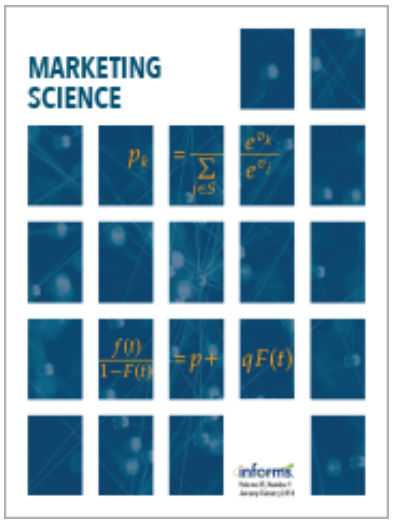

Marketing Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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To cite this article:
Meghan R. Busse, Duncan I. Simester, Florian Zettelmeyer, (2010) "The Best Price You'll Ever Get": The 2005 Employee Discount Pricing Promotions in the U.S. Automobile Industry. Marketing Science 29(2):268-290. https://doi.org/10.1287/mksc.1090.0516

MARKETING SCIENCE
Vol. 29, No. 2, March–April 2010, pp. 268–290
ISSN 0732-2399 | EISSN 1526-548X | 10 | 2902 | 0268

informs

DOI 10.1287/mksc.1090.0516

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

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During the summer of 2005, the three domestic U.S. automobile manufacturers offered a customer promotion that allowed customers to buy new cars using discount programs formerly offered only to employees. The initial months of the promotion were record sales months for each of the three firms, suggesting that customers thought that the prices offered during the promotion were particularly attractive. In reality, however, many customers paid *higher* prices under the employee discount pricing promotion. We propose that the promotion changed customers' beliefs about current versus future prices, convincing them to purchase during the promotion rather than delay in anticipation of future discounts. We investigate several alternative explanations for the simultaneous increase in prices and sales, including advertising, decreased financing costs, industry trends, disutility of bargaining, consumer differences, and changes in trade-in values. None of these explanations fully explains the concomitant increase in prices and sales.

Key words: pricing; sales promotions; natural experiments
History: Received: December 20, 2007; accepted: May 4, 2009; processed by Gary Lilien. Published online in *Articles in Advance* August 26, 2009.

1. Introduction

During the summer of 2005, the three domestic U.S. automobile manufacturers offered an "employee discount" promotion that allowed the general public to buy cars at the below-MSRP prices that their employees paid. These promotions led to record sales. Sales in the first month of Chrysler's promotion were the highest monthly sales ever; for Ford, they were the highest sales of any July ever; and for General Motors (GM), they were the highest monthly sales in nearly 20 years. Perhaps the simplest explanation for record-high sales would be record-low prices. Indeed, one of the promotional taglines for Ford's version of the employee discount promotion—"You get the best prices of the year. Period."—appears to convey exactly this message. However, we will show that prices of many models were *not* lower under the employee discount pricing promotion. Generous customer rebates had been available just prior to the start of the employee discount promotions, which meant that for many models, prices increased under the promotion. However, even on models for which prices increased, sales also increased by an average of 22%–36%.

There are several possible explanations for why a price increase and sales increase may coincide. One is that an industrywide increase in demand for cars (because of seasonal effects or economic expansion) could lead to prices and sales increasing together. An increase in persuasive advertising that increased customers' valuations (as opposed to informing them of the existence of a discount) could also raise prices and sales at the same time. A reduction in financing costs is another avenue that could lead to contemporaneously increased prices and increased sales. Also, because many customers dislike haggling with dealers over the price of a new car, the opportunity to buy without engaging in this process—which the employee discount promotion provided—could have raised customers' willingness to pay enough to result in increased prices and sales. Another possibility is that the types of customers who purchased before and after the introduction of the employee discount pricing (EDP) promotions were different. Finally, the

increased volume of sales may have affected the value of trade-ins, making them less valuable in new car transactions and raising the cash amount customers had to pay to buy cars. As we will show, the empirical evidence reveals that none of these explanations can fully account for the sales response to the employee pricing promotions.

Instead, we propose a different explanation suggested by the fact that cars are durable goods. When buying a durable good, customers can optimize not just which product to buy but also when to buy. If customers anticipate that prices may be lower in the future, they may behave strategically, delaying their purchases in order to take advantage of the future discounts (Coase 1972). We will argue that the impact of the employee pricing promotions can be partly attributed to changes in customers' expectations about how current prices compare to future prices. We will later describe scenarios that could lead to the observed outcomes and present evidence in support of this interpretation, including survey evidence about customers' price beliefs.

The implication of our results is that firms can have large effects on their sales by manipulating customers' beliefs about current versus future prices, even without changing prices themselves. This is not the first paper to show that changing customers' price expectations can be effective (see §4 for other examples). Instead, this paper's contribution is to show that firms can use these strategies successfully even in product categories where there is significant money at stake and in which customers spend a lot of time searching for product and price information.[1]

1.1. Navigating the Paper

Our analysis proceeds in three steps. In the first step we present a series of results describing how the EDP promotions affected both prices and sales. The findings reveal that prices of many models increased following the introduction of the EDP promotions. There was also a sharp increase in sales. Moreover, these two findings coincide; sales increased even for models whose prices increased. It is this last result that strongly indicates that the success of the EDP promotions was due to something other than lower prices.

The second step investigates the possibility that the EDP promotions persuaded customers that prices under the promotion were low compared to future prices, prompting them to purchase immediately rather than wait for future discounts. We describe four scenarios that could lead to a coinciding increase in price and sales. We then present evidence that is consistent with this explanation.

Finally, the third step is to investigate alternative explanations for these results. These explanations include an overall increase in industry demand, increased advertising, decreased financing costs, the perceived "no-haggle" feature of the EDP promotion, changes in the demographic composition of buyers, and changes in trade-in values.

The outcome is a broad collection of results investigating the outcome of the EDP promotions. Given the breadth of results, we begin by summarizing the results in two tables. This summary is intended as a roadmap to aid the reader in navigating the paper. In Table 1 we summarize the results from Step 1. These findings are all reported in §3 and describe the overall impact of the promotions on prices and sales. In Table 2 we summarize the results used to evaluate the different explanations, including the possibility that the EDP promotions changed customers' price expectations. These findings are reported in §§4 and 5.

Before presenting these results we briefly describe both the employee discount pricing promotions and the data used in the analysis.

Table 1 Summary of the Impact of the EDP Promotions on Prices and Sales

Immediate effects of a manufacturer's introduction of an EDP promotion

1. Total unit *sales* for that manufacturer *increase* by 30%–40%. (§3.1 and Figure 1)
2. *Prices* of individual models *increase* on average by 1.8%–3.0% for two of the three manufacturers. (§3.2, Table 3)
3. *Sales increase* by 22%–36% even on the 30%–72% of *models for which prices increase*. (§3.2, Table 3 *and* §3.3, Table 4)
   - However, the sales increase is larger (29%–60% vs. 22%–36%) on models for which price increases are smaller. (Table 4)
4. Furthermore,
   - The sales increase does not extend to *other manufacturers*. (§5.1 and Figure A1)
   - The results are unusual compared to other historical *time periods*. (§3.4)
   - There is less variation across customers in prices paid for the same model. (§5.4)
   - The sales increase extends across a broad range of *customer segments*. (§3.3)
   - The price increase (for models whose prices increased) results from (Table 4)
     - *Lower contract prices* by \$885–1,116
     - *Lower rebates* by \$1,081–1,259 (exceeding the reduction in contract price)
     - *Lower trade-in prices* by \$321–474 relative to trade in values

Effects during the remainder of the year

5. After the initial sales increases, sales fall in the following months for all three manufacturers. (Figure 1)
6. Annual sales for GM and Ford are lower by 4.0%–4.6% than in the previous year. (Table 7)

[1] A series of studies have documented consumers' search activities when purchasing a new automobile. These studies reveal that customers typically spend 15–20 hours searching for information when purchasing a new car, with more than half of this time spent searching for price information (see, for example, Bayus 1991, Ratchford and Srinivasan 1993, Ratchford et al. 2003, Zettelmeyer et al. 2006).

Table 2 Summary of the Evidence Used to Evaluate Possible Explanations

Primary hypothesis
Change in customers' price expectations • Sales increases came from a temporal shift in sales rather than substitution from other manufacturers. (§4.2.1) • Survey evidence indicates that the primary customer inference was that current prices were low. (§4.2.2)
Alternative explanations
1. Industrywide demand shocks (contradicted by data) • The sales increase did not extend to other manufacturers. (§5.1)
2. Advertising increased customers' willingness to pay (contradicted by data) • Promotions did not coincide with an increase in advertising expenditure. (§5.2) • Survey evidence indicates customers interpreted the promotion as a message about price rather than factors that would affect willingness to pay. (§4.2.2)
3. Lower financing costs (contradicted by data) • Lease and loan interest rates increased following introduction of the promotions. (§5.3) • Prime lending rate increased during this period. (§5.3) • Lease residual values also increased following introduction of the promotions. (§5.3)
4. Disutility of bargaining (cannot explain the entire effect) • The EDP promotions reduced the variation in prices, consistent with less "haggling" over price. (§5.4) • The increase in sales existed even at "no-haggle" dealerships, in which there was no change in haggling policy before and after the promotions. (§5.4)
5. Customer differences (cannot explain the entire effect) • Demographics vary little between customers purchasing immediately before and after the introduction of the promotions. (§5.5)
6. Lower value of trade-ins (cannot explain the entire effect) • The value of trade-ins was lower, but this extended to all manufacturers. (§5.6) • Sales increase even for transactions that did not involve trade-ins. (§5.6)

2. The 2005 Employee Discount Pricing Promotions

Dealer franchise laws in the United States mandate that auto manufacturers and dealers must be independent parties. Because manufacturers do not directly set retail prices, the EDP promotions were implemented as an opt-in rebate program. Dealers who chose to participate could not charge more than the employee discount price (although they could charge less). A rebate from the manufacturer to the dealer compensated dealers for participating in the program.

GM was the first of three manufacturers to introduce an EDP promotion. The GM event was announced on June 3, 2005, and started on this date. Our analysis of the GM promotion focuses on changes in sales and prices in the weeks just before and after June 3. Ford introduced its "Ford Family Plan" on July 5, whereas Chrysler introduced its "Employee Pricing Plus" plan on July 6. Our analysis of the effects of Ford's and Chrysler's promotions will focus on the weeks just before and after July 5 and 6. Both firms initially announced that their plans would only last until August 1. However, they and GM subsequently extended their programs into September.

2.1. Data

The analysis conducted in this paper was done in collaboration with a major car manufacturer who allowed us to use data they had purchased from a supplier of market information. The data supplier collects transaction data from a 25% sample of dealers. Transactions are uploaded nightly from internal dealer accounting systems and cover all new car transactions at the sampled dealerships. As we will discuss, we use a total of eight weeks of data during the period May–July 2005 to estimate the price effect of the EDP promotions, yielding a total of 290,910 observations. To estimate the sales effect of the EDP promotions, we will aggregate over individual sales transactions to obtain the daily unit sales of each model. For estimation reasons this data set extends from January 2003 to July 2005, yielding a total of 643,144 observations. Summary statistics for both data sets are in Tables A.1 and A.2 of the electronic companion, available as part of the online version that can be found at http://mktsci.pubs.informs.org. For each transaction we observe the price paid (before sales tax), 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.[2] We observe the dealer's cost of obtaining the car from the manufacturer, demographic information on the customer, detailed information on the trade-in vehicle if the customer used a trade-in, and the profitability of the car to the dealership. We also observe the exact vehicle purchased, including make, model, model year, trim level, body type, number of doors, cylinders, displacement, and drive type.

