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The Effects of Gas Prices on the U.S. Personal Saving Rate

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I. Introduction

Automobiles are the main method of transportation for the majority of Americans. A major variable factor in the cost of driving is the price of gasoline. Gasoline prices can fluctuate vastly from year to year, state to state, or even station to station. There has always been speculation that when gas prices decrease or remain lower than usual, consumers take the extra savings at the pump and use it for personal savings. It is unclear just how much of that additional savings is actually making it to their personal savings and how much ends up being spent as consumption. The JP Morgan Chase Institute claims that "consumers spend more of their gas savings than initially estimated" (Farrell, 2017), but just how much is considered "more…than initially estimated"? Since the personal saving rate has a large impact on long run economic growth, this paper will look at what effects the average annual gas price has had on the U.S. personal saving rate. We begin by looking at the statistical significance of the historical average gas price per year, along with a selection of other theoretically important variables, to the U.S. personal saving rate using regression analysis. We then examine the effects of adding lags to the model, and decide whether to leave all of the variables, or to remove some in an attempt to improve the model. From this, we determine what effect gas prices have had on the U.S. personal saving rate.

II. Literature Review

Personal saving is not a new topic of study. Economists have been analyzing it in order to try to predict various factors and fluctuations in the long run economic growth of the economy. Gough (2011) specifically looked into the various determinants of the U.S. household saving rate due to its significant contribution to the U.S.'s aggregate saving. He references Carroll's (2001) theory of consumption behavior, where it is argued that the only reason households will change their consumption behavior is if "they expect a *permanent* change in their future income" (Gough, 2011, pg.28). Gough uses this as a basis for his choice of relevant variables in his regression model. He analyzes the effects of real personal disposable income, household net worth, real interest rate, and a proxy for household uncertainty on the household saving rate for their potential impact on future income. He also looks at the retired, youth, dependent youth, and college populations, since the time of life a person is in will also drastically affect what their future income will be – if an individual is in college, their future income expectations will be much different than an individual who is retired and living on a presumably fixed income. Due to Gough's study of the U.S. household saving rate, his results are likely to be affected by similar, if not the same, factors as our dependent variable: the U.S. personal saving rate.

Franz (2011) took a different approach to the one of the variables in this study, where she researched the effects of gas prices on single mothers' time use. She analyzed whether or not the price of gas had an effect on how much time a single mother would have to care for her child. Since a child's development is largely impacted by how much time he spends with his parents, a single mother's time would be that much more important since she is the only parent giving attention and care to the child. Franz suggested that a single mother would have to allocate her time between caring for the child and working to earn money. The amount that she would have to work was hypothesized to be contingent upon the gas price – the higher the price, the more time the mother would have to spend at work, thus less time is available to be spent caring for the child. Through her regression analysis, however, she found that gas prices were insignificant even at a .10 level. So, while the idea was good in theory, she could not find significant correlation between gas prices and how much time a mother has to spend on her child. This could have been, in part, due to a relatively small sample size. Even though her work did not result in statistical significance of her gas price variable, her approach has given insight on how we will include our gas price variable in our model.

Another component to the U.S. personal saving rate that was examined was consumer sentiment. Ewing and Payne (1998) looked into this relationship and determined that "households reduce their savings rate when consumer sentiment is high, but the two variables do not drift arbitrarily far apart" (pg. 94). They then focused on what implications this had for financial planners and counselors. They saw that financial planners and counselors would have to take into account that their customers would be making investment and saving decisions based on how they perceived their future would occur. This results in them keeping most of their financial assets as the more-liquid money instead of investing it. This will effectively lower the personal savings rate. While our model does not explicitly include consumer sentiment as a variable of interest, it is important to still consider its implications on the variables we do include.

III. Model Specification and Variable Definitions

We will use an Ordinary Least Squares Regression to examine the statistical significance of relationships between the U.S. personal saving rate and the hypothetically impactful variables. Our initial hypothesis is that the most impactful variable will be disposable personal income. The data is a time-series set from 1960-2015. The following is our original model:

$$(1) \quad SAVRT_t = \beta_0 + \beta_1 GASPR_t + \beta_2 INTRT_t + \beta_3 TAXLOW_t + \beta_4 TAXHIGH_t + \beta_5 UNEMP_t + \beta_6 RETPOP_t + \beta_7 DISPINC_t$$

