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els do not capture other possible trends that may have been occurring. For example, society may have used its increasing wealth to make work more pleasant, so that the demand for leisure did not rise as much as would be predicted by a simple model. Moreover, the invention of new products, and in particular medical technology that could extend life expectancies, may have increased the weight that individuals place on market goods and services.

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1 *J.M. Keynes, "Economic Possibilities for our Grandchildren," in* Essays in Persuasion, *London: The MacMillan Press Ltd., 1931, p. 358–74.*

2 *V. A. Ramey, "Time Spent in Home Production in the 20th Century United States: New Estimates from Old Data," NBER Working Paper No. 13985, May 2008, and* Journal of Economic History, *Cambridge University Press, vol. 69 (March 2009), pp. 1–47.*

3 *J. Vanek, Keeping Busy: Time Spent in Housework, United States, 1920–1970, PhD. Dissertation, University of Michigan, 1973.*

4 *M. Aguiar and E. Hurst, "Measuring Trends in Leisure: The Allocation of Time Over Five Decades," NBER Working Paper No. 12082, March 2006, and* Quarterly Journal of Economics *122, 3 (August 2007): pp. 969–1006.*

5 *"The Rug Rat Race," with G. Ramey, NBER Working Paper No. 15284, August 2009, and* Brookings Papers on Economic Activity, *forthcoming.*

6 *A Century of Work and Leisure," with N. Francis, NBER Working Paper No. 12264, May 2006, and* American Economic Journal: Macroeconomics, *American Economic Association, vol. 1(July 2009), pp. 189–224.*

7 *J. W. Kendrick,* Productivity Trends in the United States, *Princeton: NBER and Princeton University Press, 1961.*

# A Decade of Change for the U.S. Auto Industry: The Internet, Promotions, and Rising Gasoline Prices

**Florian Zettelmeyer***

During the last decade the U.S. automotive industry has been affected by a series of major changes. First, automotive retailing, which had been firmly controlled by franchised automotive dealers, started to feel the effect of the Internet in the late 1990s. Although state franchise laws require all new cars to be sold by dealers, the Internet has become a major source of information about car characteristics and pricing.

Second, the 9/11 terrorist attacks changed the way that automotive firms compete in the United States. Eight days after 9/11, GM started an incentive promotion with the name "Keep America Rolling" which offered zero percent financing on all GM vehicles for up to five years. While manufacturers had used financing or price incentives before, "Keep America Rolling" is thought to have started a substantial escalation of average incentive amounts.[1]

Third, the dramatic increase in gasoline prices from below $1 in early 1999 to $4 at their peak in 2008 made it much more expensive for consumers to operate an automobile. This has affected manufacturers differentially, depending on the fuel efficiency of the cars they sell. In a series of research papers, my co-authors and I have investigated the consequences for the industry of these changes.

## The Effect of the Internet on the Auto Retailing Industry

Even though consumers remain interested in physically inspecting a car, the Internet has become a very important complement to the car-buying process. As early as the year 2000, 54 percent of all new vehicle buyers used the Internet in conjunction with buying a car. My work with co-authors Fiona Scott Morton and Jorge Silva Risso looks at whether and how the widespread use of the Internet by consumers has affected auto retailing.

We first investigate the effect of Internet car referral services (Autobytel.com, Autoweb.com, Carpoint.com, and the like) on dealer pricing of automobiles in the United States in 1999.[2] Combining transaction data with data from a leading online auto referral service, we compare online transaction prices to regular "street" prices. We find that Internet prices, controlling for the car purchased, on average were 1–2 percent lower than those paid by conventional consumers. In addition, we find that dealer average gross margin on an

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online vehicle sale was lower than an equivalent offline sale. However, these findings do not imply that the Internet is shifting rents from car retailers to consumers. If online car buyers would also have negotiated low prices in the offline world, then the Internet merely provides an alternative channel for a consumer-dealer interaction.

