The SAS System

The VARMAX Procedure

Number of Observations	131
Number of Pairwise Missing	0

Simple Summary Statistics

Variable	Type	N	Mean	Standard Deviation	Min	Max
Gasoline_Gallons	Dependent	131	21543836.885	20898852.457	19516.00000	144221507.00
Diesel_Gallons	Dependent	131	5756745.5878	6057975.5889	109383.00000	44502244.000
Total_Gallons_ST_Road_Tax	Dependent	131	25509405.504	24583355.458	22259.00000	176280384.00

Dickey-Fuller Unit Root Tests

Variable	Type	Rho	Pr < Rho	Tau	Pr < Tau
Gasoline_Gallons	Zero Mean	-20.40	0.0012	-2.81	0.0053
	Single Mean	-76.05	0.0011	-5.65	<.0001
	Trend	-89.97	0.0004	-6.21	<.0001
Diesel_Gallons	Zero Mean	-30.34	<.0001	-3.86	0.0002
	Single Mean	-83.53	0.0011	-6.39	<.0001
	Trend	-95.16	0.0004	-6.76	<.0001
Total_Gallons_ST_Road_Tax	Zero Mean	-18.97	0.0018	-2.74	0.0065
	Single Mean	-69.25	0.0011	-5.49	<.0001
	Trend	-83.27	0.0004	-6.07	<.0001

Eigenvalues for Cointegration Rank Test for I(2)

r\s	0	1	2	Eigenvalue of I(1)
0	0.734742	0.727292	0.568667	0.3695
1	0.729611	0.679631		0.2514
2	0.718538			0.1544

Cointegration Rank Test for I(2)

r\k-r-s	3	2	1	Trace of I(1)	Pr > Trace of I(1)
0	447.2797	276.0898	108.4730	118.4880	<.0001
Pr > Trace of I(2)	0.0000	0.0000	0.0000		
1		315.5566	146.8382	58.9851	<.0001
Pr > Trace of I(2)		0.0000	0.0000		
2			163.5406	21.6395	<.0001
Pr > Trace of I(2)			0.0000		

Long-Run Parameter Beta Estimates

Variable	1	2	3
Gasoline_Gallons	1.00000	1.00000	1.00000
Diesel_Gallons	0.75666	-1.52687	-6.27602
Total_Gallons_ST_Road_Tax	-0.87051	-0.91299	1.41350

Adjustment Coefficient Alpha Estimates

Variable	1	2	3
Gasoline_Gallons	-1.43434	0.24176	-0.23401
Diesel_Gallons	-0.45051	0.22718	-0.00900
Total_Gallons_ST_Road_Tax	-1.09979	0.61953	-0.27162

Parameter Eta Estimates			
Variable	1	2	3
Gasoline_Gallons	0.00000	-0.00000	0.00000
Diesel_Gallons	-0.00000	0.00000	0.00000
Total_Gallons_ST_Road_Tax	-0.00000	0.00000	-0.00000

Parameter Xi Estimates			
Variable	1	2	3
Gasoline_Gallons	-23390345.49	-20429144.14	-13291034.08
Diesel_Gallons	1899039.6638	-6891996.340	-5377147.327
Total_Gallons_ST_Road_Tax	-19488600.95	-34167149.04	-10703677.18

The SAS System

The VARMAX Procedure

Type of Model	VECM(2)
Estimation Method	Maximum Likelihood Estimation
Cointegrated Rank	1

Long-Run Parameter Beta Estimates When RANK=1	
Variable	1
Gasoline_Gallons	1.00000
Diesel_Gallons	0.75666
Total_Gallons_ST_Road_Tax	-0.87051

Adjustment Coefficient Alpha Estimates When RANK=1	
Variable	1
Gasoline_Gallons	-1.43434
Diesel_Gallons	-0.45051
Total_Gallons_ST_Road_Tax	-1.09979

Coefficient of Granger Representation			
Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
Gasoline_Gallons	-0.49944	-0.92878	1.03183
Diesel_Gallons	-0.38695	0.42811	0.32929
Total_Gallons_ST_Road_Tax	-0.91009	-0.69481	1.47155

