variation in the sales data, we decomposed the variance in sales onto a set of week fixed effects and a set of zip-code fixed effects. Spatial variation explained about 2.5 times as much of the sales data as temporal variation. Therefore, the model presented below accommodates zip-code-level heterogeneity in responsiveness to price and advertising variables.

When modeling advertising effectiveness, it is essential that the data include nonpurchases as well as purchases. Otherwise, one cannot fully identify advertising's lift over baseline sales. A number of recent studies (Bucklin et al. 2008, Chen et al. 2008) have estimated auto demand using transaction level data, but the transaction-level approach is not suitable to the purposes of this paper. Because every transaction, by definition, is an observation of positive demand, such an approach would exclude nonpurchase data. Instead, we estimate demand by modeling weekly zip-code purchases with nonpurchases included in the outside option, as in Berry et al. (1995, 2004), and Sudhir (2001). The online appendix (available at http://ssrn.com/abstract=2488824) explains how weekly market prices for each truck within each zip code are constructed from the observed transaction prices and how this procedure was used to impute prices for zip code/truck/weeks with zero sales.

3.2. Advertising Data

The second data source is Kantar Media's "Strategy" database. It reports estimated advertising expenditures for all truck manufacturers, dealers' associations,

Figure 6 Prices and Market Shares over Time



and individual dealerships. Television and newspaper advertising accounted for 81% of category advertising expenditures.

Video files for 130 pickup truck ads were obtained, approximately 17% of the ad creatives aired during the sample period. A content analysis of these advertisements was performed to identify the types of message conveyed by manufacturers and dealers associations. Two independent coders rated each advertisement on a 0 to 100 scale, where 0 indicated all brand messages and no price messages and 100 indicated all price messages and no brand messages.[8] Like Kaul and Wittink (1995), we found that manufacturer advertising on national networks is primarily brand advertising (mean = 19). In contrast, local manufacturer and dealers associations'

[8] Because each coder was to watch 130 advertisements, we used a scale with a large number of possible responses in an effort to reduce anchoring effects.

advertising were much more price-oriented, with average scores of 54 and 58, respectively.[9]

A closer examination of the content analysis scores showed that advertising content can be categorized by medium and sender. Of the national manufacturer advertisements, 13 had associated expenditures of at least $100,000, accounting for 99.7% of total national manufacturer advertising spending. Of these 13, 11 received average brand/price content scores between 0 and 5; one received a score of 36.5, and one received a score of 75. Of the local manufacturer advertisements, 20 had expenditures of at least $100,000, accounting for 99.4% of all local manufacturer advertising. Of these 20 ads, 14 received scores between 67 and 85.5; the remaining six ads received scores of 53, 50, 25, 2.5, 1.5, and 1, respectively. Among the dealers association advertisements, 25 ads were associated with at least $100,000 spending, accounting for 91.6% of all dealer association advertising. Of 25 ads, 19 scored between 51.5 and 84; an additional 5 ads received scores between 38.5 and 46; and 1 ad received a score of 3.

Given the robust correspondence between ad content and sender/geography combination, we defined the following three variables for consistency with the prior literature. *Manufacturer brand advertising* (MBA) is paid for by the manufacturer, carries primarily truck-specific branding messages, and is conveyed by national television networks and national newspapers in many metropolitan areas simultaneously.[10] MPA is paid for by the manufacturer, carries primarily truck-specific price messages, and is conveyed by local television stations and newspapers. *Dealers' price advertising* (DPA) is paid for by local dealers associations, carries primarily truck-specific messages about pricing terms and holiday sales events, and is conveyed by local television stations and newspapers.[11] All advertising expenditures are observed at the level of the media market (i.e., Los Angeles).

Figure 7 shows the log advertising expenditures of F-Series and Silverado by week. MPA and DPA often go to zero, and the advertising expenditures of the other four trucks follow similar patterns. Therefore, it appears that there is enough variation in the advertising data to separately identify the effects of each type of advertising.

Table 2 Correlations Among Marketing Variables

	log(MBA + 1)	log(MPA + 1)	log(DPA + 1)	Price	Market share
log(MBA + 1)	—				
log(MPA + 1)	0.37**	—			
log(DPA + 1)	0.25**	0.13**	—		
Price	0.15**	0.02**	0.00*	—	
Market share	0.06**	0.04**	0.02**	−0.01**	—

*Significant at 95% confidence level; **significant at 99% confidence level.

Table 2 displays the correlations among advertising variables, price and market share. All three types of advertising are positively correlated, indicating a weak tendency for brand advertising and price advertising to be pulsed together in the same time period. Market shares are positively correlated with advertising variables, as one would expect. The correspondence between market share and price is negative but small in absolute value at −0.01. Price is positively correlated with all three types of advertising, though the correlations between it and price advertising are small (0.017 correlation with MPA, 0.004 correlation with DPA).[12]

3.3. Model

We derive consumer demand from the direct utility function. We first introduce the basic model and then show how we adapt it to the data.

