Global Economy and Development at BROOKINGS

(Un?)Happiness and Gasoline Prices in the United States

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Gasoline purchases are an essential part of the American way of life. There were about 250 million motor vehicles in the United States in 2008 – just under a vehicle per person. Americans drive an average of more than 11,000 miles per year and gasoline purchases are an essential part of most households' budgets. Between 1995 and 2003, gasoline prices in the U.S. averaged about $1.49 a gallon, with average prices rising above $2.00 in 2004. By the summer of 2008, gasoline prices had reached a national average of $4.11 per gallon. At that time, Americans earning less than $15,000 a year were spending as much as 15 percent of their household income on gasoline – double the proportion from seven years earlier. In addition, unpredictable fuel costs make planning monthly household expenditures difficult, which can be detrimental to individual welfare and even to the overall economy.

Gasoline prices fell in the aftermath of the 2009 economic crisis. Prior and during the financial crisis, rising gasoline prices were seen as a symptom of an uncertain economic situation, as well as evidence of the questionable sustainability of our future oil supply. Gasoline prices abated along with the decrease of economic activity that accompanied the onset of the recession, reaching their minimum in late December 2008. A few months later, as the economy entered a gradual recovery phase, gasoline prices also trended upward. In contrast to the previous period of great uncertainty about future oil supplies, however, these price trends were considered more positively as signs of the U.S. economic recovery.

Given the essential role that gasoline plays in most Americans' day-to-day lives, an obvious question is how gasoline price trends affect their well-being. Do significant changes in gasoline prices have effects on par with those of inflation, unemployment, or the recent economic crisis? Do those effects vary according to how dependent particular cohorts are on driving to conduct their daily activities? What matters more – price *levels* versus *changes* in levels? In other words, do budget constraint effects dominate, as traditional theory would predict, or does uncertainty about prices and where they are heading dominate? Are there threshold effects of different price levels, such as $4 per gallon?

A simple graphic picture of the data trends suggests a remarkably close negative correlation between gasoline price increases and well-being in the pre-crisis period (January through mid-September 2008), measured both as the percent of Americans that report to be thriving each month and as reported happiness each day (based on Gallup Daily data).[2] [See

[1] Contact email is cgraham@brookings.edu. We thank Lana Labermeier for sportingly responding to our constant line of interrogation on "How would this (and that) change in gasoline prices affect you?"
[2] In this instance, "happiness" is measured by the best possible life question (BPL) in the Gallup poll (described below). BPL is one of many questions that scholars use to measure happiness, with the

Figures 1(a) – (c)] In other words, a decline in Americans' sense of happiness or well-being appears to have been significantly correlated to the rise in gasoline prices in the first three quarters of 2008. Our research takes this empirical regularity as a starting point and tests it further – both in terms of more detailed data and analysis, and across time, extending through the crisis period and beyond.[3] We first test whether mean happiness trends demonstrate the same or similar correlation with gasoline prices during the crisis and recovery periods that they did in the pre-crisis period. We also explore whether the trends of other measures of affect – such as smiling and reported depression – correlate with gasoline price movements in a manner similar to reported happiness. We employ the methods of happiness economics (one of the authors is one of the early researchers in this area) and rely on daily surveys of well-being from the Gallup Organization and data on gasoline price and consumption trends at both national and regional levels from the Oil Price Information Service for the period under study.[4]

We posit that several related phenomena could mediate the relationship between gasoline price and well-being: budget constraint effects, uncertainty and signaling effects (that is, rising gasoline prices could be an indication of worse things to come such as a possible 1973 style oil crisis or major financial crisis), and adaptation. Gasoline prices surely affect households' *budgets*, although those effects likely vary according to income levels and dependence on gasoline. In addition, gasoline prices *signaled* different things in the three periods: inflation and possible uncertainty in future oil supplies in the first period, which in turn became linked to the fears of a looming recession; the fall in the Dow Jones Industrial Average (DJIA) and the downturn in economic activity in the second period; and economic recovery in the third.

The price rises were unprecedented in the first period but then abated; in the second round of price increases during the recovery, people had learned from the first and may have *adapted* somewhat because of it, including altering their consumption behavior to cope with higher fuel costs. By this point, people's economic fundamentals had been deeply shaken by the crisis and consumer spending patterns had changed. The importance of a gasoline price increase, by the end of the second period, may well have diminished relative to the threat of losing one's job, home, or retirement account. In short, it is possible that expectations and *adaptation* played a mediating role in the relationship between prices and well-being in the latter periods.

A related subject of our research is whether the well-being costs vary across different *cohorts*,[5] and if the cohort specific effects also vary over time. Surely the effects of gasoline price increases have varying degrees of importance for people of different income levels. They may also matter according to age, with one hypothesis that younger generations are perhaps "greener" and use less gas. They also likely vary according to usage patterns and consumers' price and income elasticity of demand. Some consumers are likely more vulnerable (and therefore have less elastic demand) than do others. There may also be different patterns across rural and urban areas. Are people in areas that were particularly vulnerable during the crisis – such as auto producing regions – more affected? Our econometric analysis tests how the well-being effects of gasoline prices vary according to the socioeconomic cohort and the region/state they are in.

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particular question choice depending on both data availability and the component of happiness or well-being that is of interest. Questions such as "how often did you smile yesterday" are designed to capture the affect component of well-being, while BPL and related questions are designed to capture happiness in an overall life evaluation sense.

[3] As part of our analysis, we also briefly compared the correlation between well-being and the prices of other key commodities – such as food – during this period, to make sure that we are not just picking up a spurious correlation.

[4] See, among others, Carol Graham, *Happiness around the World: The Paradox of Happy Peasants and Miserable Millionaires* (Oxford: Oxford University Press, 2009); and Carol Graham, Soumya Chattopadhyay, and Mario Picon, "Adapting to Adversity: Happiness and the 2009 Economic Crisis in the United States", *Social Research*, 77(2), 715-748, Summer 2010.

[5] Cohorts here refer to different groupings of people, whether by age, income, region, or other category.

Understanding the *channels* by which gasoline prices affect well-being or reported happiness is as important as gauging the magnitude of the effects, and is a key focus of our research. Is it a levels or changes effect? To what extent is it an uncertainty effect, with people afraid that prices will continue to change? In other words, people may be able adapt to any price as long as it is stable, while changes in prices, even if they are from lower levels, may cause more anxiety. This may, in turn, vary according to how budget constrained particular cohorts are. The authors' research in the economic, health, and crime arena suggests that people are better able to adapt to unpleasant certainty than they are to uncertainty.[6] How do the media and publicity surrounding gasoline price increases mediate the effects? In the pre-crisis period, gasoline price increases were the story; in the post crisis period, gasoline prices are of modest importance in light of larger economic threats, such as high and persistent levels of unemployment and instability in the international and national financial systems. Our research attempted to identify the channels that are at play, and which had more importance (in relative terms) and for which cohorts.

Understanding the effects of gasoline prices on happiness, the channels by which they operate, and the cohort-specific effects is relevant to the current debate on climate and energy use policy. If the primary channel is a change rather than levels one, then a tax which results in higher but stable price levels may be more publicly acceptable than was previously thought. Yet if there are very strong income based effects across cohorts, with vulnerable cohorts bearing the brunt of the well-being effects, then the same policy would have distributional implications that would be far less acceptable. Strong regional effects could have implications for differential pricing strategies, such as state by state taxing of gasoline. Greater fears of uncertainty over changes in gasoline prices would argue against taxes - proposed by some - that are linked to volatile indexes such as to prices for carbon. While policy decisions cannot be directly made based on the results of happiness surveys for any number of reasons, the information that they provide can certainly contribute to the ongoing policy debate.[7]

Our findings, discussed in greater detail below, suggest that gasoline price changes have significant effects on well-being in the United States, but their size and direction depends a great deal on the socioeconomic station of citizens. We find that gasoline price changes matter to well-being *above and beyond* the effects of significant movements in the DJIA during the period under study, which encompassed the deepest recession the country has faced since the Great Depression.

We also find that the measure of how much a rise in gasoline prices negatively impacts happiness in America is disproportionate to the actual loss in purchasing power by families. Our estimates of the income equivalent "costs" of these declines in happiness find that they are greater than the actual value of the average household's additional expenditures on gasoline. On average, the increases in gasoline prices during the period resulted in a decline in happiness equivalent to what would have been caused by a $530 drop in monthly income - much more than the average household's additional gasoline expenditures. This is likely due to the uncertainty that the price changes generated – both about trends and about security of future gasoline supplies. This was particularly important during the first period, when price increases were unprecedented in recent memory, and there was no obvious sign of what their top end would be.

The well-being of vulnerable, low income socio-economic groups was affected negatively via the budget constraint channel during all times under study when gasoline prices increased. The well-being of the wealthy, in contrast, was often *positively* correlated with gasoline price

[6] See Carol Graham, "Adaptation Amidst Prosperity and Adversity: Insights from Happiness Surveys from Around the World", *World Bank Research Observer*, forthcoming.
[7] See, for example, Carol Graham, "Should Happiness Be An Objective of Development Policy? Promises and Potential Pitfalls", Keynote paper presented to the Annual IMF-World Bank ABCDE Conference on Growth, Stockholm, Sweden, June 1, 2010. See also, Prashanth Ak, "Towards an Economy of Well-Being: *Happiness around the World*", *Science*, Vol. 329, 6 August 2010.

increases during periods where they might have been construed as signaling the false hope that there was a recovery in economic activity that rising gasoline prices might be indicative of. There were also state and regional differences, where respondents in some states and regions much more bothered by rising gasoline prices than those in others. These differences were driven, for the most part, by how dependent people were on gasoline and cars for transport, as well as how accustomed they were to high gasoline prices.

There were threshold effects above and beyond these general movements, however. Days that gasoline prices rose above either $3.50 or $4.00 a gallon were associated with a decline in well-being for all Americans, regardless of socio-economic station. This final result suggests that proposals for fuel taxes at the levels already in place in other countries like Japan and Europe would likely meet far more political opposition here.

Data and Methods

Methods

The project's empirical analysis includes the methods used in studying the economics of happiness. *Happiness economics* differs from the more traditional approaches in empirical economics, which are based on the analysis of revealed preferences. Revealed preferences approaches begin from the presumption that what individuals say – e.g. expressed preferences – cannot be trusted as an accurate signal of their actual behaviors, as there are no consequences to the former. Thus economists traditionally only used the information that comes from revealed preferences, such as actual consumption choices. While revealed preferences may be more accurate for measuring expenditure choices, it is less clear that those choices are better measures of welfare than are expressed preferences, at least in some instances. Consumption choices can be detrimental to welfare (excessive consumption of drugs or junk food, for example), or limited (the poor, for example, cannot always consume or act in ways that enhance their welfare, because they are resource and/or information constrained).

Expressed preferences provide a method for answering questions that revealed preferences do not answer very well. One set of questions includes the welfare effects of macro and institutional arrangements that individuals are powerless to change, such as weak public institutions and/or persistent inequality. Another entails the explanation of behaviors that are driven by norms (such as lack of trust or low expectations among discriminated groups), and/or addiction or self control problems (such as cigarette smoking and obesity). [8] Survey data are also well suited for capturing variance in tolerance to a range of phenomenon, from poor health to crime and corruption to inequality. Norms of what is acceptable differ a great deal across countries and cultures, in part due to how common or uncommon these phenomena are, and well-being surveys are one of the few tools that we have to measure this variance.[9]

Expressed preferences are best gauged via survey data – which, of course, have their own flaws and limitations. Indeed, economists shied away from the use of survey data/expressed preferences for decades. Yet they are increasingly applying survey data – and particularly well-being surveys – to a range of theoretical and empirical questions. One reason is that econometric innovations are increasingly helpful in correcting for the bias that unobservable personality traits

[8] For a reviews of the approach, see, among many others, Bruno Frey and Alois Stutzer, Happiness and Economics (Princeton: Princeton University Press, 2002); Rafael Di Tella and Robert MacCulloch, "Some Uses of Happiness Data in Economics", *Journal of Economic Perspectives*, vol. 20, no. 1, 2006; Andrew Clark, "Relative Income, Happiness and Utility: An Explanation for the Easterlin Paradox and Other Puzzles" (with Paul Frijters and Mike Shields), *Journal of Economic Literature*, Vol.46, no.1, March, 2008; and Carol Graham, "The Economics of Happiness", in Larry Blume and Steven Durlauf, eds., *The New Palgrave Dictionary of Economics*, 2nd Edition, (Palgrave Mac-Milan, 2008).

[9] See, for example, Carol Graham, "Happiness and Health: Lessons – and Questions – for Public Policy", *Health Affairs*, January-February, 2008; and Graham (2009).

introduce to survey data. Another is the range of questions that remain unanswered by revealed preferences.

The relationship between gasoline prices and well-being is an example of such a question. Because the demand for gasoline of many consumers is fairly inelastic, revealed preferences – as gauged by consumption patterns – may not vary much, but there may be significant well-being costs associated with gasoline price changes. Survey data is the one of the few means we have to measure these costs. While this surely does not discount the utility of demand data and revealed preference based models of gasoline consumption, it complements them with a metric which can identify welfare effects that may vary more than consumption trends suggest.

Data

The Gallup Daily Poll, a unique data set that provides household level data on individual perceptions on a daily basis, is our source of individual well-being data. The dataset spans the period from January 2008 to December 2009. This dataset is a stratified sample of an average of 1000 households across the U.S. (all localities with land-line phones and mobile cell phone connections), surveyed almost every day for the entire period. [10] It has about 704,600 individual observations. The questions in the survey include the demographic details of the respondents (age, race, ethnicity, household size, marital status, education level); economic conditions (employment status, job security, job mobility; respondents' perceptions about their standards of living and the state of the economy; access to services (such as health insurance, medical care, telephone and internet); and personal health, emotional experiences, and emotional conditions, among others.