2.2. Dependent Variables

We begin by studying how prices and sales differ across cars and over time. Conceptually, we would like our price variable to measure the customer's total wealth outlay, which we will refer to as the "*Final Price*." To compute the *Final Price* we make two modifications to the observed transaction price. First, we subtract the customer cash rebate (if any) because the manufacturer pays this amount on the customer's behalf. Second, we add to (subtract from) the purchase price any loss (profit) the customer made on his or her trade-in:

$$\textit{Final Price} = \textit{Contract Price} - \textit{Rebate} + \textit{Trade-In Buyer Loss}.$$

[2] 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.

Specifically, we define the *Trade-In Buyer Loss* as the estimated wholesale value of the trade-in vehicle (as booked by the dealer) minus the trade-in price. This *Trade-In Buyer Loss* is not always positive because dealers may trade off profits on the new vehicle transaction for profits on the trade-in. The *Final Price* is thus the contract price minus the customer cash rebate (if any) plus the trade-in buyer loss (if any). Because the impact of the employee discount promotions on these different price components is itself interesting, in §3.5 we will also decompose the effect of the promotion on *Final Price* by analyzing the outcome for each component separately.

For the analysis of sales, we aggregate individual transactions to obtain measures of daily unit sales volume for each make–model–model year as our dependent variable (e.g., the number of 2005 Honda Accords sold on May 22, 2005).

2.3. Controls

We control for car-type fixed effects, which allows us to compare only identical products to each other. We define a "car type" 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 type is a 2005 Honda Accord sedan with automatic transmission, a 2.4 liter engine, four doors, four cylinders, and the EX trim). We have 4,565 thus-defined car types in our sample.

The only characteristics not captured by the fixed effects are factory- and dealer-installed options that vary within trim level. The transaction price we observe covers such options, but we do not observe what options the car actually has. 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.[3] The *Vehicle Cost* measure does not reflect the 5%–6% of the MSRP that GM, Ford, and Chrysler paid to participating dealers in the period during the EDP promotions. Hence, our *Vehicle Cost* variable will be the same for identical cars, whether a car was sold prior to or during the EDP.

To control for time variation in prices, we use dummy variables identifying the day of the week on which the car was sold. If there are volume targets or sales on weekends, we will pick them up with these variables.

[3] "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 the car is sold at the invoice price.

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

We 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. Specifically, we control for the race (percentage of African American, Asian, and Hispanic), education (percentage of less than high school, and college educated), occupation (percentage in following categories: professional, health support, protective, food, maintenance, housework, sales, administration, repair, construction, production, and transportation), median household income, median household size, median house value, percentage of house ownership, number of vehicles per household, commute time to work, percentage of unemployment, percentage of poverty, and percentage of English proficiency of residents of the zip code in which the buyer resides.

2.4. Other Data

To evaluate explanations for the findings, we collected data from two additional sources. First, we purchased data from TNS Media Intelligence describing weekly advertising expenditure in the automobile industry. We use these data to evaluate whether the introduction of the EDP promotions coincided with an increase in advertising expenditure by these manufacturers. Second, we obtained survey data collected by one of the three domestic manufacturers following the introduction of this firm's EDP program. The survey comprised a sample of 200 vehicle owners, and asked them to list the most important reason for purchasing a vehicle under the EDP promotions. The findings provide a direct measure of how the EDP promotions influenced customers' price expectations and willingness to pay.

3. Empirical Approach and Results

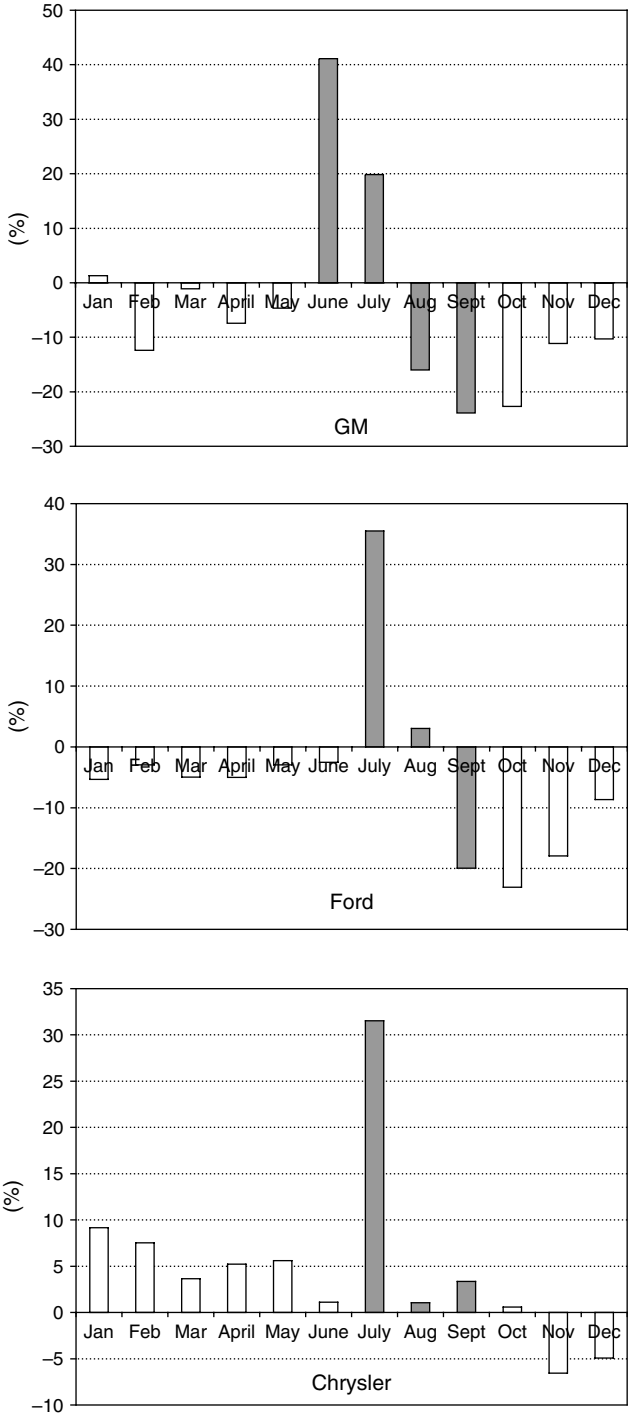
In this section, we assess the effect of the EDP promotions on the sales and prices of new cars. We begin by looking at total unit sales and average prices for manufacturers who did and did not offer EDP promotions. We then look at effects on individual models, paying particular attention to a subset of models for which both prices and sales increased in conjunction with the EDP promotion.

3.1. Manufacturer-Level Sales and Prices

We begin by documenting what happened to total unit sales and average prices for individual manufacturers following the introduction of the EDP promotions. Figure 1 shows the change in total monthly unit sales for GM, Ford, and Chrysler between 2004 and

2005. The lighter bars in Figure 1 show the months of the EDP promotions. GM's unit sales had been mostly down during January–May 2005 relative to the same months in 2004. However, during the first month of the EDP promotion, June 2005, unit sales were more than 40% higher than they had been during June 2004. 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 were just over 30% higher.

Figure 1 2004 vs. 2005 Change in Monthly Unit Sales



Notes. The figure summarizes the percentage change in GM's, Ford's, and Chrysler's total monthly unit sales between 2004 and 2005. The data were obtained from company press releases.

In the electronic companion, we report the same data for each of the major foreign manufacturers in Figure A.1. The sales figures for the major foreign competitors show no particular effect of the U.S. manufacturers' EDP promotions. For foreign automakers, 2005 sales were generally increased by 5%–15% over sales in the same months of 2004, and the months of the EDP promotions do not seem systematically different from other months of the year.

The monthly sales trends for the three U.S. companies also share another common feature. After the initial months of the EDP promotion, sales fell (relative to 2004) at all three companies. The drop in sales was particularly pronounced for GM and Ford; as a result, their total unit sales in 2005 were actually lower than in 2004. We will later interpret this finding and the lack of an effect on foreign manufacturers as evidence that the short-term sales increase reflected temporal substitution of demand, rather than substitution from competing manufacturers. It appears that the EDP promotions prompted many customers to accelerate their purchases to the EDP promotion period rather than buying later in the year.

We can also calculate the average prices paid immediately before and after the introduction of the EDP promotions. The average prices paid for GM and Chrysler cars were 3.1% and 2.4% higher, respectively, in the two weeks after their EDP promotions were introduced than they had been in the two weeks before. The average prices paid for Ford cars in the first two weeks of its EDP promotion were 1.2% lower than in the two prior weeks. Given the low price emphasis of the EDP marketing message, the increased average prices for GM and Chrysler are somewhat surprising.

We next evaluate the impact of the EDP promotions on prices and unit sales at a more disaggregate level. This analysis allows us to investigate whether models for which prices increased are also models for which unit sales increased.

3.2. Price Effect

We estimate the effect of the EDP promotions on transaction prices using a hedonic price regression. We regress the natural log of the *Final Price* paid by customer i for vehicle j at time t in region r on a vector of customer demographics ($\boldsymbol{Demographics}_i$), dummies for the day of week on which the car was purchased ($\boldsymbol{Day\ of\ Week}_t$), the cost to the dealer

of acquiring the car from the manufacturer (*Vehicle Cost*$_{ijt}$), and detailed region-specific car-type fixed effects which are the cross product of make, model, model year, body type, transmission, displacement, number of doors, number of cylinders, trim level, and the region in which the sale occurred (***Car Type***$_j$ ∗ ***Region***$_r$). We estimate the effect of the employee discount promotion separately for each model by interacting make–model–model year dummies with the time-varying employee discount promotion indicator (EDP_t). We will refer to the make–model–model year dummies (***Model***$_j$) as "model" dummies to distinguish them from the more granular "***Car Type***$_j$ ∗ ***Region***$_r$" dummies:[4]

$$\begin{aligned}\ln(\textit{Final Price}_{irjt}) &= \boldsymbol{\alpha}_j \textbf{\textit{Model}}_j \cdot EDP_t + \boldsymbol{\beta}_1 \textbf{\textit{Demographics}}_i \\ &\quad + \boldsymbol{\beta}_2 \textbf{\textit{Day of Week}}_t + \beta_3 \textit{Vehicle Cost}_{ijt} \\ &\quad + \boldsymbol{\beta}_4 \textbf{\textit{Car Type}}_j * \textbf{\textit{Region}}_r + \varepsilon_{irjt}. \end{aligned} \quad (1)$$

The coefficients of interest are the vector $\boldsymbol{\alpha}_j$, from which we can estimate the percentage change in the average transaction price for a model before and after the introduction of the EDP promotions.[5]

To control for possible changes in demand conditions, we use a regression discontinuity approach. Regression discontinuity takes advantage of discontinuities around the introduction of a treatment. For example, if a scholarship were available to students with SAT scores of 1,400 and above, then one could consider students who got an SAT score of 1,400 and received a scholarship and students who got SAT scores of 1,390 and did not receive a scholarship to be essentially randomly assigned to the treatment and control groups. The key identifying condition is that there are no unobservable characteristics relevant to the outcome of interest that change discontinuously around the treatment discontinuity (Hahn et al. 2001, Imbens and Angrist 1994).

In the case of EDP promotions, we use transactions that occurred just before the promotion took effect as the "control" or "pre" observations, and transactions that occurred immediately after the introduction of the promotion as "treatment" or "post" observations. The identifying assumption is that nothing other than the EDP promotion occurred at the same time as the EDP promotion that would have had a discontinuous effect on the price. Because demand conditions change gradually over time, and manufacturers observe these changes gradually as information filters up from the dealer network, we would expect that the start date of the promotion would be essentially randomly chosen within a period of evolving demand. A similar approach was used by Busse et al. (2006) to estimate the pass-through of automobile manufacturers' promotions.

