

Real GDP Reliance of the Top-Three Oil Producing Countries (U.S.A., Saudi Arabia, Iraq) to Oil-Production: A Test for Linearity

Simon Philip M. Alejandrino (Sy)

Huy Bao (Kai) Nguyen Dam

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Appendix A.

Data Points (U.S.A, Saudi Arabia, and Iraq respectively)

Year	Field Production of Crude Oil (Thousand Barrels Per Day)	Average Market Price of WTI Crude Oil (\$/barrel)	Inflation, Consumer Prices (% Annual)	Real GDP (current US\$)
1991	7,417	21.54	4.234963965	6.15813E+12
1992	7,171	20.57	3.028819678	6.52033E+12
1993	6,847	18.45	2.951656966	6.85856E+12
1994	6,662	17.21	2.607441592	7.28724E+12
1995	6,560	18.42	2.805419689	7.63975E+12
1996	6,465	22.16	2.9312042	8.07312E+12
1997	6,452	20.61	2.337689937	8.57755E+12
1998	6,252	14.39	1.552279099	9.06282E+12
1999	5,881	19.31	2.188027197	9.63117E+12
2000	5,822	30.26	3.376857271	1.02509E+13
2001	5,801	25.9	2.826171119	1.05819E+13
2002	5,744	26.17	1.586031627	1.09291E+13
2003	5,649	31.01	2.270094973	1.14564E+13
2004	5,441	41.25	2.677236693	1.22172E+13
2005	5,184	56.44	3.392746845	1.30392E+13
2006	5,086	66	3.225944101	1.38156E+13
2007	5,074	72.26	2.852672482	1.44742E+13
2008	5,000	99.06	3.839100297	1.47699E+13
2009	5,357	61.73	-0.355546266	1.44781E+13
2010	5,484	79.39	1.640043442	1.5049E+13
2011	5,674	94.88	3.156841569	1.55997E+13
2012	6,524	94.05	2.069337265	1.6254E+13
2013	7,497	97.98	1.464832656	1.68432E+13
2014	8,793	93.17	1.622222977	1.75507E+13
2015	9,442	48.66	0.118627136	1.8206E+13
2016	8,848	43.29	1.261583206	1.86951E+13
2017	9,359	50.88	2.130110004	1.94796E+13
2018	10,953	64.94	2.442583297	2.05272E+13
2019	12,315	56.99	1.812210075	2.13726E+13
2020	11,318	39.16	1.233584396	2.08937E+13
2021	11,254	67.99	4.697858864	2.29961E+13

Year	Field Production of Crude Oil (Thousand Barrels Per Day)	Average Market Price of OPEC Crude Oil (\$/barrel)	Inflation, Consumer Prices (% Annual)	Real GDP (current US\$)
1991	8,115	18.62	4.861111111	1.32223E+11
1992	8,332	18.44	-0.077006006	1.37088E+11
1993	8,198	16.33	1.055795314	1.32968E+11
1994	8,120	15.53	0.564325479	1.35175E+11
1995	8,231	16.86	4.868431031	1.43343E+11
1996	8,218	20.29	1.222069885	1.58662E+11
1997	8,362	18.86	0.057154704	1.65964E+11
1998	8,388	12.28	-0.371269735	1.46775E+11
1999	7,833	17.44	-1.333763502	1.61717E+11
2000	8,403	27.6	-1.124994779	1.89515E+11
2001	8,031	23.12	-1.120944775	1.84137E+11
2002	7,634	24.36	0.247186514	1.89606E+11
2003	8,775	28.1	0.612194395	2.15808E+11
2004	9,100	36.05	0.515506767	2.58742E+11
2005	9,550	50.59	0.479230398	3.2846E+11
2006	9,152	61	2.209024079	3.769E+11
2007	8,721	69.04	4.167823301	4.15965E+11
2008	9,259	94.1	9.870247913	5.19797E+11
2009	8,217	60.86	5.057223147	4.29098E+11
2010	8,176	77.38	5.339416806	5.28207E+11
2011	9,382	107.46	5.826216088	6.71239E+11
2012	9,792	109.45	2.866268875	7.35975E+11
2013	9,653	105.87	3.532524707	7.46647E+11
2014	9,695	96.29	2.236290315	7.5635E+11
2015	10,128	49.49	1.206073222	6.5427E+11
2016	10,420	40.76	2.068840361	6.44936E+11
2017	10,089	52.51	-0.83819458	6.88586E+11
2018	10,380	69.78	2.45814158	8.16579E+11
2019	9,778	64.04	-2.093333333	8.03616E+11
2020	9,211	41.47	3.44545826	7.03368E+11
2021	9,113	69.72	3.063289889	8.33541E+11

