3. GLOBAL ECONOMIC POLICY UNCERTAINTY AND ENERGY PRICES: A MARKOV-SWITCHING VAR APPROACH (APPENDIX)

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Abstract

Economies are under the influence of global macroeconomic variables as well as national macroeconomic variables. In this context, global economic policy uncertainties are used as an important variable. The relationship between economic uncertainties and energy prices in the literature is examined over oil prices, and natural resources such as coal and natural gas, which have a significant share in world energy consumption, are rarely discussed. In this study, the relationship between the global economic policy uncertainty index and the prices of fossil fuels coal, natural gas, and oil as natural resources has been examined with the Markov Switching VAR Model. The model used enables the analysis of uncertainty and energy prices variables, which are directly affected by the expansion and recession periods of the world economy, under different regimes. As a result of the model application, it has been concluded that there is an asymmetrical relationship between global economic policy uncertainties and oil, coal, and natural gas prices, especially during the expansion periods of the global economy, and that the 1 standard deviation shock in all energy prices is explained by the global economic policy uncertainty index by approximately 50%.

Keyword: *GEPU, Oil Prices, Coal Prices, Natural Gas Prices, MS-VAR*

JEL Classification: *Q47, Q3*

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Appendix

Table 1: Bai Perron (1998, 2003) Multiple Structural Break Test Results

Lngepusa	**lnpcoalsa**	**lnpoilsa**	**lnpgassa**
UD_{max}=108.05	UD_{max}=12.47	UD_{max}=17.37	UD_{max}=20.77
Critical Value* = 8.88	Critical Value* = 8.88	Critical Value* = 8.88	Critical Value* = 8.88
WD_{max}=155.55	WD_{max}=21.90	WD_{max}=17.69, Critical Value* =9.91	WD_{max}=29.90, Critical Value* =9.91
Critical Value* =9.91	Critical Value* =9.91		
Sequential Bai-Perron analysis Results:	**Sequential Bai-Perron analysis Results:**	**Sequential Bai-Perron analysis Results:**	**Sequential Bai-Perron analysis Results:**
(1 vs 2*), $Sup\ Fr(2/1)$=100.99, Critical Value =7.22	(1 vs 2*), $Sup\ Fr(2/1)$=11.89, Critical Value =7.22	(1 vs 2*), $Sup\ Fr(2/1)$=14.43, Critical Value =7.22	(1 vs 2*), $Sup\ Fr(2/1)$=7.84, Critical Value =7.22
(2 vs 3*), $Sup\ Fr(3/2)$=108.055, Critical Value =5.96	(2 vs 3*), $Sup\ Fr(3/2)$=12.47, Critical Value =5.96	(2 vs 3*), $Sup\ Fr(3/2)$=11.70,Critical Value =5.96	(2 vs 3*), $Sup\ Fr(3/2)$=20.77,Critical Value =5.96
(3 vs 4*),	(3 vs 4*),	(3 vs 4*),	(3 vs 4*),
$Sup\ Fr(4/3)$=82.55, Critical Value =4.99	$Sup\ Fr(4/3)$=10.37, Critical Value =4.99	$Sup\ Fr(4/3)$=17.37, Critical Value =4.99	$Sup\ Fr(4/3)$=16.61, Critical Value =4.99
(4 vs.5*),	(4 vs.5*),	(4 vs.5*),	(4 vs.5*),
$Sup\ Fr(5/4)$=67.18,	$Sup\ Fr(5/4)$=9.98,	$Sup\ Fr(5/4)$=12.54,	$Sup\ Fr(5/4)$=7.22,
Critical Value=3.91	Critical Value=3.91	Critical Value=3.91	Critical Value=3.91
Estimated Number of Breaks: 3	**Estimated Number of Breaks: 3**	**Estimated Number of Breaks: 4**	**Estimated Number of Breaks: 4**
$\check{T}_1$=2003M08, $\check{T}_2$=2008M03, $\check{T}$3=2016M06	**$\check{T}_1$=2004M01, $\check{T}_2$=2007M09, $\check{T}$3=2013M07**	**$\check{T}_1$=2000M08, $\check{T}_2$=2004M10, $\check{T}$3=2010M11**	**$\check{T}_1$=2005M08, $\check{T}_2$=2011M05, $\check{T}$3=2015M04**