Our measure of happiness is the "best possible life" (BPL or happiness) question in the Gallup Daily Data set. This question asks respondents to imagine their best possible life, and to then place their current life condition in comparison to that imagined best life on a 0-10 eleven-step ladder. It is a widely used measure of reported happiness which has been found to be robust through cross-country and cross-individual comparisons.

The Gallup Daily Poll is collation of cross-section surveys, one for each day in the period. Because the data is cross-section rather than panel, we have had to use alternative proxies to control for individual-specific traits, such as relying on a proxy measure of each individual's innate optimism, when assessing other attitudes.[11] The large size of the sample and the level of detail therein, combined with daily interviews, provides a unique data set with which to analyze the effects of any number of phenomena on human well-being.

Our data on gasoline prices comes from the Oil Price Information Service. We use national daily average prices, and state daily averages for California, New York, Illinois, Florida, and Texas. In our analysis, we focus on the national average prices. The national average prices are adjusted for the difference between price trends in the period studied versus average fluctuations over the past fifteen years (the period of time for which we have data). The adjusted gasoline price is the observed *daily* price of gasoline for the period under study minus the average price over the past fifteen years for the corresponding week that the daily observation

[10] One of the authors, Graham, is an academic advisor to the Gallup World Poll, and is granted access to the daily data set in that capacity.

[11] Panel data – in which the same person is surveyed each day or at least some proportion of the respondents was surveyed repeatedly - would have been ideal, because it would allow us to capture over-time trends in attitudes while at the same time controlling for unobservable characteristics which are specific to individual respondents. In the absence of panel data, this proxy measure of optimism - or derivations thereof - has become increasingly common in the analysis of well-being surveys. For a detailed description and examples of use across multiple domains, see Carol Graham and Eduardo Lora, eds., (2009). *Paradox and Perception: Measuring Quality of Life in Latin America* (Washington, D.C.: The Brookings Institution Press and the Inter-American Development Bank).

falls into. The latter specification aims to determine how different the fluctuations of the period under study are from historical seasonal and other variations. As is displayed graphically in Figure 2, the difference is marginal. Our regional gas price data, meanwhile, is the average monthly price, as reported by the service.

We include the daily DJIA as a control for economic trends at a time of significant macroeconomic volatility. For weekend dates when the DJIA is not reported, we extrapolate the closing value for the last day of observation – typically the closing value on Friday to Saturday and Sunday – under the assumption that most people will have that most recent figure in mind when considering trends in the economy/DJIA over the weekend.

We also use monthly data from the Reuters/University of Michigan Survey of Consumers (www.sca.isr.umich.edu/) about consumer expectations about gasoline prices in the next one and five years. Consumers' expectations about gasoline price increases in the next year were highest in the June 2008 survey, when prices were still rising, although they again spiked almost as high in January 2009 and then fell steadily through April 2010. A simple look at media coverage, meanwhile, corroborates the expectations data: gasoline prices were a big story in the June-July period, but by January had been super-ceded by stories with either crisis or recession in the title. [See Figure 3]

Our comparisons of income equivalences used the Bureau of Labor Statistics – Consumer Expenditure Survey data for 2008.

Gasoline Prices versus Other Variables

National average gasoline prices surpassed $4/gal in June and July 2008. Many macroeconomic indicators were slowly deteriorating in the pre-crisis period and could have contributed to the February through June-July decline in BPL. However, no substantial independent variables besides gasoline prices changed significantly in late July and August 2008, precisely at the time that mean BPL made a recovery. The only other major indicator that showed a change at that time was the DIJA, which ended a two-month 2,000-point decline in mid-July and stayed very stable until the crisis period.

The consumer price index for food, unemployment and Freddie Mac delinquencies were all steadily rising (monthly) during the period.[12] Industrial production and the Case-Shiller 20-City Housing Price Index were relatively flat, but they were on a slow downward trend and did not show any unusual movements or reversals in July or August.[13] Residential electricity prices, meanwhile, most closely followed gasoline prices, but they peaked in August, too late to have much of an impact on BPL, and media coverage of electricity was flat throughout the period.[14] [Figure 3] Instances of the word "gasoline", in contrast, very clearly peaked in mid-2008. Gasoline should have had greater economic impact than that of electricity: the Consumer Expenditure Survey finds that households spend twice as much on gasoline as electricity, and gasoline prices rose at twice the rate of electricity prices. [15]

Food was the other key commodity with rising prices. In July 2008, a Gallup poll which found that 76 percent of Americans believed rising gasoline prices had a greater negative impact

[12] Unemployment did have a sudden jump from 5.0 to 5.5 between April and May, but it also increased from 5.8 to 6.2 between July and August, suggesting a worsening economy at the same time mean BPL was rising. All macroeconomic data from the Federal Reserve Bank of St. Louis – Economic Data (FRED)
[13] "Case Shiller Housing Prince [sic] Index Data - The University of North Carolina", www.unc.edu/~salemi/Sub-prime Crisis/Case Shiller Index.xls.
[14] EIA – Energy Information Administration. "Table 5.3. Average Retail Price of Electricity to Ultimate Customers: Total by End-Use Sector, 1996 through February 2010" Report obtained May 20, 2010. http://www.eia.doe.gov/electricity/epm/table5_3.html;
[15] BLS – Bureau of Labor Statistics. "Consumer Expenditure Survey." United States, Department of Labor. October 6, 2009. http://www.bls.gov/cex/ .

on their family's finances than increasing food prices, while only 14 percent reported that rising food prices affected them more. The poll report cited: "a very high correlation between overall economic mood and the average price of regular gasoline this year." The Gallup daily poll found that 90% of respondents said the economy was getting worse between July 14 and 16 when gasoline prices were still at their peak, while a *substantially lower 76%* thought the economy was worsening by early August when gasoline prices were falling. [16]

Indeed, the dip in the gasoline prices after July 2008 was read by many as positive economic news, the following quote suggests: "The decline in oil prices has been a welcome relief for consumers and a rare piece of positive news in a bleak economic landscape." (*New York Times*, 9/4/08). Once it became clear that the crisis had struck, however, marked by the collapse of Lehman brothers, then trends in the DIJA and media coverage of the crisis clearly dominated gasoline prices in terms of their effects on BPL movements.

Econometric approach

We first tried to establish the basic correlation between gasoline prices and well-being, and how or if it varied across the three time periods of interest. Our base-line regression has individual reported happiness on the left-hand side (e.g. the dependent variable), and a vector of the usual socioeconomic controls; the daily level of the DJIA; and the daily national average gasoline prices (adjusted for the weekly average over the past fifteen years – as discussed above) for all three periods: pre-crisis (January 1 – September 14, 2008); crisis (September 15, 2008 – March 20, 2009); and recovery (March 21, 2009 – January 2010), on the right hand side.

$Y_{ij} = \beta_1$ *[age, age*^{2}*, gender, marital status, and income controls]* $+ \beta_2$ *[the daily DJIA]* $+ \beta_3$ *[adjusted daily national average gasoline prices]*.

We ran the same regression with the sample split into the three different time periods, to see if there is any significant difference in the coefficients on gasoline prices and changes. We then re-ran the full three-period regression but with a dummy variable marking out the crisis period and with that dummy interacted with the DJIA.

For the full period regressions, our socio-economic variables work as expected: there is a U-shaped relationship between happiness and age, with the low point at age 48; on average women are happier than men; those that are married are happier than those that are not; and income is strongly and positively correlated with happiness. The DJIA was significantly and positively correlated with reported happiness, while gasoline prices were significantly and negatively correlated with happiness. Thus, a base-line finding, we find that higher gasoline prices are associated with lower levels of well-being across the full period. [See Table 1(a)]

When we split our sample into the three relevant periods, our findings differ somewhat, but in intuitive ways. In the pre-crisis period, the coefficient on the DJIA is negative but statistically insignificant, suggesting that most people were either unaware of trends in the DJIA, or had become accustomed to high and stable levels and were not bothered by the initial and modest DJIA downturns. National average gasoline prices are, again, negatively and significantly correlated with reported happiness, which could be the result of the unprecedented increases in gasoline prices in that time and the related concerns about inflation and oil supply, and/or the subsequent linkages to the looming financial crisis. [See Table 1(b)]

For the crisis period we get quite different results. The coefficient on the DJIA is negative and significant and large in magnitude. [Table 1(c)] This is not surprising as both the DJIA and

[16] Newport, Frank. "Americans Hold Out Little Hope for a Drop in Gasoline Prices." Gallup, July 15, 2008; http://www.gallup.com/poll/108829/americans-hold-little-hope-drop-gas-prices.aspx Newport, Frank. "Consumer Confidence Edges Up as Gasoline Prices Go Down." Gallup, August 15, 2008. http://www.gallup.com/poll/109522/Consumer-Confidence-Edges-Gas-Prices-Down.aspx.

reported well-being fell dramatically during this period – almost mirroring each other – until the instability in the markets stopped in late March of 2009. [See Figure 1(a)] The correlation between average gasoline prices – which were *falling* during this period – and happiness was positive, meanwhile, as happiness levels were also falling.

For the final period, the correlation between the DJIA, which was recovering notably, and happiness was again positive (as mean happiness levels were also rising), while the correlation between gasoline prices, which began to increase again, and happiness was also positive. [Table 1(d)] One possible explanation for this phenomenon is that the potential negative budgetary implications of an increase in gasoline prices seem to have been less important than their signaling economic recovery at a time that people were looking for confirmation of positive trends in the market. In addition, it is also possible that Americans in lower and middle income groups began to feel less fearful that there would be a permanent energy crisis or that a shortage of gasoline would last indefinitely. Moreover, consumers may have adapted to price changes, either by driving less as indicated in vehicles miles traveled data or by adjusted household spending to take higher fuel costs into account by other changes in spending or budgeting.

The findings from all three periods suggest that *gasoline price movements have significant effects on well-being, even after controlling for the unprecedented levels of macroeconomic volatility that characterized the period*. [17]

We split our self-reported income cohorts in the Gallup Daily data into three like-size groups to get a sense of how different income cohorts might be affected by gasoline prices and movements in the DJIA. Our lower income cluster covered groups 0 to 5: from no income to $2,999 pre-tax monthly income and made up roughly 35% of the sample. Our middle category covered groups 6-8: from $3,000 to $7,499 and made up 40% of the sample. Our rich cluster was made up of groups 9 and 10: $7,500 to $9,999 and $10,000 and over, and made up 24% of the sample.[18] Our data on consumer expenditures, for example, show a significant difference in the percentage of expenditures that is spent on gasoline across income quintiles, with lower income quintiles – and in particular quintiles 2 and 3 – typically spending a higher percent of their expenditures on gas. [See Table 2(a)]

[17] As a robustness check, we ran the first and last models after including fixed-effects specification for each day that well-being observations were taken (e.g. daily fixed effects). Our results remained essentially unchanged. Fixed effects regression results available from the authors. In an additional exercise, we re-ran the full period regression, this time including a marker dummy variable for the crisis period and a variable inter-acting the crisis dummy and the DJIA. The dummy variable controls for the levels effect – e.g. lower overall well-being levels during the crisis – while the interaction variable explores whether the slope in the relationship between well-being and the DJIA also changed during this period. With this specification, the estimated coefficients of the DJIA, gasoline prices, and the trend marker dummy were all negative and significant. The coefficient on our interaction variable, meanwhile, was positive, reflecting the co-movements in the DJIA and well-being (both negative). The combined result of the trend marker dummy and the interaction term is a modest positive effect of the DJIA on well-being for the full period (coefficient of 0.0000011). [17][See Table 1(e)] The coefficient on the DJIA for the full period without the interaction term is stronger than it is with the interaction term, implying that the slope on the DJIA/well-being relationship is flatter during the crisis period. This is likely because the generally high levels of uncertainty (and noise) during that period affected well-being in addition to movements in the DJIA. While, for the most part, trends in BPL and the Dow moved in the same direction (both down and then both up), there were days in which they did not, and there is an element of averaging out for those non-conforming days, which in turn flattens out the slope. The overall effect of gasoline prices remained negative, meanwhile, which again supports the finding that gasoline price movements matter to well-being, above and beyond the effects of macroeconomic changes.

[18] The specific pre-tax household monthly income categories for each group were: 0 - no income; 1 - under $60; 2 - $60 to $499; 3 - $500 to $999; 4 - $1000 to $1999; 5 - $2000 to $2999; 6 - $3000 to $3999; 7 - $4000 to $4999; 8 - $5000 to $7499; 9 - $7500 to $9999; 10 - $10,000 and over. Roughly 24% of the sample of respondents refused to answer or said they did not know.

We created dummy variables representing each income group. We then inter-acted the dummies with daily national average gasoline prices for each period, in order to capture the specific effects of price changes on each income group, and re-ran our regressions for each period.[19] We find that rising gasoline prices had negative effects for the low and middle income groups in the first period. [Table 2(b)] It is important to note that while the low income groups are the most budget constrained, it is our middle income groups are likely the most dependent on gasoline (as they use more gasoline than lower income groups and have less income than the highest income groups; thus the percent of their expenditures on gasoline is higher than that of other groups – see Table 2a). The coefficient for the lower groups was by far the strongest, suggesting that the budget constraint effect in this period was the most important. This is not a surprise, given the marked rise in gasoline prices.

Rather remarkably, the coefficient for the high income group is positive (and significant). These very high income groups were probably not very sensitive to the budget constraint effect and one plausible explanation is that wealthy Americans may have still been looking for positive signs that the economy was not going awry; and they may have interpreted the slowing in the rising rate of gasoline prices to have signaled that average Americans could spend more money on consumer goods again because fuel would take up less of household budgets. This effect might have been true at least for those respondents that were also following trends in the markets closely (discussed above and below). The overall effect of the DIJA during this period, meanwhile, is insignificant.

