



Environmental Pollution in North African Countries: Case of Libya

¹Dr. Mariam M. R. Alkawfi.

1.Assistant.Professor-Faculty.of.Economics,.University.of.Benghazi-mariam.alkwafi@uob.edu.ly.

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Abstract

Climate change and environmental degradation, globally, have been the center of attention. Nevertheless, in some countries, environmental issues should receive greater attention, and governments should raise the level of environmental awareness and should set appropriate policies to reduce GHG emissions. Thus, it became crucial to focus on environmental degradation in these economies such as North African countries, more specifically here, Libya. This paper aims to evaluate the situation of environmental issues in Libya. Also, to review public policies towards clean energy, and inspect the emissions and carbon footprints in Libya. The study used the ARDL and ECM model to evaluate CO₂ emissions and to estimate the relationship between economic growth and CO₂ emissions during the period 1990–2021. Findings suggest that economic activities cause an increase in CO₂ emissions. Estimations show a positive relationship between GDP and emissions; however, electricity transmission loss is not significant. The study concluded that there is the absence of any actual significant policy to reduce emissions in Libya. Therefore, Libyan policymakers should make greater efforts towards clean energy usage and renewable energy sources.

Article Information

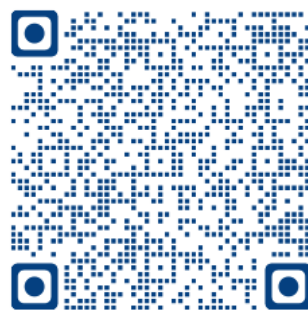
Keywords:..clean.energy,.pollution
..environment,.ARDL, Libya.

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التلوث البيئي في دول شمال إفريقيا: حالة ليبيا

¹ د. مريم محمد رمضان الكواقي.

1. أستاذ مساعد - قسم الاقتصاد - كلية الاقتصاد - جامعة بنغازي.

الملخص:

يحظى التغير المناخي والتدهور البيئي على الاهتمام الواسع على مستوى العالم، ومع ذلك، نجد في بعض البلدان، بأن القضايا البيئية لا تلقى اهتماما كبيرا، لذا يجب على الحكومات رفع مستوى الوعي البيئي ووضع السياسات المناسبة للحد من انبعاثات غازات الدفيئة. وقد أصبح من الضروري التركيز على التدهور البيئي في هذه الاقتصادات مثل دول شمال إفريقيا، وبشكل أكثر تحديداً في ليبيا. تهدف هذه الورقة إلى تقييم وضع القضايا البيئية في ليبيا. وكذلك مراجعة السياسات العامة تجاه الطاقة النظيفة، وفحص الانبعاثات والبصمة الكربونية في ليبيا. استخدمت الدراسة الأسلوب الكمي، القياسي، باستخدام نموذج ARDL و ECM لتقييم انبعاثات ثاني أكسيد الكربون والذي يمثل التلوث البيئي بالدراسة، وتقدير العلاقة بين النمو الاقتصادي وانبعاثات ثاني أكسيد الكربون خلال الفترة 1990-2021. تشير النتائج إلى أن الأنشطة الاقتصادية تسببت في زيادة انبعاثات ثاني أكسيد الكربون. حيث تظهر التقديرات وجود علاقة طردية بين الناتج المحلي الإجمالي والانبعاثات الكربونية؛ ومع ذلك، فإن الفاقد أو التسريبات أثناء نقل الكهرباء ليس ذو دلالة احصائية. خلصت الدراسة غياب السياسات التي تعنى بالبيئة وعدم وجود سياسة فعلية جدية تعمل على خفض الانبعاثات الكربونية في ليبيا. ولذلك، ينبغي لواقعي السياسات الليبيين بذل جهود أكبر نحو استخدام الطاقة النظيفة ومصادر الطاقة المتجددة.

