SWT-2017-10 JUNE 2017

NEW-VEHICLE MARKET SHARES OF CARS VERSUS LIGHT TRUCKS IN THE U.S.: RECENT TRENDS AND FUTURE OUTLOOK

MICHAEL SIVAK
BRANDON SCHOETTLE

SUSTAINABLE WORLDWIDE TRANSPORTATION
UNIVERSITY OF MICHIGAN

NEW-VEHICLE MARKET SHARES OF CARS VERSUS LIGHT TRUCKS IN THE U.S.: RECENT TRENDS AND FUTURE OUTLOOK

Michael Sivak
Brandon Schoettle

The University of Michigan
Sustainable Worldwide Transportation
Ann Arbor, Michigan 48109-2150
U.S.A.

Report No. SWT-2017-10
June 2017

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SWT-2017-10		

4. Title and Subtitle	5. Report Date
New-Vehicle Market Shares of Cars Versus Light Trucks in the U.S.: Recent Trends and Future Outlook	June 2017
	6. Performing Organization Code: 383818

7. Author(s)	8. Performing Organization Report No.
Michael Sivak and Brandon Schoettle	SWT-2017-10

9. Performing Organization Name and Address	10. Work Unit no. (TRAIS)
The University of Michigan Sustainable Worldwide Transportation 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
The University of Michigan Sustainable Worldwide Transportation	14. Sponsoring Agency Code

15. Supplementary Notes

Information about Sustainable Worldwide Transportation is available at http://www.umich.edu/~umtriswt.

16. Abstract

This study analyzed the relationship between the relative sales of cars and light trucks and the following three economic factors: disposable income, price of gasoline, and unemployment rate. Multiple linear regression was used to model the relationship in the United States for monthly data for a 10-year period from January 2007 through December 2016.

The results indicate that each of the three economic factors examined was a significant predictor of the percentage of car sales out of the combined total of car and light-truck sales. All of the effects were in the expected directions: higher disposable income was associated with lower percentages of car sales, while both higher gas prices and higher unemployment rates were associated with higher percentages of car sales. Because the best-fitting regression model provided a reasonably good fit to the data (accounting for 71% of the variance in the percentage of car sales), this model was then used to predict future percentages of car sales for 36 scenarios defined by all combinations of three levels of disposable income, three levels of the price of gasoline, and four levels of unemployment. The predicted percentages of car sales ranged from 29.8% to 52.9%. The lowest percentage of car sales was obtained for a scenario with the highest examined disposable income, the lowest gas price, and the lowest unemployment rate. Conversely, the highest percentage of car sales was obtained for the lowest disposable income, the highest gas price, and the highest unemployment rate.

17. Key Words	18. Distribution Statement
cars, light trucks, sales, multiple regression, future trends, economic factors, disposable income, price of gasoline, unemployment rate	Unlimited

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
None	None	11	

Contents

Introduction

Earlier this year, we published a report on a survey that examined consumer preferences and motivations for owning light trucks versus cars in the United States (Schoettle and Sivak, 2017). The results of that study indicate that the primary reasons for owning light trucks relate to the overall increase in utility over cars, including greater general utility, the need for larger vehicles due to family size, and the need to move cargo.

However, the greater utility of light trucks also comes with increased average purchase price (e.g., Kelly Blue Book, 2017) and lower average fuel economy (e.g., EPA, 2016). Consequently, the present study was designed to analyze economic factors that are associated with the relative sales of cars and light trucks.

Multiple linear regression was used to analyze the relationship between the percentage of purchased cars (out of the total number of cars and light trucks), and disposable income, the price of gasoline, and the unemployment rate. The analysis used monthly data for a 10-year period. If any of these factors prove to be associated with the percentage of purchased cars, then the best-fitting regression model could be used to make "what if" inferences about possible future percentages of car versus light-truck sales under a variety of possible economic scenarios.

Method

Approach

A multiple linear regression was used to analyze possible relationships using monthly data from January 2007 through December 2016.

Dependent variable

The dependent variable was the percentage of cars sold each month relative to the combined sales of all light-duty vehicles sold (cars and light trucks). *Cars* included passenger cars and station wagons, while *light trucks* included trucks (pickup trucks, SUVs, and vans) up to 14,000 pounds gross vehicle weight (BEA, 2017). The percentage was based on the seasonally adjusted annual rate (SAAR) (BEA, 2017). Figure 1 shows the corresponding percentages throughout the examined period. (For December 2016, the value was 38.1%.)