SAVRT = U.S. Personal Saving Rate
GASPR = Average U.S. Gas Price
INTRT = U.S. Interest Rate
TAXLOW = Personal Income Tax (lowest tax bracket)
TAXHIGH = Personal Income Tax (highest tax bracket)
UNEMP = U.S. Civilian Unemployment Rate
RETPOP = Retired U.S. Population (% of U.S. Population 65 or older)
DISPINC = Disposable Personal Income

IV. Data Description

For this study, we will compare the average annual gas price in the U.S., along with other relevant variables, to the U.S. personal saving rate. We will be referencing the years 1960-2015[1] for all of our datasets and regressions, and it is all annualized data from the United States – no other countries are examined in this study. The personal saving sate, interest rate, income tax rate, unemployment rate, and disposable personal income data was retrieved from the St. Louis Fed's database. The average personal saving rate for the period we are looking at was 8.48%. The data for the average annual gas price was found on the U.S. Department of Energy's website, specifically the Vehicle Technology Office. It is measured in "constant 2015 dollars per gallon", meaning it is measured by the dollar amount it cost in 2015 after inflation is considered. With this said, the average annual gas price was \$2.16 per gallon. The retired population data is the percentage of U.S. citizens that are aged 65 or older and comes from the World Development Indicators database. **Table 2** shows descriptive statistics for all of the included variables.

[1] 1960-2015 is the range where data is available for all variables, producing the most comprehensive results

Table 1

Variable	Units	Hypothesized Effect on Personal Saving Rate
Personal Saving Rate	% of total income added to personal saving	N/A
Average Gas Price	Constant 2015 dollars per gallon	Negative
Interest Rate	% per annum	Positive
Tax (lowest tax bracket)	Percent	Negative
Tax (highest tax bracket)	Percent	Negative
Unemployment Rate	Percent	Negative
Retired Population	% of total	Negative
Disposable Income	Billions of dollars	Positive

Table 2

	PERS_SAVING_RATE	GAS_PRICE	INTEREST_RATE	TAX_LOWEST	TAX_HIGHEST	UNEMP_RATE	RETIRED_POPULATION	DISPOSABLE_INCOME
Mean	8.480357	2.161964	4.906964	13.32143	52.53438	6.094643	11.69841	4924.138
Median	8.75	1.9	4.875	14	39.6	5.85	12.26259	3758.85
Maximum	14.4	3.8	12.87	20	91	10.8	14.64034	13801.5
Minimum	2.8	1.47	0.5	10	28	3.4	9.125636	378.4
Std. Dev.	3.188184	0.625429	2.929254	2.777226	19.30308	1.6047	1.377468	4187.042
Skewness	-0.107197	1.294658	0.574931	0.56791	0.509193	0.662564	-0.345003	0.653507
Kurtosis	1.833017	3.538461	3.394833	3.139819	1.872216	3.333814	2.328617	2.120607
Jarque-Bera	3.2849	16.32051	3.448841	3.055821	5.387685	4.357262	2.16268	5.790437
Probability	0.193505	0.000286	0.178276	0.216989	0.067621	0.113196	0.339141	0.055287
Sum	474.9	121.07	274.79	746	2941.925	341.3	655.1111	275751.7
Sum Sq. Dev	559.0484	21.51388	471.929	424.2143	20493.48	141.6284	104.358	9.64E+08
Observation	56	56	56	56	56	56	56	56

V. Model Estimation and Specification Testing

As mentioned before, we used an Ordinary Least Squares regression with a Newey-West adjustment to account for heteroscedasticity. From the initial model, the following regression results were achieved (**Table 3**). Only the disposable income variable was significant in this first model, with a p-value of 0.0000. Item **A** in the Appendix shows the variance inflation factors for the initial model, with no variables showing initial signs of multicollinearity. As **Table 4** shows, a ramsey reset test also concluded that there was not an issue with the original model with a p-value of .1826. A unit root test was run on each of the variables, and after necessary adjustments for seasonality and trends, are all showing stationarity in the regression's variables (see **B** through **I** in Appendix).