General scores on the index of Consumer Sentiment echo our findings for the period.[20] For many questions, the middle income group fell the most between the two periods in 2008 and between the first two months of 2008 and June. This was true for overall sentiment and for expectation questions about one year in the future (expected change in financial conditions, business conditions, unemployment, and mean inflation). On the overall consumer sentiment index, they declined by 3.5-4 points more than average, while higher-income people were average, suggesting that middle income were more sensitive to price related signals than were higher income groups. The correlations with gasoline prices during the January-August period for the middle third were also higher on nearly all questions. Higher income groups were, in contrast, much more sensitive than the average to signals relating to financial markets. Lower income groups, meanwhile, were most directly affected by the budget constraint channel.

For the second period, we find a positive correlation between the price of gasoline and happiness for the middle and upper income groups. Both variables were falling during the period. The lowest income group has a negative and significant coefficient, on the other hand. Our earlier work on the well-being effects of the crisis found that this group was far less reactive to the events signaling its onset, and that happiness levels did not fall in the same way that they did for the higher income groups. Thus there is a contrast (both empirical and econometric) with the strong positive correlation between falling gasoline prices and falling BPL in the onset of the crisis for the middle and wealthy groups. There may also be related artifact of construction issues: BPL for respondents in the low income groups was already low, so there was less of a margin for levels to fall. These vulnerable groups were likely already too preoccupied with the challenges of day to day existence to notice the signals of the onset of the crisis. This effect likely overwhelmed

[19] These "dummy"-interaction variables are distinct from pure dummy variables which compare all of the categories to a reference group that is then omitted. In this instance, each income category is interacted with a continuous variable, and there is no left out/comparator group, as each interaction variable is distinct for the group/period. One advantage of this is that as all of the groupings are nested within the same model, we can compare for significant differences in the coefficients across the groups in a way that we could not if more than one treatment (or group type) was being compared to a reference group.

[20] Index of Consumer Sentiment, January-December 2008, University of Michigan; (www.sca.isr.umich.edu/). The Consumer Sentiment Index is made up of five questions. For the first two months of 2008 and June, those with middle incomes fell more than average in a question about whether it was a good time to buy large household goods. They also fell more than average in two questions about their one-year expectations of their expected financial conditions and overall business conditions.

any positive budget effects that a decrease in gasoline prices might produce, not least as the lowest income groups use less gasoline than those in the middle. The DIJA, meanwhile, was negatively and significantly related to happiness for this period, which is not a surprise. [Table 2(b)]

For the third period, rising gasoline prices again had negative effects on the lowest income groups, and positive effects for the middle and upper income groups, with the strongest coefficients being the negative for the lowest group and the positive for the highest income groups. The effects of the DIJA during this period were positive and significant, which is not a surprise, as markets were recovering. In this instance, the findings are quite intuitive. Budget constraint effects dominate for the group that is most vulnerable, while signaling effects dominate for the other two groups and are more significant for the wealthiest. [Table 2(b)][21]

Our previous work on the U.S. crisis and well-being demonstrates that higher income respondents were more sensitive to events that signaled the onset of the crisis and then of those that signaled its recovery than were lower income respondents who were already in precarious or vulnerable economic situations (Graham, Chattopadhyay, and Picon, 2010). Our interpretation in that instance was that the former groups had more to lose in the crisis than did the already precarious ones, and were also more likely to be educated and aware of signaling events and trends, while lower income groups seem more preoccupied with day to day vulnerability. [22] The middle income group – apart from being a constructed category – likely shares some traits of both the high and low income cohorts. The coefficients for this group are then naturally smaller, as the competing effects of the responses of the high and low cohorts are averaged out.

Cohort Effects

Our priors were that these effects could vary significantly across cohorts. We added a number of dummy and interaction variables (e.g. each dummy interacted with price) to each of the above full sample specifications to get at the differential cohort effects. We added dummies for region within the United States, under the assumption that there is substantial variance in elasticity of demand for gasoline and norms of usage across these categories. Gasoline taxes vary a great deal according to state, meanwhile, and in states with very high taxes, such as California, people are used to generally high price levels and less fluctuation, as the changes are in part masked and captured in the tax. In others, such as Texas, people are accustomed to lower prices and taxes, but more price volatility. We thus also separated the sample into those respondents living in Texas and those in California.

We first included dummies for those respondents living in California and Texas in our baseline regressions for the three crisis periods. Respondents in both California and Texas are happier than the average for the whole sample. One exception, though, is Californians in period three, the recovery period; in this instance, Californians were less happy than the average for the sample as a whole. This might be explained by the depth of the housing and state budget crisis in California, and the slow nature of the recovery there.

We next ran our regressions separately for California and Texas, and included our interaction variables for the three income groups and the average gasoline price, in this instance the average price for each state, respectively. We find little difference in the income group findings in these states compared to those for the sample as a whole: budget constraint effects dominate for the low income groups while signaling effects dominate for the high ones. The coefficients run in the same direction, for the most part, although in some instances they are insignificant. This could be driven by sample size as much as anything else. One exception is in

[21] As a robustness check, we did a T-test to make sure that the difference in the coefficients across the dummies was statistically significant. Our test confirmed our results. Results available from the authors.
[22] We also ran the same regressions separately for each of our income groups (0-10). These results confirm the basic direction of our findings. Regression results available from the authors.

period one for the high income groups in Texas: the sign on the coefficient is negative (but not significant), while it is positive and significant for the sample as a whole. This is likely a sign that wealthy Texans, who are not used to high gasoline prices and are very dependent on automobiles, were more sensitive to the budget channel than to the signaling channel, at least in the pre-crisis period. [See Table 3(a)]

Our analysis of data on vehicle miles traveled (VMT), by state, bear this interpretation out. While total VMT are higher in California than Texas, the level fluctuates much more in the former than in the latter. The steady levels in Texas, including throughout the high price period, suggests higher levels of dependency on automobiles and lower elasticity of demand. This in turn, supports an interpretation in which the budget channel is more important in Texas, and the signaling channel is more important in California. [See Figure 4b]

We inter-acted our region dummy variables with the monthly average gasoline price for each region, clustering the standard errors for month and year, and included these in our baseline regression. We created a second set of interaction variables with the region dummies inter-acted with the regional gas price adjusted for trends over the past 15 years. The regions are: East Coast, Midwest, Gulf Coast, Rocky Mountain, and West Coast. Without our cluster controls, we find that the negative effects of gasoline prices is the strongest for the Rocky Mountain region and second strongest for the East Coast, followed by the Midwest and then the Gulf coast. There were no significant effects for the West Coast, perhaps because residents there are already accustomed to high gasoline prices (as our California versus Texas comparison also suggests). The coefficients on our specification with adjusted prices, meanwhile, are stronger than those for non-adjusted prices, suggesting again that a departure from what people are used to may be more important than simple trends.

When we include our clusters, which control for time trend effects as well as for auto-correlated standard errors, our results are insignificant for all regions except for the Rocky Mountain region. This holds for both the adjusted and non-adjusted price specifications. This suggests that either Rocky Mountain region residents were unaccustomed to fluctuating gasoline prices and/or are more dependent on gasoline than those in the other regions. There some evidence supporting this explanation. Of the 100 largest metropolitan regions in US, only 6 (six) are in this region (a much lower proportion than any other region grouping). Salt Lake City, Boise, Denver, Colorado Springs are the most populous cities in this region and none of them have robust public transport systems.[23]

Thus, population density in the Rocky Mountain region is very low compared to other regions and there is no meaningful alternative to driving, even in cities. When gasoline prices go up, residents there end up paying a lot more – out of necessity – because their consumption elasticity is very low. Evidence from data on vehicle miles traveled across the U.S. corroborates our interpretation. Of the five Rocky Mountain region states, VMT is highest for Colorado. But even a simple visual looks shows that there is very little variance in VMT in this region – compared to California, for example. Indeed, if anything, there was a slight increase in VMT during the high price period for some of the Rocky Mountain States. [See Figures 4a and 4b]

The East Coast stands in contrast. The marked change in significance for the East Coast region when the cluster controls (which capture region-wide unobservable correlated errors) are included is telling. It suggests that while respondents in the East may be less dependent on gasoline than those in more rural areas (such as the Rocky Mountain region), but may be more sensitive to signals related to the crisis. Of all the regions, residents in the East Coast spend the lowest percent of their consumption on gasoline and motor oil; those in the South and Mid-west spend the most.[24] [See Table 2a] The clusters pick up the effects of the time-trend related signals

[23] An anecdotal note is that more Subarus are sold in Colorado than in any other state in the U.S.
[24] Unfortunately, the regions in the Commerce/Labor Department statistics do not correspond exactly with those in the Gallup data.

in our latter specification, suggesting that these signals were driving the East Coast findings when the controls were not included. [See Table 3(b)]

Channels

We also attempted to get a sense of the *channels* driving our well-being findings. This is perhaps the most difficult component to measure, but worth exploring nonetheless. It is plausible that what the increases in price *signal* – for example looming crisis in the first period and recovery in the latter one – is what matters most to well-being. A related channel could be the uncertainty related to price rises, an effect which might eventually be mitigated by *adaptation* to fluctuating gasoline prices. Alternatively, it might be *threshold* effects – e.g. when gasoline increases above a certain point, people begin to notice it more, both due to budget constraints and to media attention to the issue. Of course, all three phenomena could be at play and also have varying degrees of importance, depending on the cohort.

One way to get a read on the signaling question is simply to look at the split time trend results. In the pre-crisis period, prices rose in a manner that was unprecedented (at least in recent memory) AND signaled a possible long term oil supply crisis. In the second period of increases, in the post-crisis period, they rose more sporadically, and in this instance could have been construed as positively associated with an improvement in economic activity and thus an indicator that American well-being will be enhanced in the future. The effect was strongest for the highest income groups, and insignificant for the lowest. This second time users had already experienced prices rising steeply and then falling; at the same time the gasoline price increases in this last period might have been associated with recovery rather than the onset of crisis. For most of the sample, and in particular the higher income cohorts, the positive signs of recovery associated with the price increases seemed to matter more to well-being than did the uncertainty or budget constraint channels. The exception was the poorest cohorts, for whom the negative budgetary implications were likely at least as important as the positive signaling effects.

We used our consumer sentiment data in an additional attempt to measure the signaling and uncertainty effects. This data – from the Michigan consumer sentiment survey – captures what consumers thought would happen to gasoline prices as well as other components of the economy. Respondents thought that gasoline prices would increase the most in the summer of 2008 – most notably June (with the average expected gain in price per gallon being 51.2 cents). Expectations of a price increase spiked up again almost as high in January 2009 (to 44.3 cents), and then fell steadily after that.

We regressed reported happiness on the monthly data from the monthly reports of consumer sentiment index (CSI) and our usual socio-demographic and economic controls, clustering the standard errors by the month and year that responses were given. We used levels of the index, changes in the index, and percentage changes, respectively, in our regressions. Broadly, our results suggest that the index per se (with higher scores capturing higher levels of optimism about where the economy is heading) is closely associated with stable happiness or optimism levels, while the change variables are more sensitive to economic changes and to signaling and uncertainty effects. Indeed, in the specifications where we include our cluster controls, the well-being effects of average national gasoline prices disappear, at least for the full period specification. With this specification, only the CSI levels remain significant and positively associated with well-being. This, no doubt, captures the innate optimism of respondents throughout the period, as well as any positive signaling effects that our gasoline prices may have been picking up in the absence of the inclusion of the CSI. The price of gasoline had mixed effects over the full period, which depended on cohort and timing. [See Table 4]

When we split our sample into the three time periods, gasoline prices only have significant effects in period one, when the negative and budget related effects were the strongest, the sense of uncertainty was the strongest and the signaling effects were the weakest. Accordingly, the effects of the CSI and changes in CSI are much weaker in period 1, as there was

still a lot of debate about whether or not a recession was going to occur. In periods 2 and 3, in contrast, the effects of gasoline prices become insignificant (as to a large extent they were signaling effects that are now picked up by the CSI variables). In period 2, the CSI (levels) is positive and significant, while changes in the CSI are negative. Again, the former may be picking up more stable innate optimism or happiness despite adversity among respondents, while changes in the CSI are more likely picking up economic signals and concerns about uncertainty. In the final period, only the positive levels effect of CSI remains significant (at the 5% level). This may reflect the tenuous nature of the recovery and thus uncertainty in what changes in the CSI signaled. [Table 4]

We also tested for threshold effects. We added marker dummies for dates that the price of gasoline rose above $3.50 and $4.00 a gallon, respectively. The coefficients on both of these marker dummies were significant and negative, suggesting that there was an additional effect on well-being – above and beyond our trend effects – from prices rising above certain levels; the high gasoline price days (where national average gasoline price exceeded $3.50/gallon) diminished BPL by an additional 0.33 points even after controlling for the levels of adjusted gasoline price. [Table 5] The coefficient on the $3.50 marker (.33) is quite a bit stronger than it is for the $4.00 marker (.10). This could be because $3.50 is a more important threshold or merely that there were very few dates that prices were above the $4.00 price. [Figure 5]

We also explored whether gasoline prices falling below a certain level – in this instance $2.00 per gallon. As in the case of the $4.00 marker, there were very few below $2.00 dates. [Figure 2]. While the high threshold markers had the expected negative effects on well-being, the converse did not hold. Gasoline prices falling below $2.00 a gallon did not have a positive impact on well-being; indeed the coefficient on the below $2.00 marker dummy is negative and significant. [Table 5] We cannot, however, make any conclusive statements about the effects of low gasoline prices on well-being. In this instance, the period of the marked decline in gasoline price (November 21, 2008 until March 25, 2009) coincided directly with the economic crisis, and the latter had the clear dominant influence on individual well-being. In all cases, our results are again robust to the inclusion of daily fixed effects as controls.

