Economics Bulletin

Volume 43, Issue 1

The labor market effects of gas price fluctuations

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Abstract

In this paper, we examine the impact of gas price fluctuations on individuals' labor market outcomes. Using the two-way fixed effects and instrumental variable approaches, we find evidence that an uptick in the retail gasoline price increases the likelihood of being employed and the number of hours worked each week. In addition, our results suggest that the effects are largest for young adults, men, unmarried individuals, and those who possess lower levels of educational attainment.

We are thankful for the insightful comments offered by our colleagues and the excellent research assistance provided by Marta Fuentes Suarez, Joseph Sarracino, and Alexander Vega Soto. All remaining errors are our own.
Citation: Nicholas A Wright and Alvin Harris, (2023) "The labor market effects of gas price fluctuations", *Economics Bulletin*, Volume 43, Issue 1, pages 328-341
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Submitted: December 21, 2021. **Published:** March 30, 2023.

1 Introduction

The United States is considered to be one of the most "automobile-friendly" countries, with 76% of workers privately commuting to work (Severen and Van Benthem, 2019) and more than 60% of households owning at least two motor vehicles (Giuliano and Dargay, 2006). This clear preference for private commute indicates that Americans have a dependency on gasoline and thus, may be sensitive to gasoline price fluctuations. The cost of transportation is a significant share of households' total spending, and this cost places an even higher burden on lower-income families (Institute of Transportation & Development Policy, 2019). The average American household spends approximately 13% (or $9,737) of their budget on transportation, and about 21% of this transportation cost is spent on gasoline. However, the burden of transportation-related expenses varies across income groups. For example, households in the bottom quintile spend about 30% of their average earnings on transportation, while this share is about 16% for those in the third quintile.

Several studies have examined the impact of gas prices on individuals' behavior (Gelman et al., 2022, Hirte and Tscharaktschiew, 2020, Severen and Van Benthem, 2019, West and Williams III, 2007). For instance, Severen and Van Benthem (2019) examined the long-term impact of the 1979 oil price shock on individuals' preference for private and public commuting options. They found that individuals who came of driving age during the oil crises of the 1970s are more likely to opt for public transit over private commute. Similarly, West and Williams III (2007) found that a 10% increase in gasoline prices would decrease gas consumption by 4.3% and increase hours worked by 0.07% or about 2 hours each year. While the literature demonstrates that individuals may alter their behavior in response to oil price shocks, there is limited empirical evidence on the impact of gasoline price fluctuations on individuals' labor market outcomes.[1]

In this paper, we utilize data on gasoline prices from the U.S. Energy Information Administration (EIA) and labor market outcomes from the Current Population Survey (CPS) to examine the impact of gas price fluctuations on individuals' labor force participation status, unemployment status, and the number of hours worked. We make two contributions to the literature (i) this study is one of

[1]In the online appendix, we provide a simple labor supply model to illustrate how changes in gasoline prices may impact individuals' labor supply decision. In particular, the model suggests that an increase in gas prices reduce leisure demand and increase the number of hours worked. There are other potential mechanisms through which gas price fluctuations may affect individuals' labor market outcomes. For example, gasoline price increases may reduce the amount of time driving, especially for leisurely activities (Alberini et al., 2021, Chi et al., 2015). West and Williams III (2007) argues that because the demand for leisure driving is more elastic than the demand for work-related driving, an increase in gasoline prices would make leisure driving more expensive, reduce the time spent in leisurely activities, and encourage people to work more.