To determine whether the Internet has a causal effect on car prices, we use instrumental variables to control for selection. We find that traditional buyers pay 2.2 percent more than Internet buyers.[3] This is consistent with consumers choosing to use the Internet because they know that they would pay more in the traditional channel, perhaps because they strongly dislike collecting information and bargaining in the traditional way.

This finding raises the question of the Internet's effect on groups of consumers who have traditionally been considered disadvantaged in the car buying process. In a follow-on paper, we analyze whether the Internet's dual role of reducing a dealer's ability to accurately assess a consumer's willingness to pay and increasing consumers' ease in finding information reduces discrimination in car buying by race and gender.[4] For offline car purchases, we find a minority race premium of 2.0 percent to 2.3 percent when we do not control for other demographics; 1.1 percent to 1.5 percent when we control for neighborhood characteristics; and 0.6 percent to 0.8 percent when we control for search costs. This demonstrates that pricing of new cars to offline consumers strongly depends on individual car buyers' characteristics. Our main finding is that the Internet eliminates most of the variation in new car prices that results from individual characteristics associated with race and ethnicity: online buyers who use the Internet referral service that we study pay the same prices as whites, even after controlling for their income, education, and other neighborhood characteristics. Because of the way race is measured in our data, it is implausible that our results are due to selection. This suggests an additional aspect of the "digital divide": not only are disadvantaged minorities less likely to use a computer, but they are also the group that would most benefit from it.

While these papers are informative about the overall effect of Internet usage on new car prices, they leave some unanswered questions about the mechanism by which the Internet lowers prices for consumers. To answer this question we added much more detailed data on the way that consumers searched offline and online, and on their personal characteristics. This led to a paper in which we use direct measures of search behavior and consumer characteristics to investigate how the Internet affects negotiated prices in car retailing.[5] We match transaction data on 1,500 car purchases in California with the buyers' responses to a survey that asks detailed questions about their Internet usage, their attitudes towards information search and bargaining, and their demographics. We show that the Internet lowers prices for two distinct reasons: first, the Internet informs consumers — the most important piece of information that consumers glean on the Internet is the invoice price of dealers; second, the referral process of online buying services, a novel institution made possible by the Internet, also helps consumers obtain lower prices. Our results show that the combined information and referral price effects are -1.5 percent. This corresponds to 22 percent of dealers' average gross profit margin per vehicle. We also find that the benefits of gathering information differ by consumer type. Buyers who really dislike bargaining but who have collected information on the specific car they eventually purchase will pay 1.5 percent less than they otherwise would. In contrast, buyers who like the bargaining process do not benefit from such information.

In summary, this research stream shows that the Internet has had a substantial effect on the level and distribution of prices paid by consumers in the auto industry. This result is remarkable because dealer franchise laws prevent direct competition from either manufacturers or independent companies using the Internet to sell cars directly to consumers. Nonetheless, the ease with which the Internet allows consumers to access information, the partial obfuscation of individual characteristics when interactions are mediated through the Internet, and the referral mechanism, are enough to affect the distribution of surplus between consumers and firms.

## The Effect of Pricing Transparency in the U.S. Automotive Market

After 9/11, incentive promotions played an increasingly important role in the U.S. automotive market. These promotions also provide an opportunity for us to investigate how pricing transparency and information asymmetry affects the auto industry and its consumers.

Meghan Busse, Silva Risso, and I exploit a natural experiment to test the effect of private information on the division of surplus between consumers and automotive dealers.[6] Automobile manufacturers frequently use two types of promotions that give cash-back payments: rebates to customers, which are widely publicized to potential customers, and discounts to dealers, which are not publicized. While the payments nominally go entirely to one party or the other, the real division of the manufacturer-supplied surplus between dealer and customer depends on what price the two parties negotiate. These two types of promotions thus form a natural experiment of the effect of information asymmetry on bargaining outcomes, with the parties symmetrically informed in the customer rebate case and the dealer having an informational advantage in the dealer discount case. We show that customers receive approximately 80 percent of the customer rebate and

approximately 35 percent of the dealer discount. This is consistent with the theoretical prediction that when customers are at an information disadvantage, they are also disadvantaged in negotiations. In this setting, the information disadvantage is substantial: for a promotion of average size, consumers receive $500 less of the surplus if they do not know that the promotion is available.