We also tested whether these threshold effects varies across the time periods. We ran our regressions using the income group dummy-gas price interactions as above, and also including the threshold markers, for each time period. The results confirm our basic story. For period one, rising gas prices had generally negative effects on income groups one and two, and positive effects on group three: budget constraint effects for the former and signaling effects for the latter. There were threshold effects in addition: days that gas rose above $3.00, $3.50, and $4.00 were associated with additional downward trends in well-being (although the coefficient for the $4.00 marker was just short of significant, likely because prices did not rise that high on that many days. [Table 5] In period two, the crisis period, days where gasoline was below $2.00 were associated with increases in well-being, while days where gas prices were above $3.00 were associated with decreases in well-being. In this instance, it is likely that budget constraint effects dominated – not a surprise during the crisis. Finally, in period three, when the positive signaling effects of rising gasoline prices dominate in general, days that gas prices were below $2.00 per day were associated with decreases in well-being. Those decreases could be due to the price trends or to other un-observables in what was a rather complex time period.

As a final exercise, which aims to see if the effects of gasoline price increases have different effects on different elements of well-being, we replaced our left hand side variable – the best possible life question – with other measures of well-being which are more closely linked to mood and affect: smiling yesterday, reported depression, financial worries, and job worries. A simple visual look at the trends suggests that these variables do not correlate the same way with gasoline prices. [Figure 5] This is in keeping with our findings of the economic crisis on well-being: while reported happiness fluctuated very closely with markers of the economic crisis, our measures of affect were much steadier. This suggests that reported happiness is more closely connected with variance in environmental conditions – such as gasoline prices or market trends –

than are measure of affect, which are more closely related to innate character traits. Smiling yesterday and reporting depression are straightforward measures of affect. And questions such as "how worried are you about financial security?" or "job security", meanwhile, are also highly correlated with innate character traits. More simply put, less happy people are much more likely to report these concerns, regardless of objective conditions.

Our regression results confirm the simpler visual picture. We used each of these measures (separately) as the left hand side variable in our baseline regression, instead of happiness. The results support the proposition that these measures of affect are much steadier over time and less sensitive to contextual variables – such as gasoline price rises – than is reported well-being. Average national gasoline prices were positively correlated with smiling yesterday, negatively correlated with reported depression, and positively correlated with reporting financial and job worries. None of the variables, meanwhile, fluctuated much – if at all – over the three periods.[25] [See Table 6]

What is the magnitude of these well-being costs? How do the unhappiness costs of significant increases in gasoline prices compare to those of other phenomena? Happiness levels fell roughly 12% from their highest point of the period - February 20, 2008 – to their lowest point – November 16, 2008 – at the height of the economic crisis.

How much, in comparison, did the steep increases in gasoline prices "cost" happiness in the pre-crisis period? In other words, how much does an increase in gas prices "cost" in terms of happiness. This is essentially comparing the relative effects of gasoline price changes on happiness compared to the effects of changing from one income group to another on happiness.

We calculated the income equivalences of an increase in gasoline prices for the full period and then for the split sample time periods (pre, during, and post crisis), as well as comparing across our 10 income groups. In order to do this, we use the coefficients on both income and gasoline in a regression with happiness (BPL) on the left hand side, as well as the usual socio-demographic and economic controls on the right. We calculate the "value" of the coefficient on gasoline prices in terms of the amount of income that would be necessary to "cause" an equivalent decline in happiness.[26]

On average, for all income groups in the sample and for the full time period, a $1 increase in the national average price of gasoline caused (notionally) a decline in happiness which was equivalent to that caused (notional) by a loss of monthly income of $530. This result is clearly out of proportion to the actual economic impact that the change in gasoline prices had on particular households and therefore show a psychological element that is beyond just mere dollars and cents.[27] In order to place this figure in context of the larger costs of the crisis, it is worth comparing it to the income equivalent happiness cost of the 12% decline associated with the economic crisis. In that instance, the average happiness decline was equivalent to the loss caused by moving down four and a half income categories: for example, from a household income of approximately $4000 per month to one of approximately $300 per month.

The income equivalent declines in happiness related to gasoline vary a great deal, though, depending on what income group the respondent is in, as the effects of gasoline prices

[25] Job worry was only asked in 2008, unfortunately, so we only can report the results of that variable for period one.

[26] Mathematically, it works thus: 1) 1 unit [Δ income group] = α units Δ BPL ; 1 unit * x$ Δ income = α units BPL ; x$/α Δ income = 1 unit BPL ; 2) 1 unit Δ gas price = β units ΔBPL ; [x/α * β] Δ income = β units β Δ BPL = 1 unit Δ gas price

[27] "Energy" Gallup, Inc. http://gallup.com/poll/2167/energy.aspx. Surveys have indicated that Americans blame groups for high prices and feel manipulated, which can lead to anger, and the act of paying the groups seen responsible for higher prices can plausibly result in feelings of disgust. This might be one reason, for example, politicians resort to talking about American energy independence when gasoline prices are rising, to shift blame on foreign parties.

differ across our socio-economic cohorts. For the entire period on average (pre, during, and post crisis) this ranges from the happiness equivalent of a $4 decline in monthly income for the poorest respondents (in those households earning around $250 per month); to a $250 decline for those in the middle income groups; to more than a $1500 decline for those earning over $10,000 a month.[28] When these same equivalences are calculated in terms of percent age of monthly income, they display a U-shaped quality, being strongest at the bottom and the top of the distribution, ranging from 16% to 19% for some of the lower groups, to 10% for those in the middle, to 18% for those near the top. [See Table 7]

The happiness equivalent income declines were greater across all income cohorts during the exaggerated increase in gasoline prices during January 2007-September 2007; the equivalent income loss for this period was about $70 month (as opposed to $4) for the poorest to more than $2000 (as opposed to $1500) for the wealthiest during this period. Indeed, because of the steep changes in gas prices during this period, it dominates the overall trend in equivalence incomes for the combined three periods.

During the latter two periods, the effects of gasoline price changes on happiness were much more mixed. They were dwarfed by those of the economic crisis during the middle period, a time that gas prices were decreasing, and then rising gas prices had positive signaling effects for the higher income groups during the latter period. In the crisis period, for example, the effects of gas price increases on the poorest group were equivalent to a happiness loss of roughly $200 for the poorest (due to budget constraint effects) and a happiness *gain* of almost $1000 for the wealthiest, due to the positive signaling effects. In the final period, meanwhile, the positive signaling effects dominated for all groups except the low middle income category (monthly incomes between $500 and $1000). This group is likely both budget constrained and dependent on gasoline for work and transport. Still, because gasoline prices changed less during these periods, the negative effects of the first period outweigh the positive signaling effects of the later ones when we calculate the overall effects for the period.

It is important to interpret these income equivalence measures cautiously. They are the result of an econometric exercise which aims to place relative orders of magnitude on the effects of different variables. While it is a useful exercise that allows us to attach relative weights to the different variables, it might play out quite differently in real life terms. For example, while the average individual might be willing to trade off a certain amount of income – and related happiness - in the short term for all kinds of things, such as his/her children's education, the same individual might not be willing to trade for a lifetime spot in a lower income category.[29] In the same vein, our gasoline price effects have a very clear inter-temporal component. While increases in gasoline prices had positive signaling effects in the short term during very tumultuous economic times (at least for those who could afford them and were aware of the signals), they might have different effects if considered as permanent and/or during a more stable economic climate.

Conclusions and policy implications

Our most important and robust conclusion is that gasoline prices matter to well-being, above and beyond the importance of extraordinary macroeconomic trends. *How* the costs matter, though, depends on what they signal on the one hand, and on how budget constrained and dependent particular cohorts are.

[28] The income amounts for each group are calculated based on the mid-points of the two categories that form an income group: the midpoint is halfway between the bottom of the lowest category and the top of the highest category in the group. The ten income categories in the Gallup data are detailed above, and range from under $60 per month to over $10,000 a month. We arbitrarily but hopefully prudently chose $12,500 per month as the midpoint for the over $10,000 category.

[29] This point is eloquently made by Danny Kahneman and Angus Deaton in a new paper, based on Gallup Health-ways data: *"Does Money Buy Happiness….Or Just a Better Life?"* Mimeo. Princeton, NJ: Princeton University.

Lower income groups are more sensitive to the budget constraint channel while high income groups seem to be more sensitive to the signaling channel. The former have stronger budget constraints and the latter are typically more aware of market trends. This result supports our earlier work on the well-being effects of the crisis in general, in which we found that wealthier groups were more sensitive to events that signaled the onset of the crisis, as well as those that signaled the recovery. In addition to the effects of gasoline prices, those of the DJIA were modest: insignificant in the first period, significant and negative in the second, and modestly positive in the recovery period. While the negative effects of the DJIA in the crisis period crossed all groups, the positive (signaling) effects in the recovery period were only significant for the two wealthiest cohorts and not for the poorest.

Our analysis covers extraordinary economic times, times during which many people were likely more sensitive to economic signals than they typically would be, and usual budgetary concerns may have been overtaken by over-arching ones, such as job instability and mortgage foreclosure, particularly for middle and upper income groups. Our lowest income groups, on the other hand, were less sensitive to signals of the crisis and more sensitive to the budget channel – at least when it involved losses from rising gasoline prices. These findings are corroborated by our earlier work on crisis, in which we find that the most vulnerable groups seem too preoccupied with day to day vulnerability to notice financial market and other signals of either the onset of the crisis or of the recovery.

There were also state and regional differences, where respondents in some states and regions much more bothered by rising gasoline prices than those in others. These differences were driven, for the most part, by how dependent people were on gasoline and cars for transport, as well as how accustomed they were to high gasoline prices. Respondents in the Rocky Mountain region, for example, which has a very low population density and few plausible alternatives for transportation other than driving cars and trucks, were made unhappier by rising gasoline prices than those in any other region. Those in the East Coast, in contrast, who are less dependent on cars and closer to the country's financial market and policymaking centers, were much more sensitive to the signaling effects of the gasoline prices, and their linkages to the onset of the crisis and then to the recovery, than they were to budget constraint effects. Our findings on California and Texas were similar. Respondents in California, where VMT fluctuated a lot throughout the period, seem more sensitive to signaling effects, while those in Texas, who seem to have inelastic demand for gasoline, were more sensitive to the budget constraint channel.

We explored the channels through which gasoline prices could affect well-being. These were signaling and uncertainty effects on the one hand and threshold effects on the other. Our time trend findings suggest that signaling were at play, but that they were more important for upper income groups, who were more likely to be aware of the signals and less sensitive to budget constraint effects than were lower income groups. Our supporting work on the consumer sentiment index (CSI) suggests that what we are picking up as signaling effects of gasoline prices during the crisis and recovery periods also correlate with the CSI, and reflect innate optimism at a difficult time on the one hand and concerns about uncertainty on the other.

We found evidence of threshold effects as well. There were negative well-being effects associated with the days that gasoline prices were above $3.50 and $4.00 a gallon respectively, effects which were above and beyond those of general price trends, and robust to the inclusion of controls for un-observables related to particular dates. In contrast, we did not find much evidence of lower level threshold effects (for prices below $2.00 a gallon) – at least not in the expected direction. These low price dates coincided with the onset of the severe economic crisis, a phenomena which likely overwhelmed any effect of gasoline prices, positive or negative. One exception is during the recovery period, when the positive signaling effects of positive gas prices were dominant, and then the days when gas fell below $2.00 a gallon were associated with lower levels of well-being.

We also found – as expected - that reported well-being or happiness was more sensitive to changes in gasoline prices than were other measures of affect, such as smiling yesterday, reporting depression, or being worried about finances. As in the case of the crisis and well-being more generally, these measures are less sensitive to economic fluctuations and signals than is reported well-being. The former variables are measures of innate affect and typically fluctuate less than the latter. Our earlier research on the crisis, meanwhile, shows that respondents who are already depressed or vulnerable typically react less to signals of either its onset or of recovery, perhaps because they are already preoccupied with their problems, or perhaps because they were already more likely to be unhappy or worried regardless of objective conditions.

Finally, we attempted to attach a numerical value to the happiness "cost" of rising prices by calculating the amount of income that a respondent in a particular income category would need to give up or lose to cause an equivalent decline in happiness. On average for the entire sample and for the entire time period, the drops in happiness associated with rising gasoline prices were equivalent to those that would be caused by a loss in monthly household income of $530. The "costs" of the increases were the highest (at least in percentage income terms) for those at the bottom and at the top of the distribution. This is likely because of the strength of the budget constraint effects for the lower income groups and the signaling effect for the highest income groups. The effects were the strongest for the pre-crisis period, both because of the steep increase in prices and because the predominant well-being effects of the economic crisis had not set in yet.