Table 3

Dependent Variable: PERS_SAVING_RATE_DIF
Method: Least Squares
Date: 12/14/17 Time: 17:59
Sample (adjusted): 1961 2015
Included observations: 55 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAS_PRICE_DIF	0.599433	0.503002	1.191710	0.2394
INTEREST_RATE_DIF	-0.272957	0.173648	-1.571903	0.1227
TAX_LOWEST	-0.011099	0.061075	-0.181725	0.8566
TAX_HIGHEST	0.006537	0.011262	0.580430	0.5644
UNEMP_RATE	0.002071	0.119085	0.017395	0.9862
RETPOP_DT	-0.210614	0.442923	-0.475510	0.6366
DISP_INCOME_DIF_DT	0.006055	0.001071	5.652283	0.0000
C	-0.302381	1.089047	-0.277656	0.7825

R-squared	0.478414	Mean dependent var	-0.083636
Adjusted R-squared	0.400731	S.D. dependent var	1.630583
S.E. of regression	1.262275	Akaike info criterion	3.437431
Sum squared resid	74.88684	Schwarz criterion	3.729407
Log likelihood	-86.52936	Hannan-Quinn criter.	3.550340
F-statistic	6.158543	Durbin-Watson stat	1.789740
Prob(F-statistic)	0.000039	Wald F-statistic	12.34200
Prob(Wald F-statistic)	0.000000		

Table 4

Ramsey RESET Test
Equation: EQ01
Specification: PERS_SAVING_RATE_DIF GAS_PRICE_DIF INTEREST_RATE_DIF TAX_LOWEST TAX_HIGHEST UNEMP_RATE RETPOP_DT DISP_INCOME_DIF_DT C
Omitted Variables: Powers of fitted values from 2 to 7

	Value	df	Probability
F-statistic	1.562715	(6, 41)	0.1826
Likelihood ratio	11.32717	6	0.0788

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	13.93832	6	2.323053
Restricted SSR	74.88684	47	1.593337
Unrestricted SSR	60.94852	41	1.486549

LR test summary:

	Value	df
Restricted LogL	-86.52936	47
Unrestricted LogL	-80.86577	41

Due to only one of the independent variables being statistically significant, we ran a correlation/covariance analysis on the variable group (**Table 5**). In doing this, we found the DISPINC variable to have a .639548 correlation with the personal saving rate. This was the only relatively high correlation that was found and it will not affect the model.

Table 5

Covariance Analysis: Ordinary
Date: 12/14/17 Time: 18:56
Sample: 1961 2015
Included observations: 55
Balanced sample (listwise missing value deletion)

Covariance Correlation	PERS_SAVI...	GAS_PRICE...	INTEREST_...	TAX_LOWEST	TAX_HIGHE...	UNEMP_RA...	RETPOP_DT	DISP_INCO...
PERS_SAVING_R...	2.610460 1.000000							
GAS_PRICE_DIF	0.100997 0.204741	0.093216 1.000000						
INTEREST_RATE_...	-0.229587 -0.097376	0.093016 0.208775	2.129467 1.000000					
TAX_LOWEST	-0.041455 -0.009777	0.036000 0.044930	0.678727 0.177230	6.887273 1.000000				
TAX_HIGHEST	0.267836 0.008922	-0.057364 -0.010112	5.110795 0.188498	27.89164 0.572010	345.2177 1.000000			
UNEMP_RATE	0.005147 0.001987	-0.053031 -0.108341	-0.895638 -0.382827	-1.164364 -0.276739	-4.479764 -0.150388	2.570334 1.000000		
RETPOP_DT	-0.100806 -0.125970	-0.041701 -0.275764	-0.027106 -0.037504	0.144961 0.111523	-1.611136 -0.175075	0.211494 0.266343	0.245315 1.000000	
DISP_INCOME_DI...	182.0213 0.639548	10.33967 0.192252	43.95746 0.171004	8.140504 0.017609	-95.74934 -0.029255	-25.09415 -0.088856	-3.276253 -0.037551	31029.93 1.000000

We then introduced lags to the variables INTRT, RETPOP, and UNEMP_RATE in an attempt to improve the significance in the model. The resulting model brought us closer, but had insignificant lags that had to be removed (**Table 6)**. After removing various combinations of lags to find the best fit, we also removed the variable TAX_HIGHEST, as it was insignificant and it improved our model by being left out. Seeing the improvement, we also removed TAX_LOWEST since it was insignificant as well. This landed us with our final version of the model, **Table 7**, and improved the statistical significance of all variables. The new model is a better fit for the data, as shown by its AIC and SIC values of 3.1633 and 3.4948 respectively. This is in comparison to **Table 6**'s 3.2855 AIC and 3.8859 SIC, and the original model's 3.4374 AIC and 3.7294 SIC. Since both the final model's AIC and SIC values are lower, it is the better model for our data. Its .6231 R-squared and .5561 adjusted R-squared are also higher than the original models' values .4784 R-squared and .4007 adjusted R-squared. Even though these are slightly lower than **Table 6**'s values, the final model is still the best since all of its lags are significant. Also, by having more variables such as the two tax rates and the insignificant lags, **Table 6**'s regression would show higher R-squared and adjusted R-squared values simply because it has more variables. A residual analysis for each of the explanatory variables showed that there were no abnormalities with the final model. Each residual plot can be found in **J** through **N** in the Appendix.