Constant Estimates	
Variable	Constant
Gasoline_Gallons	6070613.1619
Diesel_Gallons	1651042.8106
Total_Gallons_ST_Road_Tax	4975584.4605

Parameter Alpha * Beta' Estimates			
Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
Gasoline_Gallons	-1.43434	-1.08532	1.24861
Diesel_Gallons	-0.45051	-0.34088	0.39217
Total_Gallons_ST_Road_Tax	-1.09979	-0.83217	0.95737

AR Coefficients of Differenced Lag				
DIF Lag	Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
1	Gasoline_Gallons	0.28096	0.65658	-0.64480
	Diesel_Gallons	0.36380	-0.06114	-0.33237
	Total_Gallons_ST_Road_Tax	0.46122	0.46053	-0.87434

Schematic Representation of Parameter Estimates			
Variable/Lag	C	AR1	AR2
Gasoline_Gallons	*	--+	..-

Diesel_Gallons	*	...	...
Total_Gallons_ST_Road_Tax	*	--+	..-
+ is > 2*std error, - is < -2*std error, . is between, * is N/A			

Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_Gasoline_Gallons	CONST1	6070613.1619	0.00000			1
	AR1_1_1	-1.43434	0.27042	-5.30	<.0001	Gasoline_Gallons(t-1)
	AR1_1_2	-1.08532	0.20462	-5.30	<.0001	Diesel_Gallons(t-1)
	AR1_1_3	1.24861	0.23541	5.30	<.0001	Total_Gallons_ST_Road_Tax(t-1)
	AR2_1_1	0.28096	0.26767	1.05	0.2959	D_Gasoline_Gallons(t-1)
	AR2_1_2	0.65658	0.39543	1.66	0.0994	D_Diesel_Gallons(t-1)
	AR2_1_3	-0.64480	0.24880	-2.59	0.0107	D_Total_Gallons_ST_Road_Tax (t-1)
D_Diesel_Gallons	CONST2	1651042.8106	0.00000			1
	AR1_2_1	-0.45051	0.07738	-5.82	<.0001	Gasoline_Gallons(t-1)
	AR1_2_2	-0.34088	0.05855	-5.82	<.0001	Diesel_Gallons(t-1)
	AR1_2_3	0.39217	0.06736	5.82	<.0001	Total_Gallons_ST_Road_Tax(t-1)
	AR2_2_1	0.36380	0.07659	4.75	<.0001	D_Gasoline_Gallons(t-1)
	AR2_2_2	-0.06114	0.11315	-0.54	0.5899	D_Diesel_Gallons(t-1)
	AR2_2_3	-0.33237	0.07119	-4.67	<.0001	D_Total_Gallons_ST_Road_Tax (t-1)
D_Total_Gallons_ST_Road_Tax	CONST3	4975584.4605	0.00000			1
	AR1_3_1	-1.09979	0.32831	-3.35	0.0011	Gasoline_Gallons(t-1)
	AR1_3_2	-0.83217	0.24842	-3.35	0.0011	Diesel_Gallons(t-1)
	AR1_3_3	0.95737	0.28579	3.35	0.0011	Total_Gallons_ST_Road_Tax(t-1)
	AR2_3_1	0.46122	0.32497	1.42	0.1584	D_Gasoline_Gallons(t-1)
	AR2_3_2	0.46053	0.48008	0.96	0.3393	D_Diesel_Gallons(t-1)
	AR2_3_3	-0.87434	0.30206	-2.89	0.0045	D_Total_Gallons_ST_Road_Tax (t-1)

Alpha and Beta Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_Gasoline_Gallons	ALPHA1_1	-1.43434	0.27042	-5.30	<.0001	Beta[,1]'*_DEP_(t-1)
	BETA1_1	1.00000				Gasoline_Gallons(t-1)
D_Diesel_Gallons	ALPHA2_1	-0.45051	0.07738	-5.82	<.0001	Beta[,1]'*_DEP_(t-1)
	BETA2_1	0.75666				Diesel_Gallons(t-1)
D_Total_Gallons_ST_Road_Tax	ALPHA3_1	-1.09979	0.32831	-3.35	0.0011	Beta[,1]'*_DEP_(t-1)
	BETA3_1	-0.87051				Total_Gallons_ST_Road_Tax(t-1)