الكلمات المفتاحية: الطاقة النظيفة، التلوث، البيئة، نموذج تصحيح الخطأ، نموذج فترات التأخير الموزع، ليبيا



1..Introduction:

Libya.is.one.of.the.large
st.countries.in.North.Africa,.and
.an.important.member.of.the.OP
EC.(Organization.of.Petroleum.
Exporter.Countries)..Libya.depe
nds.heavily.on.the.Oil.sector.as.t
he.main.source.of.the.country's.r
evenues..Therefore,.it.is.believe
d.that.the.main.source.of.GHG.(
Green.House.Gases).emissions.i
n.Libya.is.contributed.to.the.ene
rgy.sector.(Climate.Change.Fact
sheet-

report.2017)..This.makes.it.impo
rtant.to.focus.on.reducing.emissi
ons.as.a.step.towards.clean.ener
gy.in.Libya..Libya.had.engaged.
in.the.international.agreement.to
ward.reducing.pollution..In.199
9,.Libya.signed.the.United.Natio
ns.Framework.Convention.on.Cl
imate.Change.(UNFCCC)..but.t
here.was.no.policy.framework.r

egarding.GHG.emissions.and.cli
mate.change.at.the.national.level

2.Libyan.Environmental.Polic

y.Review:

At.level.of.legalization.a
nd.policies,.Libya.is.still.far.fro
m.achieving.any.prober.effort.us
ing.low.carbon.emissions.energy
.sources.so.far..One.of.the.main.
causes.is.the.subsided.energy.pri
ces.in.all.economic.sectors.in.Li
bya,.which.make.it.difficult.to.f
oster.any.renewable.energies..M
oreover,.the.economy.mainly.de
pends.on.Oil.sector,.which.induc
es.more.pollution.in.the.area.

2.1..Current.Situation:

Libya.has.created.new.l
aw.regarding.renewable.energy,.
Law.No..426.establishing.the.Re
newable.Energy.Authority.of.Li
bya.(REAOL).and.in.2013,.the
Libya.Renewable.Energy.Strate



gic.Plan.2013-

2025.(IRENA,.2021)..

As.shown.in.Table.(1).a
nd.(Figure.1&.2)..carbon.emissi
ons.and.electricity.loss.do.not.se
em.to.take.any.significant.down.
turn.during.previous.couple.deca
des.,except.slight.reduction;this.
decrease.is.due.to.the.period.of.c
ivil.war.2011.when.the.oil.produ
ction.had.been.stopped.several.ti
mes.because.of.security.instabili
ty.

The.problem.of.carbon.e
missions.can.be.a.sign.of.the.abs
ence.of.any.effort.towards.reduc
ing.GHG's.emissions.

Table.(1)
Carbon.dioxide.emissions.(metri
c.tons.per.capita)

year	CO ₂
1990	7.145018
1991	7.119107
1992	7.082582
1993	6.984291

1994	6.901241
1995	7.325624
1996	7.248469
1997	7.303872
1998	7.492434
1999	7.607836
2000	7.662168
2001	7.662605
2002	7.77213
2003	8.06446
2004	8.189257
2005	8.173783
2006	8.025766
2007	7.860768
2008	7.564248
2009	6.71897
2010	6.836836
2011	6.680594
2012	6.327709
2013	5.751906
2014	5.387475
2015	5.563259
2016	5.498165



2017	5.437858
2018	5.376871

2019	5.311315
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Source: World.Bank

Figure.(1)