3.3.1. Consumer Utility. We assume that a consumer may purchase any of a set of trucks indexed by $j = 1, \ldots, J$. Consumer preferences are assumed to be

$$u = \max_{j=1,\ldots,J} \{x_j \psi_j\} + \alpha y, \tag{1}$$

where x_j is an indicator function that equals one if the consumer purchases truck j and ψ_j is the perceived quality of truck j. The maximum operator enters Equation (1) because any available truck is substitutable for any other truck, as all trucks perform the same basic functions of driving and hauling. However, although trucks are substitutable, each one offers a different quality level ψ_j (Liaukonyte 2014). Here, y is the numeraire, that is, the utility of all income that is not spent purchasing trucks. Each unit of y yields a marginal utility of α. The consumer's spending is constrained by

$$y + \sum_{j=1,\ldots,J} x_j p_j \le m, \tag{2}$$

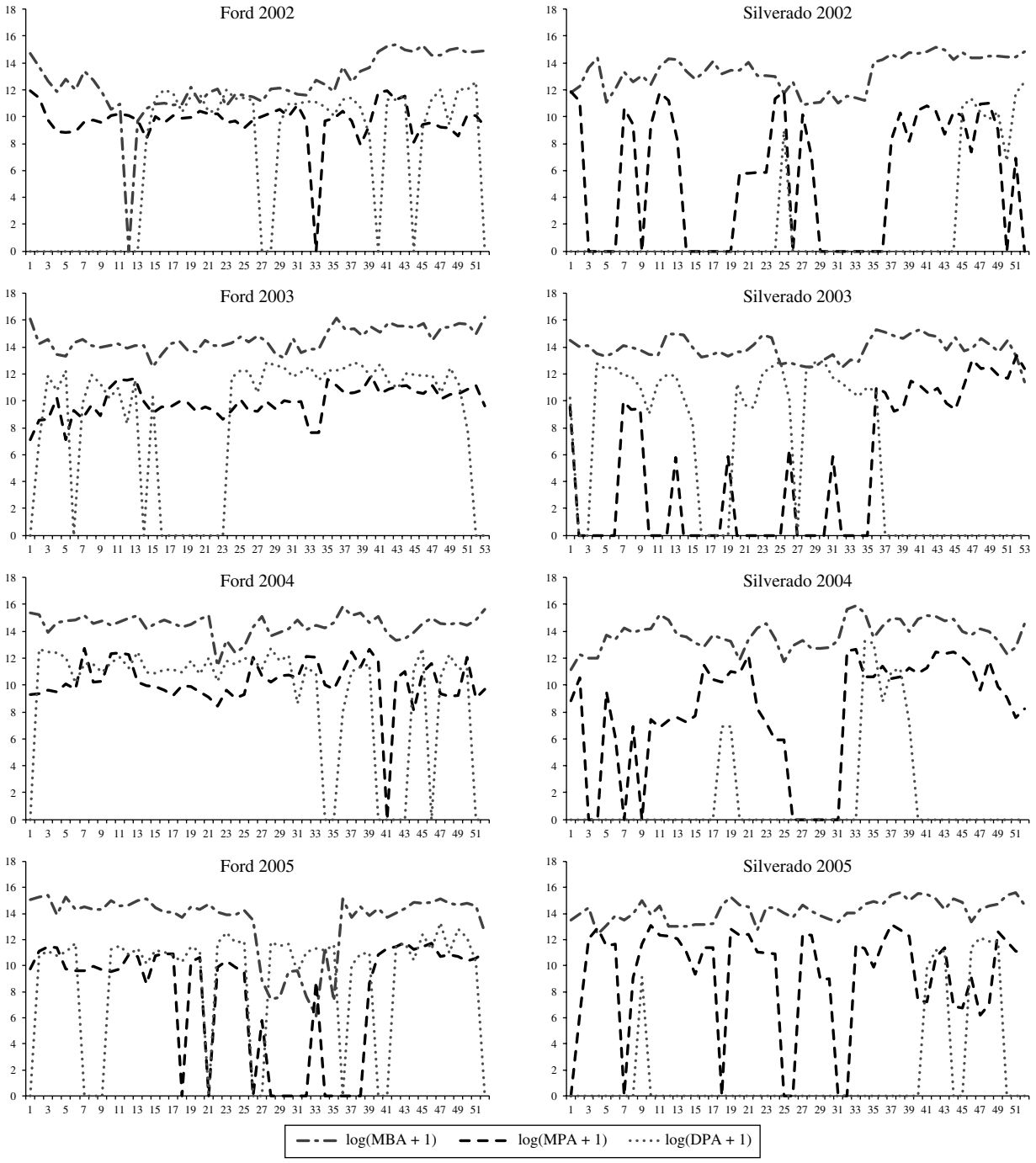
[9] Coders were not allowed to resolve discrepancies through discussion. The coders' percentage agreement was 83%; many comparable studies allowed coders to resolve discrepancies and find percentage agreement ratings near 90%. Percentage agreement is defined as $\sum_{a=1}^{130} 1(I_{1a} = I_{2a})/130$, where $I_{ka} = 1(r_{ka} \le m_k)$, r_{ka} is the rating (0–100 scale) that coder $k \in \{1, 2\}$ gave ad a, and m_k is the median rating by coder k.

[10] To equate manufacturer brand advertising expenditures to the other types of advertising, we deflate it by the Los Angeles market's share of the U.S. population. All advertising expenditures are expressed in July 2001 dollars.

[11] Individual dealership advertisements typically convey dealership existence and location information. They do not communicate category-specific branding or pricing messages. Specification tests suggested that this variable should not be included in the empirical analysis.

