"The Best Price You'll Ever Get": The 2005 Employee Discount Pricing Promotions in the U.S. Automobile Industry

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Abstract

During the summer of 2005, the Big Three U.S. automobile manufacturers offered a customer promotion that allowed customers to buy new cars at the discounted price formerly offered only to employees. The initial months of the promotion were record sales months for each of the Big Three firms, suggesting that customers thought that the prices offered during the promotions were particularly attractive. In fact, many customers paid higher prices following the introduction of the employee discount promotions than they would have in the weeks just before. We hypothesize that the complex nature of auto prices, the fact that prices are negotiated rather than posted, and the fact that buyers do not participate frequently in the market leads customers to rely on "price cues" in evaluating how good current prices are. We argue that the employee discount pricing promotions were powerful price cues, and that customers responded to the promotions as a signal that prices were discounted.

1 Introduction

For an expensive purchase such as a car, the value of having good price information is high. Not finding the lowest price for a consumer packaged good might cost a customer tens of cents. Not finding the lowest price for a car could cost a customer hundreds or thousands of dollars. Consistent with this, consumers who are in the market for a new car spend a significant amount of time searching for price information (J.D. Power 2006; and Zettelmeyer, Scott Morton and Silva-Risso 2006). However, several characteristics of the industry suggest that these search activities are unlikely to fully reveal the price information that customers would like to have. First, prices are negotiated, not posted, which means that customers need to undergo a process that is lengthy and, for many customers, unpleasant in order to figure out what is the lowest price at which they can obtain a car. Second, the final price for the car—meaning, the actual wealth outlay on the customer's part—depends on several components; the negotiated price is one, but so is the amount the customer receives for his or her trade-in and the value of manufacturer rebates. Third, the final price of a car changes over time, particularly because of changes in manufacturer rebates. These rebates, which can be worth thousands of dollars, are offered at the discretion of the manufacturers, making it difficult for customers to know whether they are better off purchasing now or in the future. Finally, customers participate in the market every several years, which is much less frequently than prices and products change.

Because of these characteristics, it is hard for customers to answer two important questions that are relevant to the purchase decision. First, what is the total amount the customer would have to pay for a car if he or she bought now? Second, is this an attractive price relative to the option of buying in the future at future prices? The research question we address in this paper is the following: In an environment in which customers are less than fully informed about the answer to the first question—what the current price is—can firms influence what customer believe about the answer to the second question—whether the current price is an attractive one?

We will refer to signals that firms send customers in order to influence their beliefs about whether the current price is attractive as "price cues." The notion of a price cue is relevant in an environment in which customers are not fully informed about what the "regular price" is, or what future prices will be, and must therefore draw inferences about how the current price compares to future prices.[1] A common example of a price cue is a posted "sale" sign announcing that a particular product is "on sale." Previous research, such as Anderson and Simester, 2001, has shown that customers respond to sales signs even when prices are not actually discounted. Since posting a sale sign involves little or no costly commitment for a seller, one might ask why customers would believe that items with sale signs have low prices.

[1] Even if the signal is fully informative about the current price, we will think of it as a "price cue" if customers are not able to fully ascertain whether the current price is less than the price that was available a month ago, or that will be available a month from now.

In order for customers to believe that a price cue corresponds to a temporary discount, it must be the case that customers believe that there are some times when firms actually do want to offer discounted prices; for example, to clear excess inventory, or to raise cash under financial constraint. Even if customers believe this, however, firms can't always announce that their products are on sale, or customers will stop believing it. Anderson and Simester (1998) show that, in an environment in which customer lack price knowledge, cues will be informative if they are true enough of the time, even if the cues are not true all the time. Firms will thus be led to use price cues selectively, and when they use a price cue for a particular product, it will be more likely to have a discounted price than a product that is not announced to be on sale. The price cue will thus be informative, and customers would be expected to respond to it.

In order to investigate whether such price cues are effective, the ideal natural experiment would be a setting in which a seller sends a signal that has some face validity as a claim of lower prices, but where prices actually rise. Then, if sales increase, we can conclude that customers were persuaded by the cue, while if sales decrease, we can conclude that customers responded to the prices themselves, not the cue. Of course, we will need to control for the possibility that other contemporaneous factors could have increased both prices and sales, such as an increase in advertising.

In this paper, we identify just such a natural experiment: the "employee discount" pricing promotions used by the Big 3 U.S. auto manufacturers during the summer of 2005. These programs allowed customers to purchase vehicles at the same discounts that the auto manufacturers offered to their employees. GM introduced the first employee discount pricing (EDP) promotion in June 2005 and it was matched approximately a month later by both the Ford Motor Company and Chrysler.[2]

There are several reasons for customers to believe that the EDP promotions really offered low prices. First, an employee discount is a perquisite that many companies offer their employees, and many customers are used to the notion that employees of retail or manufacturing firms get discounted prices. Second, during the summer of 2005, inventory levels for the Big 3 manufacturers were high, and publicly known to be high. There was also widespread discussion at the time that both GM and Ford were having financial difficulties. For example, on May 5, 2005 Standard & Poor's had lowered the corporate credit ratings for both GM and Ford to non-investment (junk) grade (Businessweek.com, 2005). Excessive inventory levels and financial difficulties are both factors that might plausibly lead a company to offer temporary price discounts. Finally, the "employee discounts for everyone" was a novel promotion in the auto industry, which means that customers did not have any prior experience in evaluating such a promotion, and no reason to dismiss this as routine.

We show that customers reacted strongly to the EDP promotions, resulting in large and immediate increases in sales. For GM, the first month of the promotion, June 2005, was the highest sales month since September 1986. July 2005, the first month of Chrysler and

[2] Each manufacturer had its own name for what were very similar plans; we refer to all three plans as "employee discount pricing," or EDP. GM's plan was called "Employee Discount for Everyone," Ford's plan was called the "Ford Family Plan," and Chrysler's plan was called "Employee Pricing Plus."

Ford's employee discount offers, was the highest sales month ever for Chrysler and the highest July sales month ever for Ford.

Of course, the strong sales response to the EDP promotion does not necessarily show that consumers with little price knowledge were reacting to a price cue. If the prices that customers paid during the EDP promotions were indeed low prices compared to the prices that had recently been available to them, then the sales response could simply be the expected demand response to a price decrease.

It turns out that for many cars, the start of the EDP promotion did not coincide with a large decrease in the final amount that customers paid for a car. Prior to the introduction of the EDP plans, many vehicle prices had been low already due to historically high rebates offered by the manufacturers. As a result, for about 40% of the cars sold under the EDP, the EDP price was actually higher than the price for an identical vehicle had been in the previous month. Nevertheless, unit sales increased dramatically during the first months of the EDP, *including* for models whose prices were higher after the introduction of the EDP.

It may seem surprising that customers would react so strongly to a price cue, even for cars for which final prices rose. Presumably, if customers had complete price knowledge, one would not expect increased prices to lead to increased sales. However, if the EDP promotions were an effective *price cue*, leading customers to infer—in the absence of complete price knowledge—that prices were low relative to historical levels even when they were not, then one could see increased prices and increased sales at the same time. Market research undertaken by Ford suggests that customers did indeed interpret the employee discount promotion to mean that current prices were a very good deal relative to past or future opportunities. When customers were asked what the most important reason for purchasing a vehicle under Employee Pricing was, the most frequently cited reason was that Employee Pricing was the "best pricing ever available to a customer." This suggests that the success of the promotion may have had more to do with its effectiveness as a price cue than with its actual effect on the total amounts customers paid for their cars.

The empirical analysis in this paper proceeds in five steps. First, we document that unit sales did indeed increase for most models as a result of the EDP. We then examine transaction prices to isolate a set of cars for which the final price paid by customers—conditional on customer demographics, car characteristics, and time effects—increased at the inception of the EDP. In the third step, we look within the subset of cars whose prices increased, and show that for many of these models, unit sales also increased. The fourth step consists of robustness checks to make sure that we have indeed correctly measured the effect of the EDP. The fifth and last step is to decompose prices into their various components to determine whether we can interpret our findings as evidence of price cues.

In the next section we briefly review the relevant literature. In section 3 we present the data and discuss the variables we use in the analysis. Section 4 establishes the main empirical result and performs several robustness checks. In section 5 we discuss whether the empirical results are evidence of consumers reacting to price cues. We conclude in section 6.

2 Literature review

Our paper is related to previous work on both price search and price signaling.

2.1 Price Signaling

The signaling literature traces its origins to the work of Spence in the 1970's, and now includes a broad array of applications. Within the consumer setting, most signaling models focus on unobserved *quality* signals. However, there is also a well-established literature describing how customers use signals to infer price information.

One of the first papers recognizing that customers may rely on signals as a substitute for price search was Bagwell (1987). In Bagwell's model customers cannot observe a firm's second period price without incurring a search cost. However, because the firm's costs are correlated over time, customers can use the first period price as a signal of future prices. Simester (1995) extends this intuition by recognizing that if a firm's costs are correlated across products then customers can use the prices of advertised products to infer the prices of unadvertised products. He tests this theory by showing that the price that dry-cleaning stores charge to clean men's shirts is an informative signal of the prices that the stores charge to clean suits and sweaters. Similar logic can be used to explain why supermarkets may take a loss on the prices of items for which customers have good price knowledge, such as soda and milk. If these prices provide a signal of the relative prices of other products for which customers have less price knowledge (e.g. baking powder), then we might expect a negative cross-price elasticity between soda and baking powder.

Perhaps the most straightforward of pricing cues is the "Sale" sign. There is considerable evidence, including several experiments conducted in the field, confirming that placing a sale sign on an item without changing the price can significantly increase sales (see for example Inman, McAlister and Hoyer 1990). The effectiveness of this simple cue is surprising; sale signs are inexpensive to use and retailers generally make few commitments when using them. As a result, they can be placed on any products and as many products as stores prefer. Anderson and Simester (1998 and 2001) offer a signaling explanation for the effectiveness of sale signs by arguing that they inform customers about which products have been discounted, thus helping customers decide whether to visit another store or wait in anticipation of future discounts. In their model the signal is self-fulfilling: if customers believe that products with sale signs are more likely to be discounted then firms prefer to place sale signs on their discounted products. They also demonstrate that sale signs are self-regulating since the signal becomes less credible the more often it is used. They validate this prediction using data from women's apparel and consumer packaged goods markets.

Other documented examples of price signals include pricing-matching guarantees (Jain and Srivastava, 2000) and 9-digit price endings (Schindler and Kibarian, 1996). The research on price endings includes a field-experiment conducted in a mail-order catalog in which randomly selected customers received different versions of a catalog (Anderson and Simester, 2003a). When prices were raised by $10 (e.g. from $34 to $44) so that the price ending remained unchanged there was essentially no change in sales. This lack of price sensitivity was interpreted as evidence that customers have relatively little price

knowledge for these items, and so they find it difficult to distinguish whether a price offers good value. However, raising the prices by $5 so that the higher price ended with the digit 9 led to a 25% *increase* in sales. These findings cannot be explained by mere truncation or rounding effects. Moreover, the effects appear to be larger on newer items, for which customers have relatively little price knowledge.

Price signaling theories all depend upon the claim that customers often do not have good price knowledge. As support for this claim, researchers often cite a series of studies investigating customers' price knowledge for grocery products. Most of these studies reveal that no more than half of customers questioned can recall the prices of recently purchased products (see for example: Dickson and Sawyer, 1990). In a recent review of the price signaling literature, Anderson and Simester (2003b) list five product characteristics that describe markets in which customers will often lack price knowledge. They include: (1) markets in which customers purchase infrequently; (2) markets in which product designs vary frequently; (3) markets in which prices vary frequently; (4) markets in which quality and/or sizes vary across firms; and (5) markets with a high proportion of new customers. Notably, the first four of these characteristics clearly fit the automobile market.

2.2 Price Search

The search literature is older and even more extensive than the literature on signaling. This includes an extensive theoretical literature describing how search costs affect firm entry, product variety, prices and price dispersion. Much of the modern literature on the relationship between pricing and search costs has its origins in Diamond (1971), which identifies what has come to be called the Diamond Paradox. Given any number of firms and any positive search costs the unique equilibrium has all firms setting prices at their monopoly level, and so anticipating this outcome, customers in equilibrium do not search. This is the opposite extreme of the Bertrand equilibrium, where in the presence of zero search costs and perfectly informed customers, firms compete prices down to marginal cost. The Diamond result has prompted a series of papers that explore the limits of the argument, including what happens when products are not homogenous. The results depend upon heterogeneity in customers' tastes, but under reasonable assumptions we return to the standard outcome in which prices rise with the number of competitors and decrease with search costs (see for example Anderson and Renault, 1999, who cite earlier work by Wolinsky, 1986; and Perloff and Salop, 1985).

The more recent empirical work on price search has focused on the role of the Internet. These studies investigate whether lower search costs on the Internet results in customers engaging in more search, and whether this impacts firms' pricing strategies. For example, using a sample of over 8,500 price observations, Brynjolfsson and Smith (2000) compare the prices of books and CDs at Internet and conventional retailers. They find that Internet retailers tend to charge lower prices and they make smaller adjustments to their prices. Brown and Goolsbee (2002) study how increases in Internet use have affected the change in the prices of life insurance. They conclude that prices have dropped by 8-15 percent, which they attribute to the Internet's role in reducing customers' search costs.

2.3 Search and the Market for New Automobiles

A series of studies have documented that consumers spend considerable time searching for information when purchasing a new automobile. Ratchford and Srinivasan (1993) report that the average customer in their sample spent 12.6 hours searching for price information. When combining the search for price and model information, this average increases to over 21 hours and includes 4.6 dealer visits. Similar findings are reported by Bayus (1991) using a separate sample of replacement buyers of new automobiles.

In a longitudinal studying comparing survey data from 1990 and 2000 Ratchford, Lee and Talukdar (2003) show that the Internet has led to a slight reduction in this level of search, with the total time spent searching falling from 18.6 hours in 1990 to 15.6 hours in 2000. They also report drops in the number of models and number of dealers considered. While customers may be spending less time searching, it is clear that many customers now use the Internet as their primary tool to obtain pricing information. J.D. Power reported that in 1999, 40% of new automobile buyers used the Internet during their purchasing process. This increased to 54% in 2000; and 67% in 2006 (J.D. Power 2000 and 2006). Similarly, Zettelmeyer, Scott Morton and Silva-Risso (2006) report that 72% of their survey respondents used the Internet to help shop for a new vehicle.

While most consumers now use the Internet, it appears that the Internet is not eliminating the price discovery process at dealerships; customers who use Internet referral services are only slightly less likely to report that their vehicle negotiations involved a long-series of offers and counter-offers (J. D. Power 2000). The persistence of this bargaining process despite the introduction of the Internet suggests that even with their search activities, customers are not fully informed about prices before visiting a dealer.