Covariance Parameter Estimates

Parameter	Estimate	Standard Error	t Value	Pr > |t|
COV1_1	4.2308244E14	0.00000		
COV1_2	7.057668E13	0.00000		

COV2_2	3.463962E13	0.00000		
COV1_3	4.8442764E14	0.00000		
COV2_3	1.0295705E14	0.00000		
COV3_3	6.2358266E14	0.00000		

Covariances of Innovations			
Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
Gasoline_Gallons	4.2308244E14	7.057668E13	4.8442764E14
Diesel_Gallons	7.057668E13	3.463962E13	1.0295705E14
Total_Gallons_ST_Road_Tax	4.8442764E14	1.0295705E14	6.2358266E14

Log-likelihood	-6381

Information Criteria	
AICC	12812.64
HQC	12828.41
AIC	12804.01
SBC	12864.06
FPEC	5.795E41

Cross Covariances of Residuals				
Lag	Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
0	Gasoline_Gallons	4.2308244E14	7.057668E13	4.8442764E14
	Diesel_Gallons	7.057668E13	3.463962E13	1.0295705E14
	Total_Gallons_ST_Road_Tax	4.8442764E14	1.0295705E14	6.2358266E14
1	Gasoline_Gallons	-6.407022E11	-1.611736E12	-1.368704E13
	Diesel_Gallons	3.4737117E12	-2.490977E12	-1.882682E12
	Total_Gallons_ST_Road_Tax	-1.750283E12	-5.040338E12	-2.122644E13
2	Gasoline_Gallons	-5.24095E13	-1.309113E13	-8.109547E13
	Diesel_Gallons	-1.1281E13	-8.71078E12	-1.953116E13
	Total_Gallons_ST_Road_Tax	-6.460156E13	-2.363803E13	-1.090101E14
3	Gasoline_Gallons	-6.0117E13	-1.874968E13	-7.564994E13
	Diesel_Gallons	-1.257202E13	-4.732177E12	-1.822433E13
	Total_Gallons_ST_Road_Tax	-9.373748E13	-2.526892E13	-1.099002E14
4	Gasoline_Gallons	6.4913431E12	465458839654	3.9538362E12
	Diesel_Gallons	4.929089E12	2.2744167E12	3.0409407E12
	Total_Gallons_ST_Road_Tax	7.4640913E12	-1.852412E11	-1.561356E12
5	Gasoline_Gallons	-8.859959E13	398273209955	-7.336823E13
	Diesel_Gallons	-1.131956E13	4.1786324E12	-1.854632E12
	Total_Gallons_ST_Road_Tax	-1.027359E14	4053210913.5	-8.811364E13
6	Gasoline_Gallons	1.713998E13	-2.91405E12	3.2178822E13
	Diesel_Gallons	4.3913637E12	-3.722009E12	5.9260929E12
	Total_Gallons_ST_Road_Tax	4.3730282E13	-2.008612E12	5.0737307E13

Cross Correlations of Residuals				
Lag	Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
0	Gasoline_Gallons	1.00000	0.58299	0.94313