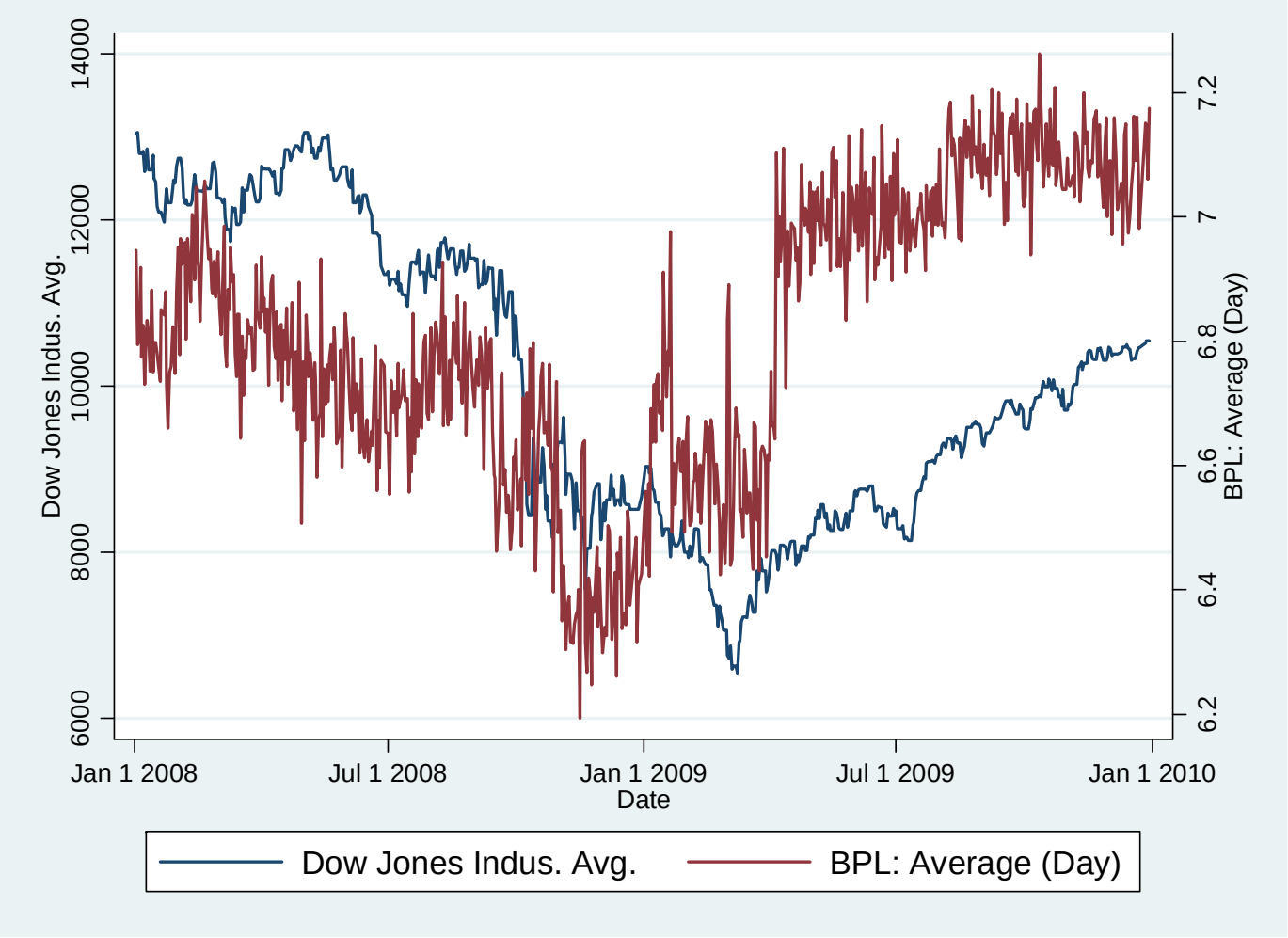
Implications for policy……

Our results suggest that gasoline prices are indeed closely correlated with well-being, and that these effects are above and beyond those of more general macroeconomic trends. They seem to operate through different channels for different groups, though, and this has obvious implications for policy.

It is also important to recognize the limits to what we can draw from our results given the exceptional nature of the period under study. While it makes intuitive sense – and is confirmed by our earlier research on the crisis – that wealthier groups are more sensitive to financial markets and to signaling effects, and that poorer groups are more sensitive to budget constraint effects, we cannot infer that gasoline price changes – and in particular rising prices – would have positive effects on the well-being of any income cohort during normal economic times. It is surely likely that the budget constraint effects would remain less important for higher income groups, but not that the signaling effects would operate the same positive way.

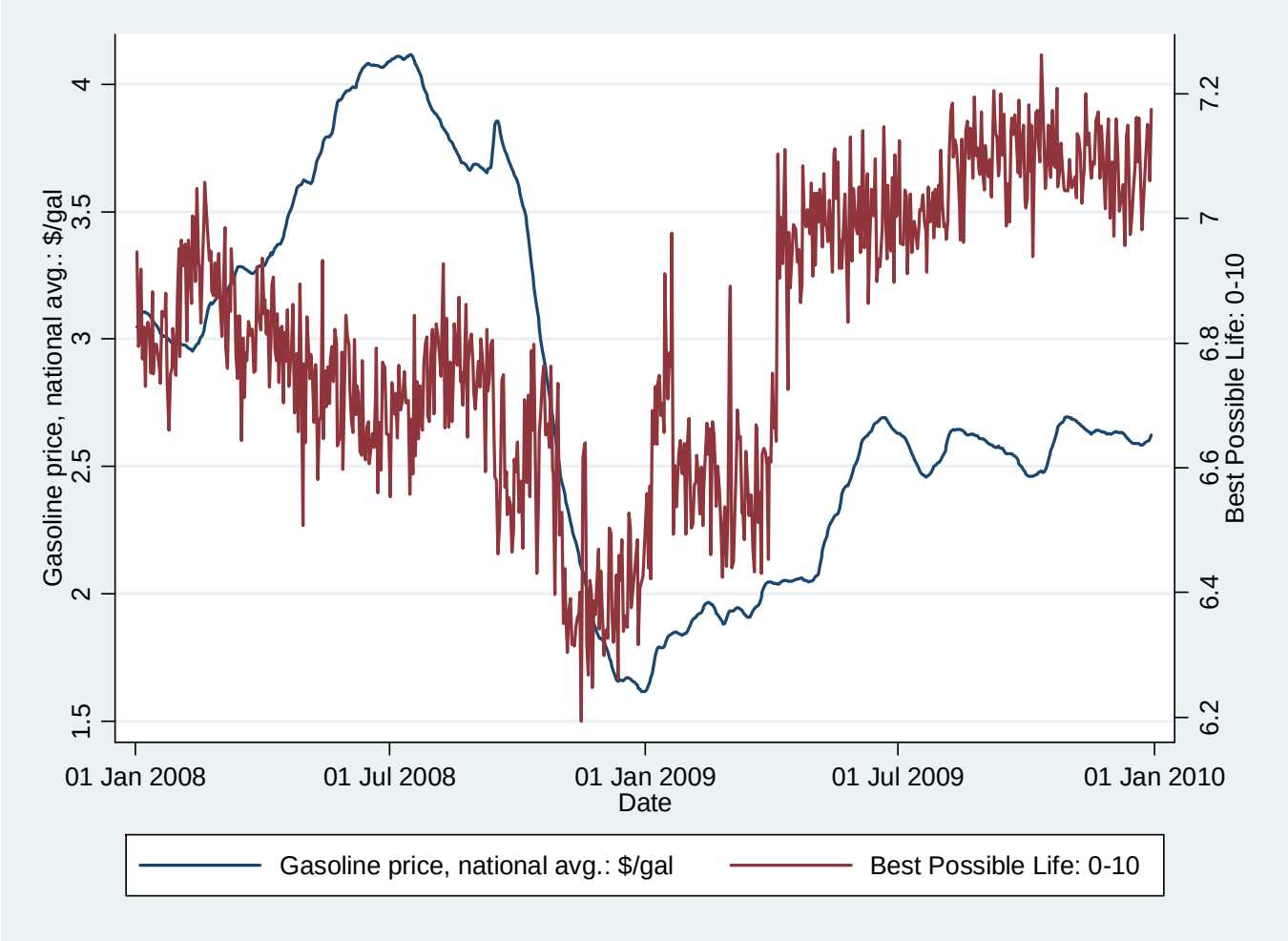
Still, all things being equal, the results of this study appears to explain the great political difficulty that would be involved in using large taxes on gasoline as a means to either stimulate energy conservation or reduce the national deficit. It similarly cautions against carbon policies that would link a fuel tax to potentially volatile changes in the prices for carbon in a pollution credits market. Finally, the results of this analysis may support policies that propel greater fuel efficient vehicles into the car fleet, thereby lessening the impact on well-being of changing gasoline prices. It might also argue for the consideration of incentives for major employers – such as the United States government – to offer ameliorating benefits, such as telecommuting days, during periods of fuel shortages.

Figure 1(a): Dow Jones Industrial Average and Average Daily BPL



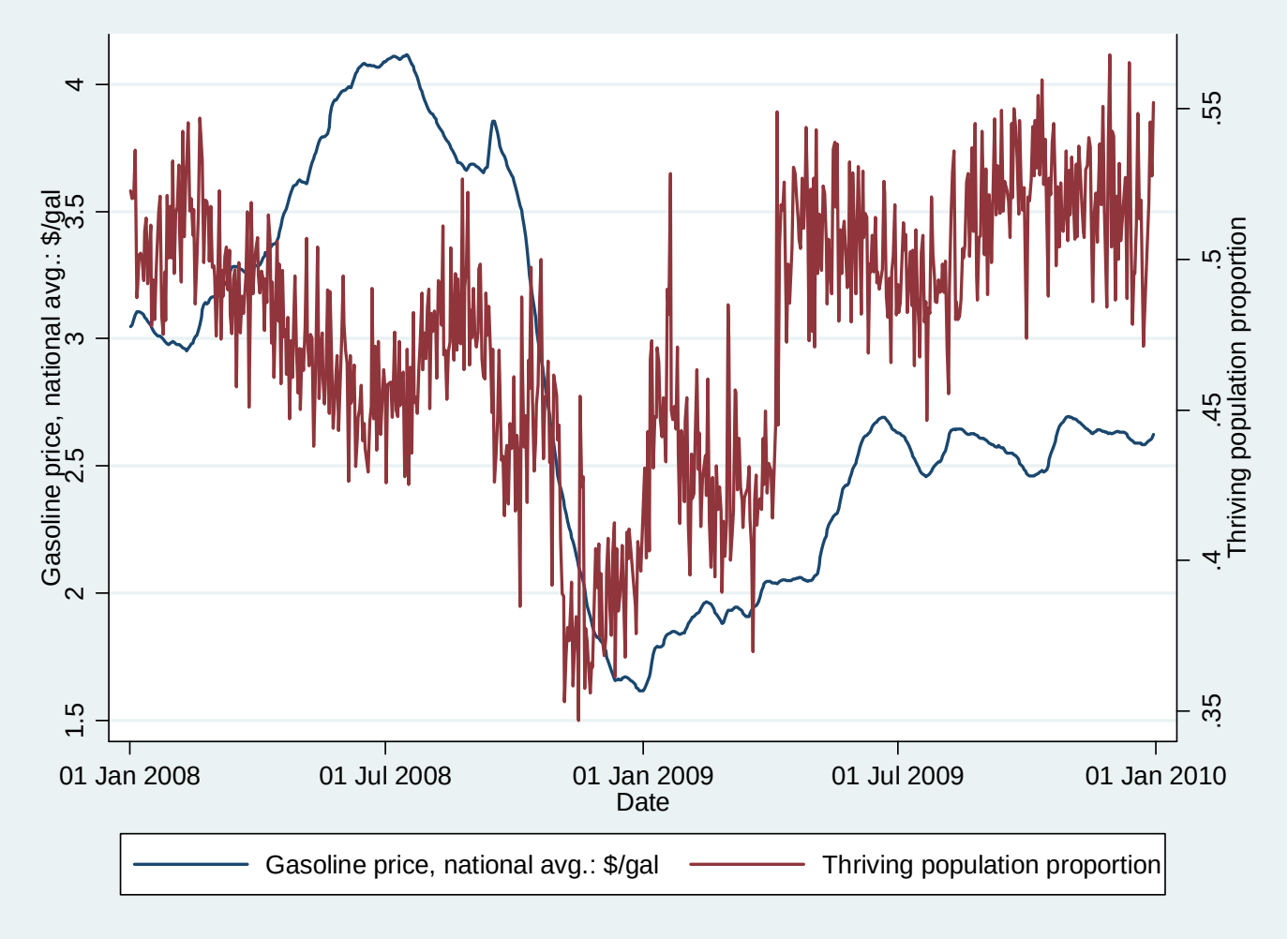
Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Figure 1(b): Average National Gasoline Price and Average Daily BPL