Year	Field Production of Crude Oil (Thousand Barrels Per Day)	Average Market Price of OPEC Crude Oil (\$/barrel)	Inflation, Consumer Prices (% Annual)	Real GDP (current US\$)
1991	305	18.62	180.952381	407796349.7
1992	425	18.44	83.61581921	553671957.7
1993	511	16.33	207.6923077	1031944881
1994	552	15.53	448.5	3991349283
1995	555	16.86	387.3108478	12894029888
1996	573	20.29	-16.11732575	10433698621
1997	1,150	18.86	23.06319968	20764857056
1998	2,145	12.28	14.76877356	20617405044
1999	2,502	17.44	12.57776234	36881601584
2000	2,565	27.6	4.978962132	48364250944
2001	2,385	23.12	16.3740815	36176430129
2002	2,018	24.36	19.3166946	32928454672
2003	1,304	28.1	33.6162106	21921569479
2004	2,008	36.05	26.96190682	36627901762
2005	1,874	50.59	36.95948092	49954890353
2006	1,992	61	53.23096291	65140147197
2007	2,083	69.04	-10.06749258	88837055195
2008	2,370	94.1	12.66285283	1.31614E+11
2009	2,371	60.86	6.873615472	1.11658E+11
2010	2,374	77.38	2.877747253	1.38517E+11
2011	2,600	107.46	5.801455371	1.8575E+11
2012	2,958	109.45	6.089096416	2.18002E+11
2013	3,029	105.87	1.879498007	2.34638E+11
2014	3,343	96.29	2.235974079	2.28416E+11
2015	4,029	49.49	1.393330288	1.66774E+11
2016	4,426	40.76	0.556521397	1.66602E+11
2017	4,440	52.51	0.184058899	1.87218E+11
2018	4,597	69.78	0.367441489	2.27367E+11
2019	4,695	64.04	-0.19896538	2.33636E+11
2020	4,064	41.47	0.574162679	1.8437E+11
2021	4,059	69.72	6.041864891	2.07889E+11

Appendix B.

Regression Analysis (U.S.A, Saudi Arabia, and Iraq respectively)

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.915130318								
R Square	0.837463499								
Adjusted R Square	0.819403888								
Standard Error	2.09112E+12								
Observations	31								
ANOVA									
	df	SS	MS	F	Significance F				
Regression	3	6.08325E+26	2.02775E+26	46.37218	8.74168E-11				
Residual	27	1.18065E+26	4.37277E+24						
Total	30	7.2639E+26							
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
Intercept	-1.85258E+11	1.82604E+12	-0.101452926	0.919941	-3.93199E+12	3.56E+12	-3.9E+12	3.56E+12	
Field Production of Crude Oil (Thou	1400121744	184726342.9	7.579437358	3.75E-08	1021094597	1.78E+09	1.02E+09	1.78E+09	
Average Market Price of WTI Crude	1.0783E+11	13651711807	7.898674544	1.72E-08	79819429651	1.36E+11	7.98E+10	1.36E+11	
Inflation, Consumer Prices (% Annu	-6.50464E+11	3.57726E+11	-1.818329244	0.080125	-1.38446E+12	8.35E+10	-1.4E+12	8.35E+10	

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.908410597								
R Square	0.825209812								
Adjusted R Square	0.80578868								
Standard Error	1.15335E+11								
Observations	31								
ANOVA									
	df	SS	MS	F	Significance F				
Regression	3	1.69563E+24	5.65211E+23	42.49030454	2.31632E-10				
Residual	27	3.59157E+23	1.33021E+22						
Total	30	2.05479E+24							
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
Intercept	-1.23858E+12	2.87138E+11	-4.313539783	0.000192225	-1.82774E+12	-6.49422E+11	-1.8E+12	-6.5E+11	
Field Production of Crude C	162396524.6	35031122.95	4.635778444	8.10552E-05	90518597.54	234274451.7	90518598	2.34E+08	
Average Market Price of OI	4506679570	1080668958	4.170268365	0.000281675	2289330023	6724029117	2.29E+09	6.72E+09	
Inflation, Consumer Prices	-5190975902	10176471064	-0.510095874	0.614129184	-26071369781	15689417977	-2.6E+10	1.57E+10	