For the GM EDP promotion, which started on June 3, 2005, we use Saturday, May 14 through Friday, May 27 as the preperiod (control), and Saturday, June 4 through Friday, June 17 for the postperiod (treatment). For the Ford and Chrysler promotions, which started on July 5 and 6, respectively, we use Saturday, June 18 through Friday, July 1 for the preperiod, and Saturday, July 9 through Friday, July 22 for the postperiod.

We are concerned that there may be serial correlation in the errors of Equation (1). To account for this, we estimate our standard errors using an estimated variance-covariance matrix that is "clustered" by make–model–model year.[6] This yields consistent standard error estimates that allow for arbitrary patterns of serial correlation and allows those patterns to vary by make–model–model year.

We begin by estimating Equation (1) around the introduction of the GM promotion. The estimation uses 148,519 transactions and yields an adjusted R^2 of 0.98. We also estimated Equation (1) around the introduction of the Ford and Chrysler events. This estimation uses 185,867 observations and yields an adjusted R^2 of 0.98.[7]

We are interested in the $\boldsymbol{\alpha}_j$ coefficients from Equation (1). These coefficients estimate the increase in ln(*FinalPrice*) for each model following the introduction of the EDP promotions. In column 1 of Table 3, we report the average of the $\boldsymbol{\alpha}_j$ coefficients for EDP and non-EDP manufacturers. The top panel shows results for the GM EDP promotion, the lower for the Ford and Chrysler events. In column 2, we report the standard error of *t*-tests that test for (i) whether the average coefficient for each manufacturer is equal to 0, and (ii) whether the difference in the average

[4] To avoid unnecessary notation, we use the *j* subscript to identify both "models" and (more granular) "car types."

[5] These coefficients are calculated at the "model" level. Because the *Car Type* ∗ *Region* dummy variables are more granular than models they collectively estimate the main effects of "model."

[6] In doing so, we follow the recommendation of Bertrand et al. (2004), who find that using the variance-covariance matrix estimator implemented by Stata's "cluster" command performs well as long as the number of panels is large. In their context, large is 50, the number of states. We estimate standard errors clustering by make–model–model year, of which there are about 350.

[7] We also compared in-sample and out-of-sample model fit. Specifically, we estimated Equation (1) based on a 50% random sample of our data. For GM the in-sample R^2 of the regression is 0.99. The R^2 of the estimated specification on the 50% out-of-sample data is 0.97 and thus very close to the in-sample fit. For the Ford/Chrysler event the R^2 values are 0.98 in sample and 0.97 out of sample. These high R^2 values reflect the large number of fixed effects included in the models.

Table 3 Estimated Price Changes Following the Introduction of the EDP Promotions

	Mean (α_j)	Standard error of t-test (H_0: Column 1 = 0)	Above 1% price increases (%)	Number of models
GM event				
GM	0.018**	0.004	54.7	86
Rest: Total without GM	0.003	0.002	24.4	271
Difference: GM vs. rest	0.015**	0.005	30.3	
Ford and Chrysler events				
Ford	−0.012	0.006	30.2	43
Chrysler	0.030**	0.001	72.0	25
Rest: Total without Ford and Chrysler	−0.001	0.004	15.3	294
Difference: Ford vs. rest	−0.011**	0.004	14.9	
Difference: Chrysler vs. rest	0.031**	0.005	56.7	

Notes. The table summarizes the estimated $\boldsymbol{\alpha}_j$ coefficients from Equation (1) using transactions either in the four-week sample period around the introduction of the GM EDP promotions (148,519 observations, Adj. $R^2 = 0.98$) or the four-week sample period around the Ford and Chrysler promotions (185,867 observations, Adj. $R^2 = 0.98$). "Above 1% price increases" denotes the fraction of estimated α_j coefficients that exceed 1% and are statistically significantly larger than zero (at the 5% significance level).

*Significantly different from zero ($p < 0.05$), **significantly different from zero ($p < 0.01$).

coefficients for the manufacturer(s) offering and not offering the EDP promotion is equal to zero.

These model-level findings are consistent with the averages for each manufacturer as a whole. From the t-test of the coefficient means, we conclude that model-level prices at GM and Chrysler increased significantly ($p < 0.01$) on average following the introduction of the EDP promotions, whereas the average model-level price change at Ford was not significantly different from zero.

We also report, in column 3, the percentage of estimated price increases that are large compared to historical price changes. To establish an historical benchmark, we replicate this analysis using 16 earlier time periods.[8] Across these historical samples the median price *change* between any two-week preperiod and two-week postperiod is −0.16% (car prices fall slightly over the model year). If we just focus on the price *increases*, the median price *increase* between any two-week preperiod and two-week postperiod is 1%. This means that historically half of all price *increases* exceed 1% in magnitude. Because price decreases slightly outnumber price increases, an increase of 1% or more occurs only 20% of the time between any two-week preperiod and two-week postperiod. Hence, to identify price increases that are large compared to historical price changes, we define an "above 1% price increase" as a price increase that is statistically significantly larger than zero (at the 5% significance level) and exceeds 1% in magnitude.[9]

In the analysis that follows we will focus on models for which there was an above 1% price increase. The majority of GM models experienced above 1% price increases following the introduction of GM's EDP promotion. Across its 86 models, 54.7% of models had statistically significant price increases that exceeded 1%. Across other manufacturers at the same time, this only occurred on 24.4% of models. A Gaussian test of equality between the fraction of above 1% prices increases for GM (54.7%) versus the other manufacturers (24.4%) rejects the null hypothesis that there is no difference in these proportions ($p < 0.01$).

The findings for the Ford and Chrysler events reveal a similar pattern: 30.2% of Ford's 43 models and 72% of Chrysler's 25 models had above 1% price increases at the start of the EDP promotion. Gaussian tests of equality between the fraction of significant price increases for Ford (30.2%) and Chrysler (72%), respectively, versus other manufacturers (15.3%) reject the null hypotheses that there is no difference in these proportions ($p < 0.05$).

We conclude that the introduction of the EDP promotions resulted in customers paying higher prices on many models.[10] The price increases were unusual compared to other manufacturers' price changes around the same time period. In addition, the price

[8] We discuss this analysis in greater detail in §3.4. The exact dates used for this benchmark estimation are described in the electronic companion.

[9] To confirm that the results do not depend on this 1% benchmark, we replicated the analysis using other benchmarks, including the 75th percentile historical price increase (2.35%). The conclusions remain unchanged.

[10] All of our price specifications control for consumer demographics. If consumer demographics change with the EDP, it is possible for the price of a model *conditional* on demographics to rise for all demographic groups, but for more "low-price" demographic consumers to buy the model so that average price paid in the market for that model declines. To investigate whether this is the case, we do two things. First, in §5.5 we analyze whether the demographic characteristics of consumers before and during the EDP promotion differ (we find that there are some differences, but they are small). Second, we reestimate Equation (1) without demographic variables. The findings are essentially unchanged.

increases were unusually large compared to historical price changes. These findings are noteworthy because they occurred in a period in which the three domestic manufacturers were promoting the availability of low prices.

3.3. Sales Response for Cars with Increased Prices

Although the findings in §3.1 reveal that overall unit sales increased for all three domestic manufacturers, we are particularly interested in what happened to sales of models whose prices increased at the start of the EDP promotions. If the change in prices accompanying the promotion led to a simple movement along the demand curve, these models' sales should have decreased. We begin with an analysis of the sales response across all consumers. We then investigate whether we can find evidence of response heterogeneity between consumer groups.

3.3.1. Average Sales Response. To estimate the effect of the EDP promotions on sales, we begin by aggregating over individual transactions to obtain the daily unit sales of each model. For example, one observation would be the number of 2005 Honda Accords sold in our sample on May 22, 2005. We focus on the models identified in §3.2 as having experienced above 1% price increases and estimate the average change in daily sales for each model between the two-week pre- and postperiods.

Our dependent variable is a count variable that takes on the value zero for 41% of the "model-day" observations in our sample. (There are models that sell zero units on some days in our sample.) In light of this, we estimate the effect of the EDP promotion on sales using a count data model. Specifically, we estimate a Poisson quasi-maximum likelihood model with make–model–model year (conditional) fixed effects (Wooldridge 1999). This estimator is consistent under quite general conditions—only a conditional mean assumption is required. In particular, this means that—in contrast to the regular Poisson model—the estimator will be consistent even if there is overdispersion or underdispersion in the latent variable model. Moreover, the robust variance-covariance matrix described by Wooldridge (1999) allows for any deviations from the Poisson distribution and for arbitrary time dependence within make–model–model year. As such, the estimates do not suffer from the fixed-effects serial correlation issues highlighted by Bertrand et al. (2004).

Using daily sales as our dependent variable means that we need to pay attention to systemic differences in daily sales. For example, sales in the last several days of the month are usually higher than on other days of the month. Because the EDP promotions start on dates 3, 5, and 6 of their respective months, the two-week preperiods contain a varying number of days late in the month. We cannot estimate these effects separately from the effect of the EDP using only our two-week pre- and two-week post-EDP sample periods. We therefore estimate the Poisson model using a data set of daily model unit sales between January 1, 2003 and July 31, 2005. This yields 643,144 observations. The model includes make–model–model year (conditional) fixed effects, and fixed effects to control for year, month of year, day of month, day of week, and the last five days of the month (because the dates of the last days of the month differ by month). In addition, the specification includes the following variables of interest:

$$\begin{aligned}&\boldsymbol{\delta}_1 \cdot \boldsymbol{Manufacturer}_j \cdot PrePost_t \cdot Above\ 1\%\ Price\ Increase_j \\ &\quad + \boldsymbol{\delta}_2 \cdot \boldsymbol{Manufacturer}_j \cdot PrePost_t \cdot EDP_t \\ &\quad \cdot Above\ 1\%\ Price\ Increase_j + \boldsymbol{\delta}_3 \cdot \boldsymbol{Manufacturer}_j \\ &\quad \cdot PrePost_t \cdot (1 - Above\ 1\%\ Price\ Increase_j) \\ &\quad + \boldsymbol{\delta}_4 \cdot \boldsymbol{Manufacturer}_j \cdot PrePost_t \cdot EDP_t \\ &\quad \cdot (1 - Above\ 1\%\ Price\ Increase_j). \end{aligned} \tag{2}$$

These variables are defined as follows:

$\boldsymbol{Manufacturer}_j$	A vector of dummy variables identifying the manufacturer of car j as GM, Ford, Chrysler, or foreign.
$PrePost_t$	A dummy variable indicating whether the transaction occurred during the two-week periods before and after the introduction of the EDP promotion.
EDP_t	A dummy variable indicating whether the time period was in the post two-week period following the introduction of the EDP promotion.
$Above\ 1\%\ Price\ Increase_j$	A dummy variable indicating whether the car had an above 1% price increase following the introduction of the EDP.

A transaction that occurs during either the pre- or the postperiod will have *PrePost* equal to 1. A transaction that occurs during the postperiod (i.e., during the EDP) will have *PrePost* equal to 1 *and* will have EDP_t equal to 1. A transaction that occurs outside of the pre- and postperiods will have these variables both equal to 0 and will thus not contribute to the estimate of the coefficient vectors $\boldsymbol{\delta}_1 - \boldsymbol{\delta}_4$ but will contribute to the estimation of the effect of the controls.