[12] It may seem counterintuitive that price is positively correlated with price advertising since our instinct as consumers is usually to believe that price advertising indicates low prices. However, this industry has many pricing levers (down payment, rebate, interest rate, etc.) and customers are imperfectly informed about typical prices. It seems possible that sellers can create an impression of low prices at some times when prices are not actually low.

Figure 7 Advertising Expenditure over Time



where p_j is the price of truck j and m is the consumer's budget.

If the consumer purchases truck j, her indirect utility will be $\psi_j + \alpha(m - p_j)$. If she buys none of the available trucks, her utility will be αm. Rationality implies that she selects the corner solution that maximizes constrained utility, conditional on perceived truck qualities, prices, and income. She will redirect spending from the numeraire to the best available truck if and only if the truck's utility per dollar ψ_j/p_j exceeds α.

We will depart from classical assumptions in two ways. First, although the consumer is aware that all J trucks exist, we will assume that each truck's perceived quality may depend on its advertising (MBA, MPA, and DPA). This is consistent with the experimental evidence presented earlier.

Second, we will allow for the possibility that consumers observe prices imperfectly. Truck pricing is complex relative to most markets. Prices depend on many variables including down payments, rebates,

interest rates, monthly payments, residual lease valuations, etc. The consumer must perform complex calculations (such as those in §A of the online appendix) to determine which transaction type is the most advantageous. Therefore, we assume instead that consumers react to perceived prices.

Further, price perceptions may depend on price advertising; otherwise, manufacturers and dealers associations might not spend $5 billion annually on price advertising. Truck price advertisements frequently deliver multiple pricing cues that are not comparable across competing truck brands' advertisements. For example, Ford might advertise a rebate while Silverado advertises a low interest rate. Because of these complexities, and because the price of any individual truck is not realized until after the consumer has finished configuring it, it seems reasonable that consumer demand responds to price perceptions, which may be influenced by price advertising. The next section shows how we incorporate these assumptions in fitting the model to the available data.

3.3.2. Empirical Model. Consumer i in zip code z's perceived quality of truck j is modeled as a function of MBA, MPA, and DPA as follows,[13]

$$\psi_{izjt} = \varphi_{js} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{MBA}} a_{jt-\tau}^{\mathrm{MBA}} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{MPA}} a_{jt-\tau}^{\mathrm{MPA}} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{DPA}} a_{jt-\tau}^{\mathrm{DPA}} + X_t \gamma_z + \xi_{zjt} + \varepsilon_{izjt}, \quad (3)$$

where φ_{js} is a truck-month intercept that captures the mean of all consumers' valuations for truck j in the calendar month s in which week t ends.[14] The sample contains data for 6 trucks and 46 months, leading to a total of 276 truck-month dummy variables capturing truck-specific demand factors that vary at the monthly level.

In Equation (3), a_{jt}^{A} is the log of one plus the expenditure of truck j on advertising of type $A \in \{\mathrm{MBA}, \mathrm{MPA}, \mathrm{DPA}\}$ in week t. Advertising expenditures do not vary across zip codes, but the model allows for zip-level heterogeneity in response to each type of advertising through the $\beta_{z\tau}^{A}$ parameters. Distributed lag functions (e.g., Tellis et al. 2000) for each advertising variable A allow advertising effects to persist over time. We found that including three lags minimized the Bayesian information criterion.[15]

Vector X_t includes gas price, holiday week dummies, and new model year release dummies.[16] The error term ξ_{zjt} captures unobserved zip-week departures from mean monthly truck demand. To allow individual demand to be influenced by past purchases within the zip code (Narayanan and Nair 2013), ξ_{zjt} is modeled as $\xi_{zjt} = \tilde{\xi}_{zjt} + YC_{zjt}\beta_z^{YC}$, where YC_{zjt} is a stock measure of recent sales of truck j in zip code z prior to time period t,[17] and β_z^{YC} is attributable to word-of-mouth. Therefore, past sales in the zip code are used to control for possible autocorrelation in zip- and week-specific departures from mean monthly truck demand (Dasgupta et al. 2007). The individual-specific component of truck utility, ε_{izjt}, is assumed to be individually and independently distributed (i.i.d.) type 1 extreme value with scale parameter one.

As discussed previously, price advertising may influence consumers' price perceptions. Thus, we assume

$$p_{zjt} = \tilde{p}_{zjt}\left(1 + \sum_{\tau=0}^{3} \eta_{\tau}^{\mathrm{MPA}} a_{jt-\tau}^{\mathrm{MPA}} + \sum_{\tau=0}^{3} \eta_{\tau}^{\mathrm{DPA}} a_{jt-\tau}^{\mathrm{DPA}}\right), \quad (4)$$

where $\tilde{p}_{zjt}$ is the price of truck j in zip code z in week t, and η_{τ}^{A} captures the effect of price advertising of type A on consumers' price perceptions. The integer one enters Equation (4) as a normalization so that, if price advertising has no impact on price perception (implying that all η parameters are zero), then price will enter the budget constraint in the traditional way.[18]