the few studies to estimate the impact of gasoline price changes on individuals outcome in the labor market, and (ii) our study examines how various sub-groups adjust their labor market engagement when the gas price changes. Our results suggest that an increase in the retail price of gasoline increases the likelihood of being employed and the number of hours worked. In addition, we find that these effects are largest for young adults, men, unmarried individuals, and those who possess lower levels of education. Our study provides some important insights for policymakers on the implications of higher fuel prices. This is timely given the debate about reducing fossil fuel use and recent significant increases in fuel prices. On the one hand, climate action advocates have lobbied for cuts in crude oil production and reduced global emissions to address the risk posed by climate change. Some scholars have argued for carbon taxes and investments in renewable energy to achieve these goals (Metcalf, 2019). On the other hand, recent increases in fuel prices due to government policy and international conflict have increased the hardship faced by poor households and, in some cases, have resulted in social unrest. For instance, after higher fuel taxes was announced in France in 2018, the Yellow Vest Movement was formed to highlight the negative impact of the policy on households' purchasing power and to protest the implementation of this fuel price hike (Douenne and Fabre, 2022). In more recent times, as economies recovered from the COVID pandemic, increased oil demand, and the war between Russia and Ukraine have resulted in rapidly rising fuel prices (Liadze et al., 2022).[2] These gas price changes will have a significant impact on workers who are already participating in a tight labor market – some groups being more affected than others. Our study will help policymakers think about the aggregate impact and distributional effects of these changes.

2 Data and Econometric Approach

2.1 Data

In this study, we use individual-level data from the Current Population Survey (CPS) to construct the main outcomes of interest. The CPS is the primary source of data on the US labor market

[2]In a statement on March 31, 2022; the White House argued that "when COVID struck, demand for oil plummeted, so production slowed down worldwide. Because of the strength and the speed of our recovery, demand for oil shot back up much faster than the supply. That's why the cost of gas began to rise last year". They also argued that "at the start of this year, gas was about $3.30 a gallon. Today, it's about — averaging $4.20, $4.22. It's higher in many states. Nearly a dollar more in less than three months. And the reason for that is because of Putin's war" (White House, 2022).

because it regularly surveys a representative sample of households across the US. The survey is collected monthly and includes various measures of labor market engagement. The outcomes we examine include labor force participation, employment status, and the number of hours worked each week. To complete our data set, we also collect state-by-month data on the average nominal retail price of gasoline and temperature from the US Energy Information Administration (EIA) and the National Oceanic and Atmospheric Administration, respectively. Our final sample includes about 11.5 million individuals that were surveyed over the period 2000-2010.[3]

Table 1 shows the mean and standard deviation of several variables that are included in the model. In addition, Figure 1 shows that there is a high degree of variation in the average price of gasoline across states and over time. The graph also suggests that while gasoline prices are procyclical, there is a strong upward trend in this variable over the period.

2.2 Econometric Approach

In this paper, we utilize the two-way fixed effects (TWFE) model to estimate the impact of gas price fluctuations on individuals' labor market outcomes. Our empirical specification can be expressed as follows:

$$Y_{ist} = \alpha_0 + \alpha_1 RGP_{st} + \alpha_2 X_{ist} + \gamma_t + \gamma_s + \epsilon_{ist},$$

where i, s, t indexes individuals, states, and time (month-by-year level), respectively. The outcome variable of interest, Y_{ist}, captures each individuals' labor market participation status, unemployment status, and the number of hours worked each week. RGP_{st} is the contemporaneous standardized monthly retail price (nominal) of gasoline in each state, and X_{ist} captures various individual- and state-level attributes that may impact individuals' labor market decisions such as gender, age, race, educational attainment, marital status, number of children, age of the youngest child, regional consumer prices, average temperature, and temperature anomalies. We also include state fixed effects, month-by-year fixed effects, and a state linear time trend to control for any unobserved trends in individuals' labor market outcomes that may also be correlated with gasoline prices. The parameter of interest, α_1, captures the impact of gas price fluctuations on individuals' labor

[3]Our sample period is restricted to 2010 because of the availability of gasoline price data from EIA.

market outcomes. Causal identification of α_1 requires that conditional on the control variables, state fixed effects, time fixed effects, and state linear time trend, gas price fluctuations are uncorrelated with any unobserved factors that influence individuals' labor market outcomes.[4]

3 Main Results

Table 2 shows the impact of retail gasoline price fluctuations on individuals' labor market participation status, unemployment status, and the number of hours worked each week conditional on being employed. Standard errors are clustered at the state level. The first row shows our baseline results for the overall sample. The estimates indicate that a 1 standard deviation (SD) increase in the gasoline price increased the likelihood of participating in the labor force by 0.2 percentage points (pp), the probability of being employed by 0.3pp, and the number of hours worked by 0.27 hours. These results suggest that higher gasoline prices encourage work at the intensive and extensive margins.[5]