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.973490537								
R Square	0.947683825								
Adjusted R Square	0.941870917								
Standard Error	20835301583								
Observations	31								
ANOVA									
	df	SS	MS	F	Significance F				
Regression	3	2.1232E+23	7.07733E+22	163.0309269	2.1E-17				
Residual	27	1.1721E+22	4.3411E+20						
Total	30	2.24041E+23							
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
Intercept	-81065391825	11226389067	-7.220967609	9.12595E-08	-1E+11	-5.8E+10	-1E+11	-5.8E+10	
Field Production of Crude	42883765.16	3734008.885	11.48464465	6.72989E-12	3.5E+07	50545319	35222212	50545319	
Average Market Price o	1496217386	145583488	10.27738383	7.86863E-11	1.2E+09	1.79E+09	1.2E+09	1.79E+09	
Inflation, Consumer Pri	109381635.6	42995865.43	2.54400358	0.01699378	2.1E+07	1.98E+08	21161407	1.98E+08	

Appendix C.

T-test, p-value test, and F-test

1. T statistics:

a. USA - B1:

- State the hypotheses:

$$H_0: B_1 = 0$$

$$H_a: B_1 \neq 0$$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 7.58 > 2.056$

- Conclusion: reject H_0

b. USA - B2:

- State the hypotheses:

$$H_0: B_2 = 0$$

$$H_a: B_2 \neq 0$$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 7.9 > 2.056$

- Conclusion: reject H_0

c. USA - B3:

- State the hypotheses:

$$H_0: B_3 = 0$$

$$H_a: B_3 \neq 0$$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = -1.82 > -2.056$
- Conclusion: do not reject H_0

d. Saudi Arabia - B1:

- State the hypotheses:

$H_0: B1 = 0$

$H_a: B1 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 4.64 > 2.056$
- Conclusion: reject H_0

e. Saudi Arabia - B2:

- State the hypotheses:

$H_0: B2 = 0$

$H_a: B2 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 4.17 > 2.056$
- Conclusion: reject H_0

f. Saudi Arabia - B3:

- State the hypotheses:

$H_0: B3 = 0$

Ha: $B3 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = -0.51 > -2.056$
- Conclusion: do not reject H_0

g. Iraq - B1:

- State the hypotheses:

$H_0: B1 = 0$

Ha: $B1 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 11.48 > 2.056$
- Conclusion: reject H_0

h. Iraq - B2:

- State the hypotheses:

$H_0: B2 = 0$

Ha: $B2 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject H_0 if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 10.28 > 2.056$
- Conclusion: reject H_0

i. Iraq - B3:

- State the hypotheses:

Ho: $B_3 = 0$

Ha: $B_3 \neq 0$

- Degrees of freedom = $n - (k + 1) = 30 - (3 + 1) = 26$ and t of .025 $\rightarrow t^{cv} = 2.056$

Decision Rule: reject Ho if $t^* > 2.056$ or $t^* < -2.056$

- Test statistic: $t^* = 2.54 > 2.056$
- Conclusion: reject Ho

2. P-value:

j. USA - B1:

- State the hypotheses:

Ho: $B_1 = 0$

Ha: $B_1 \neq 0$

- Decision Rule: reject Ho if p-value $< 5\%$
- Test statistic: p-value = $3.75E - 08$
- Conclusion: reject Ho

k. USA - B2:

- State the hypotheses:

Ho: $B_2 = 0$

Ha: $B_2 \neq 0$

- Decision Rule: reject Ho if p-value $< 5\%$
- Test statistic: p-value = $1.72E - 08$
- Conclusion: reject Ho

l. USA - B3:

- State the hypotheses:

Ho: $B3 = 0$

Ha: $B3 \neq 0$

- Decision Rule: reject Ho if p-value < 5%
- Test statistic: p-value = 0.08
- Conclusion: do not reject Ho

m. Saudi Arabia - B1:

- State the hypotheses:

Ho: $B1 = 0$

Ha: $B1 \neq 0$

- Decision Rule: reject Ho if p-value < 5%
- Test statistic: p-value = 0.000081
- Conclusion: reject Ho

n. Saudi Arabia - B2:

- State the hypotheses:

Ho: $B2 = 0$

Ha: $B2 \neq 0$

- Decision Rule: reject Ho if p-value < 5%
- Test statistic: p-value = 0.00028
- Conclusion: reject Ho

o. Saudi Arabia - B3:

- State the hypotheses:

Ho: $B3 = 0$

Ha: $B3 \neq 0$

- Decision Rule: reject H_0 if p-value $< 5\%$
- Test statistic: p-value = 0.614
- Conclusion: do not reject H_0

p. Iraq - B1:

- State the hypotheses:
 $H_0: B1 = 0$
 $H_a: B1 \neq 0$
- Decision Rule: reject H_0 if p-value $< 5\%$
- Test statistic: p-value = $6.73E - 12$
- Conclusion: reject H_0

q. Iraq - B2:

- State the hypotheses:
 $H_0: B2 = 0$
 $H_a: B2 \neq 0$
- Decision Rule: reject H_0 if p-value $< 5\%$
- Test statistic: p-value = $7.87E - 11$
- Conclusion: reject H_0

r. Iraq - B3:

- State the hypotheses:
 $H_0: B3 = 0$
 $H_a: B3 \neq 0$
- Decision Rule: reject H_0 if p-value $< 5\%$
- Test statistic: p-value = 0.017

- Conclusion: reject H_0

3. F-test:

s. USA:

- State the hypotheses:

$$H_0: B_1 = B_2 = B_3 = 0$$

$$H_a: \text{At least one of the coefficients} \neq 0$$

- Numerator of degrees of freedom = $k = 3$

$$\text{Denominator of degrees of freedom} = n - (k + 1) = 30 - (3 + 1) = 26$$

$$\rightarrow F^{cv} = 2.98$$

Decision Rule: reject H_0 if $F^* > F^{cv}$

- Test statistics: $F^* = 46.37 > 2.98$

- Conclusion: reject H_0

t. Saudi Arabia:

- State the hypotheses:

$$H_0: B_1 = B_2 = B_3 = 0$$

$$H_a: \text{At least one of the coefficients} \neq 0$$

- Numerator of degrees of freedom = $k = 3$

$$\text{Denominator of degrees of freedom} = n - (k + 1) = 30 - (3 + 1) = 26$$

$$\rightarrow F^{cv} = 2.98$$

Decision Rule: reject H_0 if $F^* > F^{cv}$

- Test statistics: $F^* = 42.49 > 2.98$

- Conclusion: reject H_0

u. Iraq:

- State the hypotheses:

$$H_0: B_1 = B_2 = B_3 = 0$$

$$H_a: \text{At least one of the coefficients} \neq 0$$

- Numerator of degrees of freedom = $k = 3$

$$\text{Denominator of degrees of freedom} = n - (k + 1) = 30 - (3 + 1) = 26$$

$$\rightarrow F^{cv} = 2.98$$

Decision Rule: reject H_0 if $F^* > F^{cv}$

- Test statistics: $F^* = 163.03 > 2.98$
- Conclusion: reject H_0

Appendix D.

Multicollinearity (U.S.A, Saudi Arabia, and Iraq respectively)

<i>Field Production of Crude Oil (Thousand Barrels)</i>				
Field Production of Crude Oil (Thousand Barrels)	1			
Average Market Price of WTI Crude Oil (\$/barrel)	0.066494269	1		
Inflation, Consumer Prices (% Annual)	-0.152581696	-0.051728526	1	
Real GDP (current US\$)	0.658768964	0.661774681	-0.265631354	1

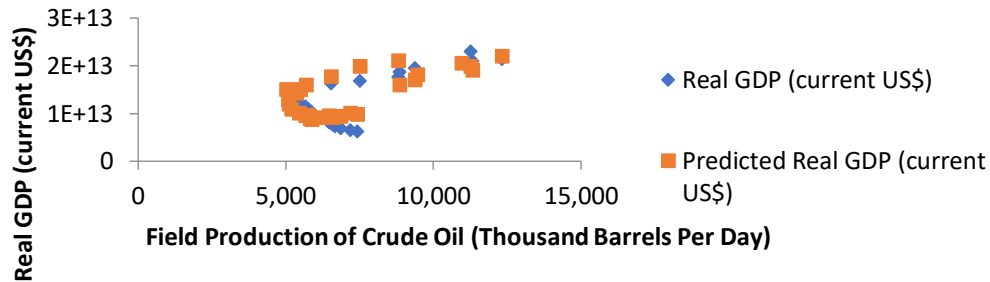
<i>Field Production of Crude Oil (Thousand Barrels)</i>				
Field Production of Crude Oil (Thousand Barrels)	1			
Average Market Price of OPEC Crude Oil (\$/barrel)	0.60507152	1		
Inflation, Consumer Prices (% Annual)	0.094237162	0.542932753	1	
Real GDP (current US\$)	0.818039974	0.807753426	0.284573461	1