	Diesel_Gallons	0.58299	1.00000	0.70052
	Total_Gallons_ST_Road_Tax	0.94313	0.70052	1.00000
1	Gasoline_Gallons	-0.00151	-0.01331	-0.02665
	Diesel_Gallons	0.02869	-0.07191	-0.01281
	Total_Gallons_ST_Road_Tax	-0.00341	-0.03429	-0.03404
2	Gasoline_Gallons	-0.12388	-0.10814	-0.15788
	Diesel_Gallons	-0.09319	-0.25147	-0.13289
	Total_Gallons_ST_Road_Tax	-0.12577	-0.16083	-0.17481
3	Gasoline_Gallons	-0.14209	-0.15488	-0.14728
	Diesel_Gallons	-0.10385	-0.13661	-0.12400
	Total_Gallons_ST_Road_Tax	-0.18250	-0.17193	-0.17624
4	Gasoline_Gallons	0.01534	0.00384	0.00770
	Diesel_Gallons	0.04072	0.06566	0.02069
	Total_Gallons_ST_Road_Tax	0.01453	-0.00126	-0.00250
5	Gasoline_Gallons	-0.20941	0.00329	-0.14284
	Diesel_Gallons	-0.09350	0.12063	-0.01262
	Total_Gallons_ST_Road_Tax	-0.20002	0.00003	-0.14130
6	Gasoline_Gallons	0.04051	-0.02407	0.06265
	Diesel_Gallons	0.03627	-0.10745	0.04032
	Total_Gallons_ST_Road_Tax	0.08514	-0.01367	0.08136

Schematic Representation of Cross Correlations of Residuals

Variable/Lag	0	1	2	3	4	5	6
Gasoline_Gallons	+++	...	...	...	...	-..	...
Diesel_Gallons	+++	...	.-.	...	...	...	...
Total_Gallons_ST_Road_Tax	+++	...	...	-.-	...	-..	...

+ is > 2*std error, - is < -2*std error, . is between

Portmanteau Test for Cross Correlations of Residuals

Up To Lag	DF	Chi-Square	Pr > ChiSq
3	9	30.83	0.0003
4	18	34.20	0.0119
5	27	52.44	0.0023
6	36	73.13	0.0002

Univariate Model ANOVA Diagnostics

Variable	R-Square	Standard Deviation	F Value	Pr > F
Gasoline_Gallons	0.2773	20568967.898	7.80	<.0001
Diesel_Gallons	0.2543	5885543.2995	6.93	<.0001
Total_Gallons_ST_Road_Tax	0.2357	24971637.205	6.27	<.0001

Univariate Model White Noise Diagnostics

Variable	Durbin Watson	Normality		ARCH	
		Chi-Square	Pr > ChiSq	F Value	Pr > F
Gasoline_Gallons	1.99465	34.95	<.0001	4.83	0.0297

Diesel_Gallons	2.13875	22.41	<.0001	66.95	<.0001
Total_Gallons_ST_Road_Tax	2.06020	15.59	0.0004	19.54	<.0001

Univariate Model AR Diagnostics

Variable	AR1		AR2		AR3		AR4	
	F Value	Pr > F	F Value	Pr > F	F Value	Pr > F	F Value	Pr > F
Gasoline_Gallons	0.00	0.9866	1.06	0.3488	1.67	0.1762	1.23	0.3018
Diesel_Gallons	0.66	0.4187	4.79	0.0099	4.85	0.0032	3.62	0.0080
Total_Gallons_ST_Road_Tax	0.15	0.7019	2.16	0.1202	3.28	0.0234	2.58	0.0409

Infinite Order AR Representation

Lag	Variable	Gasoline_Gallons	Diesel_Gallons	Total_Gallons_ST_Road_Tax
1	Gasoline_Gallons	-0.15338	-0.42874	0.60381
	Diesel_Gallons	-0.08670	0.59798	0.05980
	Total_Gallons_ST_Road_Tax	-0.63856	-0.37164	1.08303
2	Gasoline_Gallons	-0.28096	-0.65658	0.64480
	Diesel_Gallons	-0.36380	0.06114	0.33237
	Total_Gallons_ST_Road_Tax	-0.46122	-0.46053	0.87434
3	Gasoline_Gallons	0.00000	0.00000	0.00000
	Diesel_Gallons	0.00000	0.00000	0.00000
	Total_Gallons_ST_Road_Tax	0.00000	0.00000	0.00000

Testing Weak Exogeneity of Each Variable

Variable	DF	Chi-Square	Pr > ChiSq
Gasoline_Gallons	1	11.52	0.0007
Diesel_Gallons	1	8.95	0.0028
Total_Gallons_ST_Road_Tax	1	4.33	0.0374