Combining Equations (3) and (4), we denote the mean of $\psi_{izjt} - \alpha_z p_{zjt}$ as V_{zjt}, that is, the mean indirect utility of choosing truck j in week t in zip code z:

$$V_{zjt} = \varphi_{js} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{MBA}} a_{jt-\tau}^{\mathrm{MBA}} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{MPA}} a_{jt-\tau}^{\mathrm{MPA}} + \sum_{\tau=0}^{3} \beta_{z\tau}^{\mathrm{DPA}} a_{jt-\tau}^{\mathrm{DPA}} + X_t \gamma_z + \xi_{zjt} - \tilde{p}_{zjt}\left(\alpha_z + \sum_{\tau=0}^{3} \alpha_z \eta_{\tau}^{\mathrm{MPA}} a_{jt-\tau}^{\mathrm{MPA}} + \sum_{\tau=0}^{3} \alpha_z \eta_{\tau}^{\mathrm{DPA}} a_{jt-\tau}^{\mathrm{DPA}}\right). \quad (5)$$

[13] We tested whether first-order interactions of advertising variables should be included in the model and concluded that they should not.

[14] Truck-month dummies are used instead of truck-week dummies because truck-week dummies would not be separately identified from advertising response parameters.

[15] We tried modeling the advertising carryover effects using the exponential smoothing approach by holding out the first six months of advertising data to construct initial adstock values for each type of advertising. However, unlike Erdem et al. (2008), we found that the estimation results were unreasonably sensitive to the number of time periods used to construct the initial adstock. We also tried including additional lags of brand advertising or dropping the third lag of either price advertising variable, but specification tests did not support either change.

[16] The sales bump corresponding to the release of new model year units normally lasts about three weeks. We identified the new model year release week for each truck in each calendar year and created a new model year release dummy that equals one for the first three weeks these new model year units are available on the market.

[17] We construct this measure as $YC_{zjt} = \lambda q_{zjt-1} + (1-\lambda) YC_{zjt-1}$, where q_{zjt-1} is the sales of truck j in zip code z in week $t-1$, and λ is a carryover parameter.

[18] If the price advertising terms instead entered Equation (4) additively, they would not be separately identified from the effects of price advertising on perceived quality, as can be seen in Equation (5).

The mean utility of the outside option is normalized to zero, so the predicted market share of truck j in week t in zip code z takes the familiar mixed logit functional form.

In estimating any choice model, some assumption must be imposed about the market size. We assume the market potential for each zip code in each week is the maximum weekly truck sales in that zip code observed in the data set. This is the smallest time-invariant market size that preserves the identity that market shares can never sum to more than one. In robustness tests (see Online Appendix B), we found that the qualitative findings persist even when the market size assumption is increased by two orders of magnitude.

We add error distributions to account for zip-code heterogeneity by assuming

$$\theta_z = \theta + \varsigma_z, \tag{6}$$

where $\theta_z = \{\alpha_z, \beta_z, \gamma_z\}$ is a vector containing zip codes' mean responsiveness to marketing and control variables, θ is the mean of θ_z across zip codes, and ς_z captures unobserved zip-code-level heterogeneity that is distributed i.i.d. normal with mean zero and element-specific variances σ_ς^2 to be estimated. The results in §3.5 were qualitatively unchanged when we omit heterogeneity from the model, or when we include observed demographics such as income and population density (as in Albuquerque and Bronnenberg 2012).

Before proceeding, we make explicit two assumptions in the demand model. One is that truck advertising does not create awareness; all consumers know of all trucks. If this assumption is incorrect, then we might overestimate some of the β parameters in Equations (3) and (5). The other assumption is that all trucks are available in all zip codes. If this assumption were inappropriate, then we might underestimate the truck-month dummy parameters φ_{js}. Although we believe this market did not feature truck-specific differences in awareness or distribution intensity, the model might be extended by allowing the choice set to vary across zip codes or by applying techniques introduced by Bucklin et al. (2008), Goeree (2008), or Albuquerque and Bronnenberg (2012).

3.4. Endogeneity

A common concern in empirical studies of market demand is the possibility that strategic variables, such as price and advertising, may covary with unobserved variables that are known to the firm but unobserved by the econometrician.[19] To address this concern, we estimate the truck-month dummy variables to control completely for monthly fluctuations in demand shocks, and holiday week dummies to predict regular weekly changes in truck demand. The correlation between monthly demand shocks and marketing variables is then among observed variables, rather than between observed variables and the error term.

A residual concern remains that *weekly* changes in unobserved variables may be correlated with advertising expenditures. For example, individual dealerships' unobserved promotions (e.g., radio advertisements or sales events) might covary with weekly advertising expenditures. Although the truck-month dummy variables completely control for monthly fluctuations in demand shocks, weekly changes in demand that dealers anticipate and use to set unobserved promotions could influence the advertising responsiveness estimates. One could control for such a concern completely with truck-week fixed effects, however advertising data only vary across trucks and weeks (not zip codes), so advertising response parameters would be inseparable from truck-week dummies.

To investigate this possibility, we searched the trade press and interviewed several automotive advertising executives. These efforts indicated that automakers and dealers are not able to link customer purchases directly to advertising exposures. We were told that advertising effectiveness is only measured ex post as the total number of visitors to dealers' lots. Those conversations suggested that automakers do not set weekly ad expenditures based on expected weekly fluctuations in consumer demand.[20] However, if advertising expenditures are positively correlated with weekly departures from mean monthly truck demand, one would expect that the advertising coefficients below may be partially attributable to unobserved promotions.