The primary coefficients of interest are represented by the vector $\boldsymbol{\delta}_2$, which measures the effect of the EDP on sales of cars that had above 1% price increases. The $\boldsymbol{\delta}_2$ coefficients and their standard errors are reported

Table 4 Estimated Effect of the EDP Promotions on Unit Sales

	GM	Ford	Chrysler	Foreign
GM event				
Models with above 1% price increases (δ_2)	0.36** (0.06)	−0.11 (0.14)	−0.27** (0.04)	−0.19** (0.04)
Models without above 1% price increases (δ_4)	0.60** (0.06)	−0.02 (0.03)	−0.10 (0.05)	−0.04* (0.02)
Observations		643,144		
Log-likelihood		−3,499,738		
Ford and Chrysler events				
Models with above 1% price increases (δ_2)	−0.50** (0.04)	0.26** (0.05)	0.22** (0.04)	0.01 (0.04)
Models without above 1% price increases (δ_4)	−0.38** (0.03)	0.59** (0.06)	0.29** (0.12)	0.04 (0.03)
Observations		643,144		
Log-likelihood		−3,489,623		

Notes. The table summarizes the δ_2 and δ_4 coefficients from estimating Equation (2) when using EDP_t to identify the timing of either the GM event or the Ford and Chrysler events. Robust standard errors are in parentheses. Control variables are not reported.

*Significantly different from zero ($p < 0.05$), **significantly different from zero ($p < 0.01$).

in the first two rows of each panel of Table 4. For completeness, we also report the δ_4 coefficients, which measure the impact on cars which did not have above 1% price increases.

Recall that during the GM EDP period 54.7% of GM models experienced above 1% price increases. GM models with above 1% price increases experienced a 36% sales *increase* between the two weeks preceding the GM EDP promotion and the two weeks after the start of the promotion. In contrast, other manufacturers' models with above 1% price increases around this period experienced either no significant sales change or a sales decrease.

Turning to the Ford and Chrysler EDP promotions, recall that the prices of 72% of Chrysler models and 30% of Ford models exhibited above 1% price increases. Sales of these Ford models increased by 26%, whereas sales of the Chrysler models increased by 22%. This again contrasts with other manufacturers: other manufacturers' models with above 1% price increases did not exhibit any increase in sales.

One might argue that the results in Table 4 are evidence that the EDP promotions were associated with a significant decrease in sales of other manufacturers' models. For example, at the start of the GM event, Chrysler and the foreign manufacturers experienced 27% and 19% reductions in sales (respectively) on models for which prices increased by at least 1%. Although this might represent evidence of brand switching, there are other more likely explanations for this result. Most obvious, one would normally expect higher prices to lead to lower sales. In another example, at the start of the Chrysler and Ford events, we see a significant reduction in GM sales. However, the change in GM's sales is confounded by GM's own EDP promotion. As we illustrate in Figure 1, the effects of the promotion diminish over time, and it is likely that the negative coefficients for GM at least partially reflect this trend.

We conclude that the EDP promotions prompted customers to purchase more cars than they had before the EDP promotion *including* models for which prices increased. Moreover, these sales increases were unique to the manufacturers offering an EDP promotion. Other manufacturers did not see price increases lead to sales increases, which suggests that the estimated EDP effect did not reflect an industrywide increase in demand.

So far, we have estimated the average sales response across all consumers. We next investigate whether there is evidence of heterogeneity in the effects across different consumer segments.

3.3.2. Heterogeneity in Sales Response. We proceed in two steps. First, to reduce the dimensionality of consumer demographics, we perform a factor analysis of the demographic variables that describe race (percentage of white, African American, and Hispanic), gender, education (percentage of less than high school, and college educated), median household income, and other characteristics (median household size, median house value, percentage of house ownership, percentage of house vacancies, number of vehicles per household, commute time to work, percentage of unemployment, percentage of poverty, and percentage of poor English proficiency).

Four factors have eigenvalues above 1. High values of the first factor describe consumers who are likely to be Hispanic, relatively uneducated, relatively poor, relatively likely to be unemployed, and members of relatively large families (the rotated factor loadings for all four factors are reported in Table A5 of the electronic companion). High values of the second factor describe consumers who are likely to be relatively educated and relatively wealthy. High values of the third factor describe consumers who are likely to own their houses, likely to have a relatively long commute time, likely to have relatively large families, have somewhat higher incomes, and are likely to have a relatively large number of vehicles per household. High values of the fourth factor describe consumers who are likely to be African American and likely to have a relatively long commute time. The four factors explain 74% of the variance of the demographic variables.

In the second step we repeat our sales specification by separately estimating the sales effect of the EDP promotions by tertiles of each factor. Specifically, we create a dependent variable that counts the number of cars sold on a particular day in each tertile. Under

Table 5 Impact of the EDP Promotions on Unit Sales by Customer Segment

	Factor 1	Factor 2	Factor 3	Factor 4
	GM event			
GM sales change				
Low	0.40**	0.39**	0.33**	0.40**
	(0.05)	(0.06)	(0.04)	(0.06)
Medium	0.34**	0.35**	0.37**	0.35**
	(0.08)	(0.06)	(0.06)	(0.07)
High	0.34**	0.33**	0.39**	0.32**
	(0.05)	(0.05)	(0.07)	(0.04)
Observations	1,926,455	1,926,380	1,926,672	1,926,647
Log-likelihood	−4,774,745	−4,863,166	−4,637,187	−4,654,284
	Ford/Chrysler events			
Ford sales change				
Low	0.29**	0.25**	0.26**	0.29**
	(0.07)	(0.05)	(0.06)	(0.05)
Medium	0.24**	0.27**	0.21**	0.29**
	(0.03)	(0.06)	(0.07)	(0.09)
High	0.25**	0.25**	0.31**	0.20**
	(0.10)	(0.07)	(0.07)	(0.06)
Chrysler sales change				
Low	0.23**	0.21**	0.28**	0.29**
	(0.05)	(0.05)	(0.05)	(0.05)
Medium	0.21**	0.21**	0.25**	0.19**
	(0.04)	(0.04)	(0.04)	(0.04)
High	0.21**	0.25**	0.15**	0.16**
	(0.05)	(0.04)	(0.04)	(0.05)
Observations	1,926,455	1,926,380	1,926,672	1,926,647
Log-likelihood	−4,764,333	−4,852,322	−4,626,964	−4,643,574

Notes. The table summarizes the $\boldsymbol{\delta}_2$ coefficients for the respective manufacturers around their own EDP events. The coefficients for other manufacturers are reported in Table A6 of the electronic companion. Robust standard errors are in parentheses. Demographics and other control variables are not reported.

*Significantly different from zero ($p < 0.05$), **significantly different from zero ($p < 0.01$).

this specification, $\boldsymbol{\delta}_2$ measures the effect of the EDP on purchases by customers in each tertile. The findings reveal whether the effect of the EDP on sales of cars with above 1% price increases varied across these customer segments. The results for GM, Ford, and Chrysler around their own EDP events are summarized in Table 5. The coefficients for the other manufacturers are reported in Table A6 of the electronic companion.

Consider the results for factor 2. The top panel of Table 5 shows that for GM models with above 1% price increases, consumers in the bottom tertile of factor 2 (low education and wealth) purchased 39% more cars following the start of the GM EDP promotion than in the two weeks preceding the GM EDP promotion. This compares to a 35% sales increase for consumers in the middle tertile of factor 2 (medium education and wealth) and a 33% in the top tertile of factor 2 (high education and wealth). Customers with high values of factor 1 (Hispanic, uneducated, poor, unemployed, large family) and of factor 4 (African American, long commute) were less likely to increase their purchases of GM cars whose prices increased on the EDP than were those who scored low on that factor. Customers who scored high on factor 3 (homeowner, long commute, large family, high income, many vehicles) were more likely to buy GM cars whose prices rose with the EDP than those with a low value for that factor. Although the point estimates for the GM EDP promotion vary between tertiles, the differences are generally small (fewer than eight percentage points) and the coefficients are not statistically significantly different from each other.

The middle and bottom panels of Table 5 show that the point estimates for the Ford and Chrysler EDP promotions also vary between tertiles. The differences are again small, although some of them are statistically significant. Consumers in the bottom tertile of factor 4 (less likely to be African American and to travel long distances to work) purchased 29% more Ford and Chrysler models following the start of the Ford and Chrysler EDP promotions than in the two weeks preceding the Ford and Chrysler EDP promotions. This compares to a 20% (respectively, 16%) sales increase for consumers in the top tertile of factor 4 (more likely to be African American and travel long distances to work). These differences are statistically significant at a 5% level, as are the differences between the sales increases for Ford between consumers in the medium and top tertile of factor 3 (homeowner, long commute, large family, high income, many cars) and the differences between sales increases for Chrysler between consumers in the top and medium and between consumers in the top and bottom tertiles of factor 3.

These findings suggest two conclusions. First, our main finding that sales increased for models whose prices increased in conjunction with the EDP holds across all of these data samples, indicating that the finding is robust. Second, the evidence that the magnitude of the effects is relatively stable across the different segments suggests that the underlying mechanism is widespread and not limited to narrow subsamples of customers. We will further investigate heterogeneity in the effects in §5.5, where we evaluate whether there are differences in the characteristics of the customers who purchased before and after the introduction of the EDP promotions.

3.4. Other Times of the Year

Recall that our regression discontinuity approach relies on an identifying assumption that the introduction of the EDP programs did not coincide with other factors that could explain an increase in both prices and sales. We can evaluate this assumption by investigating whether the changes in prices and sales around

the introduction of the EDP programs were unique to these periods, or whether they also occurred in other periods.

We repeated the analysis in §§3.2 and 3.3 using 16 historical "alternative" periods. Each alternative period spanned five weeks, consisting of a two-week preperiod followed by a one-week interval, and then a two-week postperiod. Because new models are introduced during the second half of the year, we restricted ourselves to the 16 mutually exclusive (nonoverlapping) alternative periods between January and July in the years 2003, 2004, and 2005. The precise start and end dates for these 16 periods are specified in Table A3 of the electronic companion, where we also present the findings for each time period (Table A4 of the electronic companion). These confirm that the sales increases (of 22%–36%) following the introduction of the EDP programs were uncommonly large for cars whose prices had increased, and that the simultaneous sales increases for Ford and Chrysler during their EDP period were unique.

3.5. Price Components

The actual change in *Final Price* is so different from what the EDP program seemed designed to convey that it is of interest to decompose how the promotions affected each component of the *Final Price* to better understand how a promotion pitched as offering low prices raised prices for so many models. The final price is made up of three components: the negotiated price that the dealer and customer agreed upon (the *Contract Price*), direct-to-customer manufacturer *Rebates*, and the *Trade-In Buyer Loss*, which is positive (negative) if the customer negotiates a price that is lower (higher) than the true value of the trade-in.[11] Equation (3) describes this relationship:

$$\textit{Final Price} = \underbrace{\textit{Contract Price} - \textit{Rebate}}_{\textit{Net New Vehicle Price}} + \underbrace{\textit{Trade-In Value} - \textit{Trade-In Price}}_{\textit{Trade-In Buyer Loss}}. \quad (3)$$

We investigate how the EDP promotions affected each of these components by using them as separate dependent variables in our price regressions (Equation (1)). For ease of interpretation, we replace $\boldsymbol{\alpha}_j \boldsymbol{Model}_j \cdot EDP_t$ with $\boldsymbol{\alpha}_j \boldsymbol{Manufacturer}_j \cdot EDP_t$. As a result, we can use $\boldsymbol{\alpha}_j$ to estimate the change in these price components associated with the EDP promotions for each manufacturer (rather than each model). We also measure the dependent variable in levels instead of logs to report the decomposition in dollars. In Table 6 we report the findings for the three domestic manufacturers around their respective EDP events (findings for other manufacturers are reported in Table A7 of the electronic companion). The top panel of Table 6 reports results for all GM, Ford, and Chrysler models. The bottom panel includes only those models for which there were above 1% price increases.

[11] The *Trade-in Buyer Loss* of a consumer who did not trade in a car is equal to zero.