The preceding papers raise a more fundamental question: how well informed are automobile consumers about whether the price they negotiate with a dealer is a "good price," what we refer to as their "price knowledge"? The evidence suggests that consumer price knowledge may not be high, given that information provided by the Internet and through the format of price promotions affect pricing. Most marketing studies on this topic have found that consumers have poor price knowledge, although the marketing studies generally have analyzed only low-priced goods (often in the context of supermarkets).[7] In contrast, buying a car is the second largest purchase of typical consumers and they spend many hours engaging in price search.[8]

To determine how much consumer price knowledge exists in the U.S. auto industry, Busse, Duncan Simester, and I analyze an unusual event.[9] During the summer of 2005, the Big Three U.S. automobile manufacturers offered a customer promotion: customers could buy new cars at the discounted price formerly offered only to employees. The initial months of the promotion produced record sales for each of the Big Three firms, suggesting that customers believed that the promotional prices offered were particularly attractive. We show that in reality, the rebates that had been available before the employee discount promotion were so large that many customers paid *higher* prices following the introduction of the promotions than they would have in the weeks just before. Nevertheless, unit sales increased for these cars, as well as for cars whose prices decreased. We hypothesize that the complex nature of auto prices, the fact that prices are negotiated rather than posted, and the fact that buyers do not participate frequently in the market made it possible for auto manufacturers to manipulate customers' beliefs about current versus future prices, even without changing prices themselves.

## The Effect of Gasoline Prices on New and Used Car Markets

The dramatic increase in gasoline prices from below $1 in early 1999 to $4 at their peak in 2008 made it much more expensive for consumers to operate an automobile. As concern about climate change has grown, economists have become increasingly interested in the question of how people respond to the cost of gasoline. Fully addressing this question is not easy, in part because there are many margins over which individuals—and firms—can respond, including the usage, production choice, customer choice, and technology of vehicles.

Busse, Christopher Knittel, and I address one aspect of this question: how gasoline prices affect the transaction shares and prices of new and used cars of different fuel efficiencies.[10] We combine data on local gasoline prices and data on model-specific fuel efficiency with transaction data from a 20 percent sample of U.S. new car dealers from 1999 to 2008. These dealers sell both new and used vehicles.

We find that a $1 increase in gasoline price changes the transaction shares of the most and least fuel-efficient quartiles of *new* cars by +20 percent and -24 percent, respectively. In contrast, the same gasoline price increase changes the transaction shares of the most and least fuel-efficient quartiles of *used* cars by only +3 percent and -7 percent, respectively. We find that changes in gasoline prices also change the relative prices of cars in the most fuel-efficient and least fuel-efficient quartiles: for *new* cars the relative price increase for fuel-efficient cars is $363 for a $1 increase in gas prices; for used cars it is $2839.

There are three reasons why these results are interesting. First, the gasoline usage characteristics of the new cars added to the U.S. fleet every year affect the level of gasoline consumption (and greenhouse gas emissions) over subsequent years. Knowing how gasoline prices (and by extension gasoline taxes or carbon taxes) might affect what cars are sold is thus important for policy decisions. Specifically, our results suggest that consumer choices are quite sensitive to gasoline price changes. Second, our used car results reveal something about how consumers trade upfront capital costs against ongoing operating costs when they choose among cars of different fuel efficiencies. This can inform how policies intended to encourage energy conservation more generally should be crafted. The $2839 increase in the difference between the most and the least fuel-efficient quartiles of cars reflects fuel expenditure savings associated with driving the average car in the most fuel-efficient quartile, rather than the average car in the least fuel-efficient quartile, for ten years assuming a 3 percent discount rate. This means that we find very little evidence that consumers are "myopic" in trading off upfront capital costs versus ongoing operating costs. Third, we find that the adjustment of equilibrium transaction shares and prices in response to changes in gasoline prices differs greatly between new and used markets. In the new car market, the adjustment is primarily in market shares, while in the used car market, the adjustment is primarily in prices. We show how this difference can be explained easily by differences in the supply of new and used cars.