3.5. Results

Table 3 shows the demand parameter estimates. It is notable that, of all five sets of advertising parameter estimates (MBA, MPA, DPA, price–MPA interaction, and price–DPA interaction), the only statistically significant effect is the two-week lag. To investigate whether this odd result came from the model or from the data, we ran a variance decomposition of market shares on all of the variables included in the model. It showed that, in all five cases, the second lag of advertising explained one to four orders of magnitude more of the variation in market shares than any other lag.

[19] Parameter estimates could also be biased by measurement error in the price or advertising variables (Rossi 2014).

[20] Previous literature has also identified a concern about slope endogeneity (Kuksov and Villas-Boas 2008, Luan and Sudhir 2010), that is, the possible correlation between advertising and temporal variation in advertising sensitivity parameters. If automobile manufacturers and dealers associations knew of such a correlation, they would tend to advertise in periods when consumers are more prone to respond to advertising, implying a positive intertemporal correlation between different trucks' ad expenditures. The data do not show that correlation.

Table 3 Demand Model Parameter Estimates

Variable	Estimate (std. err.)	Variable	Estimate (std. err.)	Variable	Estimate (std. err.)
		Advertising effects on perceived quality			
β_0^{MPA}	−0.037 (0.043)	β_0^{DPA}	−0.023 (0.054)	β_0^{MBA}	−0.001 (0.006)
β_1^{MPA}	0.050 (0.046)	β_1^{DPA}	0.004 (0.063)	β_1^{MBA}	0.004 (0.007)
β_2^{MPA}	0.092* (0.046)	β_2^{DPA}	0.128* (0.063)	β_2^{MBA}	0.019** (0.007)
β_3^{MPA}	−0.026 (0.042)	β_3^{DPA}	0.007 (0.053)	β_3^{MBA}	0.007 (0.006)
		Price interactions			
$\alpha\eta_0^{MPA}$	−0.011 (0.011)	$\alpha\eta_0^{DPA}$	−0.009 (0.014)		
$\alpha\eta_1^{MPA}$	0.013 (0.012)	$\alpha\eta_1^{DPA}$	0.001 (0.017)		
$\alpha\eta_2^{MPA}$	0.025* (0.012)	$\alpha\eta_2^{DPA}$	0.035* (0.017)		
$\alpha\eta_3^{MPA}$	−0.007 (0.011)	$\alpha\eta_3^{DPA}$	0.004 (0.014)		
		Elasticities			
Mean price elasticity of market share	−2.58** (0.12)			*Mean cumulative elasticity of MBA*	0.03** (0.00)
Mean price elasticity with MPA set at one standard deviation higher	−3.00** (0.23)	*Mean price elasticity with DPA set at one standard deviation higher*	−3.33** (0.17)		
		Additional demand estimates			
α	0.423** (0.133)	*Labor Day weekend*	0.940** (0.113)	*Presidents' Day weekend*	0.111 (0.083)
Gas price	−0.775** (0.129)	*Memorial Day weekend*	0.874** (0.128)	*New model year release*	0.261** (0.063)
Christmas	0.139 (0.074)	*Martin Luther King, Jr. Day weekend*	−0.097 (0.068)	β_{YC}	5.957** (0.098)
Columbus Day weekend	−0.119 (0.079)	*New Year's*	0.521** (0.076)		
July 4th weekend	0.375** (0.115)	*Thanksgiving weekend*	−0.011 (0.080)		

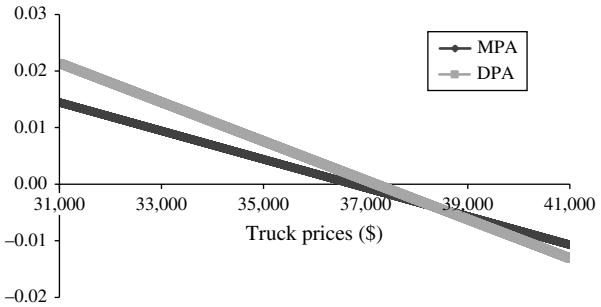
*Significant at 95% confidence level; **significant at 99% confidence level.

These results suggest that a consumer who responds to advertising typically stays in the market for about two weeks before finalizing a transaction. We searched the academic literature to find comparable results. We only found two prior papers that regressed automotive sales on automotive advertising. Kwoka (1993) ran a regression using annual data and Barroso and Llobet (2012) used monthly data, so neither provided comparable findings.

We reviewed industry literature to better understand the automotive purchase cycle. According to J.D. Power and Associates (2008), the median car buyer purchased her car 87 days after she began looking for any car; her purchase came 56 days after she first shopped in the auto segment in which she ultimately purchased; and her purchase came 29 days after she first shopped for the model she ultimately purchased. Although these data do not specifically apply to pickup trucks, it seems logical that advertising (especially price advertising) might become important halfway between the time the typical shopper starts narrowing down her model choice and her ultimate purchase time.

Among the statistically significant effects, the econometric results confirm the experimental findings. All three types of advertising—MBA, MPA, and DPA—increase perceived quality. However, DPA has a larger estimated effect on perceived quality than MPA. Further, both MPA and DPA increase the sensitivity of demand to price (equivalent to reducing consumers' price perceptions). Again, the point estimate of DPA is larger than that of MPA. These findings are consistent with the central prediction that DPA is more effective at influencing consumer demand than MPA. DPA increases perceived quality to a greater degree

Figure 8 **Marginal (Net) Effects of the Second Lags of Price Advertising on Indirect Utility**



than MPA and DPA is more effective than MPA in communicating price information to consumers.