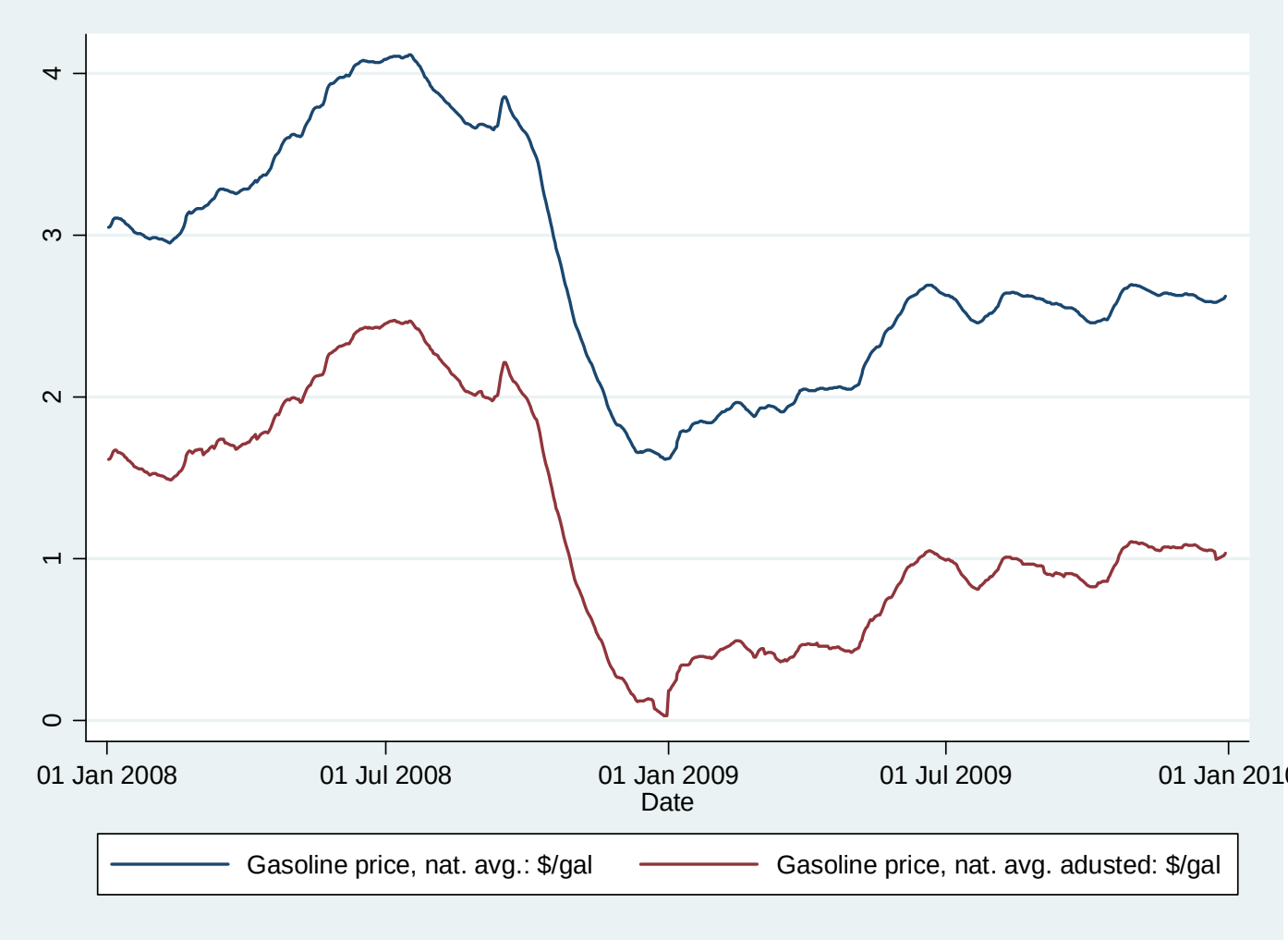
Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Figure 1(c): Average National Gasoline Price and Proportion of population deemed "thriving"



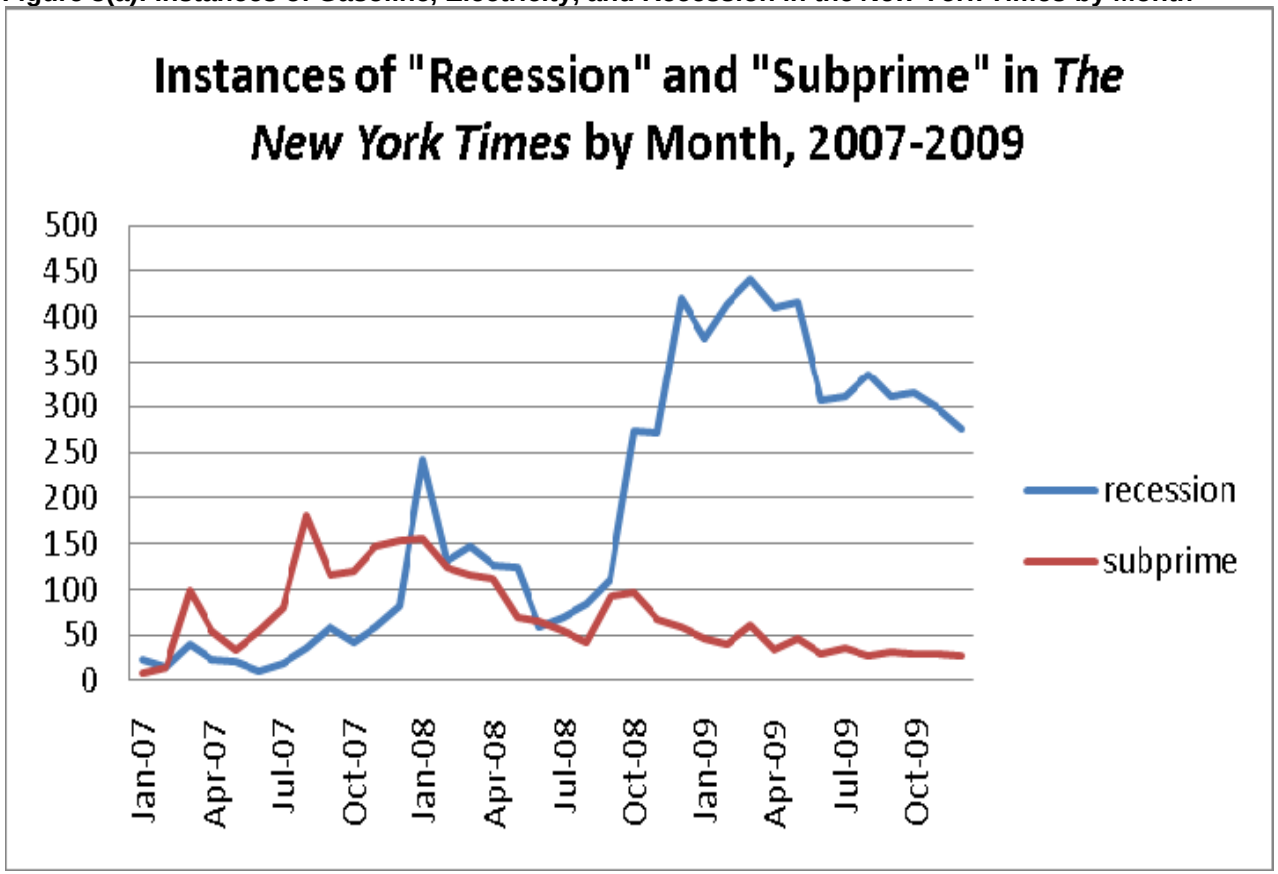
Source: Authors' calculations based on Oil Price Information Service (US Energy Information Administration).

Figure 2: Average National Unleaded Gasoline Price: Actual versus Adjusted



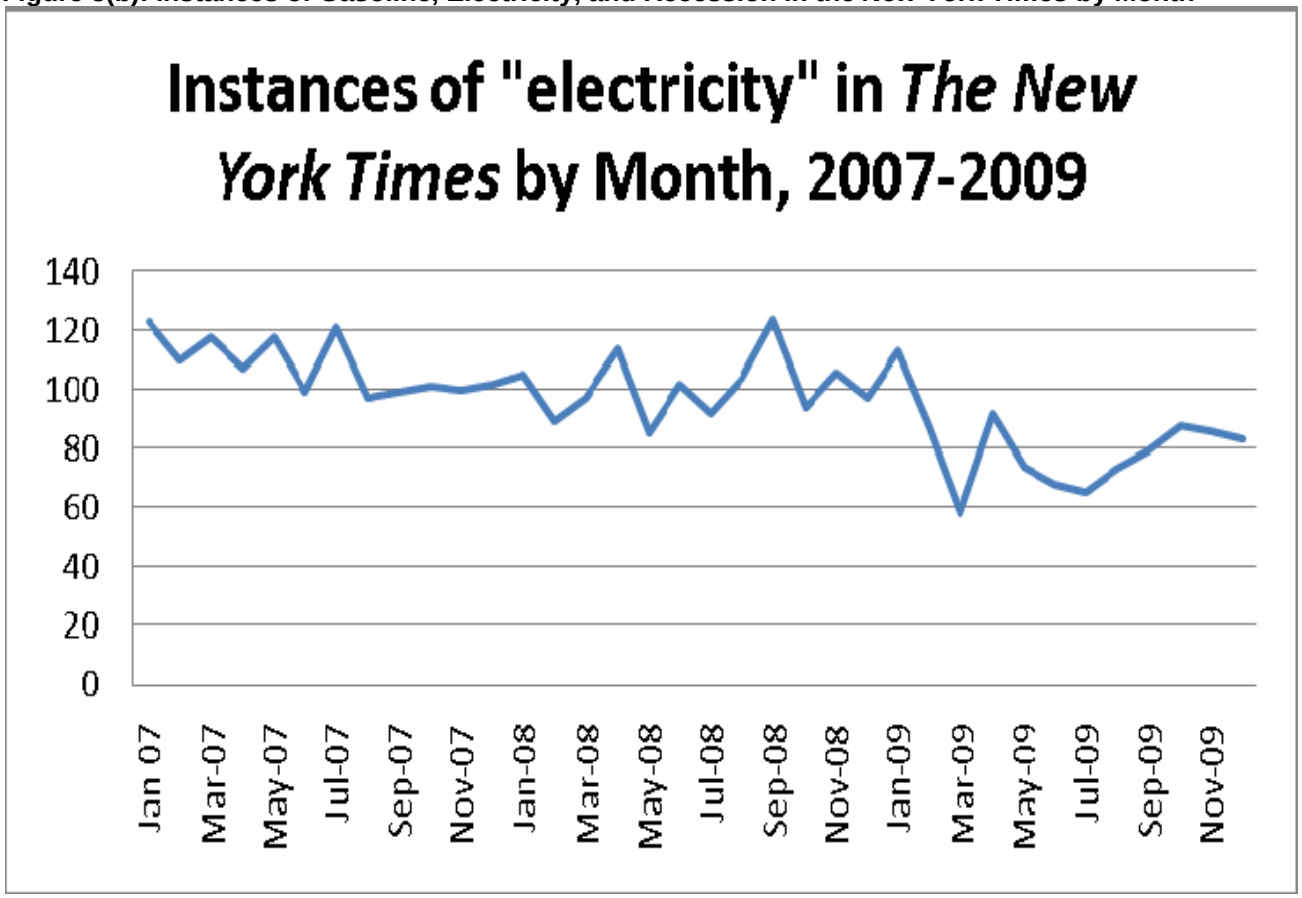
Source: Authors' calculations based on Oil Price Information Service (US Energy Information Administration).

Figure 3(a): Instances of Gasoline, Electricity, and Recession in the *New York Times* by Month



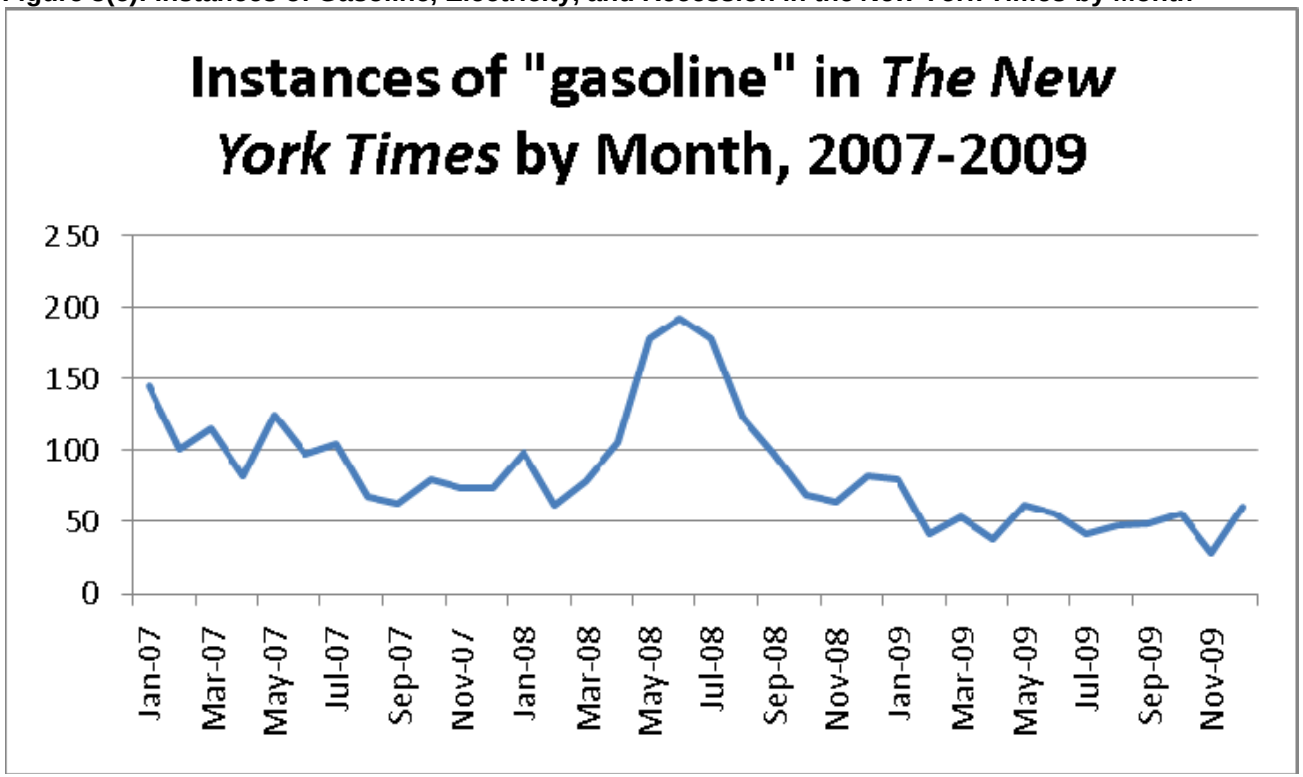
Source: Based on statistics from The New York Times.