3 Data

We base our analysis on data on automobile transactions collected by a supplier of transaction level data in the automotive industry, which we will call DSA in this paper. DSA collects transaction data from a 25% sample of dealers, designed to be representative of national sales, in the major metropolitan areas in the US. Transactions are uploaded to DSA nightly from internal dealer accounting systems and cover all new car transactions at the sampled dealerships.[3] As we will describe later, we will use 8 weeks of data during the period May-July 2005, for a total of 290,910 observations. For each transaction we observe the exact vehicle purchased (nameplate, model, model year, trim level, body type, number of doors, engine, etc.). We also observe the price paid for the car, the dealer's cost of obtaining the car from the manufacturer, detailed information on the trade-in vehicle if the customer used a trade-in, and the profitability of the car to the dealership. The data also contain individual- and census-based demographic information about buyers.

We will also use data on monthly sales and advertising expenditures for the Big 3 U.S. auto manufacturers for 2004 and 2005. These data were obtained from the companies' press releases (these are available on the respective company websites).

[3] Dealers provide their data to DSA in exchange for information about local market conditions.

To provide us details on the employee discount promotions offered by GM, Ford, and Chrysler, we also examined copies of the actual incentive announcements sent to dealers by all three domestic manufacturers. These announcements were shown to us by a manufacturer. This identifies which cars the incentives apply to, when they start and when they are scheduled to end.

3.1 Dependent Variables

In subsequent sections, we will analyze how prices and sales differ across cars and time periods. For the analysis of prices we will use a price measure based on transaction prices as the dependent variable in the estimation. The transaction price observed in the dataset is the pre-sales tax price that the customer pays for the vehicle, including factory installed accessories and options, and including any dealer-installed accessories contracted for at the time of sale that contribute to the resale value of the car.[4]

Conceptually, we would like our price variable to measure the customer's total wealth outlay, which we will refer to as the "final price," for the car. In order to compute the final price, we make two modifications to the observed transaction price. First, we subtract off the customer cash rebate amount if the car is purchased under a customer cash rebate since the manufacturer pays that amount on the customer's behalf. Second, we add to the purchase price any loss the customer made on his or her trade-in (or subtract from the purchase price any profit made on the trade-in). The estimated wholesale value of the vehicle (as booked by the dealer) minus the price the dealer pays for the trade-in vehicle is the *Trade-In Buyer Loss*. Dealers are willing to trade off profits made on the new vehicle transaction and profits made on the trade-in transaction, which is why the *Trade-In Buyer Loss* can be either positive or negative. When a customer loses money on the trade-in transaction, part of his or her payment for the new vehicle is an in kind payment with the trade-in vehicle. By adding the *Trade-In Buyer Loss* we adjust the negotiated (cash) price to include this payment. The final price is thus the contract price minus the customer cash rebate (if any) plus the trade-in buyer loss (if any). We will generally specify the regression equation using the natural log of prices; this allows us to measure the estimated effect of factors like demographics as a percentage effect on the price of a new car, rather than a dollar effect.

For the analysis of sales, we aggregate individual transactions to obtain measures of sales volume as our dependent variable. In particular, we will calculate sales on the level of manufacturers (e.g. GM, Ford, etc.) and at the level of a make-model-model year (e.g. 2006 Chevrolet Malibu). As needed, we will calculate sales over different time intervals.

3.2 The Employee Discount Programs

GM was the first of three manufacturers to introduce an employee discount pricing promotion. The GM event was announced on June 3, 2005, and started on this date. The initial announcement indicated that the program would only last until July 5, 2006. On July 5 the program was extended through August 1, and was subsequently extended again

[4] Dealer-installed accessories that contribute to the resale value include items such as upgraded tires or a sound system, but would exclude options such as undercoating or waxing.

until September 30. Most of our analysis focuses on the change in sales and prices in the two weeks before and after the initial announcement on June 3.

Ford introduced its "Ford Family Plan" on July 5, the same day that the GM plan was initially scheduled to end, while Chrysler introduced its plan on July 6. Both firms initially announced that their plans would only last until August 1. However, like GM they subsequently extended their programs into September.

3.3 Controls

In the analysis of prices we control for car fixed effects, which allows us to compare only identical products to each other. We define a "car" as a unique combination of make, model, model year, body type, transmission, displacement, number of doors, number of cylinders, and trim level (for example, one "car" is a 2003 Chevrolet Malibu sedan with automatic transmission, a 3.1 liter engine, 4 doors, 6 cylinders, and the base trim). We have 4,565 thus-defined cars in our sample.

Because there is substantial variation in price across makes and models, we include in our hedonic regression car fixed effects according to the above definition of a "car." The only characteristics not captured by the fixed effects are factory- and dealer-installed options which vary within trim level. The transaction price we observe covers such options but we do not observe what options the car actually has. In order to control for price differences attributable to options, we include as an explanatory variable the dealer's cost of purchasing the vehicle from the manufacturer. Our measure of cost also takes into account any variation in holdback and transportation charges.[5] Our *Vehicle Cost* variable will be the same for identical cars, whether it is sold prior or during the EDP.

To control for time variation in prices, we define a dummy variable *Weekend* which specifies whether the car was purchased on a Saturday or Sunday to control for price differences within a week. If there are volume targets or sales on weekends, we will pick them up with these variables. We also control for the number of months between a car's introduction and when it was sold. This acts as a proxy for how new a car design is and also for the dealer's opportunity cost of not selling the car. Based on the distribution of sales after car introductions, we distinguish between sales in the first four months, months 5-13, and month 14 and later and assign a dummy variable to each category.

We control for the region in which the car was sold. Our data lists 27 such regions (e.g. Baltimore/Washington, Chicago, Northern California, Southern California).

We also control for a large number of census-based demographic characteristics at the level of the zip code. We merge these data from the 2000 census by the zip code of the buyer in the transaction data. In particular, we control for the average race, education, occupation, income, household size, house value, house ownership, number of vehicles per household, travel time to work, unemployment, poverty status, and English proficiency of residents of the zip code in which the buyer resides.

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[5] "Holdback" is the industry term for a percentage of the invoice price that is held by the manufacturer for a period and then rebated to the dealer. It serves the purpose of creating a small margin for the dealer even if he sells the car at the invoice price.

Table 1 presents summary statistics for the data. These summary statistics cover the 8 weeks of data analyzed in this paper (two weeks before and two weeks after the GM EDP promotion start and the Ford/Chrysler EDP promotion start, respectively).

4 Empirical Results

In our empirical results we proceed in five steps. First, we examine the overall sales effect of the EDP promotions on aggregate monthly sales. Then, we look at the effect of the promotions on transaction prices. Third, we look at the sales effect within the subset of cars whose prices increased at the advent of the EDP promotion. Fourth, we test for robustness. Finally, we decompose prices into their various components to determine whether we can interpret out findings as evidence of price cues.

4.1 Aggregate Monthly Sales

Figure 1a shows the change in monthly unit sales between 2004 and 2005 separately for the three manufacturers who used employee discount pricing promotions during the summer of 2005: GM, Ford, and Chrysler. The lighter bars show the months of the promotions, June-September for GM and July-September for Ford and Chrysler.

As the top panel of Figure 1a shows, GM's unit sales had been mostly down during January-May 2005 relative to the same months in 2004. However, during June 2005, unit sales were more than 40% higher than they had been during June 2004, and 20% higher during July 2005 relative to the previous July. As the next two panels show, neither Ford nor Chrysler showed a sales spike in June 2005 relative to 2004; Ford's sales were down a few percentage points and Chrysler's up a few percentage points relative to June 2004. Other (non-domestic) manufacturers reported very similar sales for June 2005 compared to 2004, suggesting that the sales increase for GM was specific to this manufacturer and not an industry-wide effect.

When Ford and Chrysler initiated their own employee discount promotions in July 2005, both experienced sales effects similar to what GM experienced in the first month of its employee discount promotion: Ford's unit sales were about 35% higher in July 2005 than in July 2004, and Chrysler's sales just over 30% higher.

Although all three manufacturers continued their promotions through September, the sales gains relative to 2004 were much smaller in August and September than they were in June and July; in some cases, sales were even down relative to 2004 in the later months of the promotion. For Ford and GM the reduction in sales later in the year actually outweighed the sales increases associated with the EDP plans, so that annual unit sales were over 4% lower for both firms in 2005 compared to 2004. Annual sales for the industry were higher in 2005 than 2004, and so GM's market share fell from 27.2% to 25.9%, while Ford's market share dropped from 18.0% to 17.0%. Chrysler did not experience the same sales dip at the end of 2005 and so it reported an annual increase in unit sales of 4.4% and an increase in market share from 12.8% to 13.2%.

Sales figures for the five other major manufacturers (Toyota, Honda, Nissan, Hyundai, and Volkswagen) do not show evidence that the EDP promotions had a business stealing effect. As Figure 1b shows, for the four Asian manufacturers, 2005 unit sales are an increase on 2004 sales for almost all of the months of 2005, and the EDP promotion

months (June-September) do not stand out. For Volkswagen, 2005 unit sales are generally lower than in 2004, but June-September are actually smaller decreases relative to 2004 than the immediately preceding months. Furthermore, these sales figures do not appear to have been maintained through the EDP period by large, competitive price cuts. None of the five either decrease prices significantly or increase customer rebates during the GM EDP event. Only Hyundai and Nissan show any such change during the Ford and Chrysler EDP promotions, and the change is very modest—an increase of $93 in the average rebate amount for Hyundai and of $145 in the average rebate amount for Nissan.

We conclude from these initial aggregate comparisons that the EDP programs led to large short-run increases in sales for all three firms. However, at least for GM and Ford, much of this sales increase appeared to reflect temporal substitution, with customers shifting sales that would have occurred later in the year forward to the EDP periods.

4.2 Price Effect

We next investigate the effect of the EDP promotions on transactions prices. The EDP promotions certainly offered a price that was less than the manufacturer's suggested retail price (MSRP). However, even in the time period before the EDP promotions, most customers would have paid a price below MSRP for their cars by negotiating a lower price from the dealer and by taking advantage of other kinds of promotions (such as cash-back offers) that existed before the EDP went into effect.

Many customers apparently interpreted the prices offered under the employee discount promotions as non-negotiable prices.[6] Thus, a customer who was a good negotiator might have gotten a price nearly as low as (or even lower than) the EDP price even before the EDP took effect. Furthermore, if the EDP replaced other kinds of discounts that were nearly as large as (or larger than) the EDP discounts, then the actual effect of the EDP on transactions prices could be much smaller than the comparison between the MSRP and the employee discount price would suggest.

We estimate the effect of the EDP promotions on transaction prices by using a hedonic price regression approach. We regress the natural log of the final price[7] paid by customer i for vehicle j at time t on a vector of customer demographics ($\boldsymbol{X}_{it}$), a vector of time effects such as whether the car was purchased on the weekend and the age of the model ($\boldsymbol{X}_t$), the cost to the dealer of acquiring the car from the manufacturer, regional dummy variables, and detailed car fixed effects which are the cross product of make, model, model year, body type, transmission, displacement, number of doors, number of cylinders, and trim level (ϕ_j).[8]

$$ln(p_{ijt}) = \alpha\, EDP_t + \boldsymbol{\beta}_1\, \boldsymbol{X}_{it} + \boldsymbol{\beta}_2\, \boldsymbol{X}_t + \beta_3\, Vehicle\ Cost_{ijt} + \beta_4\, Region_{ij} + \phi_j + \varepsilon_{ijt}. \qquad (1)$$

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[6] This was not, in fact, the case. Under the rules of the promotion set by the manufacturer, dealers who were participating in an EDP promotion were not allowed to sell cars above the EDP price, but they could sell cars below the EDP price.

[7] The "final price" is the transaction price minus any customer rebate plus the trade-in buyer loss, as described in section 3.1.

[8] Section 3 contains a more detailed description of these variables.

EDP_t is a time-varying indicator that is equal to 1 during the period that an EDP promotion is in effect. The coefficient of interest is α, from which we can estimate the percentage change in the transaction price before and after the introduction of the EDP promotions.

Because we would expect the impact of the EDP promotions on price to depend on whether a manufacturer was participating in the program, we interact EDP_t with indicators for each of the Big 3 manufacturers (GM, Ford, and Chrysler). For example, define $GM_j = 1$ if vehicle j is produced by GM. The hedonic regression specification we estimate is therefore:

$$ln(p_{ijt}) = \alpha_{GM}\, GM_j \cdot EDP_t + \alpha_{Ford}\, Ford_j \cdot EDP_t + \alpha_{Chrysler}\, Chrysler_j \cdot EDP_t + \alpha_O\, Others_j \cdot EDP_t + \boldsymbol{\beta}_1 \boldsymbol{X}_{it} + \boldsymbol{\beta}_2 \boldsymbol{X}_t + \beta_3\, Vehicle\ Cost_{ijt} + \beta_4\, Region_{ij} + \phi_j + \varepsilon_{ijt}. \quad (1')$$

One might be concerned about the exogeneity of the EDP promotion indicator variable, especially if one believed that the automobile manufacturers decided to implement these promotions *because* transaction prices for cars were declining. In order to accommodate this, we use a regression discontinuity approach. Regression discontinuity has been used primarily in the program evaluation literature when researchers wish to evaluate the effect of a treatment, such as a policy intervention, on an outcome of interest when the application of the treatment is correlated with the outcome of interest. One example would be the effect of remedial education on academic performance where the students who are offered remedial education are those who are already performing poorly. Regression discontinuity takes advantage of the fact that there are often discontinuities in the application of the treatment—for example, subjects who fall just to one side or just to the other side of a cutoff. If one looks in a narrow window around the cutoff, one can consider assignment to the treatment or control group within that window to be essentially random. For example, if a scholarship is available to students with SAT scores of 1400 and above, then one could consider students who got an SAT score of 1400 and received a scholarship and students who got SAT scores of 1390 and did not receive a scholarship to be essentially randomly assigned to the treatment and control group—the students in the two groups are presumably indistinguishable in their underlying academic ability. The key identifying condition is that there be no unobservable characteristics that are relevant to the outcome of interest that change discontinuously at the same point as the treatment discontinuity (Hahn et al. 2001; Imbens and Angrist 1994).

In the case of EDP promotions, we use data on transactions that occurred just before the promotion took effect as the "control" observations and data on transactions that occurred at the beginning of the promotion as "treatment" observations. The argument for doing this is that demand conditions change gradually over time; certainly the data that filters up to the manufacturers from the dealer network would reveal changes in demand gradually. Thus, the precise date that is chosen as the start of the promotion will be essentially random within a period of evolving demand. Furthermore, there is a time lag of several weeks to several months between the vintage of the data that a manufacturer uses to plan a promotion and when the promotion actually takes effect (see Busse, Silva-Risso, and Zettelmeyer (2006) which uses regression discontinuity to estimate the price effects of promotions.)