In summary, the last decade has brought significant changes to the U.S. auto industry, culminating in the restructuring of much of that industry in the wake of the financial crisis. These changes have enabled us as researchers to learn about the effect

of new Internet institutions, information, price transparency, and usage cost on the U.S. auto market.

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[1] *See, for example the "Automotive Leasing Guide" https://www.alg.com/pdf/ND09_RVR_US.pdf*

[2] *F. Scott Morton, F. Zettelmeyer, and J. Silva Risso "Internet Car Retailing", NBER Working Paper No. 7961, October 2000, and* Journal of Industrial Economics, *Vol. 49 (4), 2001, pp.501–19.*

[3] *F. Zettelmeyer, F. Scott Morton, and J. Silva Risso, "Cowboys or Cowards: Why are Internet Car Prices Lower?" NBER Working Paper No. 8667, December 2001.*

[4] *F. Scott Morton, F. Zettelmeyer, and J. Silva Risso, "Consumer Information and Discrimination: Does the Internet Affect the Pricing of New Cars to Women and Minorities?" NBER Working Paper No. 8668, December 2001, and* Quantitative Marketing And Economics, *Vol. 1 (1), 2003, pp. 65–92.*

[5] *F. Zettelmeyer, F. Scott Morton, and J. Silva Risso, "How the Internet Lowers Prices: Evidence from Matched Survey and Auto Transaction Data", NBER Working Paper No. 11515, August 2005, and* Journal of Marketing Research, *Vol. 43 (2), 2006, pp. 168–81.*

[6] *M. Busse, J. Silva Risso, and F. Zettelmeyer, "1000 Cash Back: The Pass-Through of Auto Manufacturer Promotions", NBER Working Paper No. 10887, November 2004, and* American Economic Review, *Vol 96 (4), 2006, pp. 1253–70.*

[7] *For a review of the literature, see E. T. Anderson and D. Simester, "Price Cues and Customer Price Knowledge," in* Handbook of Pricing Research in Marketing, 2008, *Elgar Publishing Ltd.*

[8] *See, for example, B. Ratchford, M. Lee, and D. Talukdar, "The Impact of the Internet on Information Search for Automobiles,"* Journal of Marketing Research, *40 (May 2003), pp. 193–209.*

[9] *M. Busse, D. Simester, and F. Zettelmeyer, "'The Best Price You'll Ever Get': The 2005 Employee Discount Pricing Promotions in the U.S. Automobile Industry", NBER Working Paper No. 13140, May 2007, and* Marketing Science, *Vol. 29 (2), 2010, pp. 268–90.*

[10] *M. Busse, C. Knittel, and F. Zettelmeyer, "Pain at the Pump: The Differential Effect of Gasoline Prices on New and Used Automobile Markets", NBER Working Paper No. 15590, December 2009.*

## NBER Profile: *Jens Ludwig*

Research Associate Jens Ludwig co-directs the NBER's Working Group on the Economics of Crime and is a member of the Program on Children and the Program on Health Economics. He is also the McCormick Foundation Professor of Social Service Administration, Law, and Public Policy at the University of Chicago.

After receiving his doctorate in economics from Duke University, Ludwig was on the public policy faculty at Georgetown University. His research focuses on urban problems related to crime, housing, health, and education.

Ludwig is a co-editor of the *Journal of Human Resources* and a member of the Institute of Medicine/National Academy of Sciences Board on Children, Youth and Families. In 2006 Ludwig received the David N. Kershaw prize for "distinguished contributions to public policy analysis and management by age 40." He lives in the Hyde Park neighborhood of Chicago with his wife Liz, daughter Annika, and rescue mutt Trixi.