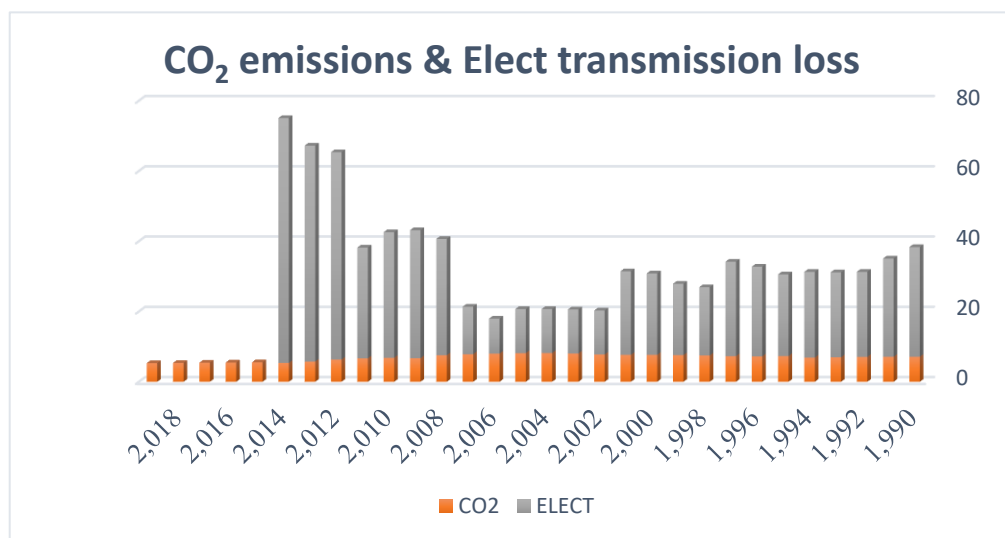




Figure.(2) CO2.emissions.(metric.tons.per.capita)

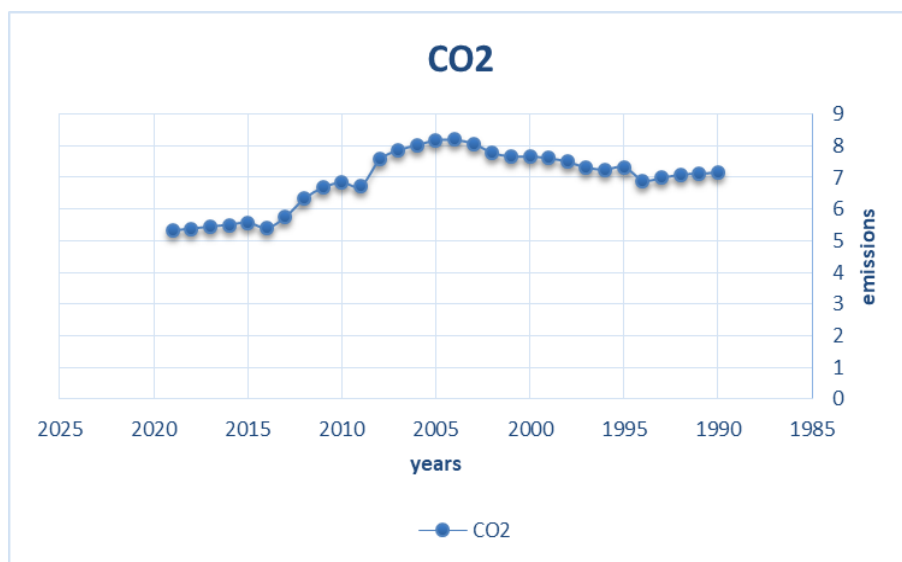
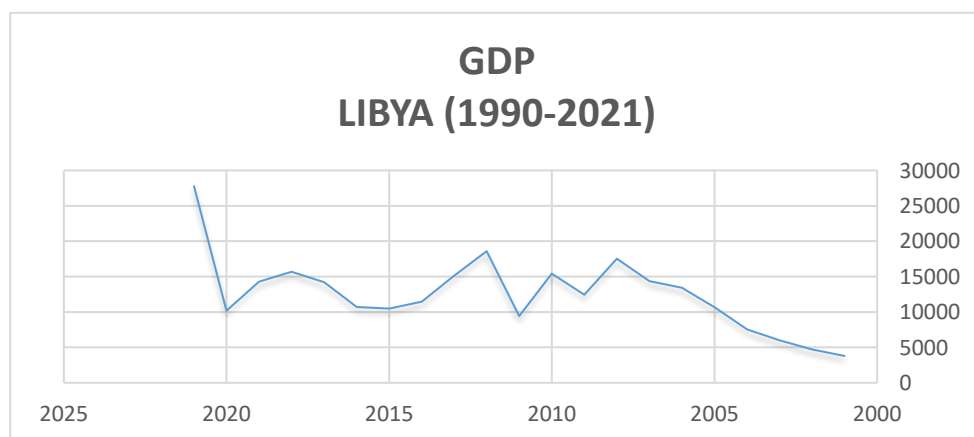


Figure.(3)





2.2..Prospective.Situation:.

Libya.would.have.a.grea
t.potential.for.solar.energy.if,.an
d.only.if.government.paid.enoug
h.attention.to.the.renewable.ener
gy.resources.in.Libya.and.do.co
nsiderable.effort.towards.clean.e
nergy.pathway..It's.stated.that.av
erage.sun.duration.is.more.than.
3,500.hours.per.year,.which.is.e
quivalent.to.a.layer.of.25.cm.of.
crude.oil.per.year.on.the.land.su
rface.(Salem..A..Al-
Hashmi..et.al.2017).