In the price regressions, we use two Saturday-to-Friday calendar weeks of data before the promotion starts, and two such weeks of data at the beginning of the promotion, leaving out the Saturday-to-Friday week that contains the promotion start date itself. (So, for the GM EDP promotion, which started on Friday, June 3, 2005, we use transactions that occurred from Saturday, May 14, 2005 through Friday, May 27, 2005 as the pre-test (control) data, and transactions that occurred from Saturday, June 4, 2005 through Friday, June 17, 2005 as the posttest (treatment) data.)

We estimate a separate specification for the GM promotion, which started on June 3, 2005, and the Ford and Chrysler promotions, which started on July 5 and 6, 2005, respectively.

The results for the estimates of equation (1') surrounding the GM promotion start date are reported in column 1 of Table 2; estimates surrounding the Ford/Chrysler promotion start dates are reported in column 2. The demographics have the expected sign in most cases. In both columns, there is a positive and statistically significant effect on price for customers who are female, who are older, and who are from neighborhoods with a higher percentage of black residents, a higher percentage of residents with less than a high school education, larger average household size, and more vacant housing. There is a negative and statistically significant effect for customers from neighborhoods with a higher percentage of Asian residents, with higher average house values, and with more vehicles per household. Most of the occupation indicators are not statistically significant, and are unreported. Cars sell for higher prices on the weekend. The time since the model's introduction has a negative (but not consistently statistically significant) effect on prices.

The coefficients of primary interest are the price effects of the promotion, estimated by the α coefficients on the EDP promotion indicator and its interaction with the manufacturer dummies. In the results for the GM EDP promotion, reported in column 1, the EDP coefficient indicates that, for the non-Big 3 manufacturers, *ln(price)* was not significantly different in the initial weeks of the promotion from what it had been in the weeks just preceding the promotion. However, the coefficient of 0.0129 on the $GM_j \cdot EDP_t$ variable indicates that GM's prices were *higher* by approximately 1.3% during the promotion than they had been before the promotion. During this same period, namely the weeks around the start of the GM EDP promotion, Ford's prices fell by 0.9%, and Chrysler's prices increased by 0.8%.

The analogous estimates for the time window around the start of the Ford and Chrysler promotions are reported in column 2. The non-Big 3 manufacturers' prices decreased by 0.1% during this period. Chrysler's prices increased by an estimated 2.5%, and Ford's prices fell by 0.2%. During this same time period GM's prices increased by 0.3% (statistically significant at the 1% level). The implication is that final prices did not fall on average at the inception of the EDP promotion. Indeed, prices for GM and Chrysler rose at the advent of their respective EDP promotions.

Because of the variety of promotions that were available prior to the EDP, including very large cash-back offers for some cars, this average effect for each manufacturer may mask considerable heterogeneity between models in the effect of the EDP on prices. To investigate this heterogeneity, we can estimate the effect of the employee discount

promotion separately for each make and model. In particular, we interact make-model-model year dummies with the employee discount promotion indicator. We will refer to the make-model-model year dummies as "model" dummies to distinguish them from the more granular "car" dummies described in section 3 and labeled ϕ in equation 1. The regression equation, which differs from equation 1 only in the first term on the right hand side of the equation, is:

$$ln(p_{ijt}) = \alpha_j \mu_j \cdot EDP_t + \boldsymbol{\beta}_1 \boldsymbol{X}_{it} + \boldsymbol{\beta}_2 \boldsymbol{X}_t + \beta_3 VehicleCost_{ijt} + \beta_4 Region_{ij} + \phi_j + \varepsilon_{ijt}. \quad (2)$$

μ_j represents the "model" dummies. In this specification, we also use a regression discontinuity approach, which means that we estimate one specification for the window around the GM promotion start date, and a separate specification for the window around the Ford and Chrysler start dates.

Table 3 summarizes the coefficients on $\mu_j \cdot EDP_{ijt}$ (the "model"-promotion interaction terms) for the GM specification. These coefficients estimate the increase in log price for each model at the advent of the EDP promotion. Of all 369 interaction term coefficients, 54.5% are positive—implying that the start of the GM EDP promotion was associated with a price increase for that model, and 15.4% are positive and statistically significant. Looking within GM cars, 73.9% of the terms are positive, and 38.6% of the terms are positive and statistically significant. These are substantially higher proportions of estimated price increases than for Chrysler, Ford, or for non-domestic manufacturers (none of which were offering EDP promotions during this time period). For these sets of models, the fractions of estimated price changes that are positive and statistically significant are 15.2%, 11.1%, and 6.4% respectively.

This evidence indicates that for GM cars, transaction prices for the majority of cars were higher in the two weeks at the beginning of the EDP promotion than they had been in the two weeks just prior to the start of the EDP promotion. Indeed, the EDP promotion coincided with a statistically significant decrease in price for only 9% of GM's 85 models.

The price increases do not appear to be simply an industry trend of increasing prices that happened to occur at the same time as GM implemented the employee discount pricing promotion. A Gaussian test of equality between the fraction of positive and significant interaction terms for GM (38.6%) and for the rest of the manufacturers excluding GM (8.2%) rejects equality at the 1% level ($z = 6.90$).

Table 4 reports the analogous results to Table 3, but this time using data from the time period surrounding the start of the Ford and Chrysler employee discount pricing promotions. In these data, 23.4% of the "model"-promotion interaction terms are positive and statistically significant for Ford models, and 67.7% for Chrysler models. This compares to 13.8% for GM models in the same period, and 5.9% for non-domestic models. The fraction for the entire set of cars excluding Ford and Chrysler models is 8.4%. A test of the equality between the fraction of positive and significant interaction terms for Ford vs. the non-Ford/non-Chrysler cars (23.4% vs. 8.4%) rejects equality at the 5% level of significance ($z = 2.65$), while a test of the Chrysler vs. non-Ford/non-Chrysler sample (67.7% vs. 8.4%) rejects equality at the 1% level ($z = 8.74$).

4.3 Sales Response for Cars whose Prices Increased

As described in the introduction and section 4.1, sales during the employee discount promotion periods (June and July 2005, especially) were record sales months for GM, Ford, and Chrysler. These sales increases occurred despite the evidence in section 4.2 that prices actually increased for a majority of GM and Chrysler models, and for a substantial share of Ford models. In this section, we investigate whether sales went up for cars whose prices increased, or whether the overall sales increases were a result of sales increases for models whose prices went down overwhelming sales decreases for models whose prices increased. We will examine unit sales in the same pairs of pre-test and post-test fortnights that we used in section 4.2 to estimate the change in prices around the starts of EDP promotions. We examine specifically the sales of the models that were identified in section 4.2 to have positive and statistically significant increases in prices at the advent of the EDP promotions.

4.3.1 The GM EDP promotion

We perform separate analyses for the GM and the Ford/Chrysler promotion periods. Table 5 reports the results. There are 34 GM models for which transaction prices are estimated to have increased by a statistically significant amount. Among these 34 models, 26 models (76.5%) experience increased unit sales between the pre- and post-test periods. Because there is considerable variation in the sales volume of the different models, we recalculated this proportion when weighting the models by their sales during the two-week "pre-promotion" period. This amplified the effect; when weighting the models by pre-promotion period, we observed demand increases for 88.6% of the models for which there was a significant price increase.

Moreover, this demand increase was specific to GM models. Around the same time period (the start of the GM EDP promotion), 6 Chrysler models and 13 non-domestic models were estimated to have had statistically significant price increases. None of these 19 models had an increase in unit sales over the same period. There were 5 Ford models with significant price increases, of which only one had a sales increase. Overall, if we compare the fraction of GM models for which price increased and sales increased at the same time, to non-GM models for which price increased and sales increased we find very different results. The fraction is 76.5% for GM vs. 4.2% for non-GM models if we do not weight by pre-promotion sales, and 88.6% vs. 1.0% if we do weight by sales. With or without the weighting, a t-test rejects at the 1% level that these proportions are equal in the GM and non-GM samples.

Another way to look at these data is to test for each manufacturer whether sales increased between the pre- and post-test period. We do this using a non-parametric sign test, which tests whether increases in sales are statistically significantly more likely than decreases. Note that we are looking within the set of models whose prices have increased between the pre and post-test periods, which makes evidence for prevalent sales increases particularly noteworthy. Table 6 lists the six of the largest eight auto manufacturers that have any models with positive and significant estimated price increases at the time of the GM EDP promotion, and counts the number of those models that had sales increases during the same period. The one-sided test rejects that sales decreases are as likely as

sales increases for GM with a p-value of 0.001. For the other five manufacturers, the *lowest* p-value is 0.969.

The sign test only counts the number of sales increases vs. sales decreases, without considering the size of the increases and decreases. For each of the models considered in the sign test above, we calculate the percentage increase or decrease in sales that model experienced, and then use a signed rank test to test whether increases were statistically significantly more likely than decreases, giving greater weight to large changes than small changes. The results are reported in the last column of Table 5. The results show that we reject that sales decreases were as likely as sales increases for GM models whose prices increase at the advent of GM's EDP promotion with a p-value of 0.002, but the next lowest p-value among the other manufacturers is 0.841, again a stark contrast to GM.

To summarize, what we have found is that around the start of GM's employee discount pricing promotion, sales increased for most of the GM models for which prices increased, but sales did not increase for the vast majority of non-GM models for which prices increased at the same time. This evidence yields several conclusions. First, GM was not experiencing some industry-wide changes in market conditions that led to both increased prices and increased sales; almost no non-GM model that experienced a price increase experienced a sales increase at the same time, while almost all GM models for which prices increased also had increased sales.[9] Second, it appears that GM's EDP promotion affected buyers' purchasing decisions in a way that led them to be willing to increase their purchases of GM cars, despite price increases. For other manufacturers, we see the more familiar result that price increases do not lead to sales increases.

4.3.2 The Ford/Chrysler EDP promotion

In the lower half of Table 5 we examine the change in sales for cars whose prices increased between the pre- and post-test periods around the start of the Ford and Chrysler EDP promotions. There are 19 Chrysler models for which prices increase during this time period, and for 52.6% of them, unit sales also increase (41.8% when weighted by pre-promotion sales). For Ford, 11 models have price increases, of which 36.4% (50.0% when weighted) experience sales increases. This is a contrast both to GM, which has 12 models with increased prices, none of which experience sales increases, and to the 12 non-domestic models that have increased prices, 16.7% of which have increased sales (9.6% when weighted). If we test the fraction of models with increased prices which also have increased sales for Chrysler models vs. non-Ford/non-Chrysler models we reject equality at the 1% confidence level using either weighted or unweighted numbers. For testing Ford models vs. non-Ford/non-Chrysler models on the same criterion, we reject equality at the 5% level if we use unweighted numbers and at the 1% level if we use a sales-weighted measure.

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[9] Although GM cars with increased prices also had increased sales, GM cars that did *not* experience price increases experienced a *larger* increase in sales, as one would expect. Of the 85 GM models that were covered by the EDP promotion, the 34 models for which price increased had increased sales of 24% on average. The 51 models that did not experience price increase had increased sales of 42% on average.

Table 6 reports sign and signed rank tests for the five manufacturers that had models with positive and significant price increases around the start of the Ford and Chrysler EDP promotions. For these manufacturers, we cannot reject that sales decreases were as likely as sales increases for any of the manufacturers using either the sign or the signed rank test. This is the case even though, in the previous paragraph, we were able to conclude that the *proportions* of models that experience sales increases is different for Ford and Chrysler compared to the rest of the sample.

We suspect that part of the reason that we get a failure to reject for the Ford and Chrysler promotion period has to do with the timing of the promotion relative to quarterly sales incentives. Ford's EDP promotion began on July 5, 2005, and Chrysler's on July 6, 2005. The pre-test period for these promotions is June 18-July 1, 2005 and the post-test period is July 9-22, 2005, leaving out the Saturday-to-Friday week in which the start dates actually fall. In this case, the pre-test period includes the last few days of June, which are also the end of the second quarter. We know that dealers often face end of month sales quotas and bonuses, and may also have quarterly incentives. Examining the daily number of transactions industry-wide during this period (see Table 7), we see that the two highest sales days during the Ford/Chrysler pre- and post-test periods were the last and second to last days of June, 2005 with sales of 17,245 and 11,198 cars respectively. Because the pre-test period includes the end of a month, that may push up the pre-test sales, diminishing the difference between the pre- and post-test periods. We address this issue in our next test.

4.4 Controlling for Industry Trends

One potential criticism of the results so far—which the month-end issue discussed in the previous paragraph highlighted—is whether the increase in sales in conjunction with the increase in prices at the time of the EDP is the result of an industry-wide factor that changed both price and sales, or that enabled sales to increase even as prices were increasing. One way to address this is to use a difference-in-differences style of analysis. In other words, we could look at the changes in sales for the three manufacturers of interest relative to the changes in sales that were happening at the same time for other manufacturers. In order to implement this, we start with the models for GM, Ford, and Chrysler whose prices are estimated to have increased in conjunction with the Ford/Chrysler EDP promotions. For each of those models, we construct the percentage change in sales for the model's vehicle segment, leaving out that particular model.[10] To be precise, the percentage change in vehicle segment sales for model *j* is:

$$S_j = \frac{\sum_{k \neq j} Q_k^1 - \sum_{k \neq j} Q_k^0}{\sum_{k \neq j} Q_k^0} \tag{2}$$

where Q_k^1 represents unit sales in the post-test period for model *k* in the same segment as model *j*, Q_k^0 refers to the pre-test period. Next, we perform a sign and a signed rank test

[10] Models are divided into 8 vehicle segments, such as Compact, Midsize, SUV, etc.

using the differences between the percentage change in a model's own sales, and the percentage change in vehicle segment sales:

$$\Delta_j = \frac{Q_j^1 - Q_j^0}{Q_j^0} - S_j \tag{3}$$

Table 8 reports the results of these tests. For the 19 Chrysler models whose prices are estimated to have increased during the Ford/Chrysler EDP period, 16 models experienced sales increases relative to the change in sales in their segment (compared to 10 that experienced absolute increases, as reported in Table 7). We can reject (with a p-value of 0.012) that decreases relative to the segment are as likely as increases. The results are similar for Ford. For the 11 Ford models whose prices are estimated to have increased during the Ford/Chrysler EDP period, all 11 models experienced sales increases relative to the change in sales in their segment (compared to only 4 that experienced absolute increases, as reported in Table 6). We reject equal probability of increases and decreases relative to the segment for Ford with a p-value of 0.002. The results are essentially the opposite for GM during this period. There were 12 GM models that are estimated to have price increases during the Ford/Chrysler EDP period. None of those models had increased sales relative to their segment.

Table 9 reports the results of an analogous signed rank test, but using data around the GM promotion window. Since we concluded that GM models with increased prices had increased absolute sales (in Table 6) it is not surprising that we also conclude that these models had increased relative sales as well (p-value of 0.000). We also conclude that Ford and Chrysler models with increased prices did not experience relative sales (a failure to reject with p-values of 0.960 and 0.986, respectively).