<i>Field Production of Crude Oil (Thousand Barrels)</i>				
Field Production of Crude Oil (Thousand Barrels)	1			
Average Market Price of OPEC Crude Oil (\$/barrel)	0.515336274	1		
Inflation, Consumer Prices (% Annual)	-0.575978283	-0.420651705	1	
Real GDP (current US\$)	0.861373022	0.820562318	-0.469539154	1

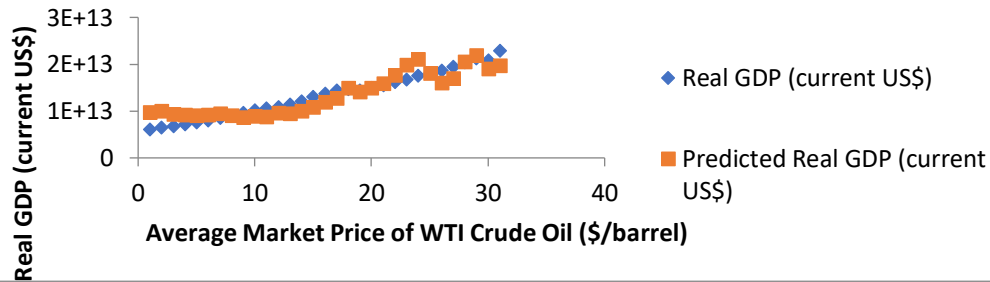
Appendix E.

U.S.A Line Fit Plot Graphs

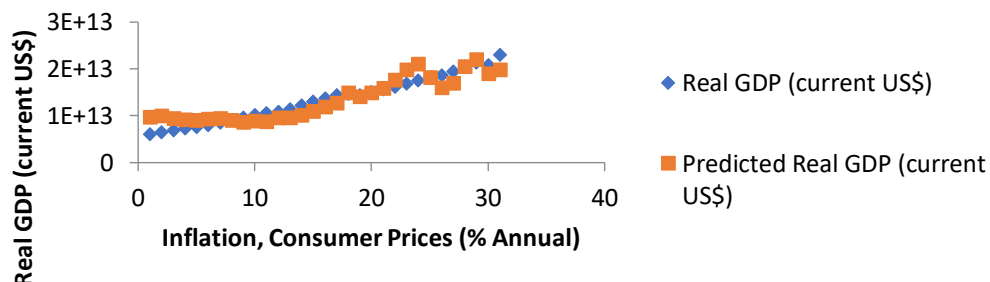
Field Production of Crude Oil (Thousand Barrels Per Day) Line Fit Plot



Average Market Price of WTI Crude Oil (\$/barrel) Line Fit Plot



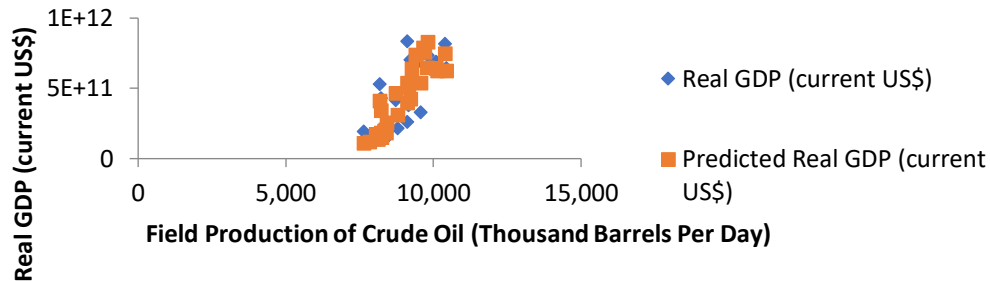
Inflation, Consumer Prices (% Annual) Line Fit Plot