Figure 8 graphs the marginal effects of the second lags of MPA and DPA on mean indirect utility. The graph shows the net result of price advertising's positive effect on perceived quality and negative impact on perceived price, drawn over the range of prices observed in the data. As one would expect, the model predicts that advertising prices has a larger net effect when price is relatively low. For every price below $38,416 (the 73rd percentile of the price distribution), the net effect of DPA exceeds that of MPA.

The mean price elasticity of market share is −2.6.[21] To gauge the effects of price advertising on price elasticity, we recalculated the mean elasticity when each type of price advertising is increased by one standard deviation. Increasing dealer price advertising by one standard deviation raises the price elasticity to −3.3; increasing manufacturer price advertising by one standard deviation raises the mean price elasticity to −3.0. This confirms that DPA is more effective than MPA in increasing demand responsiveness to promotions.

The cumulative sales elasticity of MBA is 0.03, similar to the value reported in Lodish et al. (1995). The effects of control variables on demand parameter estimates conform to intuition. Price reduces demand with a main effect that is strongly significant. Gas prices also reduce truck demand, with an effect that is significant at a very high confidence level. Holiday departures from mean monthly demand for trucks are highest on Labor Day and Memorial Day and lowest on Columbus Day. The release of new model-year units increases mean monthly demand. Recent truck sales in a zip code have a short-lived[22] positive effect on truck demand, consistent with the positive installed-base effects found by Narayanan and Nair (2013).

[21] This finding is smaller than the –4.1 found by Albuquerque and Bronnenberg (2012) and the −7.6 reported by Chen et al. (2008), but neither paper focused on pickup trucks.

[22] λ is estimated to be 0.05.

3.6. Alternate Explanations for Estimated Advertising Effects

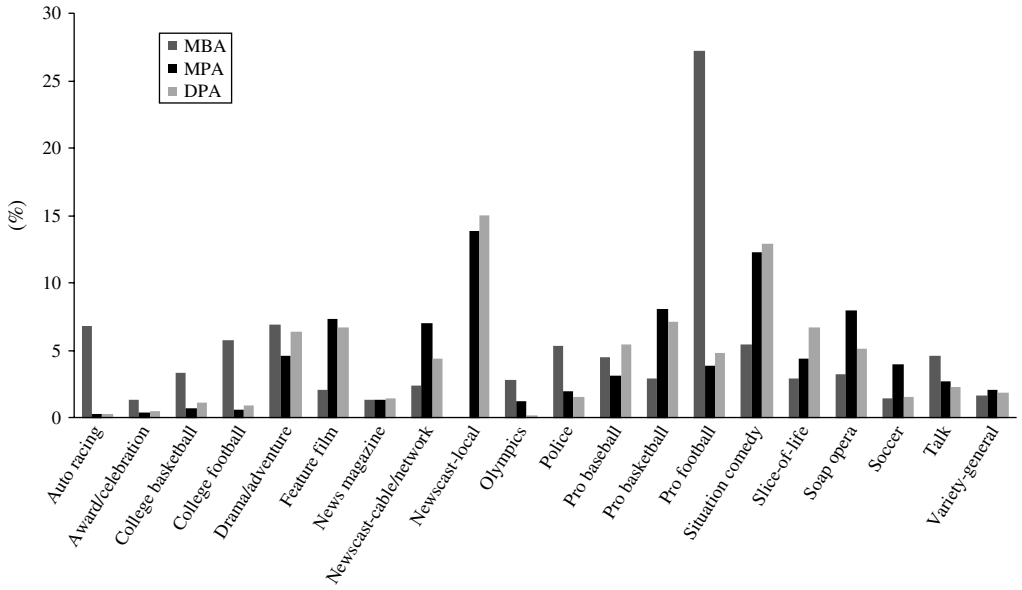
The econometric analysis confirmed the central prediction that dealer price advertising is more effective than manufacturer price advertising, as it increases perceived product quality more and also makes demand more responsive to price, consistent with the experimental evidence. However, because the econometric results are not based on a field experiment, they may be attributable to reasons other than the central prediction discussed in the introduction. A range of alternate explanations was explored, including advertising targeting, transaction characteristics, trade promotions, and price advertising content. None of these alternate explanations has clear support.

3.6.1. Robustness Check: Advertising Targeting. Dealers may have more knowledge of local market conditions than manufacturers, which may lead to the possibility that the manufacturers and dealers association target their price advertising to different groups of consumers. This targeting may explain why one type of price advertising is more effective than the other. However, Figures 9–11 show that there is surprisingly little difference in how each type of price advertising expenditure is distributed across program genre, hours of the evening, and network affiliates, apparently ruling out targeting as an alternate explanation for the main results.

3.6.2. Robustness Check: Transaction Characteristics. It could be that MPA and DPA appeal to different types of consumers, lead to sales of trucks with different characteristics, or are associated with different transaction types or price structures. We compared how each factor differs as the intensities of each advertising variable change. For each of the three advertising variables for a given truck, each week is classified as "high" or "low" if the observed ad spending for that variable is above or below the sample median, giving eight different classifications (e.g., high/high/high, high/high/low, etc.). If the variable in question (e.g., customer gender) is relatively constant across all eight classifications, or if changes in the variable accompanied by high MPA intensity are in the same direction as changes accompanied by high DPA intensity, then transaction characteristics will not constitute an alternate explanation for the empirical results.