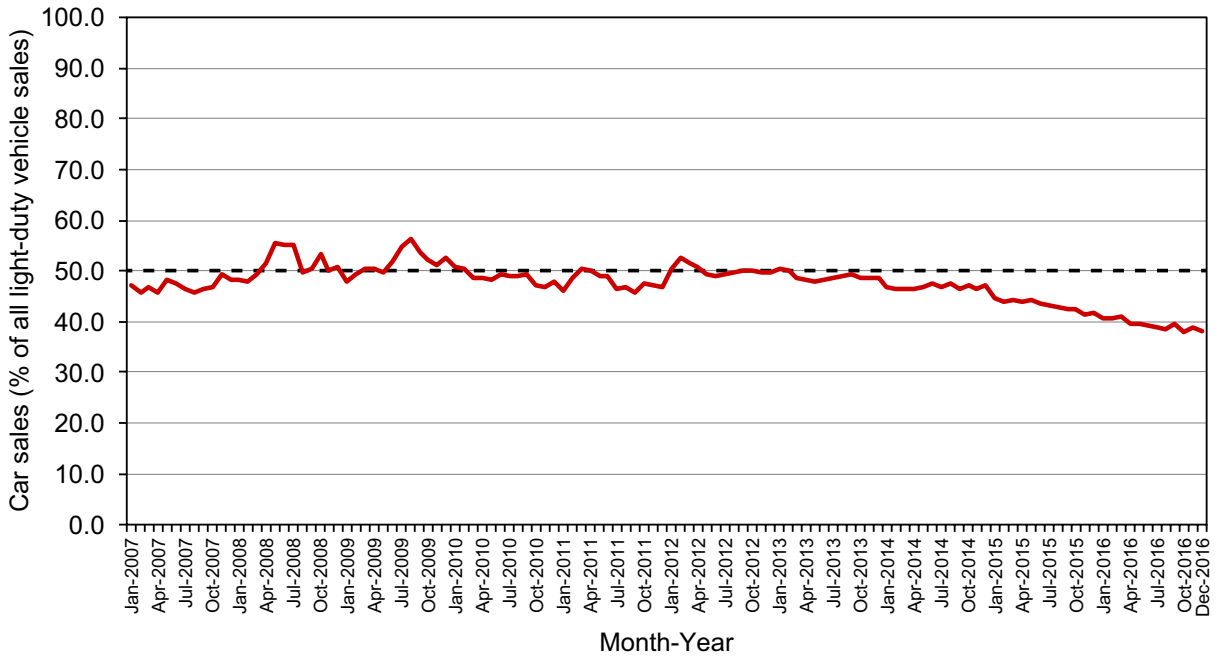

Figure 1. Percentage of car sales out of the total sales of cars and light trucks, January 2007 through December 2016 (BEA, 2017).

Independent (predictor) variables

The following three independent variables were used:

- Real disposable income per capita in chained 2009 dollars, seasonally adjusted annual rate (Federal Reserve Bank of St. Louis, 2017b)
- Price of regular gasoline (EIA, 2017), adjusted for inflation relative to the December 2016 price (Federal Reserve Bank of St. Louis, 2017a)
- Unemployment rate, seasonally adjusted (BLS, 2017)

Results

Model fit to the data from 2007 through 2016

The overall regression was statistically significant, $F(3,116) = 93.5$, $p < .001$). The model accounted for 71% of the variance in the percentages of car sales ($r^2 = 0.71$). The best fitting equation was as follows:[1]

*Percent cars = 100.572 - (1.684 * disposable income) + (1.841 * price of gasoline) + (0.435 * unemployment rate)*

Each of the three independent variables was a significant predictor: disposable income ($t = -8.00$), price of gasoline ($t = 5.59$), and unemployment rate ($t = 3.44$). A positive t value indicates a positive relationship between the predictor and the dependent variable, and vice versa. The directions of all three effects were as expected. Specifically, higher disposable income was associated with lower percentages of car sales, while both higher gas prices and higher unemployment rates were associated with higher percentages of car sales.

Using the regression model to calculate percentages of car sales for "what if" scenarios

Given the reasonably good fit of the regression model to the data from 2007 through 2016, the model was used to calculate percentages of car sales for 36 possible future scenarios. These scenarios were defined by all combinations of the following levels of disposable income, price of gasoline, and unemployment rate:

- Disposable income per capita: $35,000, $40,000, and $45,000 (for comparison, the December 2016 value was $39,217)
- Price of gasoline per gallon: $2, $3, and $4 (the December 2016 value was $2.25)
- Unemployment rate: 3%, 5%, 7%, and 9% (the December 2016 value was 4.7%)

The predicted percentages of car sales for the 36 selected scenarios are listed in Table 1. The percentages range from 29.8% to 52.9%.

[1] Disposable income was entered into the regression in thousands of dollars (e.g., 35,000 = 35).

Table 1
Predicted percentages of future car sales for 36 economic scenarios.