Notice that our control for the change in vehicle sales in the rest of the segment is conservative: we are averaging the changes in sales over all models, including models whose prices have decreased—and whose sales would therefore be expected to increase—and comparing them to the subset of models on EDP promotion that have price increases. Nevertheless, the subset of EDP models still have greater sales increases than the average increase in the segment, even though some of the non-EDP models presumably had price decreases.

Although the way we have made our difference-in-differences style calculation is conservative, it allows us to net out the average sales trend in the industry. However, one might also be interested in a more "apples-to-apples" comparison of cars that experience similar price increases, some of which are on an EDP promotion and some of which are not. This would allow us to draw conclusions about the effect of the EDP-induced price changes compared to price changes of a similar size which are not marketed as employee discount pricing.

In Figures 2 and 3, we plot for each model the percentage change in price and the corresponding percentage change in quantity between the pre- and post-test periods. Figure 3 shows changes for GM models separately from models produced by other manufacturers for the time period around the GM EDP promotion. Figure 3 shows Ford and Chrysler separately from other manufacturers for the time period around the Ford and Chrysler EDP promotions. The figures both use the raw data on price changes, and not the hedonic price coefficients that give the estimated price changes conditional on other covariates.

As Figure 3 shows, GM models and other models are both well-represented in the price increase (above the horizontal axis) and price decrease (below the horizontal axis) regions. What is strikingly different about the two is the distribution of sales changes. Along any latitude line (representing a particular level of price change) there is a greater share of GM cars with sales increases than sales decreases, while the reverse is true for models of other manufacturers. In some sense, the top left and bottom right quadrants of this figure are not unsurprising—these are the quadrants corresponding to a negative correlation between price changes and quantity changes. Moreover it is not surprising that GM would be better represented in the bottom right quadrant (price decreases and quantity increases) and the other manufacturers in the top left (price increases and quantity decreases) because GM was running a promotion that promised lower prices. What is surprising is the top right quadrant, which shows that for a number of GM models, sales increase even though prices increase, although this is the case only for a handful of non-GM models.

Figure 3 shows that a similar phenomenon was in effect for Ford and Chrysler cars around the Ford/Chrysler EDP promotion. Again, holding a price change fixed, many more Ford and Chrysler models have sales increases than do non-Ford, non-Chrysler models. However, the data are less dense here than they are for the GM promotion.

4.5 Robustness

4.5.1 One-week windows

We have argued that demand changes gradually enough in this industry that by restricting attention to two-week windows around the introduction of the EDP events, it is unlikely that the sales changes we have reported can be explained by some abrupt, intervening change in demand. This argument is strengthened by the evidence that the sales changes are specific to the firms that introduced the EDP programs and do not extend to other manufacturers. However, to further test the robustness of our results we repeated the analysis using one-week (rather than two-week) data windows. For the GM event, the pre-test week is May 21, 2005 through May 27, 2005, and the post-test week is June 4, 2005 through June 10, 2005. For the Ford/Chrysler EDP, the pre-test week is June 25, 2005 through July 1, 2005 and the post-test week is July 9, 2005 through July 15, 2005.

The results are very similar to what we find with the two-week windows. The fractions of GM, Ford, and Chrysler models that have positive and significant price increases (reported in Table 10 and Table 11) are within a few percentage points of the two-week window results (reported in Table 3 and Table 4).

The sales change results for the one-week windows (reported in Table 12 and Table 13) are also very similar to those of the two-week windows (reported in Table 9 and Table 8). Starting with the GM event, Table 12 shows that of the 27 GM models with increased prices 20 had increased sales relative to their segment (p-value of 0.001 in the signed rank test). As expected, for the GM event we also conclude that Ford and Chrysler models with increased prices did not experience sales increases relative to their segment (a failure to reject in the signed rank test with p-values of 0.93 and 0.97, respectively).

For the Ford/Chrysler EDP event, Table 13 shows that of the 15 Chrysler models whose prices are estimated to have increased, 13 models experienced sales increases relative to the change in sales in their segment. We can reject (with a p-value of 0.003 in the signed rank test) that decreases are as likely as increases. The results are similar for Ford. For the 12 Ford models whose prices are estimated to have increased during the Ford/Chrysler EDP period, 11 models experienced sales increases relative to the change in sales in their segment. We reject equal probability of increases and decreases for Ford with a p-value of 0.002 in the signed rank test. The results are essentially the opposite for GM. There were 10 GM models that are estimated to have price increases during the Ford/Chrysler EDP period. None of those models had increased sales relative to their segment.

In summary, our results are essentially unchanged if we consider a narrow one-week instead of a two-week window. This makes it more likely that our price and sales results are driven by the discontinuity created by the EDP promotion, and not by changes in demand conditions between the pre- and post-EDP introduction periods.

4.5.2 Other times of the year

As another robustness check, we replicate our procedure of finding cars with statistically significant price increases and then testing whether sales increase for those cars for other time periods than those surrounding the start of the EDP promotions. Specifically, we use data starting in March (the beginning of the second half of the model year) and compare an evenly spaced selection of two-week "pre-test" periods with matching two-week "post-test" periods, leaving out a week in between. We pick these periods so that they start and end on the same day of the week as our GM and Ford/Chrysler pre- and post-test periods. This yields 7 pre-test periods with start dates between March 4, 2005 and June 17, 2005 and 7 pre-test periods from the corresponding same time period of 2004. For none of the Big 3 manufacturers in any of these time periods could we reject that cars that experienced statistically significant price increases were at least as likely or more likely to experience sales decreases than sales increases (not reported). Only for the EDP period do we find this result.

4.6 Summary

The findings reported in this section appear to confirm that the introduction of the EDP programs resulted in very large short-run increases in sales. In the case of Ford and GM, these short-run sales increases were followed by steep falls in sales in the subsequent months. We interpreted this as evidence that at least for Ford and GM, the promotions convinced customers to shift sales forward, leading to intertemporal substitution.

The findings allow us to rule out two explanations for the findings. The sales increases associated with the EDP promotions cannot be fully explained by reductions in the

vehicle prices. For many models customers actually spent more (on an equivalent vehicle) after the EDP plans were introduced, and the sales increase extended to these models. The findings also cannot be fully explained by industry-wide demand shocks, since we did not observe similar sales changes for manufacturers who did not participate in the programs.

5 Components of Price

The price measure we have used in our analysis so far corresponds to the customer's final price for the car. The final price in a new car purchase transaction depends on the outcome of two negotiations, one over the price of the new car, and one over the price that the dealer pays the customer for the trade-in. The price that the customer pays for the new car is the negotiated price that the dealer and customer agree upon (which we call the "contract price") minus any direct-to-customer manufacturer rebate. We can think of the manufacturer rebate as a portion of the contract price that the manufacturer pays on behalf of the customer, meaning it is not part of the customer's final price for the car. If the customer has a trade-in vehicle, this can either increase or decrease the customer's final price for the car depending on whether the customer negotiates a price that is less than or more than the actual value of the trade-in. Equation 4 describes this relationship:

$$\textit{(Final price)} = \underbrace{\textit{(Contract price)} - \textit{(Rebate)}}_{\textit{Net new vehicle price}} + \underbrace{\textit{(Trade-in value)} - \textit{(Trade-in price)}}_{\textit{Trade-in buyer loss}} \qquad (4)$$

We refer to the contract price minus the rebate as the "Net new vehicle price" and to the trade-in value minus the trade-in price as the "Trade-in buyer loss," which can be either positive or negative.

We now investigate how the EDP promotions differentially affected each component of price in order to better understand the impact of the promotion on customers' final price. We begin by analyzing how trade-in credits changed at the start of the EDP promotions.

5.1 Trade-In Credits

As described above, when a customer buys a new car using a trade-in, she must actually negotiate two prices: the price she will pay for the new car, and the price that the dealer will pay her for her old car. In these negotiations, the dealer is usually quite willing to trade off profits on the sale of the new car for profits on the trade-in transactions. In fact, it is well-known by industry insiders that a skillful salesperson will hone in on whichever transaction the customer is most preoccupied with (getting a good price on the new car or getting a good price for her trade-in), and offer a price that is advantageous to the customer on that dimension, holding out for a price that is advantageous to the dealer on the other.

We propose that this is relevant to the price cue story because the EDP may have focused customers on the net new vehicle price, leading them to let their guard down in the negotiation on the trade-in price. Said another way, customers may have been so sure that they were getting a good deal on the car they were buying, that they felt less pressure to make sure that they were also getting deal on the trade-in car they were selling. If the trade-in buyer loss increases enough in conjunction with the EDP, then it could be that

the net new vehicle price could fall and the final price still rise. If this is the case, then we would conclude that the "price cue" effect of EDP operates by distracting customers from the significance of the trade-in buyer loss, *not* by leading customers to a mistaken belief about what has happened to the net new vehicle price.

We investigate how trade-in buyer losses changed following the introduction of the EDP promotions by regressing *Trade-In Buyer Loss* on the manufacturer times EDP interaction terms, and on the other control variables:[11]

$$\begin{aligned} \textit{Trade-in Buyer Loss}_{ijt} = \; & \alpha_{GM}\, GM_j \cdot EDP_t + \alpha_{Ford}\, Ford_j \cdot EDP_t + \\ & \alpha_{Chrysler}\, Chrysler_j \cdot EDP_t + \alpha_O\, Others_j \cdot EDP_t + \\ & \boldsymbol{\beta}_1 \boldsymbol{X}_{it} + \boldsymbol{\beta}_2 \boldsymbol{X}_t + \beta_3\, VehicleCost_{ijt} + \beta_4\, Region_{ij} + \phi_j + \eta_{ijt}. \end{aligned} \qquad (5)$$

In Table 14, column 2 we report the α coefficients from this regression. We use data from the time period surrounding the start of the GM EDP promotion. The estimated effects are that the trade-in buyer loss increased by $320 for GM cars during this time period, but was virtually unchanged for Ford, Chrysler, or the other manufacturers taken together. If we look at the set of GM cars for which the final price is estimated to have increased by a statistically significant amount (lower panel of Table 14), we see a very similar estimated effect: $329.

In Table 15, column 2 we report the findings when replicating the analysis for the Ford and Chrysler EDP promotions. These estimates indicate that the trade-in buyer loss increased by $277 for Ford during this period, and by $433 for Chrysler. GM and the other manufacturers taken together have virtually no change in the trade-in buyer loss. If we look just at the sample of Ford and Chrysler cars that experience statistically significant increases in final price (lower panel of Table 15), the losses are slightly larger: a $337 increase in trade-in buyer loss for Ford, and a $471 increase for Chrysler.

Our main final price specification has so far been in logs. To more easily compare the magnitudes of the trade-in buyer loss with the magnitudes of the final price increase, we repeat the specification in equation (5) with *Final Price* as the dependent variable (the estimated coefficients are reported in column 1 of Table 14 and Table 15). If we look at the set of GM cars for which the transaction price is estimated to have increased by a statistically significant amount around the GM event, we see an estimated increase in final price of $626. If we look just at the sample of Ford and Chrysler cars that experienced positive and significant price changes around the Ford/Chrysler event, we find an estimated increase in final price of $593 for Ford, and a $650 increase for Chrysler.

Comparing the change in trade-in buyer losses to the change in final price for the three domestic manufacturers around their respective EDP promotions, we find that the increased trade-in buyer loss during the EDP promotion *cannot* fully explain why consumer's final price increased for many cars under the EDP promotion. Clearly, the increased buyer loss on the trade-in is only a partial explanation for why customers ended

[11] The *Trade-in Buyer Loss* of a consumer who did not trade in a car is defined as 0.

up paying higher amounts during the EDP promotions. We now turn to contract prices and consumer rebates.

5.2 Contract Price

We now look at the contract price, or the price that buyer and dealer agree on as the initial price of the new car, before trade-ins or customer rebates. We estimate the contract price using a specification very similar to equation (5), but substituting the contract price for the *Trade-in Buyer Loss* as the dependent variable:

$$\begin{aligned} Contract\ Price_{ijt} = \quad & \alpha_{GM}\, GM_j \cdot EDP_t + \alpha_{Ford}\, Ford_j \cdot EDP_t + \\ & \alpha_{Chrysler}\, Chrysler_j \cdot EDP_t + \alpha_O\, Others_j \cdot EDP_t + \\ & \boldsymbol{\beta}_1 \boldsymbol{X}_{it} + \boldsymbol{\beta}_2 \boldsymbol{X}_t + \beta_3\, VehicleCost_{ijt} + \beta_4\, Region_{ij} + \phi_j + \upsilon_{ijt}. \end{aligned} \qquad (6)$$

In Table 14, column 3, we report the estimated α coefficients from this regression. When we use data from the time period surrounding the start of the GM EDP promotion, the contract price is estimated to have fallen by $881 for GM, but is essentially unchanged over this period for Ford, Chrysler, and the other manufacturers. For the sample of GM cars who are estimated to have a positive and significant change in the final price (see the bottom panel), the contract price is estimated to have fallen by a very similar amount as in the full sample: $888.

Surrounding the Ford/Chrysler EDP promotions (see Table 15, column 3), the contract price for Ford appears to have fallen by just over $800 for Ford, and by $1,044 for Chrysler. The contract price does not change for GM or the other manufacturers. In the sample of Ford and Chrysler models for which there was a positive and significant change in the final price, the contract prices are estimated to fall by slightly larger amounts: $875 for Ford and $1,123 for Chrysler.

We conclude that the prices customers negotiated after the introduction of the EDP promotions were in fact much lower than during the pre-promotion period. From our comparison of the trade-in buyer loss to the final price, we know that the net new vehicle price component (contract price – direct-to-consumer rebates) of the final price must have increased under EDP. This implies that direct-to-consumer rebates must have fallen by even more than the contract prices. We confirm this in the next section.

5.3 Direct-to-Consumer Rebates

When the EDP promotions took effect, customer rebates were for the most part curtailed. The dollar value of rebates had been increasing steadily since 2001, reaching averages as high as $3,000-4,000 per car for some of the American manufacturers in recent years. To investigate what happened to customer rebates following the introduction of the EDP promotions, we re-estimated equation (5) using the *Customer Rebate* as the dependent variable.[12]

[12] The *Consumer Rebate* of a transaction for which there was no rebate offered by the manufacturer is defined as 0.

$$Customer\ Rebate_{ijt} = \alpha_{GM}\, GM_j \cdot EDP_t + \alpha_{Ford}\, Ford_j \cdot EDP_t + \alpha_{Chrysler}\, Chrysler_j \cdot EDP_t + \alpha_O\, Others_j \cdot EDP_t + \boldsymbol{\beta}_1 \boldsymbol{X}_{it} + \boldsymbol{\beta}_2 \boldsymbol{X}_t + \beta_3\, VehicleCost_{ijt} + \beta_4\, Region_{ij} + \phi_j + \nu_{ijt}. \qquad (6)$$

The results of this regression are also reported in column 4 of Table 14 and Table 15. The findings indicate that for GM during the GM EDP period, customer rebates fell by about $900 on average. During the same period they rose by about $300 for Ford and fell by $131 for Chrysler. For GM cars with positive and significant price increases, customer cash fell by $1,186.