Table 6

Dependent Variable: PERS_SAVING_RATE_DIF
Method: Least Squares
Date: 12/14/17 Time: 19:02
Sample (adjusted): 1964 2015
Included observations: 52 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAS_PRICE_DIF	2.117227	0.712760	2.970461	0.0053
INTEREST_RATE_DIF	-0.272015	0.150122	-1.811955	0.0783
INTEREST_RATE_DIF(-1)	-0.466044	0.171110	-2.723643	0.0099
INTEREST_RATE_DIF(-2)	-0.234651	0.149760	-1.566849	0.1259
INTEREST_RATE_DIF(-3)	0.135008	0.131541	1.026350	0.3116
TAX_LOWEST	0.117992	0.134267	0.878780	0.3853
TAX_HIGHEST	-0.002699	0.013139	-0.205457	0.8384
UNEMP_RATE	0.377109	0.202880	1.858778	0.0712
UNEMP_RATE(-1)	-0.897425	0.312760	-2.869375	0.0068
UNEMP_RATE(-2)	0.248313	0.310231	0.800413	0.4287
UNEMP_RATE(-3)	0.091585	0.240353	0.381043	0.7054
RETPOP_DT	-7.223759	13.40415	-0.538919	0.5933
RETPOP_DT(-1)	20.65049	26.93392	0.766709	0.4483
RETPOP_DT(-2)	-14.04204	14.13490	-0.993431	0.3271
DISP_INCOME_DIF_DT	0.006485	0.000890	7.288592	0.0000
C	-0.489911	2.365212	-0.207132	0.8371

R-squared	0.686965	Mean dependent var	-0.092308
Adjusted R-squared	0.556533	S.D. dependent var	1.659535
S.E. of regression	1.105139	Akaike info criterion	3.285480
Sum squared resid	43.96799	Schwarz criterion	3.885862
Log likelihood	-69.42247	Hannan-Quinn criter.	3.515652
F-statistic	5.266865	Durbin-Watson stat	2.060566
Prob(F-statistic)	0.000022		

Table 7

Dependent Variable: PERS_SAVING_RATE_DIF
Method: Least Squares
Date: 12/14/17 Time: 17:39
Sample (adjusted): 1962 2015
Included observations: 54 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAS_PRICE_DIF	1.902655	0.657671	2.893018	0.0059
INTEREST_RATE_DIF	-0.145869	0.109241	-1.335298	0.1885
INTEREST_RATE_DIF(-1)	-0.459705	0.189784	-2.422252	0.0195
UNEMP_RATE	0.283456	0.149377	1.897583	0.0642
UNEMP_RATE(-1)	-0.633871	0.164198	-3.860417	0.0004
RETPOP_DT	5.552806	1.544681	3.594790	0.0008
RETPOP_DT(-1)	-5.262687	1.462769	-3.597756	0.0008
DISP_INCOME_DIF_DT	0.006412	0.000628	10.20816	0.0000
C	1.877879	0.692225	2.712816	0.0094

R-squared	0.623093	Mean dependent var	-0.105556
Adjusted R-squared	0.556088	S.D. dependent var	1.637695
S.E. of regression	1.091143	Akaike info criterion	3.163340
Sum squared resid	53.57668	Schwarz criterion	3.494838
Log likelihood	-76.41019	Hannan-Quinn criter.	3.291186
F-statistic	9.299112	Durbin-Watson stat	2.071988
Prob(F-statistic)	0.000000	Wald F-statistic	32.92678
Prob(Wald F-statistic)	0.000000		

VI. Results

$$(2) \quad SAVRT_t = \beta_0 + \beta_1 GASPR_t + \beta_2 INTRT_t + \beta_3 INTRT_{t-1} + \beta_4 UNEMP_t + \beta_5 UNEMP_{t-1} + \beta_6 RETPOP_t + \beta_7 RETPOP_{t-1} + \beta_8 DISPINC_t$$