To identify the groups that are most affected by gasoline price changes, we conduct several subgroup analysis by age categories, gender, marital status, race, and education level. Rows 2-4 show the impact of a 1SD increase in the gasoline price on the labor market outcomes of individuals belonging to the age groups 18 to 25, 26 to 45, and 46 to 65, respectively. The results indicate that the aggregate effect is mostly being driven by young adults between the ages of 18-25. For instance, among individuals in the age group 18 to 25, a 1SD uptick in the gasoline price increases the likelihood of participating in the labor force by 0.8pp, reduced the likelihood of being unemployed by 0.7pp, and increased hours worked by 0.71 hours. In contrast, the same increase in the gasoline price increased labor force participation by 0.3pp, reduced the likelihood of being unemployed by 0.4pp, and increased hours worked by 0.01 hours for individuals in the age group 46-65.

The results in rows 5-6 show that, unlike females, males significantly adjust their labor market behavior when the retail gasoline price increases. More specifically, while a 1SD increase in the gasoline price had no impact on females' labor market outcomes, this change increased the average number of hours males worked by 0.40 hours. When examined by marital status (rows 7-8), the results

[4]We utilize the nominal retail gasoline price because this is the price that is observed by consumers. However, we include the regional CPI to adjust for general changes in the price of other consumption goods.

[5]All the estimates for hours worked reported in this study focuses on the employed population. Focusing on individuals inside the labor force (employed & unemployed) yields larger point estimates. For instance, the corresponding baseline results for the overall sample indicate that a 1 standard deviation (SD) increase in the gasoline price increased hours worked by 0.36 hours.

show that much of the changes in labor market outcomes are being driven by single individuals. For instance, a 1SD increase in the gasoline price had no impact on married individuals' labor market behavior, but single individuals are 0.4pp more likely to participate in the labor force, 0.4pp less likely to be unemployed, and they work 0.58 more hours because of this price change. Examining the impact across race in rows 9 and 10, we find that higher gasoline prices encourage work across both racial groups, but the impact on black individuals is statistically insignificant across the various outcomes.

Lastly, rows 11 and 12 report the impact of gasoline price increases for individuals with a high school diploma or less and those with a college degree or more. The results indicate that a 1SD increase in the gasoline price increases the likelihood of being employed by 0.7pp and hours worked by 0.32 hours among individuals with a high school diploma or lower levels of education. In contrast, we found that this increase had no impact on the labor market outcomes of individuals who possessed at a college degree or greater levels of educational attainment.

Overall, our results indicate that an uptick in the retail price of gasoline increases individuals' labor market engagement. In addition, we find that the effects are largest for young adults, males, unmarried individuals, and those who possess lower levels of education.

3.1 Robustness Checks: Reverse Causality and Endogeneity

One of the main concerns with the empirical specification above is reverse causality. That is, the current labor market condition may directly impact contemporaneous gasoline prices. We assess the merits of this concern by evaluating the impact of lagged gas prices (one-month) on individuals' contemporaneous labor market decisions. The results for this robustness check are presented in Table 2O in the Online Appendix. In the overall sample, we similarly find that a 1SD increase in gasoline prices in the previous month increased the likelihood of participating in the labor force by 0.1pp, the probability of being employed by 0.3pp, and the number of hours worked by 0.18 hours in the current month. These estimates are highly consistent and yield the same conclusions as the main results.

Our TWFE estimates show a robust association between gas price and several measures of labor market engagement. However, one may be concerned that even conditioning on a broad set of covariates, gas price may still be correlated with unobserved factors that affect individuals' labor

market outcomes. This concern is reasonable given that some of the factors affecting local gasoline prices (e.g. extreme weather shocks, local energy policies, leisure demand, & oil production) may also impact local labor market conditions (Fullerton Jr et al., 2015, Nick and Thoenes, 2014, Somanathan et al., 2021). As such, gas price may be endogenous in our TWFE model.