Table 4 presents this comparison for the most-advertised truck, Ford F-Series. The ratio of female truck buyers to males holds nearly constant under each of the eight classifications, so it does not seem to explain the econometric findings. Similarly, major truck characteristics—model, drive type, engine size, and door type—move in the same direction when moving from the low-MPA/low-DPA condition to either the high-MPA/low-DPA or low-MPA/high-DPA conditions. For example, the percentage of transactions with 4WD

Figure 9 Distribution of TV Advertising Expenditures over Program Genres



increases: from 22% to 24% when the intensity of MPA moves from low to high (given MBA being low), and from 22% to 27% when the intensity of DPA moves from low to high (other variables held constant).

Next, consider pricing terms. Customer rebates are higher in the low-MPA/high-DPA condition than in the high-MPA/low-DPA condition, but this difference is roughly offset by higher down payments. In general, there are not clear patterns of movements in transaction types or pricing terms across advertising conditions.

Figure 10 Distribution of TV Advertising Expenditures over Half Hours

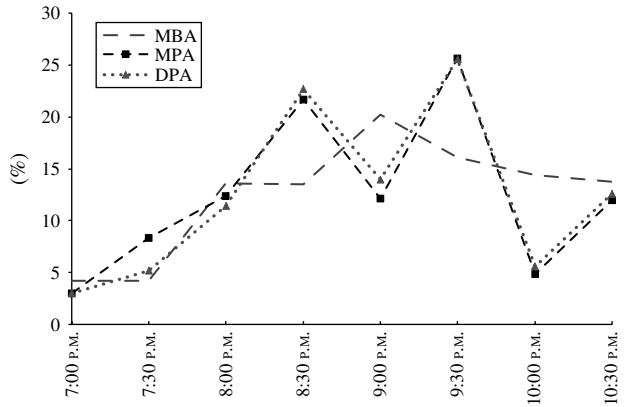
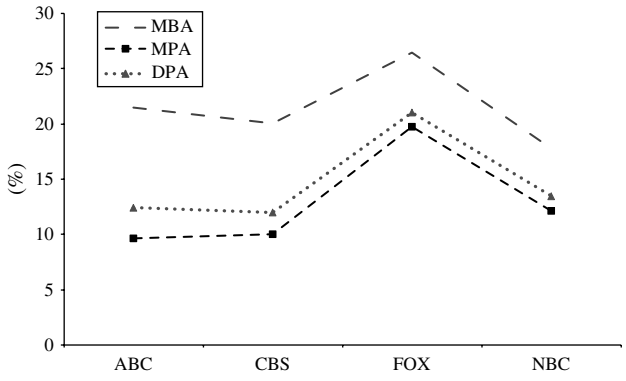


Figure 11 Distribution of TV Advertising Expenditures over Networks and Affiliates



3.6.3. Robustness Check: Trade Promotions. Busse et al. (2006) showed that \$1 in "customer cash" lowers prices more than \$1 in "dealer cash." Customer cash directly enters the price variable, as shown in §A of the online appendix, but dealer cash does not enter the demand model, since consumers typically are not informed about this trade promotion, and the dealer's "discount" passed to the consumer is implicitly included in the transaction price.

Dealer cash may motivate dealers to engage in additional price advertising, as it directly increases dealers' returns to advertising by increasing their effective margin in a way that the consumer cannot observe (Busse et al. 2006). This suggests a possible positive correlation between dealer price advertising and the latent variable of dealer cash. We collected weekly data on dealer cash from 2002 to 2005 (customer cash was already included in the price data that enter the model). For four out of six trucks, the correlation coefficient between DPA and dealer cash was not statistically significant. The two significant correlations were for F-Series and Silverado, 0.21 and −0.18, respectively. Because there is no robust pattern of positive correlations between dealer cash and dealer price advertising, dealer cash does not appear to explain the econometric results.

3.6.4. Robustness Check: Price Advertising Content. Differences in manufacturer and dealer price advertising content could potentially explain the pattern of results. To gain insight into this issue, two independent coders were hired to analyze the price

Table 4 F-Series Transaction Characteristics Across Advertising Intensity Levels

MBA:	Low	Low	Low	Low	High	High	High	High
MPA:	Low	Low	High	High	Low	Low	High	High
DPA:	Low	High	Low	High	Low	High	Low	High
No. of weeks:	42	28	29	19	30	18	17	53
Model (%)								
F-150	75	76	75	74	73	70	72	72
F-250	25	24	25	26	27	30	28	28
Gender (%)								
Female	17	17	18	18	17	18	19	17
Male	83	83	82	82	83	82	81	83
Drive type (%)								
2WD	78	73	76	74	72	70	70	71
4WD	22	27	24	26	28	30	30	29
Cylinder type (%)								
6-cylinder	74	84	79	85	85	88	91	89
8-cylinder	17	11	15	10	8	6	5	6
10-cylinder	8	5	6	5	7	7	4	4
Door type (%)								
4D ext cab	5	15	8	14	18	22	25	21
Crew cab	50	56	52	56	56	58	57	57
Ext cab	36	21	31	23	19	13	9	14
Regular cab	9	9	9	8	8	7	8	7
Transaction type (%)								
Cash	14	15	13	14	13	15	13	13
Dealer finance	72	77	73	77	82	78	81	81
Lease	14	9	15	9	6	7	6	6
Pricing terms								
APR	6.36	6.68	6.54	6.73	6.00	6.29	6.47	6.27
Rebate	$1,379	$1,809	$1,451	$1,927	$1,525	$1,654	$2,209	$1,855
Monthly payment	$527	$531	$536	$531	$541	$551	$550	$544
Term (months)	56	61	56	60	60	62	61	62
Down payment	$5,737	$6,136	$5,892	$6,700	$6,134	$6,211	$7,274	$6,504
Residual	$13,810	$14,182	$14,193	$15,203	$14,666	$15,563	$16,279	$14,532