The various alterations to the original model resulted in the model shown above – the final model. In the final model, the only variable that is not statistically significant is the interest rate, with a p-value of .1885. The unemployment rate is significant at a 10% level with a p-value of .0642, the interest rate lag (p-value of .0195) is significant at a 5% level, and all of the remaining variables are significant at a 1% confidence level. This makes this final version a much more substantial model. From the final model's regression results (**Table 7**) we can see that for every one dollar change in the average price of gasoline in the U.S., the personal saving rate increases by 1.90%. This goes against the hypothesized effect of a rise in gas prices reducing the rate of personal saving. This is most likely due to the fact that the personal saving rate has been increasing in the U.S. over time at the same time that gas prices have also been increasing. Even though the interest rate variable was not statistically significant, the results from the lag on the interest rate show that a one percent increase in the U.S. interest rate today will decrease the personal saving rate next period by approximately .46% – which is also against the hypothesized positive effect. The unemployment rate's short run multiplier shows that with every one percent increase, the unemployment rate increases the saving rate by .28%. However, the long run multiplier shows the hypothesized negative effect, where every one percent increase in the interest rate today results in a .35% decrease in the saving rate next period. The retired population's short run multiplier was 5.55, meaning that for every 1% increase in the retired population, it increases the personal saving rate by 5.55%. This goes against the hypothesized effect as well, and while the long run multiplier of .29 still shows that the retired population has a positive effect on the saving rate, it is much closer to what we estimated it would be. Finally, every one billion dollar increase in disposable income for the U.S. is shown to increase the saving rate by only .006%. As mentioned before, the final model has an R-squared value of .6231 and an adjusted R-squared value of .5561.

VII. Conclusion

In the end, we found that the average price of gasoline in the U.S. has a positive correlation with the personal saving rate. However, since the average gas price and the personal saving rate have been rising slightly throughout the time range that has been observed due to a growing economy, that could have caused this positive correlation. It could also be the case that rising gas prices are a sign of improving economic times, which would, in fact, yield a higher average personal saving rate. A time frame that is more recent and includes newer data might correct for this and cause gas prices to have the hypothesized negative effect on the personal saving rate. We also believe that if we could get the tax rates to be significant, it would further benefit the model. If we made the adjustment to only include more recent years in the study, this could potentially bring the tax rates into significance since it would not have to account for the large fluctuations in the personal income tax rate experienced from the 1930's to the early 1980's. A possible extension of this research could be to add more relevant variables such as consumer sentiment and consumption to see how they affect the model and if they begin to change the effects the other variables seem to have on the personal saving rate.

Nonetheless, the results show that the gas price, interest rate, unemployment rate, retired population, and disposable income all have significant effects on the personal saving rate. Even though the variables do not all have the effect that we originally hypothesized they would, their significance means that they are still possible triggers that can alter the average personal saving rate in the United States. For instance, if we observe that the interest rate is beginning to increase, we can expect to experience an overall decrease in the personal saving rate in the coming periods and better prepare for it. According to the regression results, we could also look at the average gas price – which is already monitored – and know that during times when it is rising we will also see a rise in the personal saving rate. Knowing what triggers to look for can help in identifying when we will be entering periods of higher or lower saving.

VIII. Appendix

A.

Variance Inflation Factors
Date: 12/14/17 Time: 18:01
Sample: 1960 2015
Included observations: 55

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
GAS_PRICE_DIF	0.253011	1.525362	1.517231
INTEREST_RATE_DIF	0.030154	2.004298	1.936757
TAX_LOWEST	0.003730	38.66147	1.781641
TAX_HIGHEST	0.000127	22.79127	2.419955
UNEMP_RATE	0.014181	26.46839	2.007355
RETPOP_DT	0.196180	2.257748	2.208745
DISP_INCOME_DIF_DT	1.15E-06	1.808700	1.806681
C	1.186024	61.11397	NA

B.

Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.857184	0.0000
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GAS_PRICE_DIF)
Method: Least Squares
Date: 12/14/17 Time: 18:09
Sample (adjusted): 1962 2015
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAS_PRICE_DIF(-1)	-0.880915	0.150399	-5.857184	0.0000

R-squared	0.391827	Mean dependent var	-0.016852
Adjusted R-squared	0.391827	S.D. dependent var	0.396593
S.E. of regression	0.309285	Akaike info criterion	0.509237
Sum squared resid	5.069829	Schwarz criterion	0.546070
Log likelihood	-12.74940	Hannan-Quinn criter.	0.523442
Durbin-Watson stat	1.793157		

C.

