Changes in Gasoline Prices and Consumer Sentiment

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Volatile gasoline prices are frequently mentioned in the press. Using more than thirty years of consumer sentiment data, we analyze the relationship between changes in gasoline prices and its impact on consumer sentiment. We find a negative relationship between changes in gasoline prices and changes in consumer sentiment, suggesting that as gasoline prices rise (fall), this negatively (positively) impacts consumer sentiment. Additionally, causality analysis provides support that changes in gasoline prices leads consumer sentiment and changes in consumer sentiment. Our results are consistent with the documented fact that the demand for gasoline by consumers is inelastic in the short-run.

INTRODUCTION

Consumer sentiment, as it relates to economic and financial decisions, has come to represent pessimism or optimism regarding current and future economic conditions. Attempting to measure consumer sentiment has become popular in recent decades as personal spending has come to account for a long-term average of 65% of gross domestic product (GDP).[1] Conventional wisdom would suggest that major purchases by consumers such as homes and cars are more likely to occur when consumers are optimistic versus consumers who are weary and pessimistic. Stock market investors eagerly await this monthly data because if investors can track consumers and their state of mind, forecasting a major portion of U.S. growth (or lack of growth) becomes marginally easier.

More recently, the topic of gasoline prices has appeared in the media with headlines such as "Why High Gasoline Prices are Causing the Drop in GDP Growth[2]" and "Oil Prices Need to Fall Much More to Avoid Recession[3]." Another recent article documenting the first decline in consumer spending in nearly two years attributed a good deal of this reduction in consumer consumption to high gasoline prices.[4] With the focus on high gasoline prices and its impact on consumers, a natural question to ask would be: How do changes in gasoline prices affect consumer sentiment? Intuitively, lower gasoline prices (or negative changes in gasoline prices) would benefit the consumer as it would result in more discretionary money available whereas higher gasoline prices (or positive changes in gasoline prices) would financially hurt the consumer.

Within the ten-year period from 2001 until 2010, the compound annual growth rate of nominal gasoline prices per gallon has been 7.51% while during this same period, the compound annual growth rate of the Consumer Price Index (CPI) for all items less energy was 1.91%. The annual increase in gasoline prices has been noticed and has imposed an economic hardship on consumers. An example of the attention high gasoline prices has received would be the announcement by the U.S. government and the International Energy Agency (IEA) on June 23, 2011 to release 60 million barrels of crude oil from participating countries' reserves into the global oil supply. The intended purpose of such an action was to increase the supply of crude oil in order to depress high prices at the pump.

Research on consumer sentiment has increased as of lately but the more recent consumer sentiment studies tends to be used in relation to consumer sentiment's predictability power with respect to future stock returns (e.g., Fisher and Statman (2003), Lemmon and Portniaguina (2006), Akhtar et al. (2011)) or household spending (e.g., Ludvigson (2004)). Research on consumer sentiment has also shown that changes in consumer sentiment are related to credit card usage (Lamdin (2008)).

With so much recent attention by policymakers and the media, gasoline prices have become an important issue that affects today's consumers and households. We seek to investigate if changes in gasoline prices impact consumer sentiment. If so, this could provide important insights given consumer sentiment is tied to household spending, which in turn, is heavily tied to U.S. economic growth (i.e., GDP). Using more than 30 years of consumer sentiment data, we employ regression analyses and causality tests to look further into this relationship between gasoline prices and consumer sentiment. The remainder of the paper is organized in the following manner. We first discuss how consumer sentiment is typically measured and briefly survey the related literature pertaining to our study. Then we present preliminary results regarding consumer sentiment and changes in gasoline prices. Afterwards, we introduce the results of our causality tests and discuss their implications. We then conclude the paper with final remarks.

CONSUMER SENTIMENT AND THE RELATED LITERATURE

Consumer sentiment is the attempted measurement of the economic outlook of consumers. The phrase consumer sentiment is sometimes used interchangeably with the phrase consumer confidence. Consumer sentiment (or confidence) is difficult to define because sentiment cannot be directly observed whereas consumer behavior is observed (Curtin (2007)). This of course does not deter economists and other social scientists from attempting to capture this somewhat obscure concept. Two popular consumer sentiment sources are the University of Michigan's Index of Consumer Sentiment (ICS) and the Conference Board's Consumer Confidence Index (CCI). Fisher and Statman (2003) and Lemmon and Portniaguina (2006) acknowledge that despite survey design differences between ICS and CCI, the indices are highly correlated. Due to this correlation, as well as Ludvigson (2004) recognizing that many studies employ ICS, our study employs ICS as the proxy for consumer sentiment.