Figure 3(b): Instances of Gasoline, Electricity, and Recession in the *New York Times* by Month



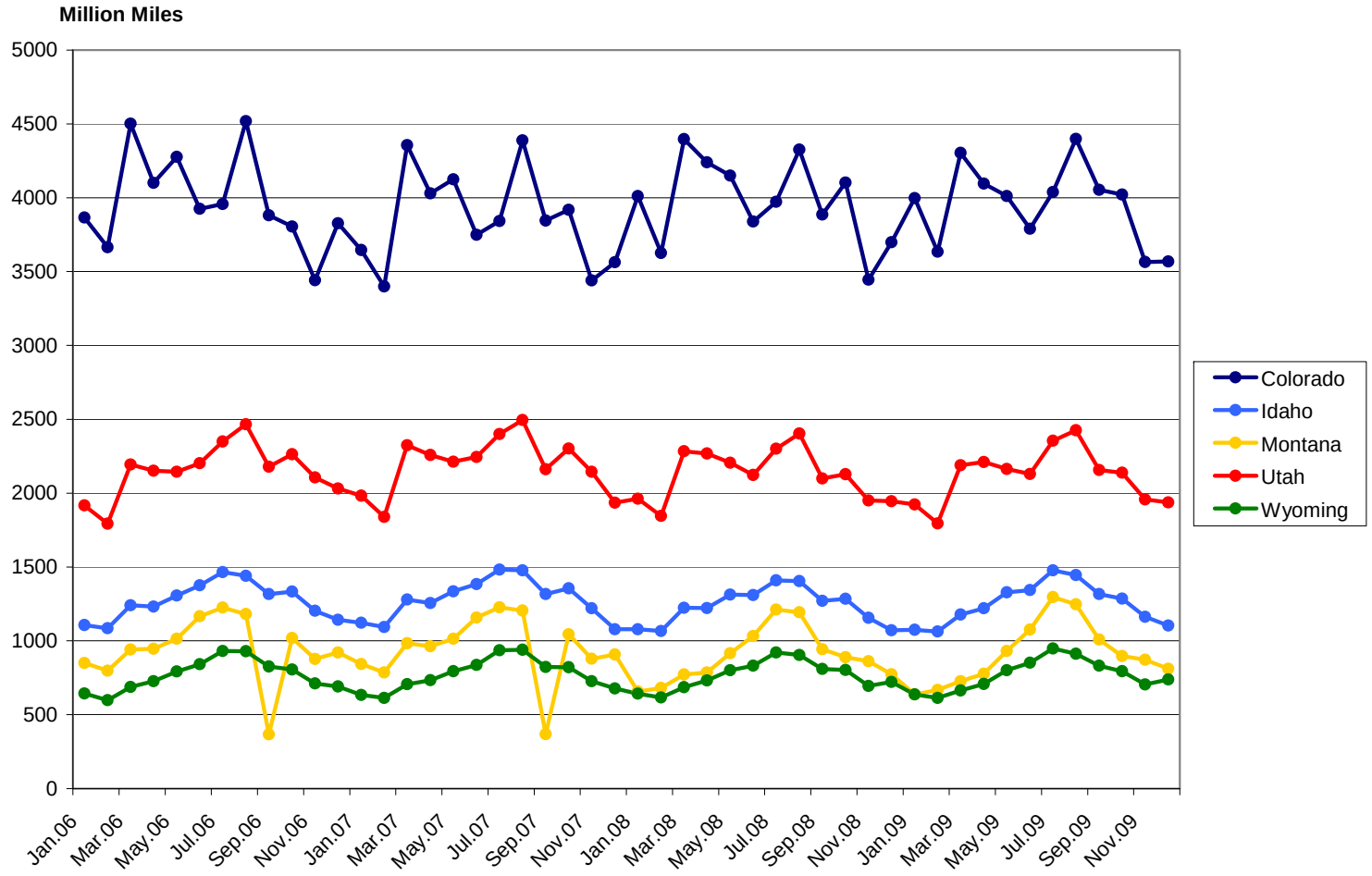
Source: Based on statistics from The New York Times.

Figure 3(c): Instances of Gasoline, Electricity, and Recession in the *New York Times* by Month



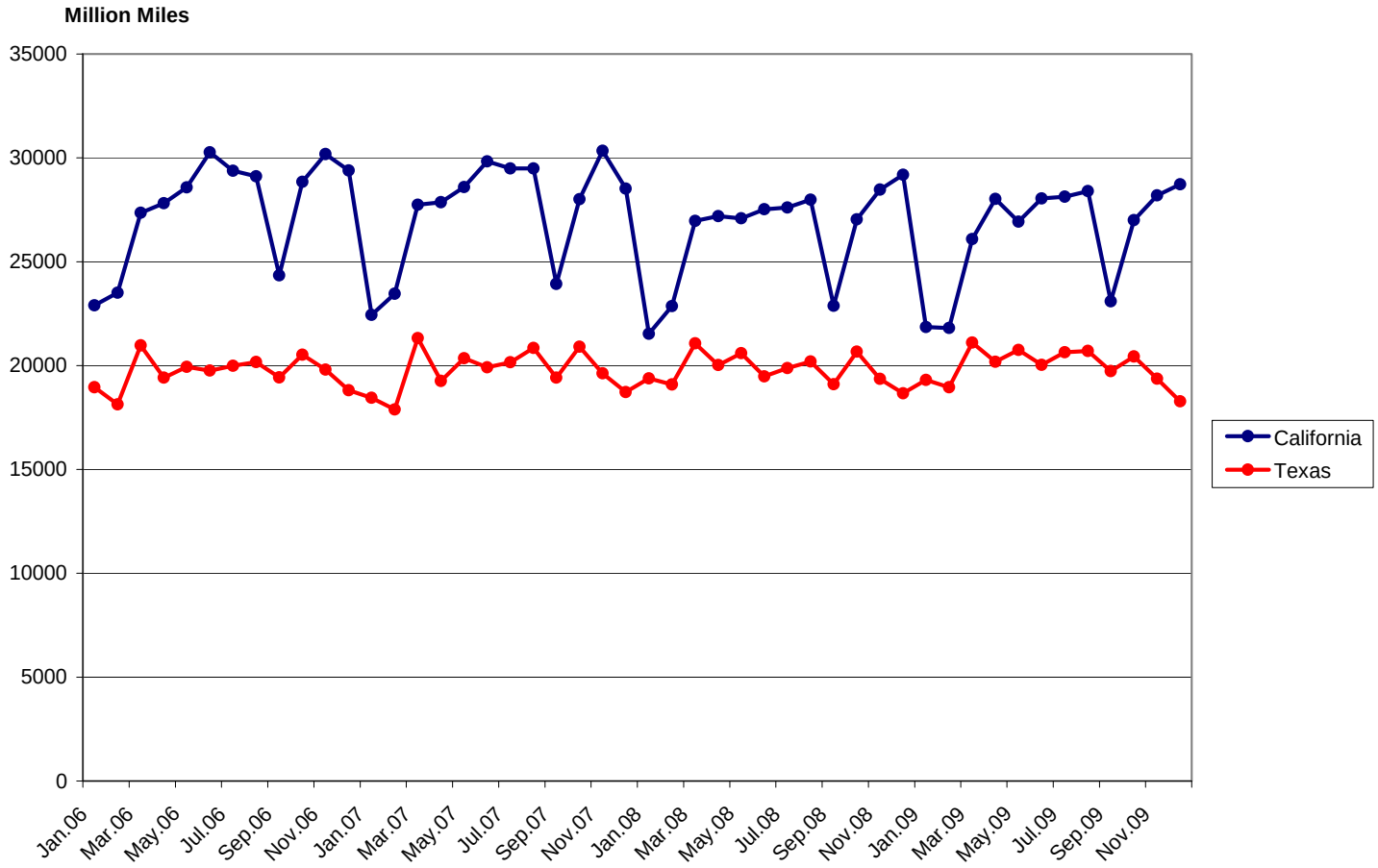
Source: Based on statistics from The New York Times.

Figure 4(a): Vehicle Miles Traveled in the Rocky Mountain States



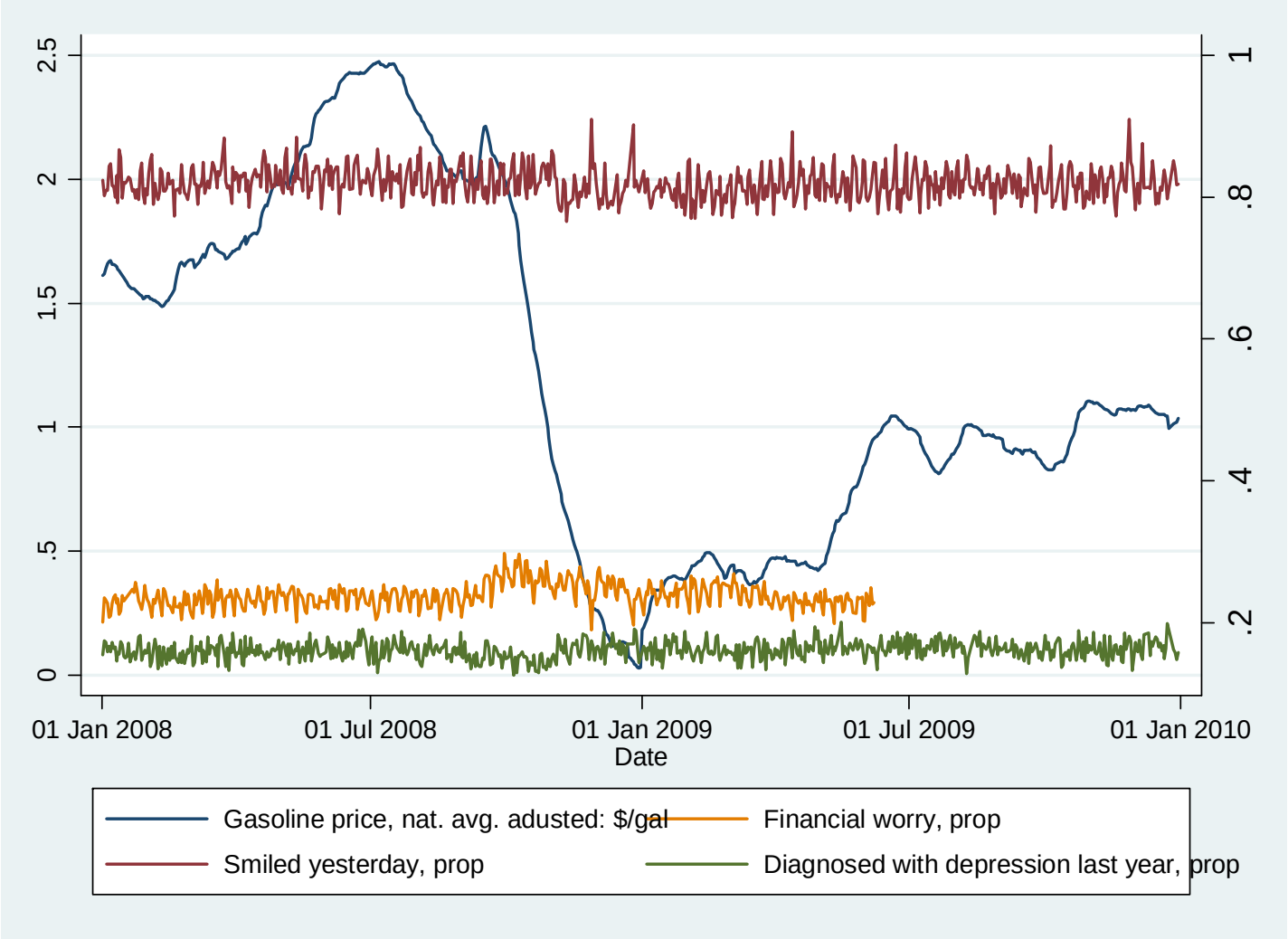
Source: Based on data from US Department of Transportation Federal Highway Authority statistics.

Figure 4(b): Vehicle Miles Traveled: California and Texas



Source: Based on data from US Department of Transportation Federal Highway Authority statistics.

Figure 5: Average National (Adjusted) Gasoline Price Gasoline Prices and Affect Measures, Financial Worry, Etc.



Source: Authors' calculations based on Oil Price Information Service (US Energy Information Administration).

Tables 1(a) – (d): Effect of gasoline prices on well-being (all periods and in each period)

	1(a)	1(b)	1(c)	1(d)
	All periods	**Period 1**	**Period 2**	**Period 3**
	Dependent variable (Best possible life, 0-10)			
Age	-0.068***	-0.071***	-0.073***	-0.063***
	[0.001]	[0.001]	[0.002]	[0.001]
Age Squared	0.001***	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.246***	-0.209***	-0.195***	-0.318***
	[0.005]	[0.008]	[0.010]	[0.008]
Marital Status (1=Married)	0.265***	0.273***	0.204***	0.305***
	[0.005]	[0.009]	[0.011]	[0.009]
Dow Jones Indus. Avg.	0.000***	0.000	-0.000***	0.000***
	[0.000]	[0.000]	[0.000]	[0.000]
Gasoline price (national avg. adjusted $/gal)	-0.093***	-0.199***	0.104***	0.100***
	[0.007]	[0.015]	[0.011]	[0.027]
Household income group 0-10	0.221***	0.239***	0.234***	0.203***
	[0.001]	[0.002]	[0.002]	[0.002]
Observations	*532636*	*186938*	*139422*	*206276*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 1(e): Effect of gasoline prices on well-being (pre-crisis, crisis, and recovery periods)

	Dependent variable (Best possible life, 0-10)		
Age	-0.068***	-0.068***	-0.068***
	[0.001]	[0.001]	[0.001]
Age Squared	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.246***	-0.247***	-0.247***
	[0.005]	[0.005]	[0.005]
Marital Status (1=Married)	0.265***	0.267***	0.266***
	[0.005]	[0.005]	[0.005]
Household income group 0-10	0.221***	0.223***	0.223***
	[0.001]	[0.001]	[0.001]
Gasoline price (national avg. adjusted $/gal)	-0.093***	-0.039***	0.005
	[0.007]	[0.007]	[0.008]
Dow Jones Indus. Avg.	0.000***	0.000***	0.000***
	[0.000]	[0.000]	[0.000]
Dummy Var: Period 1 (Pre-crisis)		-0.312***	-0.200*
		[0.011]	[0.110]
Dummy Var: Period 2 (Crisis)		-0.436***	0.493***
		[0.006]	[0.059]
Dow Jones Indus Avg * Period 1 interaction			-0.000**
			[0.000]
Dow Jones Indus Avg * Period 2 interaction			-0.000***
			[0.000]
Observations	*532636*	*532636*	*532636*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Period 3: Recovery is the control period