Null Hypothesis: DISP_INCOME_DIF_DT has a unit root
Exogenous: None
Lag Length: 10 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.196605	0.0001
Test critical values:	1% level	-2.618579	
	5% level	-1.948495	
	10% level	-1.612135	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DISP_INCOME_DIF_DT)
Method: Least Squares
Date: 11/29/17 Time: 19:46
Sample (adjusted): 1972 2015
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DISP_INCOME_DIF_DT(-1)	-3.514513	0.837466	-4.196605	0.0002
D(DISP_INCOME_DIF_DT(-1))	2.137274	0.770340	2.774457	0.0090
D(DISP_INCOME_DIF_DT(-2))	1.960012	0.708800	2.765254	0.0092
D(DISP_INCOME_DIF_DT(-3))	2.045731	0.688975	2.969240	0.0055
D(DISP_INCOME_DIF_DT(-4))	1.734506	0.652205	2.659451	0.0120
D(DISP_INCOME_DIF_DT(-5))	1.706781	0.573075	2.978282	0.0054
D(DISP_INCOME_DIF_DT(-6))	1.509634	0.510703	2.955995	0.0057
D(DISP_INCOME_DIF_DT(-7))	1.257275	0.478836	2.625688	0.0130
D(DISP_INCOME_DIF_DT(-8))	2.448302	0.432845	5.656303	0.0000
D(DISP_INCOME_DIF_DT(-9))	1.549308	0.483878	3.201857	0.0030
D(DISP_INCOME_DIF_DT(-10))	0.873131	0.383002	2.279706	0.0292

R-squared	0.926245	Mean dependent var	-0.362121
Adjusted R-squared	0.903895	S.D. dependent var	340.8701
S.E. of regression	105.6723	Akaike info criterion	12.37088
Sum squared resid	368499.0	Schwarz criterion	12.81693
Log likelihood	-261.1594	Hannan-Quinn criter.	12.53630
Durbin-Watson stat	1.927164		

D.

Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.327594	0.0000
Test critical values:	1% level	-2.609324	
	5% level	-1.947119	
	10% level	-1.612867	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTEREST_RATE_DIF)
Method: Least Squares
Date: 11/29/17 Time: 19:51
Sample (adjusted): 1963 2015
Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTEREST_RATE_DIF(-1)	-0.990900	0.156600	-6.327594	0.0000
D(INTEREST_RATE_DIF(-1))	0.369330	0.130171	2.837257	0.0065

R-squared	0.448701	Mean dependent var	0.004717
Adjusted R-squared	0.437891	S.D. dependent var	1.805879
S.E. of regression	1.353938	Akaike info criterion	3.480918
Sum squared resid	93.49059	Schwarz criterion	3.555268
Log likelihood	-90.24432	Hannan-Quinn criter.	3.509509
Durbin-Watson stat	2.138178		

E.

Null Hypothesis: RETPOP_DT has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.890161	0.0002
Test critical values:	1% level	-2.609324	
	5% level	-1.947119	
	10% level	-1.612867	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RETPOP_DT)
Method: Least Squares
Date: 11/30/17 Time: 09:07
Sample (adjusted): 1963 2015
Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RETPOP_DT(-1)	-0.023115	0.005942	-3.890161	0.0003
D(RETPOP_DT(-1))	1.346075	0.128478	10.47709	0.0000
D(RETPOP_DT(-2))	-0.308117	0.144039	-2.139116	0.0373

R-squared	0.980345	Mean dependent var	0.022714
Adjusted R-squared	0.979559	S.D. dependent var	0.105585
S.E. of regression	0.015096	Akaike info criterion	-5.493857
Sum squared resid	0.011394	Schwarz criterion	-5.382331
Log likelihood	148.5872	Hannan-Quinn criter.	-5.450970
Durbin-Watson stat	2.127592		

F.

Null Hypothesis: TAX_LOWEST has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.675990	0.0883
Test critical values:	1% level	-2.607686	
	5% level	-1.946878	
	10% level	-1.612999	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TAX_LOWEST)
Method: Least Squares
Date: 11/29/17 Time: 20:03
Sample (adjusted): 1961 2015
Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TAX_LOWEST(-1)	-0.017833	0.010640	-1.675990	0.0995

R-squared	0.022518	Mean dependent var	-0.181818
Adjusted R-squared	0.022518	S.D. dependent var	1.090207
S.E. of regression	1.077863	Akaike info criterion	3.005853
Sum squared resid	62.73660	Schwarz criterion	3.042350
Log likelihood	-81.66094	Hannan-Quinn criter.	3.019966
Durbin-Watson stat	1.753740		

G.