During the Ford/Chrysler EDP promotions, customer rebates fell by almost $500 for Ford and by $1,189 for Chrysler. During this same period, there was very little change in GM or other manufacturers' customer rebate amounts. For the Ford and Chrysler cars with positive and significant price increases, customer cash fell by $1,131 for Ford and by $1,302 for Chrysler.

While the change in trade-in buyer loss was not very different in the full sample and in the sample of models with positive and significant price increases, the change in customer rebate amounts has a greater difference between the samples, most dramatically for Ford around the Ford/Chrysler EDP promotion. This suggests that the decrease in customer rebates may be an important determinant of whether a model is included in the "positive and significant" sample or not.

We can conclude that on average the increase in final prices was attributable to increases in trade-in buyer losses, and to customer rebates falling by more than the EDP-induced decreases in contract price. The effects of these two factors on final prices are roughly equal.

5.4 Excluding Trade-Ins

In the previous sections, we have examined the effect of the EDP promotions on the final price by looking separately at the trade-in buyer loss and the net new vehicle price (contract price minus customer rebate). While we believe that the trade-in buyer loss should be included in the final price measure in order for final price to correspond to customers' actual wealth outlay for the car, trade-in transactions do introduce complications. While we find it an interesting question how the EDP offer for the new car price affects the negotiation over the trade in, we also recognize that if the EDP promotion affects the trade-in negotiation, that complicates how we interpret the comparative static of what the effect of the EDP is on price.

In light of this, we repeat our analysis of the effect of EDP promotions on the price components by looking at the subsample of transactions that do not involve trade-ins. A slight majority of transactions (about 55%) that do not use trade-ins. In this subsample, we can avoid the question of how the EDP promotion offer affects customers' negotiation over the trade-in.

These results are reported in Tables 16 and 17. We focus on the results for the samples of cars with positive and significant price changes. For the full sample of GM transactions at the time of the GM EDP promotion, Table 14 showed an average increase in final price

of $626, of which $298 was an increase in net new vehicle price (the change in the contract price minus the change in customer cash). In Table 16, when the sample is restricted to GM transactions that did not involve trade-ins (for which the trade-in buyer loss is perforce zero), the net new vehicle price increases by $693. For Ford and Chrysler, the full sample results show an increase of $256 and $179 in the net new vehicle price for Ford and Chrysler respectively, while restricting the sample to transactions that did not involve trade-ins yields estimated increases in net new vehicle prices of $366 and $398 respectively.

There are multiple possible explanations for these differences. We note that the change in customer cash is different between the "full" and "no trade-in" samples (a bigger decrease in customer cash in the no trade-in sample for GM, but a smaller decrease for Ford and Chrysler), which suggests that the mix of cars is not the same in the two samples. We have noted above that dealers are willing to shift profits between the trade-in and new car transactions, and the results may indicate that dealers were less willing to agree to a discount from the EDP price for customers not using trade-ins (and therefore not providing the dealer an opportunity to make back his concession on the new car via profits on the trade-in). The results may also be explained by differences in customer types between those who use and do not use trade-ins. We have not yet devised a way to distinguish among these explanations. For now, we draw a more modest conclusion, which is that these results argue that the increase in final price measured in the previous subsections does not appear to be some perverse effect of how we have calculated or incorporated the trade-in buyer loss. Even in transactions that do not use trade-ins, final prices for a subset of cars increase at the advent of the EDP.

5.5 Financing Costs

In the previous several subsections, we have considered the final price, defined as contract price minus manufacturer rebate plus trade-in buyer loss, as the customer's total wealth outlay for the car. In doing so, we have not taken into account that for customers who borrow money in order to pay for their new car, the total wealth outlay over time will also depend on the interest rate of that loan. We investigated whether three different aspects of financing changed at the time of the EDP promotions in a way that would affect our interpretation of how the EDP promotions affected customers' total wealth outlays for their cars.

The three components that we examined were the annual percentage rates offered for new car purchases (the "loan APR") and for new car leases (the "lease APR") by the captive lending arms of the Big 3 manufacturers, and the residual values offered for leased cars. The higher the loan or lease APR, the more the customer will pay over time in order to own a new vehicle obtained for a given final price. Thus, lowering APRs would be one way the manufacturers could counteract the higher final prices we found to be associated with the advent of the EDP promotions. In unreported regressions, we find no evidence that manufacturers lowered APRs at the time of the EDP promotions. The GM loan APR rose by 0.6 percentage points (p-value 0.000) and the lease APR by 0.1 percentage point (p-value 0.003) at the time of the GM EDP, while Ford and Chrysler's loan APRs rose by 0.8 and 1.8 percentage points (p-values 0.000) respectively at the start of the Ford and Chrysler EDP promotions. The lease APR rose by 1 percentage point (p-value 0.000) for

Ford but fell by 0.5 percentage point (p-value 0.000) for Chrysler at the advent of their EDP promotions.[13] While our estimates are based on the APRs offered by captive lending arms of the Big 3 manufacturers, the EDP promotions occurred in the middle of a period in which interest rates in general were steadily rising. For example, the prime rate had risen monotonically from 4% in January 2004 to 6% in early May 2005. It stayed at 6% through the end of June (the GM EDP promotion started on June 3, 2005), rising to 6.25% the same week as the Ford and Chrysler promotions started, on July 5 and 6, respectively.

The third financial component we investigate is the residual value. When a customer leases a car, he or she negotiates a purchase price with the dealer. The difference between that purchase price and the residual value of the car is the amount that the customer must finance over the lifetime of the lease.[14] The higher the residual value, the less the lessee will have to pay per month over the course of the lease. If manufacturers wished to counteract an increase in final price, one way to do so would be to increase residual values. We find that residual values *decreased* at the advent of the EDP promotion, increasing the amounts customers who leased paid for their cars, similar to the effect on final price estimated in the previous sections. At the start of the GM EDP promotions, we estimate that residual values fell by $170 (p-value 0.008) for GM, while the start of the Ford and Chrysler EDP promotions coincided with a decrease in residual values of $1235 for Ford and $258 for Chrysler.[15]

These results lead us to conclude that the effect on final prices that we estimated in previous sections was not counteracted or undone by changes in financing terms. If anything, changes in financing terms appear to further increase the wealth outlay of customers who bought at the beginning of the EDP promotions relative to those who bought just before.

5.6 Summary

We did find evidence that the EDP programs coincided with customers receiving less for their vehicle trade-ins. However, the net new vehicle price (contract price minus rebates) also increased under EDP promotions. While the average contract price decreased markedly, direct-to-consumer rebates decreased even more, resulting in consumers paying higher prices not just through less favorable trade-ins but also through higher net new vehicle prices. Finally, this price increase was not counteracted or undone by changes in financing terms.

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[13] Looking just within the sample of cars with statistically significant estimated price increases, the results are similar. GM's loan APR rises by 0.6 (p-value 0.000) and its lease APR has no statistically significant change. Ford and Chrysler's loan APRs both rise by 1 percentage point (p-values 0.000) while the lease APR rises by 0.5 percentage point for Ford and falls by 0.5 percentage point for Chrysler (p-values 0.000).

[14] At the end of the lease period, the customer has the option of returning the car to the dealer, or purchasing the car for the residual value.

[15] If we look only with the sample of cars with statistically significant price increases, we estimate that residual values decreased by $76 for GM, by $820 for Ford, and by $257 for Chrysler at the advent of their respective EDP promotions.

6 Understanding the role of EDP promotions as price cues

In this section we address the question of why the EDP promotions worked successfully to increase short-run sales, despite the evidence that the final price paid by customers increased on many models. We begin by elaborating on the price signaling interpretation proposed in the introduction. We then consider alternative explanations for why prices and unit sales may have increased at the same time. In particular, we consider three possibilities. First, we consider the possibility that there was an increase in advertising expenditure following the introduction of the EDP promotions. Second, we investigate whether the increased sales may have been driven by customers taking advantage of the opportunity to purchase without needing to engage in price negotiations with the dealers. Finally, we investigate whether there were differences in the types of customers who purchased before and after the introduction of the EDP programs.

6.1 Price Cues

As discussed in section 2, EDP promotions are not unique as an instrument to convey a price cue. Previous research has reported evidence that when customers lack knowledge of how prices compare with the prices of outside options, they may rely on cues such as sale signs or even price endings to infer the unobserved price information.

The difficulty of searching for price information in the automobile industry leaves ample scope for car buyers to utilize price signals. Recall that we identified four factors that make it difficult for customers to search for price information. First, prices are negotiated, and so to obtain the "lowest price" customers must engage in a sometimes lengthy bargaining process. For many customers this bargaining process is costly. Second, most customers participate infrequently in the automobile market, much less frequently than products and prices change. As a result, customers often cannot use past price information as a substitute for search. Third, the final price—the total amount that a customer pays—for a new automobile has several components. As we illustrated in the previous section, obtaining a favorable price on one component is not sufficient to guarantee that the overall price will also be favorable. Finally, most customers have the option of waiting if they anticipate additional future discounts. As a result, customers are not just concerned about the current prices in the market, they would also like to know future prices. While searching for current prices is possible (though costly), searching for future prices is generally not feasible. Indeed, discussions with a large manufacturer reveal that the firms often do not know what the future prices will be since they are determined by stochastic variations in future demand and inventories.

Our explanation that the EDP promotions acted as a credible signal that prices were discounted contrasts with our empirical evidence that many prices were not discounted. One possible explanation is that the market was out of equilibrium. This would mean that if the firms were to continue such a policy, customers would eventually recognize that the promotions do not coincide with genuine discounts, and so the signal would no longer be credible. Consistent with this interpretation, when Chrysler attempted to repeat the promotion in 2006, there was little apparent lift in sales.

There are two alternative interpretations. The first interpretation is that the signal was accurate because the contract prices for many models did decrease. Recall from Tables

14 and 15 that the contract prices fell by over $800 for all three manufacturers following introduction of the EDP plans. This is the component of price that the EDP promotion claimed to lower, and it was, in fact, lowered by the EDP. Recall that the trade-in loss is not something that is controlled by the manufacturer. The fact that customers negotiated worse prices for the trade-ins is hardly the fault of the manufacturer, who is not a party to these negotiations.

The second interpretation is that signals need not always be accurate to be informative. Indeed, this is the argument that Anderson and Simester (1998) use to explain why customers rely on sale signs as a credible price cue, even though they are free for retailers to use, and retailers make few commitments when doing so. The key to their argument is that retailers prefer to put sale signs on items that are truly discounted. Once all of the discounted items have sale signs, retailers may also put them on undiscounted items. However, the cues are self-regulating since using too many sale signs reduces their credibility, and in turn their effectiveness. In equilibrium, while all of the discounted items have sale signs, only some of the undiscounted items have them. As a result, the sale signs are informative but they are not fully revealing; an item that has a sale sign is more likely to be discounted than one without, but not all items with sale signs are discounted.

One can adapt this argument to the context of promotions for new cars: Suppose that manufacturers always initiated an "EDP promotion" price cue when market prices reached the employee discount price levels. Then observing the cue would suggests two possible scenarios to consumers. First, because of temporary demand or supply conditions, such as excess unsold inventories of new cars, manufacturers could have temporarily discounted their prices to the employee discount level. Once these temporary conditions pass, prices would be increased again and so customers could gain by purchasing immediately. Under this scenario the price cue would indeed suggest that prices are lower. The second scenario that the start of an EDP promotion could suggest to consumers is that price reductions are not temporary, and instead reflect enduring market conditions. In this scenario, additional end-of-model-year discounts would be offered, and so customers would benefit by delaying their purchases in anticipation of future discounts. Whether the EDP promotion price cue is credible thus depends upon customers' prior beliefs about the likelihood that the weak market conditions are temporary, and thus that the prices offered under the EDP promotions are unusually low prices.

Suppose such logic led customers to believe that manufacturers *could* want to offer discounted prices during the summer of 2005. There are several reasons that might have led customers to believe that employee discount pricing (as opposed to a promotion with a different marketing slant) indicated that manufacturers *were* offering discounted prices. In other words, there are several factors that give "employee pricing for everyone" more face validity than a different promotional pitch might have. First, it is common for manufacturers to allow employees to purchase at preferential prices and it seems implausible that manufacturers would use these plans to trick employees into paying as much as (or more than) everyone else. Second, if the employee price does not represent a discount, there is little benefit from incurring the administrative effort to set up the plan because employees can simply buy in the open market. Finally, participating dealers

were obliged to sell to the public at prices no higher than the employee prices, as the program announcements sent by manufacturers made clear. Failing to honor these discounts, or manipulating the employee price to raise the effective price, would have exposed the firms to potential lawsuits. In this sense, employee discount pricing was not mere "cheap talk" as the sale signs of Anderson and Simester's (1998) model are.

6.2 Advertising

One alternative explanation that might be offered for why sales could increase following introduction of the EDP promotions even on cars for which prices had also increased is that advertising that coincided with the EDP promotions could have raised buyers' willingness-to-pay. To investigate this possibility we purchased detailed data from TNS Media Intelligence describing weekly advertising expenditure in the automobile industry. In Table 18, we report the advertising expenditure for GM during the two-week pre-test period before the start of the GM EDP promotion, and for the two-week period at the beginning of the GM EDP period. We also report Ford's and Chrysler's advertising expenditure in the pre-test and post-test periods surrounding the start of the Ford and Chrysler promotions. For comparison, we list the advertising expenditures for the same calendar period in 2004, the year before the EDP promotions.

As Table 18 shows, advertising expenditure *decreased* for all three manufacturers between their respective pre-test and post-test periods. For GM, advertising expenditure actually decreased by 21% between the pre-test and post-test periods, similar to the 17% decline for the same calendar periods in 2004. For Ford, advertising expenditure decreased by 2% between the pre-test and post-test periods, compared to a 6% increase over the same period the previous year. Finally, Chrysler's advertising expenditure decreased by 24% between the pre-test and post-test periods, compared to a 1% decrease the previous year.

Figure 4 shows the monthly advertising expenditures for 2005 for each of the Big Three manufacturers, with the EDP promotion months highlighted. These graphs further reinforce the message that the EDP promotions did not coincide with a big increase in advertising expenditure. If anything, the EDP months were low advertising months compared to the months before and after.