To address this potential concern, we utilized the instrumental variables (IV) design to estimate the impact of the gas price on labor market outcomes. In the first stage, we use state-level gasoline and diesel taxes and fees to instrument for the average retail gasoline price in each state. Causal identification requires that an increase in state fuel taxes and fees increases the retail price of gasoline, but has no direct impact on individuals' labor market outcomes. The relevance condition is likely satisfied because several studies have shown that fuel taxes is one of the key determinants of fuel prices (Bajo-Buenestado, 2017, Doyle Jr and Samphantharak, 2008). In addition, given that the F-statistic on our excluded instruments is about 12, it is unlikely that our estimates are affected by the weak instruments problem.

The results from the IV model are presented in Table 3. This model suggests that a 1SD uptick in the retail gasoline price, because of an increase in gasoline taxes or fees, reduces labor force participation by 0.8pp, the likelihood of being unemployed by 1pp, and increases the average time at work by 1.02 hours. While the impact on labor force participation and the unemployment rate is statistically insignificant at conventional levels, the IV estimates are typically larger than those found under the TWFE model across all the outcome variables. For instance, the estimated impact on the unemployment status and hours worked variables are 3.3 and 3.8 times larger than the corresponding TWFE estimates. As such, using a plausibly exogenous instrument for the gasoline price yields larger point estimates but does not change the main qualitative conclusion.[6]

4 Discussion and Conclusion

In this study, we find consistent evidence that a higher gasoline price increase the likelihood of being employed and the average number of hours an individual works. In addition, we find that the effects are largest for young adults, men, unmarried individuals, and those who possess lower levels of educational attainment. Our estimate on hours worked is moderately higher than West and

[6]In fact, the point estimates from the TWFE belong to the confidence interval from the IV model.

Williams III (2007) who found that a 10% increase in the gasoline price would induce each household to work about 2 more hours each year. Our findings similarly suggest that a 1SD uptick in the gasoline price would increase hours worked for the average person by at least 0.27 hours each week. This corresponds to an annual increase of about 3.5 hours.[7]

This result suggests that one consequence of higher gasoline prices is that it increases individuals' incentive to work and the number of hours worked. In addition, the results indicate that the impact/burden of gasoline tax increases are not equally distributed across all sub-groups in the population. As such, policymakers should consider these labor market effects when setting the gas tax rate and while making other policy decisions that may affect the price of gasoline.

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[7] A 1SD increase in the gas price was 0.68 or about 40% of the mean gas price over the sample period. We find that this corresponds to an increase in hours worked of 0.27-1.02 across our two estimation approaches. A simple back of the envelope calculation suggests that a 10% uptick in gas price would correspond to an annual increase in hours worked of about 3.5-13.3 hours.

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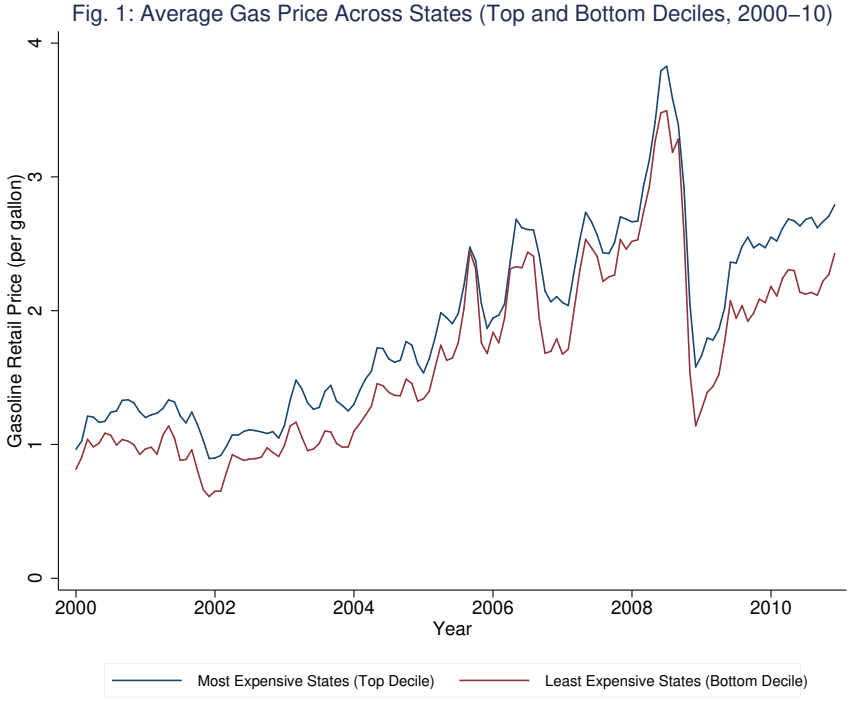
Figures and Tables