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 2(a): Proportion of household expenditure on gasoline

Percent of Consumption Spent on Gasoline and Motor Oil by Income Quintile and Region, 2008

By Quintile

Q1 = 5.57%
Q2 = 6.36%
Q3 = 6.34%
Q4 = 5.83%
Q5 = 4.32%

By Region

Northeast = 4.34
Midwest = 5.57
South = 6.27
West = 4.83

Source: Authors' calculations based on Department of Labor and Department of Commerce statistics

Table 2(b): Effect of gasoline prices by different income cohorts in each period

	Period 1	Period 2	Period 3
	Dependent variable (Best possible life, 0-10)		
Age	-0.069***	-0.059***	-0.059***
	[0.001]	[0.002]	[0.001]
Age Squared	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.201***	-0.140***	-0.306***
	[0.008]	[0.010]	[0.008]
Marital Status (1=Married)	0.319***	0.395***	0.360***
	[0.009]	[0.010]	[0.009]
Dow Jones Indus. Avg.	0.000	-0.000***	0.000***
	[0.000]	[0.000]	[0.000]
Gas Price for Low Income Group	-0.532***	-0.367***	-0.507***
	[0.015]	[0.014]	[0.028]
Gas Price for Middle Income Group	-0.152***	0.162***	0.232***
	[0.015]	[0.012]	[0.028]
Gas Price for High Income Group	0.128***	0.560***	0.714***
	[0.015]	[0.014]	[0.029]
Observations	*186938*	*139422*	*206276*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 3(a): Comparison of US average to California and Texas

	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
	Entire US data			*Only CA respondents*			*Only TX respondents*		
	Dependent variable (Best possible life, 0-10)								
Age	-0.068***	-0.059***	-0.059***	-0.067***	-0.067***	-0.068***	-0.062***	-0.060***	-0.051***
	[0.001]	[0.002]	[0.001]	[0.004]	[0.005]	[0.004]	[0.006]	[0.007]	[0.005]
Age Squared	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.201***	-0.140***	-0.305***	-0.221***	-0.183***	-0.300***	-0.210***	-0.212***	-0.360***
	[0.008]	[0.010]	[0.008]	[0.026]	[0.029]	[0.024]	[0.035]	[0.042]	[0.033]
Marital Status (1=Married)	0.320***	0.394***	0.359***	0.325***	0.245***	0.376***	0.349***	0.223***	0.305***
	[0.009]	[0.010]	[0.009]	[0.027]	[0.032]	[0.026]	[0.039]	[0.046]	[0.037]
Dow Jones Indus. Avg.	0.000	-0.000***	0.000***	0.000	0.000	0.000	-0.000***	0.000	0.000**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gas Price for Low Income Group	-0.532***	-0.365***	-0.508***						
	[0.015]	[0.014]	[0.028]						
Gas Price for Middle Income Group	-0.152***	0.164***	0.232***						
	[0.015]	[0.012]	[0.028]						
Gas Price for High Income Group	0.126***	0.561***	0.714***						
	[0.015]	[0.014]	[0.029]						
Dummy: CA	0.065***	0.025*	-0.032**						
	[0.013]	[0.015]	[0.013]						
Dummy: TX	0.160***	0.215***	0.143***						
	[0.018]	[0.021]	[0.017]						
Gas Price in CA for Low Income Group				-0.312***	-0.242***	-0.036			
				[0.032]	[0.032]	[0.060]			
Gas Price in CA for Middle Income Group				-0.132***	0.020	0.179***			
				[0.032]	[0.031]	[0.060]			
Gas Price in CA for High Income Group				0.020	0.244***	0.350***			
				[0.032]	[0.031]	[0.060]			
Gas Price in TX for Low Income Group							-0.405***	-0.279***	-0.255**
							[0.053]	[0.049]	[0.108]
Gas Price in TX for Middle Income Group							-0.232***	0.017	0.034
							[0.052]	[0.048]	[0.108]
Gas Price in TX for High Income Group							-0.053	0.270***	0.223**
							[0.052]	[0.050]	[0.108]
Observations	*186938*	*139422*	*206276*	*20002*	*14968*	*22358*	*10540*	*7466*	*12169*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 3(b): Comparison of gasoline price effects by geographic regions

	Dependent variable (Best possible life, 0-10)									
	Adjusted weekly average gasoline prices					**Adjusted weekly average gasoline prices**				
Age	-0.062***	-0.076***	-0.060***	-0.078***	-0.068***	-0.062***	-0.076***	-0.060***	-0.078***	-0.068***
	[0.001]	[0.002]	[0.003]	[0.004]	[0.002]	[0.002]	[0.002]	[0.003]	[0.005]	[0.002]
Age Squared	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.231***	-0.230***	-0.288***	-0.268***	-0.262***	-0.231***	-0.230***	-0.288***	-0.268***	-0.262***
	[0.008]	[0.009]	[0.015]	[0.024]	[0.011]	[0.010]	[0.012]	[0.018]	[0.023]	[0.014]
Marital Status (1=Married)	0.251***	0.252***	0.228***	0.333***	0.302***	0.251***	0.252***	0.228***	0.333***	0.302***
	[0.009]	[0.011]	[0.017]	[0.027]	[0.012]	[0.010]	[0.012]	[0.019]	[0.029]	[0.014]
Dow Jones Indus. Avg.	0.215***	0.239***	0.208***	0.230***	0.215***	0.215***	0.239***	0.208***	0.230***	0.215***
	[0.002]	[0.002]	[0.004]	[0.006]	[0.003]	[0.003]	[0.003]	[0.004]	[0.007]	[0.003]
Gasoline price (national avg. adjusted $/gal)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.000	0.000*	0.000**	0.000**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gas Price for East region (adjusted)	-0.084***					-0.084				
	[0.011]					[0.056]				
Gas Price for Midwest region (adjusted)		-0.061***					-0.061			
		[0.013]					[0.064]			
Gas Price for Gulf region (adjusted)			-0.057***					-0.057		
			[0.021]					[0.046]		
Gas Price for Rocky Mountain region (adjusted)				-0.149***					-0.149**	
				[0.030]					[0.060]	
Gas Price for West region (adjusted)					-0.026*					-0.026
					[0.015]					[0.046]
Clustered (weekly)	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	*201544*	*146776*	*58227*	*23214*	*101436*	*201544*	*146776*	*58227*	*23214*	*101436*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 4: Effect of Consumer Sentiment Index

	All periods	Period 1	Period 2	Period 3	All periods	Period 1	Period 2	Period 3
	Dependent variable (Best possible life, 0-10)							
Age	-0.068***	-0.071***	-0.073***	-0.063***	-0.068***	-0.071***	-0.073***	-0.063***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]
Age Squared	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.246***	-0.209***	-0.196***	-0.318***	-0.246***	-0.209***	-0.195***	-0.319***
	[0.013]	[0.008]	[0.019]	[0.009]	[0.014]	[0.008]	[0.019]	[0.009]
Marital Status (1=Married)	0.266***	0.273***	0.204***	0.305***	0.266***	0.273***	0.204***	0.305***
	[0.011]	[0.008]	[0.012]	[0.012]	[0.011]	[0.008]	[0.012]	[0.012]
Household income group (0-10)	0.222***	0.239***	0.234***	0.203***	0.222***	0.239***	0.234***	0.203***
	[0.004]	[0.003]	[0.006]	[0.002]	[0.004]	[0.003]	[0.006]	[0.002]
Dow Jones Indus. Avg.	0.000	0.000	-0.000***	0.000*	0.000	-0.000**	-0.000***	0.000**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gasoline price (national avg. adjusted $/gal)	0.037	-0.266***	0.103*	0.054	0.052	-0.127***	-0.024	-0.044
	[0.099]	[0.056]	[0.057]	[0.093]	[0.089]	[0.041]	[0.062]	[0.100]
Consumer Sentiment Index	0.025***	-0.003*	0.012	0.013*	0.029***	0.004*	0.036***	0.018*
	[0.006]	[0.002]	[0.009]	[0.008]	[0.006]	[0.002]	[0.011]	[0.009]
Change in Consumer Sentiment Index					-0.009	-0.008***	-0.017***	-0.006
					[0.007]	[0.003]	[0.006]	[0.004]
Clustered by month	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	*532636*	*186938*	*139422*	*206276*	*532636*	*186938*	*139422*	*206276*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009, University of Michigan-Reuters Data, and Oil Price Information Service (US Energy Information Administration).

Table 5: Threshold Effects at $2.0/gallon, $3.0/gallon, $3.5/gallon and $4.0/gallon gas prices

	All periods	All periods	Period 1	Period 2	Period 3
	Dependent variable (Best possible life, 0-10)				
Age	-0.037***	-0.060***	-0.069***	-0.059***	-0.059***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]
Age Squared	0.000***	0.001***	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.174***	-0.215***	-0.201***	-0.140***	-0.306***
	[0.004]	[0.005]	[0.008]	[0.010]	[0.008]
Marital Status (1=Married)	0.546***	0.382***	0.320***	0.395***	0.361***
	[0.005]	[0.005]	[0.009]	[0.010]	[0.009]
Dow Jones Indus. Avg.	0.000***	0.000***	0.000	-0.000***	0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gasoline price (national avg. adjusted $/gal)	0.072***				
	[0.013]				
Gas Price in CA for Low Income Group		-0.316***	-0.407***	-0.114***	-0.551***
		[0.015]	[0.045]	[0.031]	[0.028]
Gas Price in CA for Middle Income Group		0.122***	-0.026	0.415***	0.188***
		[0.015]	[0.045]	[0.030]	[0.028]
Gas Price in CA for High Income Group		0.440***	0.254***	0.813***	0.670***
		[0.015]	[0.045]	[0.031]	[0.029]
Dummy: Gas Price below $2/gallon	-0.309***	-0.310***		0.222***	-0.322***
	[0.009]	[0.010]		[0.022]	[0.030]
Dummy: Gas Price above $3/gallon	-0.259***	-0.268***	-0.049***	-0.177***	
	[0.011]	[0.012]	[0.017]	[0.032]	
Dummy: Gas Price above $3.5/gallon	-0.122***	-0.124***	-0.061***	-0.151***	
	[0.010]	[0.011]	[0.021]	[0.032]	
Dummy: Gas Price above $4/gallon	-0.045***	-0.024*	-0.025		
	[0.011]	[0.012]	[0.019]		
Observations	*695832*	*532636*	*186938*	*139422*	*206276*

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 6: Effects of gasoline price changes on alternative affect traits

	All Periods						Period 1
Dependent Variables	**Smiled yesterday (0-1)**		**Diagnosed with depression (0-1)**		**Financial worry (0-1)**		**Job worry (0-1)**
Age	-0.024***	-0.030***	0.039***	0.048***	0.021***	0.032***	0.044***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.004]
Age Squared	0.000***	0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender (1=Male, 0=Female)	-0.090***	-0.093***	-0.303***	-0.309***	-0.107***	-0.110***	0.057***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.006]	[0.018]
Marital Status (1=Married)	0.224***	0.181***	-0.366***	-0.269***	-0.166***	-0.090***	-0.207***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.006]	[0.007]	[0.018]
Dow Jones Indus. Avg.	0.000	0.000	0.000	0.000*	-0.000***	-0.000***	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gasoline price (national avg. adjusted $/gal)	0.024***		-0.014***		0.078***		0.076**
	[0.005]		[0.005]		[0.006]		[0.034]
Gas Price for Low Income Group		-0.060***		0.131***		0.223***	
		[0.006]		[0.006]		[0.008]	
Gas Price for Middle Income Group		0.068***		-0.090***		0.027***	
		[0.006]		[0.006]		[0.008]	
Gas Price for High Income Group		0.095***		-0.183***		-0.045***	
		[0.006]		[0.007]		[0.008]	
Constant	1.413***	1.551***	-1.529***	-1.769***	0.077***	-0.185***	-1.897***
	[0.021]	[0.024]	[0.022]	[0.025]	[0.029]	[0.034]	[0.371]
Observations	*695271*	*531960*	*698514*	*533900*	*255931*	*198014*	*53972*

Standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).

Table 7: Income equivalence of gasoline price changes (between select income groups)

Income equivalences	All income groups	Inc group 1-2	Inc group 5-6	Inc group 6-7	Inc group 8-9	Inc group 9-10
All periods						
Inc. Eq. (gp midpoints)	-$529.09	-$3.53	-$276.95	-$467.69	-$1,359.49	-$1,617.47
Inc. Eq. % of income (gp midpoints)	-7.1%	-1.4%	-9.2%	-11.7%	-18.1%	-14.4%
Period 1						
Inc. Eq. (gp midpoints)	-$1,039.40	-$68.90	-$587.44	-$633.55	-$2,195.00	-$2,871.01
Inc. Eq. % of income (gp midpoints)	-13.9%	-27.6%	-19.6%	-15.8%	-29.3%	-25.5%
Period 2						
Inc. Eq. (gp midpoints)	$556.86	-$212.72	$422.79	$298.36	$620.42	$1,273.64
Inc. Eq. % of income (gp midpoints)	7.4%	-85.1%	14.1%	7.5%	8.3%	11.3%
Period 3						
Inc. Eq. (gp midpoints)	$614.82	$422.05	$315.26	$72.80	$2,285.90	$2,354.04
Inc. Eq. % of income (gp midpoints)	8.2%	168.8%	10.5%	1.8%	30.5%	20.9%

Source: Authors' calculations based on Gallup Daily Poll, 2008-2009 and Oil Price Information Service (US Energy Information Administration).