Regarding the existing literature pertaining to consumers and gasoline consumption and prices, prior studies have looked at how gasoline prices impact other aspects of households besides sentiment. Earlier studies such as Willenborg and Pitts (1977) ask the following question: How effective is the price mechanism in reducing consumption of gasoline? They show that consumers' attitudes do in fact adjust to the dynamic nature of changing gas prices but at the same time, changes gas prices alone are not extremely effective in getting households to consume less fuel. They note that in the short-run, consumers are not likely to drastically reduce the number of miles driven as a result of the short-run inelastic nature of gasoline demand. Pitts, Willenborg and Sherrell (1981) study changes in gasoline prices and document that certain socio-economic groups were greater affected by rising gasoline prices due to financial constraints. McManus (2007) shows that prices for vehicles with different fuel economy values is affected by gasoline prices, further evidence of the sensitivity of consumers to gasoline prices.

Kayser (2000) finds that gasoline prices impact different populations in different ways. Kayser's study identifies a number of effects such as rural-area households with little or no access to public transportation are more greatly impacted by higher gasoline prices than comparable urban-area households with access to public transportation. Kayser (2000) also documents that low-income individuals who use automobiles to commute to work and have no access to public transportation are more negatively affected by rising gasoline prices when compared to individuals who do not work but live with the assistance of government-funded transfer programs.

An interesting recent study by Gicheva et al. (2008) investigates how sudden spikes in gasoline prices impacts disposable income and food expenditures. They use rich data contained within the Consumer Expenditure Survey (CES) as well as exhaustive scanner data from grocery stores to examine if grocery and food expenditures subsequently change due to gasoline price spikes. Their results show that consumers decrease the amount of money spent on food not prepared at home as well as a substitution effect in grocery stores whereby consumers substitute sale items for regular priced food items. Blendon and Benson (2008) summarize recent survey results. Rising gasoline and home-heating prices were by far the problem most affecting family financial situations, remarkably far exceeding health care costs, food prices, or the cost of a college education. They also show that gasoline is the necessity most difficult for families to afford. These types of survey findings we believe further reinforce the need to conduct additional research on how gasoline prices impacts consumers.

THE DATA AND PRELIMINARY TESTS

The variables of most importance for this study are the gasoline prices as well as the consumer sentiment figures (ICS data). The gasoline data are from the U.S. Energy Information Administration (EIA), which is part of the U.S. Department of Energy. The EIA primarily collects and analyzes energy data for the purpose of aiding U.S. policymakers with updated and accurate data regarding energy usage and potential opportunities and concerns regarding this area. The EIA makes gasoline data available on their website[5] along with a short-term energy outlook as well as international energy outlook. We obtain our gasoline data from their 'Petroleum and Other Liquids' section using real prices per gallon (June 2011 dollars). We use real gasoline prices instead of nominal prices as an appropriate measure of today's purchasing power and use the most recent real price data available at the time of this study.

The ICS data used in this study was obtained from the Federal Reserve Bank of St. Louis (data series UMCSENT, www.http://research.stlouisfed.org/fred2/series/UMCSENT). The ICS data were originally compiled quarterly by the University of Michigan but was changed to a monthly frequency in 1978 and is the reason that our data begin with this particular year. Additionally, we obtain data from the Federal Reserve Bank of St. Louis regarding real disposable personal income as this is monitored by economists as a measure of the state of the economy due to its relationship with saving and spending levels. By definition, real disposable income is personal income less income taxes, and in recessionary periods or periods of high inflation, tends to trend downward. This data series was also obtained from the website of the Federal Reserve Bank of St. Louis (data series DPIC96, www. http://research.stlouisfed.org/fred2/series/DPIC96?cid=110). The intuition for including a disposable income variable in our preliminary analyses is that gasoline consumption impacts the disposable income of consumers. Higher (lower) gasoline prices result in less (more) discretionary money available to spend on non-staple items for households.

Table 1 presents the summary statistics of the variables used. The average price of one gallon of gasoline for the entire sample period was \$2.22. According to the EIA, in June 2008, gasoline hit the highest level in our sample period of \$4.22 per gallon. Regarding the ICS data series, 86.12 was the average level of consumer sentiment for the sample with the highest recorded level occurring January 2000. This period also corresponded with the dot-com bubble of the early 2000s and interestingly, the NASDAQ reached its highest recorded level in March 2000, just a few months after consumer sentiment was at a historically high level.