Note. For each advertising variable, "high" indicates a weekly expenditure above the median.

advertising content. Four aspects of the content were analyzed: (1) affective reactions, as measured by the extent to which the ad is overall likable or funny; (2) the extent to which the ad contains comparative information; (3) pricing terms, including the product price (e.g., MSRP), sales promotion (e.g., cash back, rebate), and financial information (e.g., APR, monthly payment); and (4) the presentation of the pricing terms, for example, the average time in seconds that the pricing terms were displayed on screen. The results are presented in Table 5. None of the content measures, except the extent to which financial information was included in the ad, was significantly different at the 95% level. Thus, price advertising content does not offer a clear alternate explanation for the econometric results.

Table 5 Price Advertising Content Analysis

	MPA	DPA
Likeable (1–5 scale)	2.8	2.6
Funny/humorous (1–5 scale)	1.5	1.4
Comparative information (1–5 scale)	2.1	1.8
Product price (MSRP) (%)	55	50
Promotions (cash back, rebate, discount, etc.) (%)	82	76
Financial terms (APR, monthly payment, down payment, etc.) (%)	17	31
Average time price info. is displayed onscreen (seconds)	3.4	3.2
Relative font size of onscreen price information (1–4 scale)	2.9	2.7
If price information is repeated, number of repetitions	4.0	3.7
Is price presented as a math problem? (0 = no, 1 = yes) (%)	52	62

3.7. Summary

The econometric analysis of the truck market data showed that manufacturer price advertising is less effective than dealer price advertising, consistent with the experimental findings. It also showed that manufacturer price advertising has positive effects on demand, which might help to explain why we observe so much of it in the market.

4. Discussion

This was the first study to consider how the effects of a price advertisement depend on its sender. An experiment established that manufacturer price advertising reduces indicators of potential demand relative to dealer price advertising. A similar pattern of effects was found in an econometric model estimated using data from the pickup truck market. These findings suggest that manufacturers and dealers may benefit by

increasing the coordination of their price advertising expenditures and price advertising messages.[23]

It may be tempting to conclude that manufacturers should leave the price advertising to their dealers. However, it is well known that channel conflict is common when manufacturers' incentives are misaligned with their retailers'. By providing price incentives directly to the consumer and announcing them via price advertising, manufacturers can reduce the double marginalization that occurs when giving discounts to their dealer (Busse et al. 2006). The positive effects of manufacturer price advertising reported in §3.5 indicate that price advertising is a tool a manufacturer can use to manage potential channel conflict with its dealers.

This paper has produced several implications for both manufacturers and their distributors such as dealers and retailers. First, the results may suggest that manufacturers might profit by framing price messages in ways that are likely to dampen consumers' automatic price/quality inferences. For example, offering a free service (e.g., "free extended warranty") may be more effective than a rebate of a similar size. It also may be advisable to deemphasize price advertisement creative elements that place the focus on the product's features. A promising avenue for future research would be to investigate how creative elements might help in framing a discount offer to alleviate the negative price-quality inference that accompanies a manufacturer advertisement.

Manufacturers might also profit by deemphasizing their role as the sender of their price advertisements. They might try to influence consumers' sender perceptions by hiring celebrity spokespeople or using customer testimonials to deliver the pricing message. How manufacturers and retailers may alter their ad copy to optimize return on their advertising investments could be another interesting direction for future research.

This study could be extended in several directions. First, our advertising data were limited to expenditures rather than exposures, a data limitation that the industry is only starting to solve. Digital set-top boxes should enable precise zip-level audience measurements in the future, so it would be interesting to reexamine the effectiveness of price advertising by different channel members using more precise data. Second, price advertising may alter consumers' expectations of future prices, but this is an empirical question. Therefore, their purchase timing is a very interesting topic but one that is probably better addressed with data on consumers' expectations of future prices. Finally, the effects measured here come from a market in which manufacturers used exclusive dealers. Consumers' quality inferences in other channel structures may depend on such factors as brand strength, store traffic patterns, retailers' bargaining power, or category management strategies.

More generally, we believe that this work aligns with an increasing interest in examining how the *content* of advertising helps to determine the *effects* of advertising. We hope future studies will continue this direction to improve our understanding of how advertising works to influence market outcomes.

[23] Section C of the online appendix describes a counterfactual analysis based on the econometric model, suggesting that a reallocation of price advertising budgets between the manufacturer and dealers association may increase total channel profits by 0.3%–0.4%.

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