The employee discount promotions were widely publicized and many potential customers seemed to have been aware of them. We suspect that this was accomplished despite lower advertising than in the weeks before the promotion started because the promotions received a lot of press coverage. While this press coverage would have spread the message for the Big Three manufacturers without their actually spending advertising dollars, we would argue that the press coverage was not free advertising of the brand-building sort that would generally increase willingness to pay. The information content of the press coverage was, as far as we can tell, purely informative in the sense that it described the EDP promotions. In that sense, it may have contributed to the price cue perception that the EDP prices were very attractive prices. We would thus argue that if it was press coverage that helped fuel the phenomenon that sales increased even though prices increased, it was because the coverage reinforced the price cue perception, not because it conveyed a conventional utility-boosting advertising message.

6.3 Disutility of Bargaining

We now discuss a second alternative explanation for the result that under the EDP promotion, sales increased even for cars whose prices increased. We know from Zettelmeyer, Scott Morton, and Silva-Risso (2006) that many consumers dislike the bargaining process usually associated with buying a car. Consumers may thus have been taking advantage of the EDP promotion as an opportunity to obtain a car at a relatively low price (meaning higher than the price that could normally be obtained by haggling, but lower than the price one would normally obtain without haggling) without having to undergo an unpleasant negotiation in order to get that low price.

One indication that the perceived no-haggle feature of the EDP was attractive to customers is suggested by the results of the Ford customer survey that we briefly discussed in the Introduction. When customers were asked the most important reasons for purchasing a vehicle under the employee pricing promotion, "best pricing ever available to a customer" was cited by 67% of respondents. In addition, 31% of respondents cited "no need to negotiate price". Notice that the "no-haggle" explanation and the "price cue" explanation are not mutually exclusive—both could be operating at the same time.

If there was less price haggling as a result of the EDP promotions, we would expect to see the variance of prices decrease when the EDP takes effect. Because there are so many car models and configurations of those models, it is difficult to make a pre- vs. post-comparison on the basis of final prices, particularly since the mix of models or configurations could have changed between the pre-test and post-test periods. We can get some idea of whether the variance of prices has changed, however, by regressing prices on car fixed effects, geographic regions, and vehicle cost (to control for unobserved options) and then analyzing the variance of the residuals. We find in unreported results that the variance of residuals falls between the pre-test and post-test periods, with the largest and most statistically significant decrease for GM at the time of the GM EDP promotion, and for Ford and Chrysler at the time of the Ford and Chrysler EDP promotions. The reduction in variance suggests that the EDP promotions may indeed have led to customers being able to obtain better prices without haggling than they could have before the EDP, which may in turn contribute to the increase in sales that we see despite an increase in average prices.

We can further examine whether the "no-haggle" aspect of EDP could alone explain the observed sales increase by analyzing prices and sales at "no-haggle" dealerships. There are two such categories of dealership. One category is Saturn dealerships. Saturn is a nameplate of GM, and its business model dictates that all Saturn dealerships are "no-haggle." The second category is a major publicly traded national chain (NC) owning about 300 dealerships of many different nameplates. This chain has an explicit policy of not haggling. For sales at dealerships belonging to NC and also at Saturn dealerships, any difference in final prices and sales between the pre and post EDP periods cannot be attributed to a change from "haggle" to "no-haggle" pricing—transactions were "no-haggle" both before and after the EDP. Thus, any change associated with the advent of EDP should not be attributable to the "no-haggle" aspect of the EDP promotion.

We repeat the analysis, now within "no-haggle" dealerships, of identifying cars that experienced positive and significant price changes and then measuring whether sales of those cars increased. If sales of most such cars increased within the subset of "no-haggle" dealerships, then it suggests that the empirical finding that sales increase for cars whose prices increase is not attributable to EDP introducing a "no-haggle" aspect to negotiations, since that was true in both the pre-test and post-test period for Saturn and NC dealerships.

Table 19 shows that 28.6% of GM models had positive and significant price changes at "no-haggle" dealerships around GM's introduction of the EDP promotion. In contrast, at non-GM dealerships owned by NC, only 2.9% of models had positive and significant price changes. Table 20 shows that 30% of Ford models and 26.7% of Chrysler models had positive and significant price changes at the start of the Ford and Chrysler EDP promotions. In contrast, at non-Ford/non-Chrysler dealerships owned by NC, only 2.9% of models had positive and significant price changes.

Table 21 examines the sales changes relative to the model's vehicle segment around the GM EDP promotion. Of the 8 GM models whose prices increased at no-haggle dealerships, 7 of those models had increased sales at these dealerships. Both a sign test and a signed rank test reject that sales decreases are as likely as increases for GM. Table 22 presents the same analysis for the Ford/Chrysler EDP. For Ford, there are 6 models with positive and significant price changes at no-haggle dealerships, and 5 of those models experience sales increases. A signed rank test rejects that sales decreases are as likely as sales increases for these models (because of the small sample size, the sign test rejects only at a p-value of 0.11). For Chrysler, there are 4 models with significant price increases, all of which experience sales decreases.

Overall, the conclusion is that the EDP led to a lower fraction of models with positive and significant price changes at no-haggle dealerships than at regular dealerships. However, for those GM and Ford cars whose prices increased, sales tended to also increase. Finding this result in the no-haggle dealerships—which had no-haggle policies both before and after the introduction of EDP—suggests that the positive association between price and sales cannot be solely the result of customers' valuing the EDP promotion because of its no-haggle aspect.

6.4 Customer Differences

If the EDP promotions had greater appeal to some types of customers than others, we might expect that there would be differences in the characteristics of the customers who purchased before and after the introduction of the EDP promotions. Notice that this explanation is perhaps best interpreted as a complement to the price cue and no-haggle interpretations, rather than as an alternative explanation. If the price cue prompted purchases by customers who would not have otherwise purchased, it seems plausible (indeed likely) that these incremental customers were more price sensitive than customers who would have purchased even without the EDP promotion. Similarly, the no-haggle interpretation anticipates an increase in the proportion of customers who do not like to negotiate. It would be surprising if there were no differences in the characteristics of customers who like to negotiate and those who are averse to it.

To investigate whether there are differences in the types of customers who purchased before and after the introduction of the EDP promotions, we compared the characteristics of the customers on both demographic measures and the types of vehicles (if any) that they traded-in. To look at demographic measures, we regressed each demographic measure on our EDP indicator variable in order to estimate how customers who bought during the EDP promotions differed from those who bought just prior to the EDP period. The regressions were run separately for each of the Big 3 manufacturers. Tables 23-25 report the estimated coefficients that were statistically significant. There are, for each of the manufacturers, a number of demographic measures that vary statistically significantly between the pre-test and post-test samples; across the three manufacturers, the most common differences are in age, travel time, median household size, and vehicles per household. Although these differences are statistically significant, the sizes of the differences are small, in most cases, a difference of around 1% relative to the mean value of the demographic variable. For example, the largest effects relative to the mean is for Ford cars in the percent black (which decreases by 0.6 percentage points at the start of the EDP promotion relative to a mean of 8%) and the percent Asian (which decreases by 0.2 percentage points at the start of the EDP promotion relative to a mean of 3%). It does not seem possible that differences of this size could be responsible for the 30-40% increases in unit sales that coincided with the EDP promotions.

We also investigated whether EDP buyers are more likely to use trade-ins than non-EDP buyers. In unreported results, we find that customers who buy a GM car during the GM EDP are more likely by 3.6 percentage points to use a trade-in (compared to customers who buy a GM car in the weeks just previous to the EDP promotion, 51% of whom use a trade-in.) For Ford, the fraction of buyers using a trade-in increases by 1.7 percentage points at the start of the EDP, while the fraction of Chrysler buyers using trade-ins falls by 8.3 percentage points.

A more interesting piece of information is what happens to the value of the cars that customers trade in. We regressed the trade-in value, as booked by the dealer, on the EDP indicator, on the mileage of the traded-in car, and on fixed effects for the traded-in car including make, model, model year, trim level, cylinders, doors, and a the decile of mileage into which the car fell, to account for mileage having a differential effect on trade-in value across cars. What we found was that dealers booked the value of a given car (as defined by the fixed effects) by about $200-300 less at the beginning of the EDP promotion than they had in the weeks just prior to the start of the promotion. This may indicate that dealers respond to the increased volume of transactions, and therefore the increased supply of trade-ins arising from those transactions, by reducing the booked value of a given trade-in vehicle. This result is interesting because, as we have shown above, customers are receiving less for their trade-ins relative to the booked value of the trade-ins at the start of the EDP. If the booked values fall at the start of the EDP, then this amplifies the amount that customers lose on their trade-in relative to what they would have received had they bought in the weeks just before the start of the EDP.

When we regress the trade-in value on the EDP post-test indicator and fixed effects for the *new vehicle*, we find that the trade-in values fall by $700-800 at the start of the EDP. If $200-300 of this is a decrease in the value that dealers are assigning to any given trade-in car on average, then what this suggests is that for any given new car purchased, the

trade-ins that customers are bringing in in exchange for that car are worth about $500 less than the cars that they brought in to purchase the same car before the EDP took effect. We think that this is suggestive of a trading up effect: The difference between the value of the new car that customers are buying under the EDP and the value of the trade-in car they are bringing is $500 larger than that difference before the EDP. While we do not wish to endow this finding with more significance than it warrants, we believe that it is consistent with the hypothesis that customers thought that the EDP was giving them such good prices that they could afford to buy a more expensive car that they otherwise would have afforded.

7 Concluding remarks

In this paper, we have investigated whether customers are susceptible to price cues in purchasing automobiles. The employee discount pricing promotion offered by the Big 3 U.S. manufacturers provides a natural experiment to test the effect of price cues. This is because prices for about 40% of models actually increased as a result of the promotions, although the price cue was designed to communicate that prices went down. For this subset of vehicles, therefore, customers should be expected to increase their purchases if they are responding to the price cue, but decrease their purchases if they are responding to actual prices. We find that following introduction of the EDP program, sales increased even when prices also increased, suggesting that customers were responding to the cue, not to actual price levels. We find that this cannot be explained by overall industry trends, or by advertising.

In decomposing the final price of a car into its components, we find that the price increases that occurred at the time of the EDP were caused partly by increases in the trade-in buyer loss (customers getting paid less for their trade-ins relative to the value of those trade-ins than before the EDP promotion), and partly by the fact that decreases in direct-to-customer rebates were greater than the EDP discounts to the contract price.

We conclude that customers can be influenced by price cues, even in a market for an expensive purchase, where the gain to having accurate price information is high and where customers expend effort searching for that information. The characteristics of pricing in the car industry—that prices are negotiated, that they are made up of multiple components, that they change unpredictably—make the search for price information by customers less than fully revealing. If it is true that price cues—not just prices themselves—are an important determinant of customer response, then they should play an important role in the promotional strategies of many firms.

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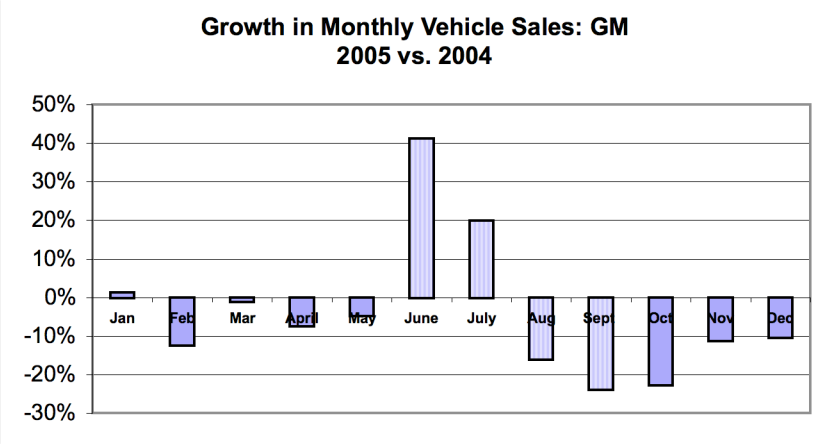
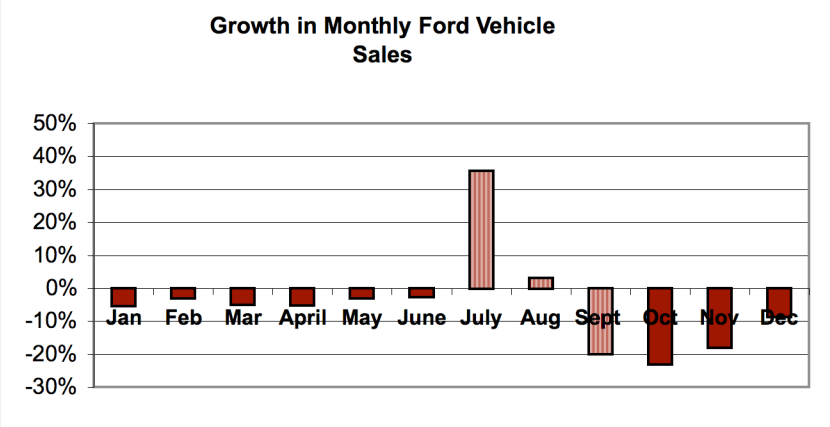
Figures

Figure 1a: Percent Change in Monthly Unit Sales from 2004 to 2005

Domestic Manufacturers





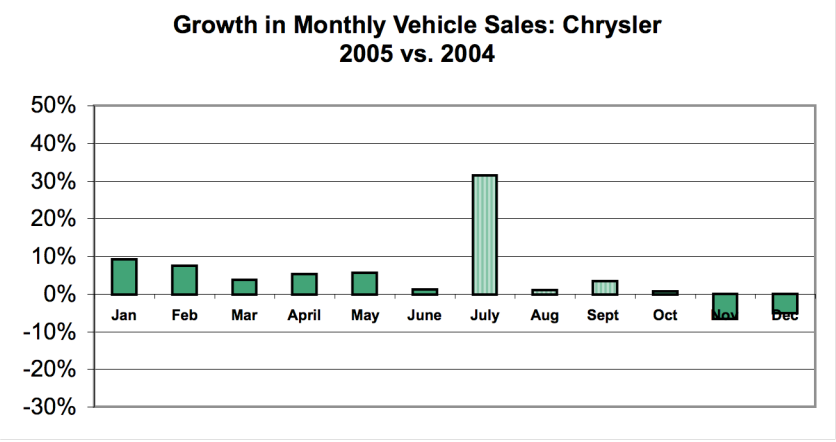
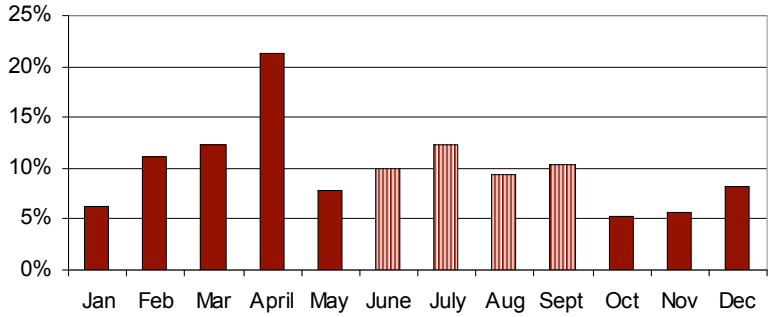
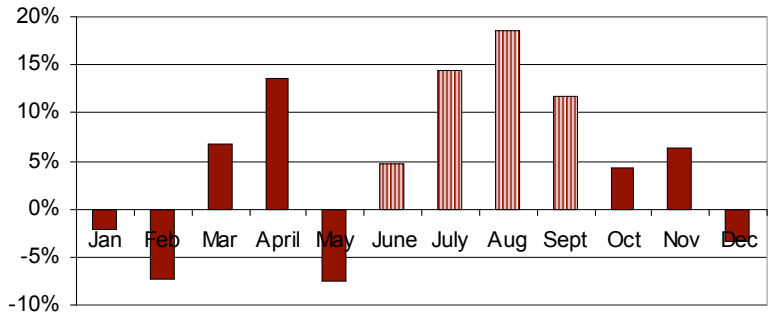