Null Hypothesis: TAX_HIGHEST has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.221102	0.0266
Test critical values:	1% level	-2.607686	
	5% level	-1.946878	
	10% level	-1.612999	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TAX_HIGHEST)
Method: Least Squares
Date: 11/29/17 Time: 20:02
Sample (adjusted): 1961 2015
Included observations: 55 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TAX_HIGHEST(-1)	-0.022325	0.010051	-2.221102	0.0306

R-squared	0.039017	Mean dependent var	-0.934545
Adjusted R-squared	0.039017	S.D. dependent var	4.270540
S.E. of regression	4.186399	Akaike info criterion	5.719574
Sum squared resid	946.4006	Schwarz criterion	5.756070
Log likelihood	-156.2883	Hannan-Quinn criter.	5.733687
Durbin-Watson stat	1.624780		

H.

Null Hypothesis: UNEMP_RATE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.775610	0.0256
Test critical values:	1% level	-4.137279	
	5% level	-3.495295	
	10% level	-3.176618	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMP_RATE)
Method: Least Squares
Date: 11/29/17 Time: 20:05
Sample (adjusted): 1962 2015
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMP_RATE(-1)	-0.319316	0.084573	-3.775610	0.0004
D(UNEMP_RATE(-1))	0.463762	0.126083	3.678220	0.0006
C	1.797400	0.529660	3.393498	0.0014
@TREND("1960")	0.004992	0.008262	0.604218	0.5484

R-squared	0.294758	Mean dependent var	-0.018519
Adjusted R-squared	0.252444	S.D. dependent var	1.062939
S.E. of regression	0.919031	Akaike info criterion	2.740194
Sum squared resid	42.23091	Schwarz criterion	2.887526
Log likelihood	-69.98523	Hannan-Quinn criter.	2.797014
F-statistic	6.965898	Durbin-Watson stat	1.898483
Prob(F-statistic)	0.000525		

I.

Null Hypothesis: PERS_SAVING_RATE_DIF has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.784021	0.0000
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	

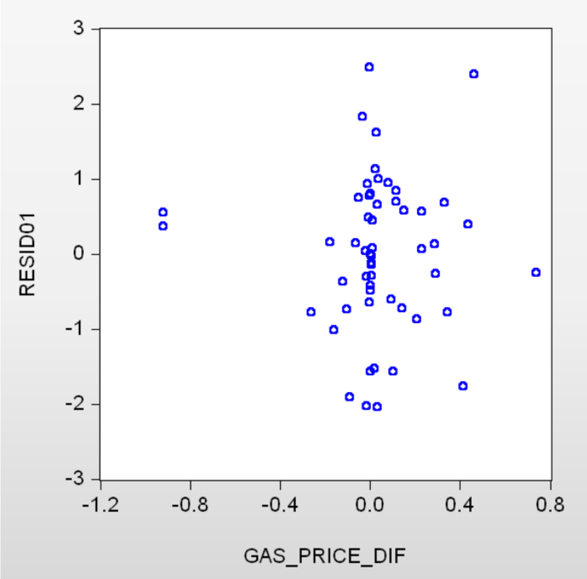
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PERS_SAVING_RATE_DIF)
Method: Least Squares
Date: 11/29/17 Time: 20:15
Sample (adjusted): 1962 2015
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PERS_SAVING_RATE_DIF(-1)	-1.283381	0.131171	-9.784021	0.0000

R-squared	0.643607	Mean dependent var	-0.025926
Adjusted R-squared	0.643607	S.D. dependent var	2.635475
S.E. of regression	1.573343	Akaike info criterion	3.762627
Sum squared resid	131.1966	Schwarz criterion	3.799460
Log likelihood	-100.5909	Hannan-Quinn criter.	3.776832
Durbin-Watson stat	2.072482		

J.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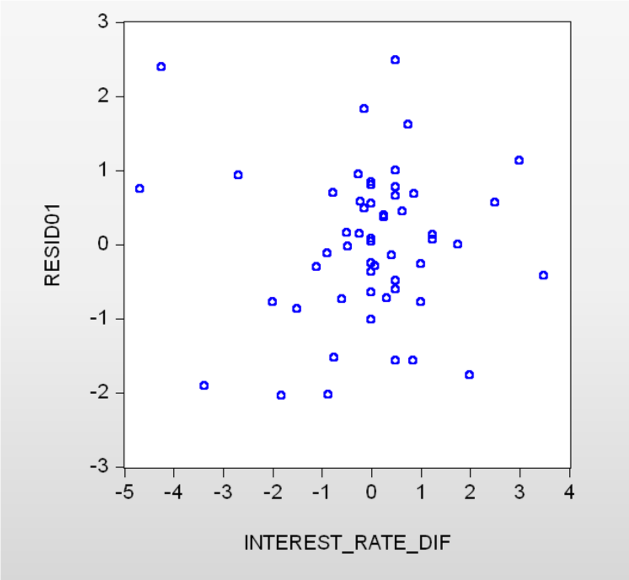
GAS_PRICE_DIF