Table 6 Estimates of Price Components

	Final price	Rebate	Contract price	Trade-in buyer loss
GM event				
GM ($)	326**	−883**	−869**	312**
	(116)	(100)	(51)	(34)
Observations	148,519	148,519	148,519	148,519
Adj. R-squared	0.98	0.75	0.97	0.10
Ford and Chrysler events				
Ford ($)	−16	−490**	−772**	266**
	(107)	(107)	(62)	(37)
Chrysler ($)	549**	−1,149**	−1,038**	437**
	(105)	(130)	(82)	(49)
Observations	185,867	185,867	185,867	185,867
Adj. R-squared	0.98	0.73	0.97	0.09
Cars with above 1% price increases				
GM event				
GM ∗ EDP ($)	551**	−1,115**	−885**	321**
	(148)	(133)	(71)	(46)
Ford and Chrysler events				
Ford ∗ EDP ($)	595*	−1,081**	−903**	417**
	(236)	(231)	(93)	(56)
Chrysler ∗ EDP ($)	617**	−1,259**	−1,116**	474**
	(64)	(100)	(84)	(474)

Notes. The table reports the α_j coefficients from a modified version of Equation (1). The dependent variables are in levels instead of logs, and the $\boldsymbol{Model}_j \cdot EDP_t$ terms are replaced with $\boldsymbol{Manufacturer}_j \cdot EDP_t$. Results for other manufacturers are reported in Table A7 of the electronic companion. Robust and clustered (by make–model–model year) standard errors are in parentheses. Demographics and other controls are not reported.

*Significantly different from zero ($p < 0.05$), **significantly different from zero ($p < 0.01$).

If one were to look only at contract prices (the prices negotiated between customers and dealers for the new car), one could conclude that the EDP promotions had the expected effect: *Contract Price* is estimated to have fallen by $869 for GM, by $772 for Ford, and by $1,038 for Chrysler. Because the *Final Price* did not fall, however, there must have been either decreases in customer rebates or increases in trade-in buyer losses. In fact, both occurred: *Trade-In Buyer Losses* increased by between $266 and $437, whereas *Rebate* values fell between $490 and $1,149.

As Table 6 shows, for GM and for Chrysler during their respective EDP events, rebates fell by just a little more than did contract prices on average across all their models. Ford's rebates actually fell by less than contract prices did. This means that the average effect of the EDP promotions—*if* there had been no effect on trade-in buyer loss—would have been prices lower by

several hundred dollars for Ford, and slightly higher prices for GM and Chrysler.

This characterization, however, is true only on average. Examining this decomposition of *Final Price* is helpful in understanding the subsample of cars we have been focusing on so far, namely, those for which prices increased by at least 1%. Within this subset of cars, as shown in the bottom panel of Table 6, rebates fell by more relative to contract prices than in the sample as a whole. For all three manufacturers, within this subset of the data, rebates fell by \$143 to \$230 more than contract prices did.

One way to understand these results is that the EDP replaced a set of discretionary rebates, which could vary greatly across car models, with a uniform percentage discount across all car models. The results suggest that the EDP discounts were on average across all models comparable to the rebates formerly available, but that for some cars (those that ultimately made it into our significant price increase sample), the EDP discounts were less than the rebates that had formerly been available.

In both the whole sample and in the subset of cars whose prices increased significantly, an important component of the change in *Final Price* is the change in *Trade-In Buyer Loss*. The trade-in buyer loss rose by between \$266 and \$474 for transactions involving a car on the EDP promotion. However, trade-in buyer losses were unchanged for other manufacturers during the same time periods. In other words, buyers of EDP cars negotiated much less good prices for their trade-ins relative to the trade-ins' booked values, but there was no such effect for buyers of other cars. We conjecture that the EDP promotions may have focused customers on the new car price, leading them to let their guard down when negotiating 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 a good deal on the trade-in car they were selling.

A notable feature of the price decomposition presented in this section is that the net change in *Final Price* is the result of large, offsetting changes in the components that make up the *Final Price*—in particular, large decreases in *Contract Prices* offset by large decreases in *Rebates*. In results from our 16 alternative control periods, reported in Table A8 of the electronic companion, we investigate the correlation between these components of *Final Price* in non-EDP periods. We find a strong negative correlation between *Trade-In Buyer Loss* and *Contract Price*, which most likely reflects dealers' willingness to trade off profits made on the new car and profits made on the trade-in, depending on which component the buyer seems to care most about.[12] There is no general pattern of correlation between *Rebate* and *Contract Price* in non-EDP periods. This may reflect the novelty of the EDP promotion in manipulating *Contract Prices* directly. Previously, manufacturers almost always turned to some form of rebate when they wished to influence prices. There is also no general pattern of correlation between *Trade-In Buyer Loss* and *Rebate*, perhaps because trade-in buyer losses are controlled by dealers and rebates are set by manufacturers.

3.6. Summary

We have studied how introduction of the EDP promotions by the three domestic manufacturers affected their prices and sales compared to the prices and sales of other manufacturers in the market. The findings reveal that the promotions led to coinciding increases in prices and sales for the domestic manufacturers. This outcome did not extend to other manufacturers and was unusual compared to other historical time periods. The overall price changes reflected changes in three price components: lower contract prices, lower rebates, and lower trade-in prices.

In the analysis that follows we evaluate a number of explanations for these findings, beginning with the possibility that the EDP promotions changed customers' expectations about how current prices compared with future prices.

4. Changes in Price Expectations

For a large durable good purchase where prices are known to fluctuate, we would expect customers to trade off the gains of having the good in hand immediately versus the possibility of lower prices in the future. If the EDP promotions convinced customers that prices under the promotion were low compared to what future prices would be, this could shift sales forward, leading to an immediate increase in sales followed by a subsequent depletion. This may explain the pattern of monthly sales results reported in Figure 1.

An argument that the EDP promotions changed price expectations requires that customers are not fully informed about prices. Given that this is an industry characterized by extensive customer search, it may appear surprising that customers could be uninformed. However, there are several industry characteristics that hinder customers' search processes. First, a customer can only learn the lowest

[12] We are not the first to recognize that trade-in negotiations may affect contract prices. Scott Morton et al. (2001) find that consumers who trade in their old vehicles pay on average a 0.77% higher contract price than consumers who have no trade in. Zhu et al. (2008) report that automobile buyers who trade in a used vehicle pay a \$452 higher contract price than customers without a trade-in. Similar findings from survey data are reported by Goldberg (1996).

prices at which he or she can actually obtain a specific vehicle by engaging in negotiations. In addition, the final price of a car changes over time, particularly because of changes in manufacturer rebates. Finally, the total wealth outlay by the customer depends on multiple price components, including the negotiated price, the amount the customer receives for his or her trade-in, and the value of manufacturer rebates. These characteristics make it difficult for customers to answer the two key questions that are important for timing the purchase of a durable good. 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 compared to the option of delaying and waiting for future discounts? Customer uncertainty on these two points provides sellers with an opportunity to influence customers' expectations about how current prices compare with future prices.

In this section, we describe four scenarios that could lead to the concomitant increases in prices and sales that we have documented so far in the paper. We then present additional evidence that is consistent with a price expectations explanation.

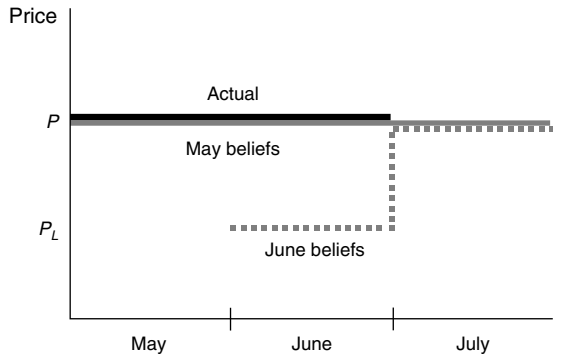
4.1. Scenarios for Price Expectations and Actual Prices

Each of the following scenarios describes a situation in which (1) actual prices do not fall when the EDP promotion is introduced, but (2) changes in customers' price expectations could lead to large sales increases. For simplicity we will restrict attention to two price levels, a regular price (P) and a discounted price (P_L). We will also consider a single hypothetical EDP promotion starting at the beginning of June.

4.1.1. An Obfuscating Price Cue. Suppose that in both the month before the EDP begins (May) and the first month of the EDP (June), actual prices are at their regular level. In May consumers correctly recognize that prices are at the regular level, and they expect these prices to continue. In June, when they learn about the EDP, consumers' beliefs diverge from their beliefs in May. Specifically, they now believe that the current (June) price is low but that prices will return to the regular level in the future. We refer to this configuration of actual prices and beliefs as an "obfuscating price cue." It is depicted in Figure 2.

The key aspect of this story is that in June customers believe that prices are discounted when they are not. Why might customers believe this? First, the story requires that customers are imperfectly informed about prices. We cited three characteristics of this market that make imperfect price information likely: the price can only be ascertained by engaging in negotiations, prices change frequently over time, and the final price comprises several components.

Figure 2 An Obfuscating Price Cue



Even if customers are imperfectly informed about prices, why would they believe that prices actually fell in June when they did not? First, the promotional message seemed designed to convey this. Employee discounts are offered by many firms to their employees, and it is common for them to offer true discounts. Second, if customers believed that the car manufacturers do offer discounts, then summer 2005 would have been a reasonable time to believe this: inventories were known to be high and there was widespread discussion of the financial difficulties of GM and Ford. Third, there is ample experimental evidence that customers respond to price cues that suggest prices are low, even when they are not. For example, retailers often frame prices as being on "sale" and there is considerable evidence that the use of this cue can increase purchasing (Berkowitz and Walton 1980, Lichtenstein et al. 1991, Inman and McAlister 1993, Grewal et al. 1996, Anderson and Simester 2001, Anderson et al. 2009). Additional findings have been reported for other types of price cues, including price-matching policies (Jain and Srivastava 2000) and price bundles (Heeler et al. 2007).

It is often presumed that the reason price cues are effective is because they influence consumers' price perceptions. Consumers with poor price information favorably update their price expectations when they observe a price cue. Anderson and Simester (1998) incorporate this consumer behavior into an equilibrium model and provide an economic rationale for why retailers use price cues and why consumers rationally respond to them. The retailer in their model uses sale signs as a signal that an item is discounted. The signal is "noisy" in equilibrium because not all items with sale signs are truly discounted. Customers anticipate this noise and adjust their expectations according to the number of items with sale signs. Although we have focused on the subset of cars for which *Final Price* increased, there was also a subset of cars for which the *Final Price* decreased. In that sense, as in Anderson and Simester's model, the signal was accurate for some items, misleading for others.

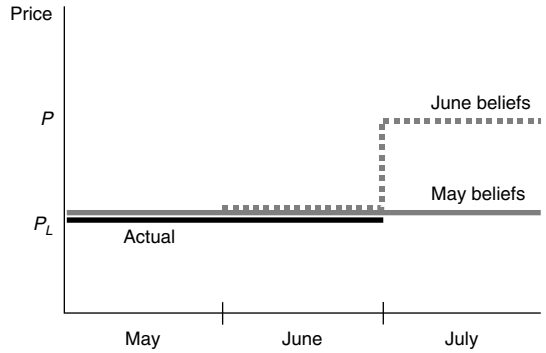
4.1.2. An Attention-Focusing Price Cue. A second possibility is that prices are discounted during May and June, but customers in May believe that prices are at the regular level and will continue to stay at this level in the future. The EDP announcement in June may successfully alert customers that (1) prices are discounted, and (2) prices will be returning to the regular level in the future. If so, the EDP announcement may encourage customers to buy in June to benefit from the temporary discounts. We call this configuration of actual prices and beliefs an "attention-focusing price cue" (see Figure 3 for an illustration).

Why would customers not be aware that prices in May were low? As in the previous subsection, it would have to be the case that customers were imperfectly informed about prices. The same features of the industry that allow customers to believe prices were discounted when they were at regular levels would also allow customers to believe prices were at regular levels when they were discounted.