Given the dynamic nature of gasoline prices, we pay particular attention to their changes with respect to changes in sentiment. As a result, we first investigate the regression models shown below.[6] The t-statistics for the regression coefficients are in parentheses under the coefficients.

$$\%\ \Delta\ \text{ICS} = \alpha + \beta\ \%\ \Delta\ \text{Real Gasoline Prices} + \varepsilon \tag{1}$$

$$\%\ \Delta\ \text{ICS} = \underset{}{0.001} - \underset{(-3.97)}{0.204}\ \%\ \Delta\ \text{Real Gasoline Prices}$$

$R^2 = 0.04$

$$\% \Delta \text{ ICS} = \alpha + \beta \% \Delta \text{ Real Gasoline Prices} + \delta \% \Delta \text{ Disposable Income} + \varepsilon \quad (2)$$

$$\% \Delta \text{ ICS} = 0.0003 - \underset{(-3.77)}{0.195} \% \Delta \text{ Real Gasoline Prices} + \underset{(1.34)}{0.452} \% \Delta \text{ Disposable Income} + \varepsilon$$

$R^2 = 0.04$

$$\% \Delta \text{ ICS} = \alpha + \beta_1 \% \Delta \text{ Real Gasoline Prices} + \beta_2 \% \Delta \text{ Real Gasoline Prices}_{t-1} + \delta_1 \% \Delta \text{ Disposable Income} + \delta_2 \% \Delta \text{ Disposable Income}_{t-1} + \varepsilon \quad (3)$$

$$\% \Delta \text{ ICS} = -0.0003 - \underset{(-2.54)}{0.145} \% \Delta \text{ Real Gasoline Prices} - \underset{(-2.07)}{0.119} \% \Delta \text{ Real Gasoline Prices}_{t-1} + \underset{(1.41)}{0.490} \% \Delta \text{ Disposable Income} + \underset{(0.70)}{0.244} \% \Delta \text{ Disposable Income}_{t-1} + \varepsilon$$

$R^2 = 0.05$

The basic equation is equation (1), where the relationship between real gasoline prices and consumer sentiment is examined. Gasoline price changes have a negative and statistically significant impact on changes in consumer sentiment. The t-statistic of -3.97 shows a large degree of statistical significance. Equations (2) and (3) are extensions of equation (1), and tell a consistent story; changes in gasoline prices and consumer sentiment are negatively related. Equation (2) includes changes in disposable income as an additional regressor. Changes in real gasoline prices remain statistically significant and negative. Changes in real disposable income are positively related to changes in consumer sentiment and with a t-statistic of 1.34, the statistical significance is marginal (10% significance with a one-tailed test, but not 5% significance). Equation (3) includes lagged independent variables to see if this story remains unchanged and it does. Thus, the negative relationship between consumer sentiment and changes in gasoline prices persists. Changes in gasoline prices clearly affects consumer sentiment, and more clearly than does disposable income. Our conjecture about this finding is that gasoline prices are salient to practically all consumers, particularly abrupt changes in prices. Changes in aggregate real disposable income are more gradual, and result in large part due to economic recessions and expansions that may have a strong impact on those individuals who lose or gain employment (income) at those times, but those individuals will not make up a large portion of those sampled to crease the sentiment index.

These results are encouraging but deserve further testing. Given that the data used in this analysis are monthly, it is important to measure this relationship over an adequate time period. Moreover, understanding the lead-lag relationship between changes in gasoline prices and consumer sentiment should be established. We therefore focus on the answers to these questions and undertake causality tests.

ADDITIONAL EMPIRICAL TESTS

Granger (1969) introduced his popular causality test which, succinctly defined, examines the relation between cause and effect between two variables. The two variables at hand are gasoline prices and consumer sentiment. By exploring this cause and effect, the following conclusions can be drawn by conducting causality tests: (i) variable one Granger causes variable two (ii) variable two Granger causes variable one (iii) variable one Granger causes variable two and variable two Granger causes variable one (iv) variable one does not Granger cause variable two and variable two does not Granger cause variable one. Also, we seek to examine different lag structures because as Willenborg and Pitts (1977) note, in the short-run, consumers typically do not reduce the number of miles driven because the demand for gasoline is inelastic. We hypothesize that it takes months for consumers to begin to adjust their outlook as well as driving consumption and habits given this documented fact.

Tables 2 - 4 present the results of the Granger causality tests for different lag structures. We report the *F*-statistics and corresponding *p*-values from these tests. For each table, we report three dependent variables: % Δ ICS, ICS and % Δ Real Gasoline Prices. The independent variables tested against these dependent variables seek to test whether or not they cause the dependent variable. Looking first at Table 2 which looks at the 3 month-lag structure, we see that percentage changes in gasoline cause changes in both ICS and percentage changes of ICS at a 1% level of significance. When percentage changes in gasoline is the dependent variable in Table 2, the percentage change in ICS never Granger causes percentage change in gasoline price (using a customary 5 percent significance). This is intuitively what was expected. Gasoline prices affect the change in the ICS (or its level), but consumer sentiment does not cause a change in gasoline prices.