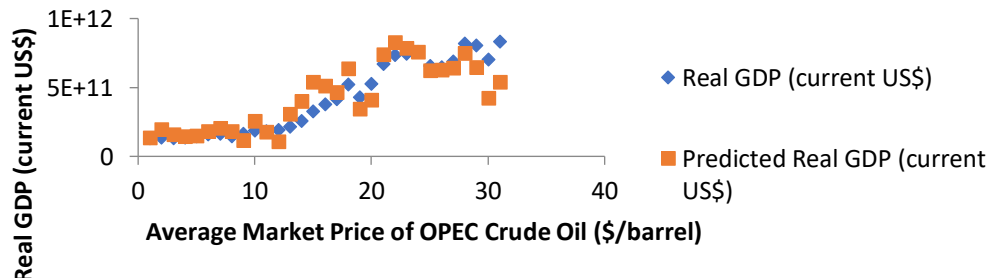
Appendix F.

Saudi Arabia Line Fit Plot Graphs

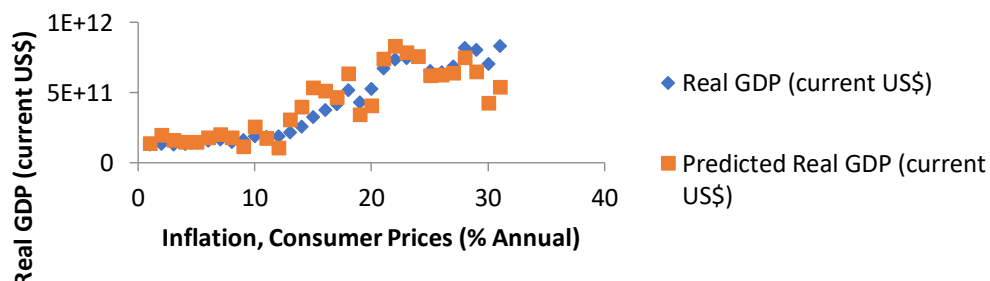
Field Production of Crude Oil (Thousand Barrels Per Day) Line Fit Plot



Average Market Price of OPEC Crude Oil (\$/barrel) Line Fit Plot



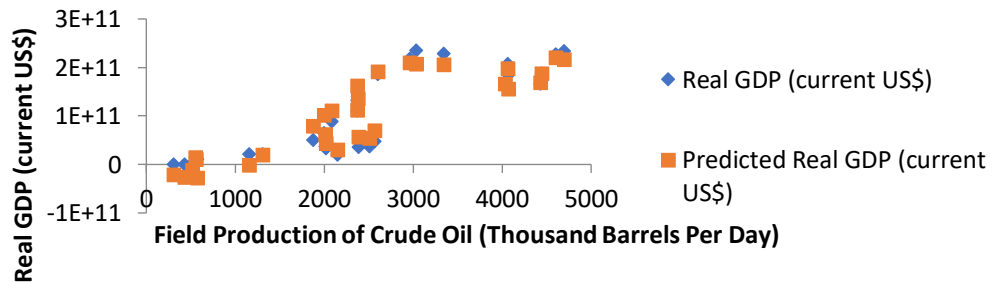
Inflation, Consumer Prices (% Annual) Line Fit Plot



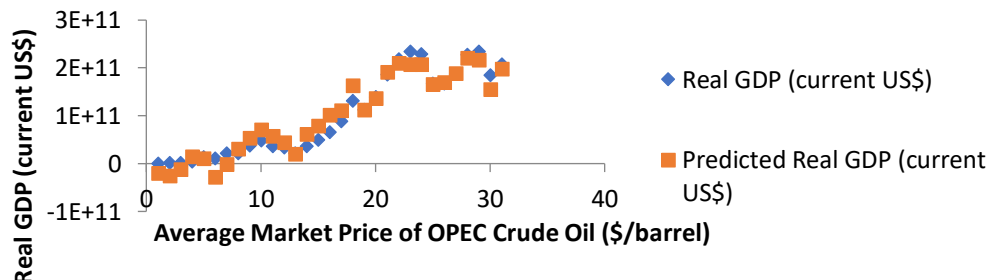
Appendix G.

Iraq Line Fit Plot Graphs

Field Production of Crude Oil (Thousand Barrels Per Day) Line Fit Plot



Average Market Price of OPEC Crude Oil (\$/barrel) Line Fit Plot



Inflation, Consumer Prices (% Annual) Line Fit Plot