Furthermore, in the years before the EDP promotions, the depth and frequency of manufacturers' price promotions had been escalating. After the September 11, 2001 attacks, GM launched an aggressive "Keep America Rolling" promotion in the face of fears of a recession. Since then, rebates had been creeping steadily up. To offer larger rebates, manufacturers had also been edging up MSRPs, eroding how much a $3,000 rebate was worth. The manufacturers' perception was that customers had become less responsive to large rebate values. In the months prior to the EDP, rebate values were indeed large compared to historical levels, but customers may not have paid attention to these rebates, believing them to be just another round of price-promotion escalation.

4.1.3. Information About the Future. A third possibility is that rather than influencing beliefs about current prices, the EDP promotion convinced customers that future prices would increase. For example, suppose that in May customers correctly recognize that prices are discounted and expect these discounts to continue in future months. However, in June when customers learn about the EDP promotion, they believe that the low prices will only continue for the duration of the promotion, and will then rise (see Figure 4 for an illustration).

Figure 4 Information About the Future



Why might customers believe this? A salient feature of the EDP promotions was the explicit termination dates. Much of the paid advertisements and media coverage highlighted that they were available for only a "limited time." In contrast, the rebate programs that the EDP promotions replaced often lasted for months at a time.

4.1.4. Customers Care About Contract Prices. A fourth possible explanation is that customers focus primarily on the negotiated *Contract Price*. As we showed, although *Final Prices* generally did not decrease following introduction of the EDP programs, one component of the price—the *Contract Price* negotiated for the new car—did fall. If customers focus on this price, then customers may have correctly recognized in May that prices were at their regular level, and correctly recognized in June that they were discounted (see Figure 5 for an illustration).

The chief obstacle to this story is that it requires that customers know what happened to the *Contract Prices* (they fell), but not what happened to *Rebate* values (they fell by more than the *Contract Prices*). The *Contract Prices* are individually negotiated with

Figure 3 An Attention-Focusing Price Cue

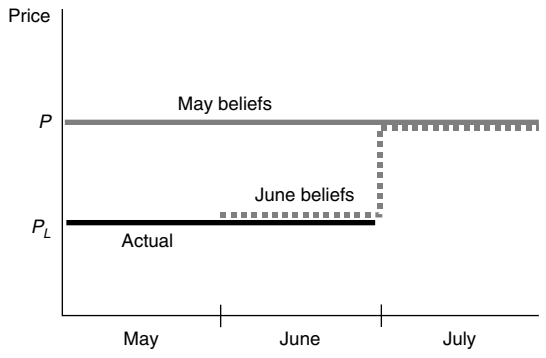
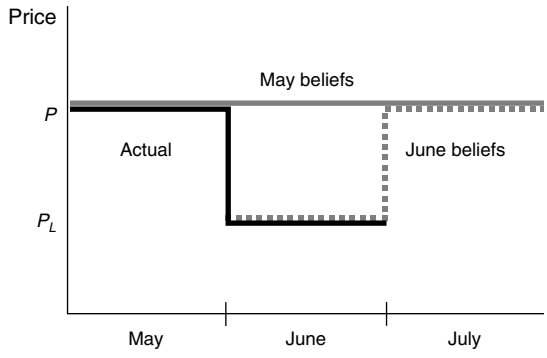


Figure 5 Customers Care About Contract Prices



dealers for a specific car, whereas *Rebates* are widely advertised. It seems unlikely that a customer who was sufficiently well informed to know that the *Contract Price* had changed would not realize that *Rebates* had also changed, and by enough to wipe out any gains from a lower *Contract Price*.

4.2. Evidence

The marketing message that accompanied the EDP promotions ("You get the best prices of the year. Period.") certainly seemed designed to convey that the EDP program was—under some version of the four scenarios—a good time to buy relative to waiting for the future. In addition, there were several corroborating reasons for customers to believe that the EDP prices were indeed low relative to future prices. As we have already mentioned, inventory levels were high, and Ford and GM had financial difficulties—two good reasons for manufacturers to offer a temporary price discount.[13] Additionally, all three manufacturers had preexisting employee purchase programs, with prices that were lower than posted MSRPs. It seems reasonable for customers to believe that a manufacturer would not go to the effort of establishing an employee purchase plan and then not offer below-market prices. Finally, had the prices been higher than those offered to employees, or had they raised the employee prices in conjunction with the EDP promotions, manufacturers (and dealers) would have been exposed to potential lawsuits. Indeed, managers at one of the manufacturers confirmed that the EDP promotions had attracted the attention from several state attorneys general who wanted to ensure that the programs were not misleading.

We can more directly evaluate the price expectations explanation using data from two sources. If the EDP programs convinced customers to purchase immediately rather than delay in anticipation of future discounts, we should see evidence of temporal substitution, with the increase in sales in June and July followed by a drop in sales in later months. If instead we saw sales for the EDP manufacturers up for the year and sales for other manufacturers down for the year, that would be more supportive of a "business-stealing" explanation than temporal substitution. As we describe below, the monthly sales data in Figure 1 are consistent with temporal substitution.

Our second data source is a survey conducted by one of the domestic manufacturers in the weeks immediately after the introduction of the EDP programs. These data provide a measure of how the EDP program affected customers' perceptions about the EDP prices and their expectations about future prices.

4.2.1. Temporal Shift in Sales. We begin by looking for evidence that the sales surge at the start of the EDP promotions was due to changes in the timing of customers' purchases. Recall first from Figure 1 that although GM continued its promotion through September, sales were lower in the last five months of 2005 than in 2004. This is precisely the pattern we would expect to see when customers of a durable good shift the timing of their purchases to take advantage of what they believe are temporary discounts. If the EDP promotion convinced customers that current prices were low compared to future prices we would expect to see a large expansion in sales following introduction of the promotion, followed by a "post-promotion dip" once demand is depleted (Krishna 1992, 1994; Thompson and Noordewier 1992).

In Table 7 we report the aggregate annual sales for Ford, GM, and Chrysler and the five largest nondomestic manufacturers. For Ford and GM there is little evidence of either an outward shift in demand or substitution of sales from competing manufacturers. For both firms, annual unit sales were at least 4% lower in 2005 compared to 2004; the reduction in sales later in the year outweighed the sales increases associated with the EDP plans. In contrast, four of the foreign manufacturers (none of whom offered EDP promotions) enjoyed healthy sales growth between 2004 and 2005, showing no signs that the EDP promotions of the domestic manufacturers cannibalized their sales. (Although Volkswagen's sales were down over the year, Figure A1 in the electronic companion, shows that this was true through most of the year and not a feature only of the EDP period.)

4.2.2. Survey Evidence. To test whether the sales increase associated with the EDP promotions resulted from changes in customers' price expectations, we would ideally compare customers' price expectations

Table 7 Change in Aggregate Unit Sales

	2004	2005	Difference (%)
	Domestic and nondomestic manufacturers		
GM	4,707,416	4,517,731	−4.0
Ford	3,111,228	2,967,960	−4.6
Chrysler	2,207,128	2,304,837	4.4
Toyota	2,060,049	2,260,296	9.7
Honda	1,394,398	1,462,472	4.9
Nissan	985,987	1,076,669	9.2
Hyundai	418,615	455,012	8.7
Volkswagen	334,028	307,261	−8.0

Notes. The table reports the total annual unit sales of the three domestic and five largest foreign manufacturers. The data were obtained from company press releases and annual reports.

[13] On May 5, 2005, Standard & Poor's had lowered the corporate credit ratings for both GM and Ford to noninvestment (junk) grade (*Businessweek.com* 2005).

just before and just after the introduction of the promotions. This is impossible to do after the fact, but we do have some closely related evidence that yields some insight on customers' price beliefs during this period.

In the weeks following the introduction of its EDP program, one of the three domestic manufacturers conducted a telephone survey to help evaluate why the EDP program was effective. The firm surveyed a sample of 200 vehicle owners to learn how they first heard about the EDP programs and with which manufacturers they associated it. They also asked what the most important reason was for purchasing a vehicle under the EDP promotions and what the program's biggest disadvantage was. For these last two questions, customers were offered lists of possible answers and asked to indicate with which responses they most agreed.

The responses to these two questions are summarized in Table 8 (the data are proprietary, and so we only received findings for the questions that are most relevant to our study).

Four of the top five reasons for buying under the EDP promotion relate to price. This suggests that the primary information buyers took from the EDP promotion was about price (as opposed to quality, image, or other factors that could be part of a marketing message). The single most frequently cited reason for purchasing under the program was that the EDP promotion offered the "best pricing ever available to consumers," a reason cited by fully two-thirds of the respondents. In some sense, the belief that the EDP promotions offered the best pricing *ever* is even stronger than what is required for our hypothesis; our hypothesis is only that customers believed prices available under the EDP were lower than prices would be in the future.

Table 8 Survey Responses

	Percentage of respondents
The most important reasons to purchase a vehicle under employee pricing	
Best pricing ever available to consumers	67
Clear and simple pricing communication	47
No need to negotiate prices	31
Feel valued as a consumer by receiving same price as employees	28
Easy to compare prices across manufacturers	27
The biggest disadvantages of employee pricing	
Limited time offer	47
Certain models are excluded	44
No other incentive is available	24

Notes. The table summarizes survey responses from a sample of 200 vehicle owners. The responses were collected by one of the domestic manufacturers following the introduction of its EDP promotion.

The responses measuring the biggest perceived disadvantage of the EDP program also support our hypothesis. The most commonly cited disadvantage, chosen by 47% of the respondents, is that the EDP program was a "limited time offer." This suggests that customers believed that the prices available under the EDP program would no longer be available in the future. Because consumers interpreted this as a disadvantage, the belief was presumably that the EDP prices were low but would rise in the future.

Although we cannot now go back and observe what consumers believed before and after the start of the EDP programs, this survey, conducted very near the time of the EDP program, seems to indicate not only that the EDP programs were successful at convincing customers that current prices were low compared to future prices but that this was the *primary* inference (or at least the most frequently cited inference).

Although price expectations may have been one of the primary messages that consumers took from the promotions, it was not the only message. Of the respondents, 31% said that "no need to negotiate prices" was a reason to buy a car during the EDP promotion. This supports what we call the "disutility of bargaining" explanation, which we will discuss in §5.4.

4.3. Repeated Use of the Cue

The findings in §3 offer one additional result that could be interpreted as evidence that the EDP promotions acted as a price cue. Past research has established that price cues become less effective as they are used more often (Anderson and Simester 2001). The intuition is that the credibility of the cues diminishes with use. This is consistent with the findings in Table 2, which confirm that the first manufacturer to introduce an EDP promotion (GM) enjoyed a larger short-run sales increase than the manufacturers that followed (Ford and Chrysler). The sales increase for GM was 36%, compared to 26% and 22%, respectively, for Ford and Chrysler (only the difference between GM and Chrysler is statistically significant). It is possible that the EDP promotion became less credible as more manufacturers adopted it.[14]

4.4. Summary

We reviewed four scenarios under which the EDP programs change customers' price expectations and convince them to purchase immediately rather than delay in anticipation of future discounts. Although inconclusive, there is evidence supporting this interpretation. This is an industry in which it is difficult to

[14] Loss of credibility could also explain why the effectiveness of the promotion diminished over time. However, it does not easily explain the evidence in Figure 1 that the promotions *lowered* GM and Ford's sales in September.

search for price information, and so customers may remain uninformed despite extensive price search. The timing and nature of the EDP promotions may have also added to the credibility of the promotion. The promotions were novel in this industry and coincided with a period in which GM and Ford's financial problems and excess inventory were widely publicized. We also presented evidence that the increase in sales following the introduction of the EDP promotions resulted primarily from a temporal shift in demand, as we would expect if changes in customers' price expectations influenced the timing of their purchasing decisions. Finally, we summarized findings from a customer survey conducted following the introduction of the EDP promotions. These survey data provide our most direct evidence that the promotions influenced customers' beliefs about current versus future prices, prompting them to purchase immediately rather than waiting for future discounts.