Figure 1b: Percent Change in Monthly Unit Sales from 2004 to 2005
Foreign Manufacturers

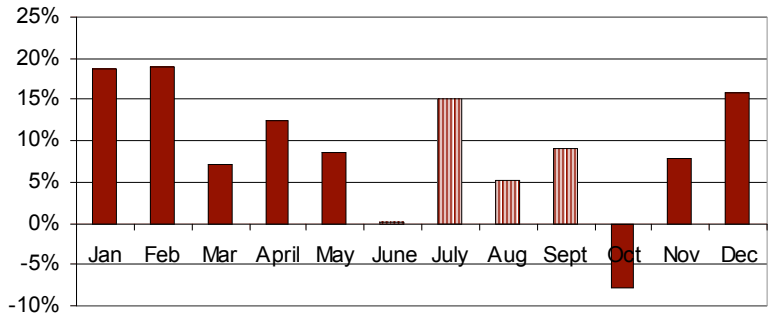
Toyota



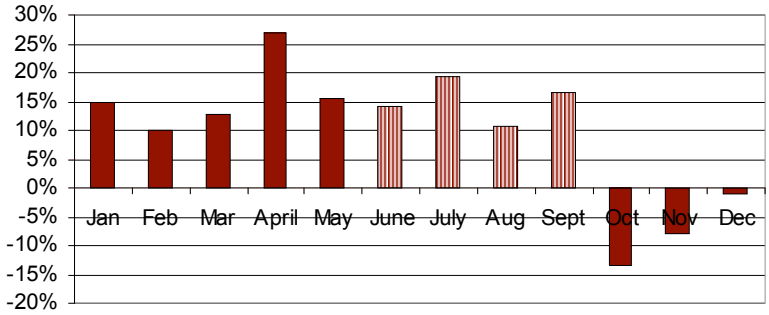
Honda



Hyundai



Nissan



Volkswagon

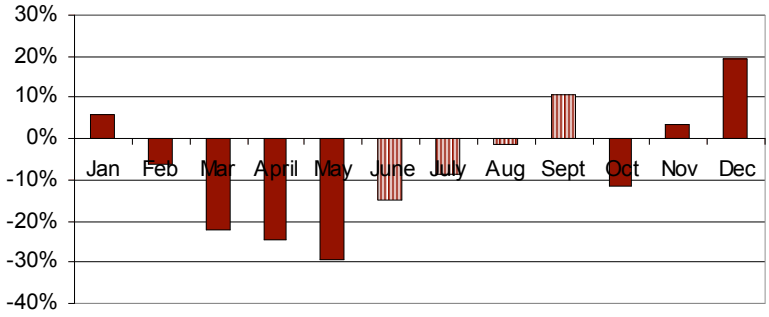


Figure 2: Price and Sales Changes Around the GM Event

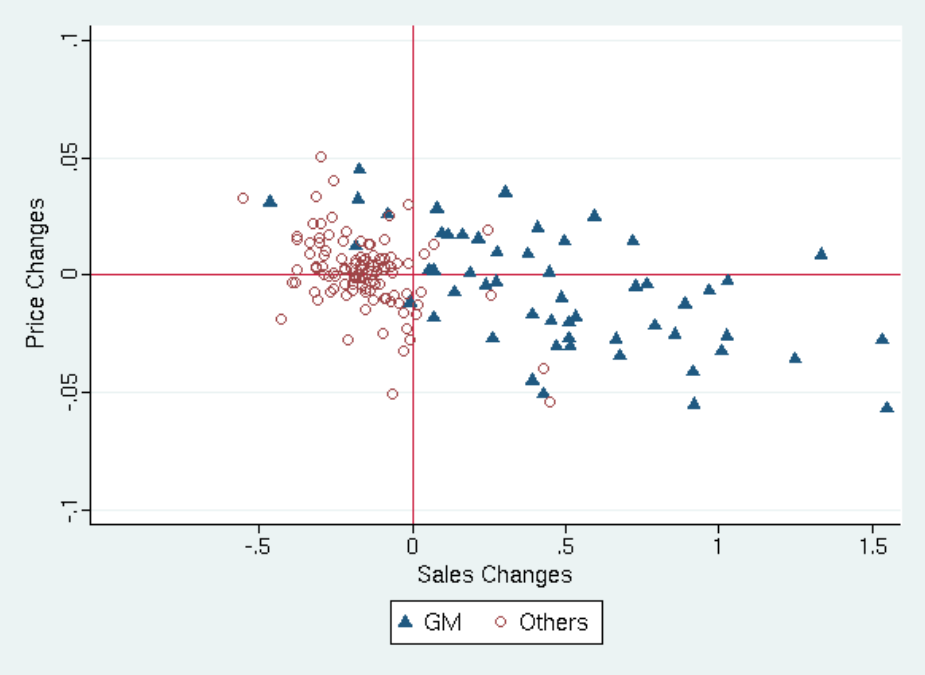


Figure 3: Price and Sales Changes Around the Ford/Chrysler Event

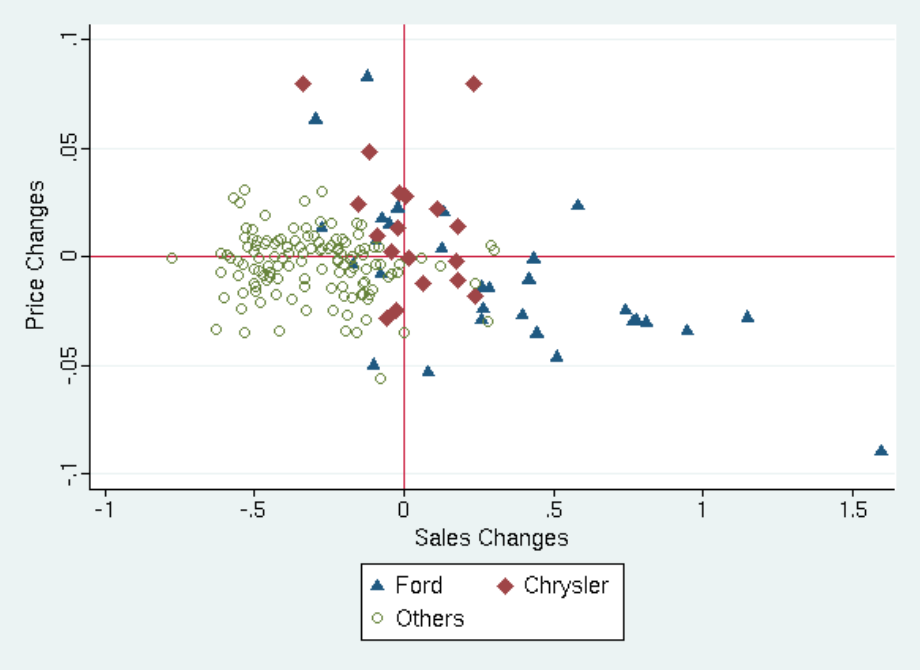


Figure 4: Percent Change in Monthly Advertising Expenditures, 2004 to 2005

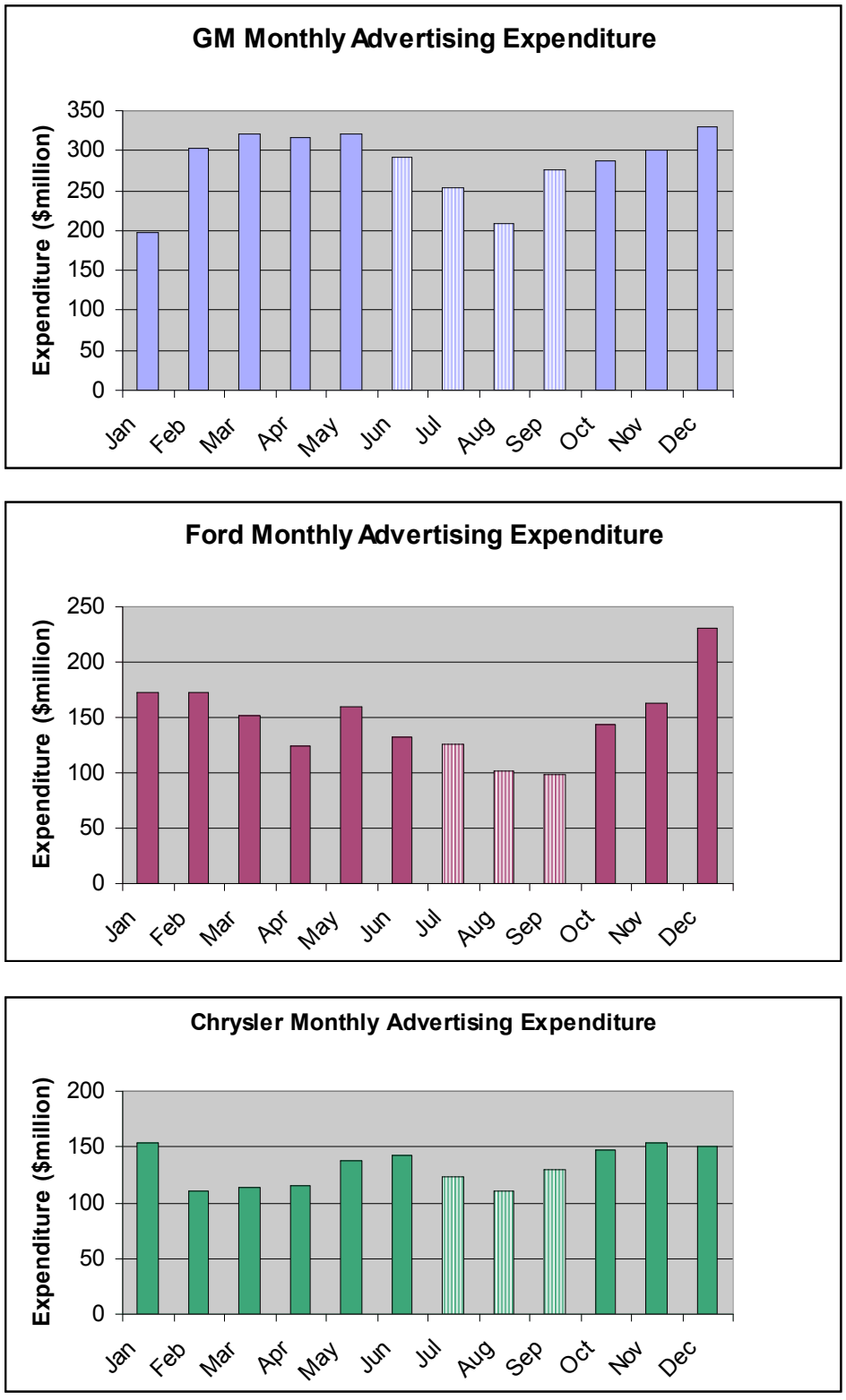


Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Contract Price	28,214	10,182	7,500	163,690
Customer Cash	1,462	1,614	0	10,000
Trade Buyer Loss	-410	1,581	-18,500	12,550
Final Price	26,342	10,134	6,731	163,690
GM	0.24	0.43	0	1
Ford	0.14	0.35	0	1
Chrysler	0.09	0.28	0	1
Female	0.33	0.47	0	1
Age	45.52	14.53	16	105
% Black	0.09	0.14	0	0.99
% Asian	0.04	0.07	0	0.67
% Hispanic	0.13	0.18	0	1
% Less High School	0.16	0.11	0	1
% College	0.36	0.16	0	0.96
% Professional Occup.	0.22	0.07	0	0.75
% Health Support Occup.	0.02	0.01	0	0.27
% Protective Occup.	0.02	0.01	0	0.77
% Food Occup.	0.04	0.02	0	0.46
% Maintenance Occup.	0.03	0.02	0	1
% Housework Occup.	0.03	0.01	0	1
% Sales Occup.	0.12	0.03	0	1
% Administrative Occup.	0.16	0.03	0	0.56
% Repair Occup.	0.04	0.02	0	0.65
% Construction Occup.	0.05	0.03	0	1
% Production Occup.	0.07	0.05	0	0.53
% Transportation Occup.	0.05	0.03	0	1
Income	53,130	19,130	4,444	200,001
Household Size	2.68	0.4	1	8.49
House Value	161,152	102,025	0	1,000,001
Vehicles / Household	1.78	0.3	0	4
% Own House	0.70	0.17	0	1
% Vacant	0.07	0.07	0	0.89
Travel Time for Work	27.29	5.60	3.04	123.5
% Unemployed	0.05	0.03	0	0.83
% Bad English	0.05	0.07	0	0.69
% Poverty	0.09	0.07	0	0.86
Sale on Weekend	0.24	0.43	0	1
Model Month 5-13	0.73	0.44	0	1
Model Month 14+	0.22	0.42	0	1
Vehicle Cost	26,699	9,572	6,370	143,274
Sample Size	290,910			

Table 2: Hedonic Price Regressions
2-Week Windows*

	GM Event	Ford/Chrysler Event
EDP*GM	0.013**	0.0034**
	(0.00089)	(0.00073)
EDP*Ford	-0.0085**	-0.0016+
	(0.0011)	(0.00085)
EDP*Chrysler	0.008**	0.025**
	(0.0013)	(0.001)
EDP*Others	-0.000065	-0.0013**
	(0.00048)	(0.00041)
Female	0.0036**	0.0038**
	(0.00038)	(0.00031)
Age	0.00012**	0.000064**
	(0.000013)	(0.000011)
% Black	0.0078**	0.008**
	(0.0019)	(0.0016)
% Asian	-0.012**	-0.0087**
	(0.0035)	(0.0031)
% Hispanic	0.00046	0.00024
	(0.0026)	(0.0022)
% Less High School	0.022**	0.019**
	(0.0066)	(0.0054)
% College	0.014*	0.0021
	(0.0057)	(0.0047)
Income	8.8e-08*	5.2e-08+
	(3.6e-08)	(2.9e-08)
HH Size	0.0026*	0.0019*
	(0.0011)	(0.00089)
House Value	-2.0e-08**	-8.0e-09*
	(3.7e-09)	(3.1e-09)
Vehicles per HH	-0.0089**	-0.004**
	(0.0015)	(0.0012)
% Own House	-0.00091	-0.0011
	(0.0024)	(0.002)
% Vacant	0.013**	0.013**
	(0.0033)	(0.0028)
Travel Time for Work	-0.000027	-0.000067+
	(0.000043)	(0.000036)
% Unemployed	0.019+	0.035**
	(0.01)	(0.0085)
% Bad English	-0.0085	-0.012+
	(0.0075)	(0.0064)

% Poverty	-0.013+	-0.0091
	(0.0068)	(0.0056)
Weekend	0.0015**	0.00099**
	(0.00041)	(0.00034)
Model Month 5-13	-0.0026	-0.011**
	(0.0029)	(0.0032)
Model Month 14+	-0.00093	-0.0063+
	(0.0034)	(0.0038)
Vehicle Cost	0.00003**	0.000029**
	(9.7e-08)	(8.1e-08)
Observations	129,284	161,076
Adj. R-squared	0.969	0.972

Robust standard errors in parentheses. Occupational demographics, car, and region fixed effects are unreported.