Tables 3 and 4 look at the 6-month lag structure and 12-month lag structure respectively. Both of these tables report similar results: percentage changes in gasoline cause changes in both ICS and percentage changes of ICS at a 1% level of significance. Additionally, percentage changes in ICS or the level of ICS do not cause percentage changes in gasoline prices. We note that as the number of months (lags) increases, the results become slightly weaker as the *F*-statistics decrease and thus the *p*-values increase as lags are added. This is plausible considering that consumers observe and react to the impact of gasoline prices quickly. Adding more lags beyond 3 months does not, however, alter the conclusion about gasoline prices affecting changes (or the level of) consumer sentiment as in Table 2, but statistically muddies the water just a bit. The tests of consumer sentiment changes causing gasoline prices changes are more strongly rejected as the *F*-statistics shrink and the *p*-values rise with additional lags.

FINAL REMARKS

Gasoline prices impact the U.S. economy in many ways. One particular group that is impacted is the American consumer. Using more than thirty years of data on consumer sentiment and gasoline prices, we analyze the relationship between these two variables. Using regression analysis, we find a negative relationship between changes in gasoline prices and changes in consumer sentiment. This suggests that as gasoline prices rise (fall), this negatively (positively) impacts consumer sentiment. Further causality analysis provides support that changes in gasoline prices leads consumer sentiment and changes in consumer sentiment for 3, 6 and 12 month periods. This is expected given previous research has found that the demand for gasoline by consumers is inelastic in the short-run. We thus provide empirical support to the notion that changes in gasoline prices does impact consumers' psyche.

ENDNOTES

1. U.S. Department of Commerce Bureau of Economic Analysis and Lynch, David J., October 12, 2009, "Consumer spending at 71% of GDP as other sectors shrink," USA TODAY.
2. Post Carbon Institute, August 9, 2011, "Why high gasoline prices are causing the drop in GDP growth," www.oilprice.com.
3. August 12, 2011, "Oil prices need to fall much more to avoid recession," www.cnbc.com/Thomson Reuters.
4. Crutsinger, M. August 2, 2011, "Americans cut spending for first time in 20 months," Associated Press.
5. www.eia.gov
6. The percent change in each variable is used rather than the level of each variable in the regressions to avoid the problem of using variables that are non-stationary in level form. Using the percentage change leads to low R^2 values.
7. Data Source: U.S. Energy Information Administration (EIA) Short-Term Energy Outlook.

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TABLE 1
SUMMARY STATISTICS
ALL DATA ARE MONTHLY AND FROM JANUARY 1978 UNTIL DECEMBER 2010.

Variable	Mean	Min	Max	Std. Dev.
Real Gasoline Prices (June 2011 Dollars)	\$2.22	\$1.26	\$4.22	\$0.63
% Δ Real Gasoline Prices	0.19	-29.21	16.34	4.84
ICS	86.12	51.70	112.00	13.10
% Δ ICS	0.10	-18.07	24.57	5.02
% Δ Real Disposable Income	0.24	-3.90	4.78	0.74

TABLE 2
GRANGER-CASUALITY TESTS – 3-MONTH LAGS

	Dependent variable: % Δ ICS	
	F-statistic	*p*-value
% Δ Real Gasoline Prices	5.82	0.001
	Dependent variable: ICS	
% Δ Real Gasoline Prices	6.14	0.000
	Dependent variable: % Δ Real Gasoline Prices	
% Δ ICS	2.24	0.083
ICS	2.00	0.114

TABLE 3
GRANGER-CASUALITY TESTS – 6-MONTH LAGS

	Dependent variable: % Δ ICS	
	F-statistic	*p*-value
% Δ Real Gasoline Prices	3.76	0.001
	Dependent variable: ICS	
	F-statistic	*p*-value
% Δ Real Gasoline Prices	3.79	0.001
	Dependent variable: % Δ Real Gasoline Prices	
% Δ ICS	1.44	0.198
ICS	1.49	0.181

TABLE 4
GRANGER-CASUALITY TESTS – 12-MONTH LAGS

	Dependent variable: % Δ ICS	
	F-statistic	*p*-value
% Δ Real Gasoline Prices	2.36	0.006
	Dependent variable: ICS	
% Δ Real Gasoline Prices	2.28	0.009
	Dependent variable: % Δ Real Gasoline Prices	
% Δ ICS	0.94	0.512
ICS	0.95	0.501

FIGURE 1
TIME-SERIES GRAPH OF CONSUMER SENTIMENT AND GASOLINE PRICES
(REAL PRICES PER GALLON, JUNE 2011 DOLLARS[7])