In the next section, we consider several alternative explanations for the evidence that the EDP promotions led to an increase in both prices and sales.

5. Other Explanations for Price and Sales Increases

In this section, we consider several explanations other than the price expectations hypothesis laid out in the previous section for the simultaneous increase in prices and sales observed at the time of the EDP promotion. The alternative explanations include the following: (1) the EDP promotion coincided with an industrywide increase in demand, (2) advertising in conjunction with the EDP promotion led to an increase in customers' willingness to pay, (3) financing costs decreased in conjunction with the EDP promotion, (4) customers were attracted by the "no-haggle" feature of the EDP promotion, (5) customers who bought before the EDP promotion differed from those who bought during the promotion, and (6) *Final Price* rose because of reduced trade-in values resulting from an increased volume of trade-ins used to buy new cars during the EDP promotion.

5.1. Industrywide Demand Shocks

In principle, an industrywide demand shock that coincided with the two EDP promotions could allow new car sales to increase even as prices were increasing. However, the evidence shows no sign of such a shock having occurred. We have already pointed out (in §3.3) that among models with above 1% price increases, only GM models (around the GM EDP event) and Ford and Chrysler models (around the Ford and Chrysler EDP events) showed sales increases that were statistically different from zero. We can more formally demonstrate this by using a chi-square test to evaluate whether the sales increases associated with the respective EDP promotions are significantly different from those of other manufacturers. In each comparison, we reject ($p < 0.01$) the hypothesis that sales for a manufacturer that introduced an EDP program are the same as sales of manufacturers that did not introduce an EDP program during the same time period. Furthermore, unit sales for five major foreign manufacturers showed no unusual increases during this period (this can be seen in Figure A1 in the electronic companion).

We conclude that the finding that sales increased even on models for which prices increased cannot be explained by industrywide demand shocks. We next consider the role of advertising.

5.2. Advertising Expenditure, Press Coverage, and the Role of Customer Attention

A second explanation for the coinciding increase in sales and prices is that the firms may have increased their advertising expenditure to coincide with the EDP promotions. To investigate this possibility, we purchased detailed data from TNS Media Intelligence describing weekly advertising expenditure in the automobile industry. In Table 9, we report the advertising expenditures by the three domestic manufacturers in the two-week pre- and postperiods around the introduction of their respective EDP events. For comparison, we also list the advertising expenditures for the same calendar periods in 2004, the year before the EDP promotions.

As Table 9 shows, advertising expenditure *decreased* for all three manufacturers between their respective preperiods and postperiods. For GM, we see that advertising expenditure decreased by 21% between the pre- and postperiods in 2005, similar to the 17% decline for the same calendar periods in 2004.

Table 9 Advertising Expenditure Before and After the EDP Introduction

	2004	2005
GM spending around the GM event		
Preperiod (5/14/2005–5/27/2005) ($)	115,046,400	145,568,700
Postperiod (6/4/2005–6/17/2005) ($)	95,328,300	114,307,600
Difference (%)	−17	−21
Ford spending around the Ford event		
Preperiod (6/18/2005–7/1/2005) ($)	55,714,500	49,057,300
Postperiod (7/9/2005–7/22/2005) ($)	58,871,900	48,005,100
Difference (%)	6	−2
Chrysler spending around the Chrysler event		
Preperiod (6/18/2005–7/1/2005) ($)	42,323,900	55,937,300
Postperiod (7/9/2005–7/22/2005) ($)	42,091,200	42,635,300
Difference (%)	−1	−24

Notes. The table reports the aggregate advertising expenditure by three domestic manufacturers in the two-weeks before and after their respective EDP promotions. It also reports the expenditure by the firms in the same weeks in 2004.

Source: TNS Market Intelligence.

For Ford, advertising expenditure decreased by 2% between the pre- and postperiods, compared to a 6% increase over the same period the previous year. Finally, Chrysler's advertising expenditure decreased by 24% between the pretest and posttest periods, compared to a 1% decrease the previous year. Further investigation of monthly expenditure confirms that for all three manufacturers, advertising expenditure was relatively low in the months that the EDP programs were introduced compared to the months before and after the introductions.

Before concluding that the simultaneous increase in price and sales cannot be attributed to advertising, we consider two additional possibilities. First, there is a difference between advertising expenditure and the advertising message. If the advertising message increased customers' willingness to pay, then we might observe an increase in both prices and sales. However, the survey evidence collected by one of the three domestic manufacturers (which we described in §4.2.2) revealed that four of the five top reasons that customers listed for buying in response to the EDP promotion were about price, which suggests that the advertising message of the EDP promotion focused on price, and not product benefits.

Second, it is possible that the extensive press coverage that the employee discount promotions received could have made up for a decrease in paid advertisements. A review of articles in *USA Today*, *The Wall Street Journal*, and *The New York Times* around the introduction of the promotions reveals that most simply describe the existence and structure of EDP promotions. By the end of June, the articles started describing the sales success of these promotions. Reading the coverage, it seems unlikely that it served to increase willingness to pay in the way that traditional brand-building advertising would.

5.3. Financing Costs

In defining the final price, we have not considered any borrowing costs incurred by customers when purchasing their new cars. In this subsection, we investigate whether the introduction of the EDP programs coincided with reductions in these costs. If so, although the *Final Price* may have increased, the total cost to the customer of purchasing the car may have fallen, and that could explain how *Final Price* and sales could increase at the same time. We examine three types of financing costs: (1) the annual percentage rates offered for new car purchases (the "loan APR"), (2) the implicit interest rates for new car leases (the "lease APR"), and (3) the residual values offered for leased cars. For the loan and lease APRs, we restrict attention to GM, Ford, and Chrysler's captive lending divisions.

We find no evidence that manufacturers lowered APRs at the time of the EDP promotions. The average GM loan APR rose by 0.6 percentage points and its average lease APR rose by 0.1 percentage points at the time of the GM EDP, whereas Ford and Chrysler's average loan APRs rose by 0.8 and 1.8 percentage points, respectively, at the start of the Ford and Chrysler EDP promotions. The average lease APR rose by 1 percentage point for Ford but fell by 0.5 percentage points for Chrysler at the advent of their EDP promotions. These changes are all statistically significant ($p < 0.01$).

Although we do not observe the interest rates for customers who do not finance through the dealer, the prime lending rate had risen monotonically from January 2004 through our sample period; indeed, the prime rate jumped from 6.00% to 6.25% during the same week as the Ford and Chrysler EDP promotions started.

The third financial component we investigate is the residual value. When customers lease a car they negotiate 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. 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. At the start of the GM EDP promotions, we estimate that residual values fell by \$170 ($p < 0.01$) for GM, whereas the start of the Ford and Chrysler EDP promotions coincided with a decrease in residual values of \$1,235 for Ford and \$258 for Chrysler.[15]

These results lead us to conclude that the price increases described were not mitigated by changes in financing terms. If anything, changes in financing terms appear to have further increased the wealth outlay of customers who bought at the beginning of the EDP promotions relative to those who bought just before.

5.4. Disutility of Bargaining

Zettelmeyer et al. (2006) present evidence that many consumers dislike the bargaining process usually associated with buying a car. These consumers may have taken advantage of the EDP promotion as an opportunity to obtain a car at a relatively low price

[15] If we look only at the sample of cars with above 1% 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.

without having to undergo an unpleasant negotiation, even if they could have obtained a lower price via haggling before the EDP promotion.[16] If enough buyers prefer "EDP price with no haggling" to "lower price with haggling" then the EDP could be associated with an increase in both prices and sales.

We begin by investigating whether the EDP promotions did indeed lead to less price negotiation. Under a no-haggling regime, we might expect lower variation in prices. Therefore, as a preliminary investigation of this explanation, we investigated whether the EDP promotions affected the variation in prices paid for the same vehicle. This investigation confirmed that there was less variation in prices following introduction of the EDP promotions (these results are available from the authors).

To further investigate this explanation we repeated our earlier analyses, restricting attention to no-haggle dealerships. There are two categories of no-haggle dealers. 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 more than 100 dealerships of many different nameplates. In the late 1990s this chain declared a no-haggle policy for new cars.[17] 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 perceived change from "haggle" to no-haggle pricing because transactions were no-haggle both before and after the EDP.

We estimated Equation (1) using only transactions at no-haggle dealerships. Around the introduction of the GM promotion, the estimation used 12,869 observations and yielded an adjusted R^2 of 0.97. A total of 42.9% of GM models had above 1% price increases at no-haggle dealerships around GM's introduction of the EDP promotion (compared to 54.7% across all dealers as reported in §3.2). Around the introduction of the Ford and Chrysler promotions, the estimation used 16,048 observations and yielded an adjusted R^2 of 0.98. A total of 47.8% of Ford models at no-haggle dealerships (versus 30% at all dealers) and 53.3% of Chrysler models at no-haggle dealerships (versus 72% at all dealers) had above 1% price increases at the start of the Ford and Chrysler EDP promotions. As in the full sample, the EDP promotion was associated with an unusually large fraction of cars with large price increases compared to equivalent historical measures.

Table 10 Impact of the EDP Promotions on Sales at No-Haggle Dealerships

	GM	Ford	Chrysler	Foreign
GM event				
Models with above 1% price increases (δ_2)	0.33** (0.08)	−0.25 (0.17)	−0.14* (0.06)	−0.14 (0.09)
Models without above 1% price increases (δ_4)	0.55** (0.08)	−0.02 (0.05)	−0.07 (0.09)	0.07* (0.03)
Observations		457,645		
Log-likelihood		603,576		
Ford and Chrysler events				
Models with above 1% price increases (δ_2)	−0.45** (0.10)	0.40** (0.13)	−0.13 (0.08)	0.04 (0.08)
Models without above 1% price increases (δ_4)	−0.43** (0.08)	0.54** (0.09)	0.22** (0.07)	−0.04 (0.04)
Observations		457,645		
Log-likelihood		−602,577		

Notes. The table summarizes the δ_2 and δ_4 coefficients from estimating Equation (2) when using EDP_t to identify the timing of either the GM event or the Ford and Chrysler events. In this analysis we only include unit sales at no-haggle dealerships. Robust standard errors are in parentheses. Demographics and other control variables are not reported.

*Significantly different from zero ($p < 0.05$), **significantly different from zero ($p < 0.01$).

To estimate the impact of the EDP promotions on sales at no-haggle dealerships, we reestimated Equation (2) using sales data from these dealerships. Recall that the δ_2 coefficients estimate the change in sales of models that had above 1% price increases. The findings for the no-haggle dealerships are reported in Table 10.

Following the introduction of GM's EDP promotion, GM models that had an above 1% price increase at no-haggle dealerships experienced a sales increase of 33% at those dealerships. In contrast, other manufacturers' models with above 1% price increases at no-haggle dealerships experienced either no statistically significant sales change or a sales decrease. Around the Ford and Chrysler promotions, Ford models with above 1% price increases at no-haggle dealerships experienced a 40% sales increase at those dealerships. Chrysler models with above 1% price increases had a small (although not statistically significant) sales decrease of −13%. Other manufacturers' models with above 1% price increases at no-haggle dealerships experienced either no significant sales change or a sales decrease.

Overall, our findings at no-haggle dealerships are similar to most of our earlier results. For those GM and Ford cars whose prices increased, sales also tended to increase at no-haggle dealerships by a similar amount as we found before. These findings suggest that the simultaneous increase in prices and

[16] Although many customers apparently interpreted the prices offered under the employee discount promotions as nonnegotiable, this was not 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.

[17] We cannot independently confirm that this chain consistently adhered to a no-haggle policy during our sample period.

sales cannot be solely the result of customers believing that they could avoid haggling costs by buying under the EDP promotions.