** significant at 1 %

* significant at 5 %;

+ significant at 10%.

Table 3: Summary of Promotion Interactions GM Event

	Positive & Significant	Positive
GM	38.6%	73.9%
Chrysler	15.2%	63.6%
Ford	11.1%	40.0%
Non-domestic models	6.4%	47.8%
Totals		
Without GM	8.2%	48.4%
Including GM	15.4%	54.5%
Test statistic (GM vs. rest)	6.90**	4.19**
Sample size	369	369

Table 4: Summary of Promotion Interactions Ford/Chrysler Event

	Positive & Significant	Positive
GM	13.8%	48.9%
Ford	23.4%	40.4%
Chrysler	67.7%	80.6%
Non-domestic models	5.9%	45.0%
Totals		
Excluding Ford & Chrysler	8.4%	46.3%
Including Ford & Chrysler	15.2%	48.4%
Ford test statistic	2.65*	(0.75)
Chrysler test statistic	8.74**	3.64**
Sample size	374	374

Table 5: Models with Sales Increases Amongst Models with Price Increases

	Unweighted	Weighted by Pre-Promotion Sales	Sample Size
GM Event			
GM	76.5%	88.6%	34
Chrysler	0.0%	0.0%	6
Ford	20.0%	29.2%	5
Non-domestic models	0.0%	0.0%	13
Total without GM	4.2%	1.0%	
Total with GM	46.6%	53.3%	
Test statistic (GM vs. rest)	7.63**	12.67**	
Ford & Chrysler Events			
GM	0.0%	0.0%	12
Chrysler	52.6%	41.8%	19
Ford	36.4%	50.0%	11
Non-domestic models	16.7%	9.6%	12
Totals			
Excluding Ford & Chrysler	8.3%	3.2%	
Including Ford & Chrysler	29.6%	22.8%	
Ford test statistic (t,1)	2.11*	3.96**	
Chrysler test statistic (t,1)	3.60**	3.59**	

Table 6: Sales Changes for Cars with Price Increases*
GM Event

	Models For Which Prices Increased				Sign test	Signed rank test
Manufacturer	Sales Increased	No Sales Change	Sales Decreased	Total	p-value	p-value
General Motors	26	0	8	34	0.001	0.002
Ford	1	0	4	5	0.969	0.931
Chrysler	0	0	6	6	1.000	0.986
Hyundai	0	0	1	1	1.000	0.841
Nissan	0	0	4	4	1.000	0.966
Toyota	0	0	2	2	1.000	0.910

* Honda, Nissan, and Volkswagen had no models with statistically significant price increases.

Table 6: Sales Changes for Cars with Price Increases*
Ford/Chrysler Event

	Models For Which Prices Increased				Sign test	Signed rank test
Manufacturer	Sales Increased	No Sales Change	Sales Decreased	Total	p-value	p-value
Chrysler	10	0	9	19	0.500	0.389
Ford	4	0	7	11	0.887	0.535
General Motors	0	0	12	12	1.000	0.999
Hyundai	0	0	1	1	1.000	0.841
Toyota	1	0	3	4	0.938	0.642

* Honda, Nissan, and Volkswagen had no models with statistically significant price increases.

Table 7: Daily Industry Sales Around the Ford/Chrysler Event

Pre-Introduction Period	Industry Sales	Post-Introduction Period	Industry Sales
18 June 2005	9,297	9 July 2005	9,337
19 June 2005	2,258	10 July 2005	2,678
20 June 2005	8,474	11 July 2005	7,111
21 June 2005	7,386	12 July 2005	6,289
22 June 2005	7,617	13 July 2005	6,554
23 June 2005	7,444	14 July 2005	6,925
24 June 2005	8,761	15 July 2005	7,881
25 June 2005	10,735	16 July 2005	10,434
26 June 2005	3,276	17 July 2005	2,795
27 June 2005	10,475	18 July 2005	8,244
28 June 2005	9,732	19 July 2005	6,942
29 June 2005	11,198	20 July 2005	7,127
30 June 2005	17,245	21 July 2005	7,169
1 July 2005	9,640	22 July 2005	8,204

Table 8: Change in Sales Relative to the Segment
Ford/Chrysler Event

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
Chrysler	16	3	19	0.002	0.012
Ford	11	0	11	0.000	0.002
General Motors	0	12	12	1.000	0.999

Table 9: Change in Sales Relative to the Segment
GM Event

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
General Motors	28	6	34	0.000	0.000
Chrysler	0	6	6	1.000	0.986
Ford	1	4	5	0.969	0.960

Table 10: Estimated Price Changes
GM Event, 1-Week Windows

	Positive & Significant	Positive
GM	36.4%	72.7%
Chrysler	12.9%	61.3%
Ford	12.8%	41.0%
Other models	6.7%	57.1%
Totals		
Without GM	8.6%	54.9%
Including GM	15.5%	59.4%
Test statistic (GM vs. rest)	5.84**	2.76*
Sample size	310	310

Table 11: Estimated Price Changes
Ford/Chrysler Event, 1-Week Windows

	Positive & Significant	Positive
GM	12.2%	59.8%
Ford	29.3%	51.2%
Chrysler	68.0%	84.0%
Other models	5.9%	45.0%
Totals		
Excluding Ford & Chrysler	8.6%	50.0%
Including Ford & Chrysler	15.8%	52.8%
Ford test statistic	3.37**	(0.15)
Chrysler test statistic	7.77**	3.25**
Sample size	322	322

Table 12: Change in Sales Relative to the Segment GM Event, 1-Week Windows

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
General Motors	20	7	27	0.010	0.001
Chrysler	0	4	4	1.000	0.966
Ford	1	4	5	0.969	0.931

Table 13: Change in Sales Relative to the Segment Ford/Chrysler Event, 1-Week Windows

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
Chrysler	13	2	15	0.004	0.003
Ford	11	1	12	0.003	0.002
General Motors	0	10	10	1.000	0.997

Table 14: Estimates of Price Components Around the GM Event

	Final price	Trade Buyer Loss	Contract Price	Customer Cash
Full Sample				
GM*EDP	344**	320**	-881**	-905**
	(18)	(19)	(23)	(10)
Ford*EDP	-234**	17	52+	303**
	(24)	(25)	(30)	(14)
Chrysler*EDP	194**	-13	77**	-131**
	(30)	(31)	(37)	(17)
Others*EDP	-11	4	-13	2
	(12)	(12)	(15)	(7)
GM Cars with Positive & Significant Changes in Final Prices				
GM*EDP	626**	329**	-888**	-1,186**
	(27)	(25)	(30)	(19)

Robust SE in parentheses
** significantly different from zero, p<0.01
* significantly different from zero, p<0.05
+ significantly different from zero, p<0.10

Table 15: Estimates of Price Components Around the Ford & Chrysler Events

	Final price	Trade Buyer Loss	Contract Price	Customer Cash
Full Sample				
GM*EDP	29^{+}	-20	-28	-77**
	(15)	(16)	(19)	(9)
Ford*EDP	-28	277**	-802**	-496**
	(18)	(20)	(23)	(11)
Chrysler*EDP	578**	433**	-1,044**	-1,189**
	(24)	(25)	(30)	(14)
Others*EDP	-36**	-17	13	32**
	(10)	(11)	(13)	(6)
Ford & Chrysler Cars with Positive & Significant Changes in Final Prices				
Ford*EDP	593**	337**	-875**	-1,131**
	(42)	(52)	(59)	(26)
Chrysler*EDP	650**	471**	-1,123**	-1,302**
	(29)	(36)	(41)	(18)

Robust SE in parentheses
** significantly different from zero, $p<0.01$
* significantly different from zero, $p<0.05$
$^{+}$ significantly different from zero, $p<0.10$

Table 16: Estimates of Price Components Around the GM Event
No Trade-In Sample

	Final price	Trade Buyer Loss	Contract Price	Customer Cash
Full Sample				
GM*EDP	345** (26)	–	-543** (21)	-888** (15)
Ford*EDP	-217** (35)	–	43 (29)	260** (20)
Chrysler*EDP	613** (48)	–	38 (39)	-575** (27)
Others*EDP	-6 (15)	–	-7 (12)	0 (8.3)
Observations	65,343		65,343	65,343
GM Cars with Positive & Significant Changes in Final Prices				
GM*EDP	693** (46)	–	-534** (31)	-1,227** (34)
Observations	6,359		6,359	6,359

Robust SE in parentheses
** significantly different from zero, p<0.01
* significantly different from zero, p<0.05
+ significantly different from zero, p<0.10

Table 17: Estimates of Price Components Around the Ford & Chrysler Events
No Trade-In sample:

	Final price	Trade Buyer Loss	Contract Price	Customer Cash
Full Sample				
GM*EDP	22 (21)	–	-45** (17)	-66** (12)
Ford*EDP	30 (27)	–	-486** (22)	-517** (15)
Chrysler*EDP	150** (39)	–	-575** (31)	-726** (22)
Others*EDP	-26* (13)	–	-5 (10)	22** (7)
Sample size	79,580		79,580	79,580
Ford/Chrysler Cars with Positive & Significant Changes in Final Prices				
Ford*EDP	366** (46)	–	-512** (33)	-879** (30)
Chrysler*EDP	398** (76)	–	-470** (55)	-868** (49)
Sample size	6,359		6,359	6,359

Robust SE in parentheses
** significantly different from zero, p<0.01
* significantly different from zero, p<0.05
+ significantly different from zero, p<0.10

Table 18: Advertising Expenditure Before and After the EDP Introduction

	2004	2005
GM Spending Around the Ford GM		
Pre-introduction	$115,046,400	$145,568,700
Post-introduction	$ 95,328,300	$114,307,600
Difference	-17%	-21%
Ford Spending Around the Ford Event		
Pre-introduction	$ 55,714,500	$ 49,057,300
Post-introduction	$ 58,871,900	$ 48,005,100
Difference	6%	-2%
Chrysler Spending Around the Chrysler Event		
Pre-introduction	$ 42,323,900	$ 55,937,300
Post-introduction	$ 42,091,200	$ 42,635,300
Difference	-1%	-24%

Table 19: Estimated Price Changes Around GM Event
No-Haggle Dealers

	Positive & Significant
GM	28.6%
Chrysler	0%
Ford	6.7%
Other models	2.7%
Totals	
Without GM	2.9%
Including GM	8.3%
Test statistic (GM vs. rest)	**
Sample size	133

Table 20: Estimated Price Changes Around Ford/Chrysler Event
No-Haggle Dealers

	Positive & Significant
GM	6.5%
Ford	30.0%
Chrysler	26.7%
Other models	1.4%
Totals	
Excluding Ford & Chrysler	2.9%
Including Ford & Chrysler	9.4%
Ford test statistic	**
Chrysler test statistic	**
Sample size	138

Table 21: Change in Sales Relative to the Segment Around the GM Event
No-Haggle Dealers

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
General Motors	7	1	8	0.035	0.013
Chrysler	0	1	1	1.000	0.841
Ford			0		

Table 22: Change in Sales Relative to the Segment Around the Ford/Chrysler Event
No-Haggle Dealers

	Models For Which Prices Increased			Sign test	Signed rank test
Manufacturer	Sales Increased	Sales Decreased	Total	p-value	p-value
Chrysler	0	4	4	1	0.966
Ford	5	1	6	0.109	0.023
General Motors	0	2	2	1	0.91

Table 23: Demographic Differences Pre- and Post-EDP
for GM Cars during GM Event*

Demographic	EDP coefficient	Standard error	Variable mean	Coefficient / mean
Age	-0.64	0.15	46.3	-0.014
Travel time	-0.21	0.06	26.8	-0.007
Percent poor English	-0.0021	0.0006	0.04	-0.053
Median house value	-2,647	817	141,585	-0.019
Percent Asian	-0.0016	0.0005	0.03	-0.050
Percent employed in sales	-0.0007	0.0003	0.12	-0.006
Median household size	-0.0095	0.0037	2.7	-0.004
Percent Hispanic	-0.0041	0.0017	0.12	-0.035
Percent employed in transportation	0.0007	0.0003	0.06	0.011
Vehicles per household	0.0066	0.0030	1.8	0.004

* Only statistically significant coefficients reported

Table 24: Demographic Differences Pre- and Post-EDP for Ford Cars during Ford/Chrysler Event*

Demographic	EDP coefficient	Standard error	Variable mean	Coefficient / mean
Percent black	-0.0061	0.0015	0.08	-0.076
Percent Asian	-0.0019	0.0005	0.03	-0.064
Percent Hispanic	-0.0051	0.0018	0.12	-0.044
Percent poor English	-0.0017	0.0007	0.04	-0.046
Percent employed in administration	-0.0009	0.0004	0.16	-0.006
Vehicles per household	0.0074	0.0030	1.81	0.004
Age	-0.40	0.17	47.0	-0.008
Travel time	-0.15	0.06	26.6	-0.006
Percent employed in repair	0.0004	0.0002	0.04	0.010
Median household size	-0.0081	0.0040	2.7	-0.003

* Only statistically significant coefficients reported

Table 25: Demographic Differences Pre- and Post-EDP for Chrysler Cars during Ford/Chrysler Event*

Demographic	EDP coefficient	Standard error	Variable mean	Coefficient / mean
Travel time	-0.37	0.08	26.9	-0.014
Median household size	-0.0217	0.0052	2.6	-0.008
Vehicles per household	-0.0108	0.0041	1.8	-0.006
Percent home ownership	-0.0056	0.0022	0.72	-0.008
Income	-596	262	52,333	-0.011
Age	0.42	0.21	45.9	0.009
Percent employed in construction	-0.0008	0.0004	0.06	-0.014

* Only statistically significant coefficients reported