		T4=2014M12	
First Regim:1997M01-2003M07, Number of Observations =79	**First Regim**:1997M01-2003M12, Number of Observations =84	**First Regim**:1997M1-2000M07, Number of Observations =43	**First Regim**:1997M1-2005M07, Number of Observations =103
δ_1= 4.484339 $P = 0.00$	δ_1= 3.363877 $P = 0.00$	δ_1= 2.858836 $P = 0.00$	δ_1= 3.156968 $P = 0.00$
Second Regim:	**Second Regim**:	**Second Regim:**	**Second Regim**:
2003M08-2008M02: Number of Observations =55	2004M01-2007M08: Number of Observations= 44	2000M08-2004M09,: Number of Observations 50	2005M08-2011M04,: Number of Observations 69
δ_2= 4.201368 $P = 0.00$	δ_2= 3.993256 $P = 0.00$	δ_2= 3.32425, $P = 0.00$	δ_2= 9.11781 $P = 0.00$
Third Regim:	**Third Regim:**	**Third Regim:**	**Third Regim**:
2008M03-2016M05,: Number of Observations =99	2007 M09-2013M06,: Number of Observations= 70	2004M10-2010M10,: Number of Observations 73	2011M05-2015M03,: Number of Observations 47
δ_3= 4.825018 $P = 0.00$	δ_3= 4.649040 $P = 0.00$	δ_3= 4.216354, $P = 0.00$	δ_3= 11.09340 $P = 0.00$
Fourth Regim:	**Fourth Regim**:	**Fourth Regim:**	**Fourth Regim**:
2016M06-2021M05 Number of Observations=60 11	2013M07-2021M05 Number of Observations,: 95	2010M11-2014M11 Number of Observations,: 49	2015M04-2021M05 Number of Observations,: 74
δ_4= 5.362320 $P = 0.00$	δ_4= 4.367134 $P = 0.00$	δ_4= 4.677609, $P = 0.00$	δ_4= 5.453363 $P = 0.00$
		Fifth Regim:	
		2014M12-2021m05 Number of Observations,: 78	
		δ_4= 3.987856 $P = 0.00$	

Note: **Bai_Perron(2003) critical values*

Table 2: Regime classification based on smoothed probabilities

Regime 1		Regime 2	
Dates	Months	Dates	Months
1997M04-1999M11	32	1999M12-1999M12	1
2000M01-2001M07	19	2001M08-2001M9	2
2001M10-2006M11	62	2016M12-2016M12	1
2007M01-2007M11	11	2007M12-2009M07	20
2009M08-2011M05	22	2011M06-2011N07	2
2011M08-2012M04	9	2012M05-2012M06	2
2012M07-2014M05	23	2014M06-2014M07	2
2014M08-2014M09	2	2014M10-2015M03	6
2015M04-2016M04	13	2016M05-2017M02	10
2017M03-2017M12	10	2018M01-2018M04	4
2018M05-2018M09	5	2018M10-2018M11	2
2018M12-2019M3	4	2019M04-2019M07	4
2019M08-2019M09	2	2019M10-2021M04	19

Table 3: Granger Causality Tests

Pairwise Granger Causality Tests
Sample: 1997M01 2021M05
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNPCOAL_SA does not Granger Cause DLNGEPU_SA	289	3.01756	0.0303
DLNGEPU_SA does not Granger Cause DLNPCOAL_SA		0.10921	0.0447
DLNPOIL_SA does not Granger Cause DLNGEPU_SA	289	0.88307	0.0503
DLNGEPU_SA does not Granger Cause DLNPOIL_SA		0.11559	0.0509
DLNGAS_SA does not Granger Cause DLNGEPU_SA	289	0.95229	0.0657
DLNGEPU_SA does not Granger Cause DLNGAS_SA		0.54129	0.0434

Table 4: VAR Residual Serial Correlation LM Tests

Sample: 1997M01 2021M05
Included observations: 289

H_o:NoserialCorelation

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	25.23386	16	0.0658	1.587837	(16, 822.4)	0.6580
2	40.24226	16	0.0007	2.555404	(16, 822.4)	0.0897
3	27.39548	16	0.0373	1.726116	(16, 822.4)	0.0973
4	28.66725	16	0.0263	1.807640	(16, 822.4)	0.0663

Table 5: VAR Residual Heteroskedasticity Tests (Levels and Squares)

Sample: 1997M01 2021M05
Included observations: 289

Joint test:

Chi-sq	df	Prob.
643.1730	240	0.0932