Fig. 1: Average Gas Price Across States (Top and Bottom Deciles, 2000–10)



	Mean	Standard Deviation
Age	39.53	13.74
Male	0.49	0.50
Married	0.53	0.50
Black	0.12	0.33
White	0.84	0.37
High School Diploma or Less	0.46	0.50
College	0.26	0.44
Temperature	55.35	16.85
Temperature Anomaly	1.03	2.93
Labor Force Participation	0.76	0.43
Unemployed	0.056	0.23
Hours Worked	39.23	13.56
State Gasoline Taxes & Fees (cents)	15.41	10.39
State Diesel Taxes & Fees (cents)	12.07	10.39
Gasoline Price	1.71	0.68

Table 1: Descriptive Statistics

Columns 1 and 2 show the mean and standard deviation of the control and outcome variables. The sample size is 7.93 millions for hours worked and 11.53m for all other variables.

	Labor Force Participation	Unemployed	Hours Worked
Baseline	0.002	-0.003	0.27**
	(0.003)	(0.004)	(0.11)
Ages 18-25	0.008*	-0.007	0.71***
	(0.004)	(0.006)	(0.21)
Ages 26-45	-0.001	-0.003	0.32***
	(0.002)	(0.003)	(0.13)
Ages 46-65	0.003	-0.004	0.01
	(0.004)	(0.004)	(0.16)
Male	0.003	-0.004	0.40***
	(0.003)	(0.004)	(0.13)
Female	0.001	-0.003	0.08
	(0.003)	(0.003)	(0.12)
Single	0.004	-0.004*	0.58**
	(0.004)	(0.003)	(0.17)
Married	-0.001	-0.003	0.16
	(0.003)	(0.004)	(0.12)
Black	-0.01	-0.009	0.25
	(0.01)	(0.007)	(0.26)
White	0.001	-0.002	0.29**
	(0.002)	(0.003)	(0.11)
HS Diploma or Less	0.001	-0.007*	0.32*
	(0.003)	(0.004)	(0.18)
College Degree or More	0.004	-0.001	0.14
	(0.003)	(0.003)	(0.15)
Controls	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes

Table 2: Main Results
The outcome variables are: (i) labor force participation (1 if employed or unemployed and 0 if out of the labor force), (ii) the probability of being unemployed (1 if unemployed and 0 if employed), and (iii) the number of hours worked. The first row shows the baseline estimates for the overall sample and rows 2-12 reports the estimates by age groups, gender, marital status, race, and educational attainment. Standard errors are clustered at the state level and reported in parentheses. Significance level: *10%, **5%, and ***1%.

	Labor Force Participation	Unemployed	Hours Worked
IV	-0.008	-0.01	1.02**
	(0.01)	(0.01)	(0.46)
TWFE	0.002	-0.003**	0.27***
	(0.008)	(0.001)	(0.07)
Controls	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
State-Specific Time Trend	Yes	Yes	Yes
Excluded Instrument F-Stat	12.31	11.44	11.86
First-Stage Adjusted R-Squared	0.95	0.95	0.95
First-Stage Partial R-Squared	0.01	0.01	0.01

Table 3: Instrumental Variables (IV) Estimates

Note: Using gas and diesel taxes and fees as instruments, row 1 shows the impact of a 1SD increase in gas price on various labor market outcomes. Though the model utilized is different, row 2 shows the baseline TWFE estimates from Table 2 for comparison. The outcome variables presented in columns 1-3 are: (i) labor force participation (1 if employed or unemployed and 0 if out of the labor force), (ii) the probability of being unemployed (1 if unemployed and 0 if employed), and (iii) the number of hours worked. Standard errors are clustered at the state level and reported in parentheses. Significance level: *10%, **5%, and ***1%.