K.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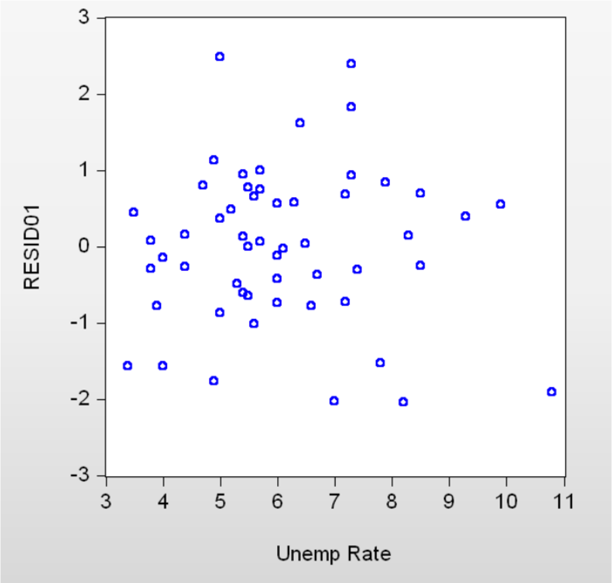
3
4
INTEREST_RATE_DIF

L.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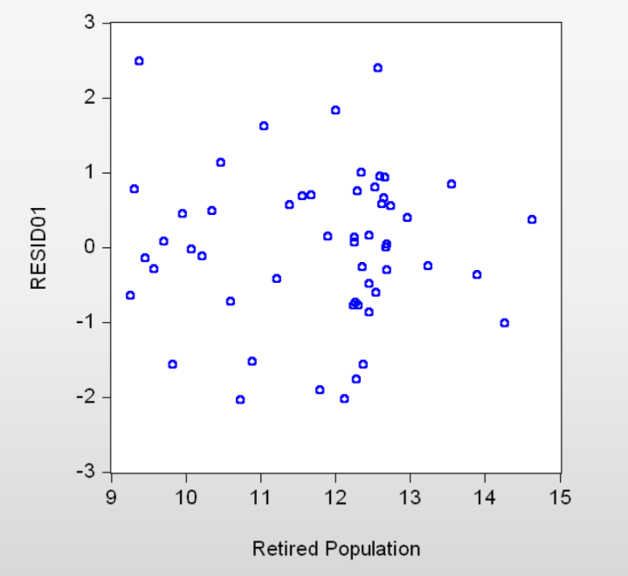
11
Unemp Rate

M.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9
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11
12
13
14
15
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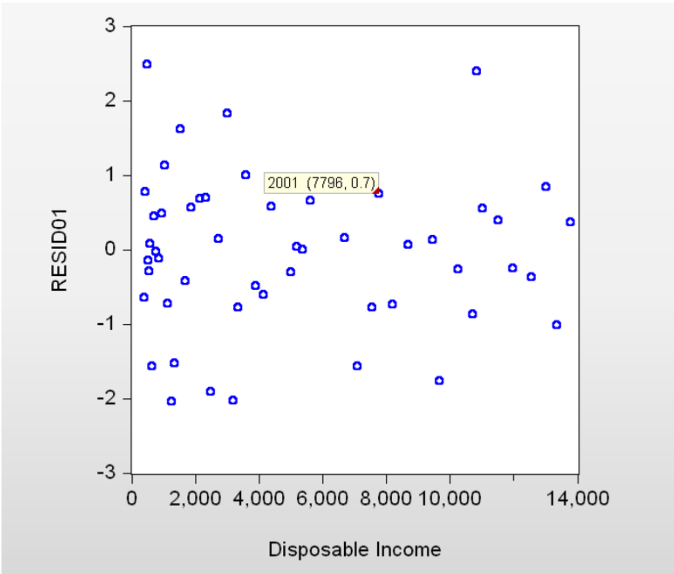
N.



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