5.5. Customer Differences

If the EDP promotions had greater appeal to some types of customers—for example, price-sensitive customers or customers who dislike haggling—than to others, we might expect that we would see differences in observable characteristics associated with these traits between customers who purchased before and after the introduction of the EDP promotions. Notice that this explanation is best interpreted as a complement to other interpretations rather than as an alternative explanation.

To investigate whether there are differences in the types of customers who purchased before and after the introduction of the EDP promotions, we regressed each of our demographic measures on the EDP indicator variable and car fixed effects. The unit of analysis was a purchase in the two-week pre- and postperiods. The coefficients for the EDP variable provide an estimate of how customers who bought a given car differed between the pre- and postperiods. The regressions were run separately for each of the three domestic manufacturers. The findings are reported in Table A9 of the electronic companion (for ease of exposition, we only report the statistically significant coefficients).

For each manufacturer, there are a number of demographic measures that vary statistically significantly between the pre- and postperiods. The most common differences between buyers who buy during the EDP and those who bought before are in commute time, median household size, and vehicles per household. Although these differences are *statistically* significant, the magnitudes of the differences are small—in most cases, around 1% of the variable value. For example, in the Ford analysis the largest effect (relative to the mean) is for the percent African American measure. The percent African Americans falls by just 0.6%, compared to a mean of 8.0%. It seems implausible that differences of this size could on their own be responsible for the 30%–40% increases in unit sales that coincided with the EDP promotions.[18]

5.6. Lower Value of Trade-ins

Most of the explanations we have investigated so far for how prices and sales of new cars could increase simultaneously have been explanations that implicitly followed the logic: "How could sales increase even if prices increased?" Increased overall industry demand, reduced financing costs, and increased advertising are all explanations we considered that fit this logic. A final alternative explains a simultaneous increase in prices and sales starting with a change in sales instead of prices. Suppose that there was, over the course of several weeks, a large increase in the volume of sales of new cars for some unspecified reason. Because many customers finance their purchase of a new car by selling a vehicle they currently own to the dealer (a trade-in), an increase in the sales of new cars will likely mean an increase in the inflow of cars that are traded in to dealers.[19] Dealers eventually sell those traded-in cars to consumers looking for used cars or at auction to other dealers. Thus, an increase in the volume of trade-in cars would be expected to reduce the value of trade-in cars to the dealer, reducing the price that dealers should be willing to pay to customers for their trade-in cars. Because our measure of *Final Price* includes the *Trade-In Buyer Loss*, when the prices dealers are willing to pay for trade-ins falls, the total amount that customers must pay for new cars will rise. This would mean that whenever sales of new cars rise markedly, one might expect to see *Final Price* rise as well through the mechanism of reduced trade-in values.

To investigate whether this phenomenon is occurring during the EDP period, we first analyze how the booked values of trade-ins (the dealer's internal records of the wholesale value of trade-ins) were affected during the EDP promotions.[20] In unreported results, we find that the booked value of a given trade-in used to purchase GM cars fell by \$183 on average at the start of the GM EDP. During this time period, the booked value of trade-ins used to purchase Ford, Chrysler, and foreign cars also fell (although the result is not statistically significant for Ford and Chrysler). The booked value of trade-ins used to buy cars of all three domestic and of foreign manufacturers fell by similar average amounts (\$162–\$256) at the start of the Ford and Chrysler promotions. (These estimates control for detailed trade-in car fixed effects.) This is consistent with an increased volume of new car transactions leading to an increased number of trade-ins, depressing their value (both because of increased supply to used car auctions and because of demand for used cars at car dealers being displaced by purchases of new cars

[18] The small sizes of these changes also indicates that customers who are usually disadvantaged in traditional price negotiations, such as women and African Americans (Scott Morton et al. 2003), are not attracted to buying in much greater numbers under the EDP promotions than are other customers. This might be interpreted as further evidence that avoiding the disutility of bargaining is not the primary appeal of the EDP promotions.

[19] We thank an anonymous referee for suggesting this explanation.

[20] Various industry sources assure us that this value is indeed the dealer's assessment of the wholesale value. Because this is an internal accounting number, there is no strategic reason for the dealer to manipulate it.

under the EDP promotion). The spread of this effect across all manufacturers (at least by the time of the Ford and Chrysler EDP events) suggests that dealers recognized that the increased inflow of trade-ins was depressing the value of trade-ins across the board.

We investigate this explanation using two approaches. First, the evidence on the decomposition of price in §3.5 suggests that the decrease in booked values of trade-ins is not the only factor affecting the *Final Price* during this period. In particular, for the sample of cars with at least 1% increases in *Final Price*, the change in *Final Price* is about \$200 larger than the increase in the *Trade-In Buyer Loss*, which indicates that about \$200 of the change in *Final Price* comes from the net new vehicle price component (*Contract Price − Rebate*).

Second, we repeated our analysis using only transactions that did not include a trade-in. For these transactions, *Final Price* equals *Contract Price − Rebate; Trade-In Buyer Loss* is zero by definition. Using this no-trade-in subsample, we reestimate Equation (1). The estimated $\boldsymbol{\alpha}_j$ terms from this specification will indicate models for which the net new vehicle price increased for buyers who did not use a trade-in.[21] Around the introduction of the GM promotion, the estimation used 77,608 observations and yielded an adjusted R^2 of 0.98. A total of 39.5% of GM models had above 1% price increases based on no-trade transactions around GM's introduction of the EDP promotion (compared to 54.7% based on all transactions reported in §3.2). Around the introduction of the Ford and Chrysler promotions, the estimation used 94,409 observations and yielded an adjusted R^2 of 0.98. A total of 30.2% of Ford models based on no-trade transactions (versus 30% based on all transactions) and 32.0% of Chrysler models based on no-trade transactions (versus 72% based on all transactions) had above 1% price increases at the start of the Ford and Chrysler EDP promotions. As in the full sample, the EDP promotion was associated with an unusually large fraction of cars with large price increases compared to equivalent historical measures.

To estimate the impact of the EDP promotions on sales based on no-trade-in transactions, we reestimated Equation (2) using sales data from these transactions. The model for the GM event was estimated using 616,666 observations and yielded a log likelihood of −2,160,225. The $\boldsymbol{\delta}_2$ coefficients (which estimate the change in sales of models that had above 1% price increases) are reported in Table A10 of the electronic companion. Following the introduction of GM's EDP promotion, GM models that had an above 1% price increase experienced a sales increase of 31% (compared to 36% in the full sample). In contrast, models with above 1% price increases from other manufacturers experienced either no statistically significant sales change or a sales decrease.

The model for the Ford and Chrysler events was estimated using 616,666 observations and yielded a log-likelihood of −2,156,393 (the $\boldsymbol{\delta}_2$ coefficients are reported in the electronic companion). Ford models with above 1% price increases experienced a 19% sales increase (compared to 26% in the full sample). Chrysler models with above 1% price increases experienced a 42% sales increase (compared to 22% in the full sample). Other manufacturers' models with above 1% price increases experienced either no significant sales change or a sales decrease.

Overall, our findings based on no-trade-in transactions are similar to most of our earlier results: for those GM and Ford cars whose prices increased, sales based on no-trade-in transactions tended to increase by a similar amount, as we found before. Although the increased volume of new car sales does appear to have depressed the value of trade-ins at the time of the EDP promotions, these findings suggest that the simultaneous increase in prices and sales cannot be solely the result of lower values for trade-in cars.

5.7. Summary

None of the explanations considered in this section can fully explain the observed price and sales outcome of the EDP promotion. Some potential explanations are directly contradicted by the data (an overall industry trend, an increase in advertising, a decrease in financing costs), whereas others do not appear to have big enough effects to explain the entire observed change (avoiding haggling, changes in customer demographics, reduced values of trade-ins).

6. Conclusions

We have investigated the impact on prices and sales of the employee discount pricing promotions offered by the three domestic U.S. manufacturers. We found that prices for many models actually increased following the introduction of the promotions. Notably, sales also increased even for the models where prices increased. We investigated a variety of explanations for this phenomenon. Our evidence indicated that this was not the result of increased advertising, decreased financing costs, or an overall industry-wide increase in demand. We have also found that the no-haggle aspect of the promotions, differences in observable characteristics of EDP and pre-EDP buyers, and reduced value of trade-ins did not have large enough effects to explain the observed changes in sales. Our leading hypothesis is that the EDP promotions changed customers' price expectations, convincing them to accelerate purchases to the EDP

[21] Rebates will be the same whether a buyer used a trade-in or not, but contract prices need not be.

promotion period rather than buying at some future time.

As support for this explanation, we demonstrate that the short-run lift in sales primarily reflects temporal substitution—accelerating sales that would otherwise have occurred later in the year. There is little evidence that the EDP programs led to either an outward shift in demand or substitution of sales from other manufacturers. Recall also that the survey evidence indicates that customers believed that the EDP programs offered low prices and that they expected prices to increase once the programs were over. Given these perceptions, it is natural that some customers would respond by purchasing immediately rather than waiting for the programs to expire.

It is useful to ask whether similar programs would work in other markets. The simple answer is yes: we know from earlier research that firms can use price cues such as these to increase sales of consumer packaged goods and less expensive durable goods (see §4.1). Indeed, an important contribution of this paper is to show that price cues are effective even in markets for high-priced durable goods. The distinction between the automobile market and these others markets is important. It is unsurprising that customers are uninformed about the prices of less expensive items because the benefit of an additional search often does not justify the cost. In contrast, an additional search in the market for automobiles can potentially save customers thousands of dollars, and so we would expect customers to be much better informed about prices in this market. We conclude that the effectiveness of the EDP promotions in the automobile market suggests that price cues may be effective in a much broader range of markets than previously thought.

We can also characterize markets for other high-priced products in which the EDP promotions may be effective even if not accompanied by a price change. First, the cues are presumably only effective if customers have imperfect information about the prices of their outside options. Because customers will generally be willing to search for price information, this suggests that there must exist obstacles hindering the search process. The obstacles in the automobile market include the norm of negotiating prices, the multiplicity of price components, and the dynamic variation in prices over time. Obstacles in other markets may include frequent changes in quality and features, or the presence of customers who lack sufficient expertise to find or interpret price information. The requirement that customers lack price information also makes it less likely that the promotions will be effective in markets for high-priced consumables that are purchased frequently. Second, the concept of "employee discounts" may be inherently more credible in industries that are known to offer deep discounts to employees. This might include airlines and department stores, both of which offer generous employee discounts. Finally, we can speculate that the EDP promotions are also more likely to succeed if product quality is generally known. If not, customers may interpret the EDP promotions as an indication that demand is weak, raising concerns about quality—customers are unlikely to respond favorably to discounts on heart surgery (Anderson and Simester 2003).

The paper's limitations include the reliance on data from a single industry, together with the absence of data directly measuring changes in customers' price expectations. Both limitations are common to papers that use historical field data to evaluate the outcomes of natural experiments.

7. Electronic Companion

An electronic companion to this paper is available as part of the online version that can be found at http://mktsci.pubs.informs.org/.

Acknowledgments

The authors are grateful for helpful comments from seminar participants at Washington University, UC Berkeley, Harvard Business School, Dartmouth College, Northwestern University, Yale University, University of Michigan, and from participants in the NBER IO Program Meeting, the GMTL conference in New Zealand, and the Summer Institute in Competitive Strategy at Berkeley. They are particularly grateful to Steve Berry and Jennifer Aaker for their detailed reviews of the paper, to Jorge Silva-Risso, and to an anonymous automobile manufacturer for their numerous contributions to the project. The authors also thank the editor, area editor, and two anonymous referees for a number of comments that improved the paper. The first author gratefully acknowledges the support of National Science Foundation (NSF) Grants SES-0550508 and SES-0550911. The second author gratefully acknowledges the support of the Ford-MIT Alliance. The third author gratefully acknowledges the support of NSF Grants SES-0550508 and SES-0550911.

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