Online Appendix: Simple Labor Supply Model

Consider the neoclassical labor supply model where an individual decides the optimal number of hours to allocate to work (h) and leisure (l). The individual earns hourly wages (w) and possesses non-labor income (v). Income is utilized to offset the cost of general consumption (c) and gas expenditure (G). Note that under this formulation, we assume that an increase in gas price increases gas expenditure because gas demand is inelastic. As such, for simplicity, we abstract away from explicitly modeling gas demand.

The individual therefore maximized $U(l, c)$ subject to the budget constraint $c = wh + v - G$ and $l + h = 24$. Assume a simple Cobb-Douglas utility function, $U(c, l) = c^{\alpha} l^{\beta}$, where $0 < \alpha, \beta < 1$.

$$\max_{c,l} \mathcal{L} = c^{\alpha} l^{\beta} + \lambda * [w(24 - l) + v - G - c]$$

First Order Conditions

$$\frac{d\mathcal{L}}{dc} = \alpha c^{\alpha-1} l^{\beta} - \lambda = 0 \tag{1}$$

$$\frac{d\mathcal{L}}{dl} = \beta c^{\alpha} l^{\beta-1} - \lambda w = 0 \tag{2}$$

$$\frac{d\mathcal{L}}{d\lambda} = w(24 - l) + v - G - c = 0 \tag{3}$$

$$c^* = \frac{\alpha w l}{\beta} \tag{4}$$

sub for c^* into equation (3) yields:

$$\frac{\alpha w l}{\beta} = w(24 - l) + v - G$$

$$l^* = \frac{24\beta}{(\alpha + \beta)} + \frac{\beta v}{w(\alpha + \beta)} - \frac{\beta G}{w(\alpha + \beta)} \tag{5}$$

Since an increase in gas price increases gas expenditure, the impact of gas price increase is given by:

$$\frac{dl^*}{dG} = -\frac{\beta}{w(\alpha + \beta)} < 0 \tag{6}$$

As such, when gas price increases, leisure demand falls and hours worked increases.

	Labor Force Participation	Unemployed	Hours Worked
Baseline	0.001	-0.003	0.18**
	(0.002)	(0.003)	(0.07)
Ages 18-25	0.002	-0.007	0.40***
	(0.005)	(0.005)	(0.18)
Ages 26-45	-0.001	-0.003	0.18
	(0.002)	(0.003)	(0.11)
Ages 46-65	0.002	-0.002	0.03
	(0.004)	(0.003)	(0.17)
Male	0.001	-0.004	0.22
	(0.002)	(0.004)	(0.14)
Female	0.000	-0.003	0.11
	(0.003)	(0.003)	(0.11)
Single	0.001	-0.004	0.30**
	(0.004)	(0.003)	(0.14)
Married	-0.000	-0.004	0.15
	(0.003)	(0.003)	(0.12)
Black	-0.018*	-0.01	0.20
	(0.01)	(0.01)	(0.25)
White	0.000	-0.002	0.21*
	(0.002)	(0.002)	(0.11)
HS Diploma or Less	0.000	-0.007*	0.25*
	(0.003)	(0.004)	(0.13)
College Degree or More	-0.003	-0.002	0.22
	(0.006)	(0.002)	(0.16)
Controls	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes

Table 2O: Sensitivity of Main Results, Impact of Lagged Gas Prices
The outcome variables are: (i) labor force participation (1 if employed or unemployed and 0 if out of the labor force), (ii) the probability of being unemployed (1 if unemployed and 0 if employed), and (iii) the number of hours worked. The first row shows the baseline estimates for the overall sample and rows 2-12 reports the estimates by age groups, gender, marital status, race, and educational attainment. Standard errors are clustered at the state level and reported in parentheses. Significance level: *10%, **5%, and ***1%.