Disposable income per capita ($)	Price of gasoline per gallon ($)	Unemployment rate (%)	Predicted car sales (%)
35,000	2	3	46.6
		5	47.5
		7	48.4
		9	49.2
	3	3	48.5
		5	49.3
		7	50.2
		9	51.1
	4	3	50.3
		5	51.2
		7	52.0
		9	52.9
40,000	2	3	38.2
		5	39.1
		7	39.9
		9	40.8
	3	3	40.0
		5	40.9
		7	41.8
		9	42.7
	4	3	41.9
		5	42.8
		7	43.6
		9	44.5
45,000	2	3	29.8
		5	30.6
		7	31.5
		9	32.4
	3	3	31.6
		5	32.5
		7	33.4
		9	34.2
	4	3	33.5
		5	34.3
		7	35.2
		9	36.1

As is evident from Table 1, car sales exceeding 50% of all sales could be expected only for the following limited combinations of the economic variables considered:

- the lowest disposable income ($35,000) and the highest gas price ($4) (regardless of the unemployment rate), or
- the lowest disposable income ($35,000), the median gas price ($3), and high unemployment rate (7% or 9%)

Conversely, car sales dropping below 30% of all sales could be expected only for the following single combination of the economic variables considered:

- the highest disposable income ($45,000), the lowest gas price ($2), and the lowest unemployment rate (3%)

Discussion

Limitation of regressions

An important caveat to keep in mind is that, while a regression can identify associations between factors, it cannot identify causal relationships. Therefore, the relationships obtained in this study are not necessarily causal.

Variables not considered

This analysis considered possible associations between the relative sales of cars and light trucks versus three key economic variables. However, vehicle-class selection is likely related to other factors as well. One obvious such factor is the difference in purchase price. That, in turn, reflects not only the inherent difference in the production costs, but also the incentives provided by the manufacturers. Such incentives are likely influenced by many factors, including the ease of meeting corporate average fuel economy (CAFE) standards. For example, if a given manufacturer has more difficulties in meeting the fuel economy standards for light trucks than for cars, that would likely influence the price differential for this manufacturer's products in such a way that its cars would be financially more attractive to consumers than would otherwise be the case.

The above example of an effect of fuel economy standards on the relative sales of cars and light trucks suggests that the possible relaxation of the standards under the current administration (New York Times, 2017) may indirectly influence the future mix of vehicles sold.

Light trucks as a broad class of vehicles

Light trucks include pickups, sport utility vehicles, and vans. The sales in each subclass are likely associated, to different degrees, with various vehicle-specific factors. A more fine-grained analysis of factors related to the sales of these subclasses of light trucks was beyond the scope of this study. Furthermore, the distinction between the two broad vehicle classes of cars and light trucks is becoming more blurred with the recent introduction of crossover utility vehicles (CUVs) that combine features of both vehicle types.

Summary

This study analyzed the relationship between the relative sales of cars and light trucks and the following three economic factors: disposable income, price of gasoline, and unemployment rate. Multiple linear regression was used to model the relationship in the United States for monthly data for a 10-year period from January 2007 through December 2016.

The results indicate that each of the three economic factors examined was a significant predictor of the percentage of car sales out of the combined total of car and light-truck sales. All of the effects were in the expected directions: higher disposable income was associated with lower percentages of car sales, while both higher gas prices and higher unemployment rates were associated with higher percentages of car sales. Because the best-fitting regression model provided a reasonably good fit to the data (accounting for 71% of the variance in the percentage of car sales), this model was then used to predict future percentages of car sales for 36 scenarios defined by all combinations of three levels of disposable income, three levels of the price of gasoline, and four levels of unemployment. The predicted percentages of car sales ranged from 29.8% to 52.9%. The lowest percentage of car sales was obtained for a scenario with the highest examined disposable income, the lowest gas price, and the lowest unemployment rate. Conversely, the highest percentage of car sales was obtained for the lowest disposable income, the highest gas price, and the highest unemployment rate.

References

BEA [Bureau of Economic Analysis]. (2017). *Motor vehicle unit retail sales*. Available at: https://www.bea.gov/national/xls/gap_hist.xlsx

BLS [Bureau of Labor Statistics]. (2017). *Unemployment rat*e. Available at: https://data.bls.gov/timeseries/LNS14000000

EIA [Energy Information Administration]. (2017). *U.S. regular all formulation retail gasoline prices.* Available at: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPMR_PTE_NUS_DPG&f=M

EPA [Environmental Protection Agency]. (2016). *Light-duty automotive technology, carbon dioxide emissions, and fuel economy trends: 1975 through 2016*. Available at: https://www.epa.gov/sites/production/files/2016-11/documents/420r16010.pdf

Federal Reserve Bank of St. Louis. (2017a). *Consumer price index for all urban consumers, seasonally adjusted*. Available at: https://fred.stlouisfed.org/tags/series?t=inflation

Federal Reserve Bank of St. Louis. (2017b). *Real disposable personal income per capita.* Available at: https://fred.stlouisfed.org/series/A229RX0

Kelly Blue Book. (2017). *2017 new car buyer's guide*. Available at: https://www.kbb.com/car-news/all-the-latest/new-car-and-suv-buyers-guides/2000011533/

New York Times. (2017). *Trump, easing emissions rule, vows to expand auto jobs.* Available at: https://www.nytimes.com/2017/03/15/business/trump-auto-industry-emissions-rules.html

Schoettle, B. and Sivak, M. (2017). *Consumer preferences and motivations for owning light trucks versus passenger cars* (Report No. SWT-2017-7). Ann Arbor: The University of Michigan Sustainable Worldwide Transportation.