Some.empirical.studies.
proved.that.adopting.renewable.
sources.for.lighting.system.coul
d.help.mitigate.CO₂.emissions..S
uch.as.the.study.concluded.that.
PV.power.plant.can.be.feasible.a
nd.sustainable.from.economic.p
erspective.scale.(A..Albarghathi.
et.al.2018).

Photovoltaic.powered.st
reet.lighting.system.as.the.most.
energy.saving.and.reduce.air.pol
lution.in.Libya.(A..Elmanfi.et.al.
2019).

Hence,.policymakers.ar
e.recommended.to.take.more.ser
ious.and.courage.steps.towards.e
nvironmental.friendly.comprehe
nsive.policies.to.utilize.to.natura
l.resources.in.this.gifted.country.
and.achieve.low.emissions.level
s.at.the.same.time..

3..Aim.and.the.Importance.of. the.Study:

This.study.aims.to.highl
ight.the.importance.of.reducing.
emissions.and.reviewing.the.rela
ted.policies.regarding.enviro
nmental.degradation..Therefore,.the
.paper.discusses.the.main.enviro
nment.pollution.issues.in.Libya,.
and.empirically.examines.CO₂.e
missions.and.the.main.factors.af



fecting.environment.in.Libya..Thus,.the.scope.of.the.study.is.important.for.two.reasons:.First,.due.to.the.considerable.increased.global.attention.regarding.reducing.emissions.towards.clean.energy.worldwide..Second,.because.of.the.lack.of.concern.at.public.policy.level,.this.study.is.important.to.shed.the.light.and.drag.the.attention.to.environment.pollution.for.both.private.and.public.levels.

4..Data.and.Study.Period:

The.paper.collect.the.data.that.represent.economic.growth.and.environmental.pollution.for.the.purpose.of.the.study.mainly.from.World.Bank.and.International.Statics..This.study.covers.the.period.from.1990.to.2021).

5..Methodology:

In.this.paper,.we.used.A.RDL.model.to.examine.the.relat

ionship.between.growth.and.GHG.emissions..We.used.CO₂.(as.the.main.pollutant.cause),.similar.to.several.studies.used.the.same.pollutant.factor.to.do.similar.work.regarding.environment.degradation..Such.as.work.of.(M..Kazemi.and.I.Ebrahimi..2008),.(R..Alam.&M..Adil..2019).and.(Saleheen.Khan.et.al.2020),.while.some.other.studies,.used.nitrous.oxide.(No₂).emissions.to.represent.the.element.of.pollution.in.Germany.(M..Monserate.&Fernandez.2017).

Generally,.almost.of.electricity.is.generated.at.main.power.stations.and.sent.through.high-voltage.transmission.lines.over.long.distance.before.distributed.and.connect.to.the.final.users,.during.this.process.part.the.electricity.with.the.fuel.used.will.be.lost..Therefore,.loss.of.transmission.



of electricity is considered as one of the main causes of emissions (S..Jordaan.&K..Surana..IEA.. 2019)..Accordingly,our model used electricity transmission loss as additional element in the pollution..

The economic growth is the dependent variable in our model, so, (GDP) is included to represent economic growth..Hence, the relationship tested in our model is as follows:

$CO_2 = f(GDP, GDP^2, ELECT)$, the adopted model is:

$$LCO_{2t} = \alpha_0 + \beta_1 LGDP_t + \beta_2 Elect_t + u_t$$

Where:.

CO_2 = Carbon dioxide emissions (metric tons per capita)

GDP = Gross domestic Product (GDP per capita GDP (current LCU))

ELC = Electric power transmission and distribution losses (% of output)¹

6..The.Empirical.Findings:

The study results show that the environmental Kuznets inverted curve (EKC) does not exist..Although the regressors' coefficients are statically significant at (P-value of 5%), the electricity consumption still does not have a significant role as expected to increase level of the pollution..This can be due to the fact that, it is not the best to describe the impact of Libyan people usage of electricity, due to the unviability of da

¹ Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution

and in the distribution to consumers, including pilferage (WB, world bank).



ta.about.usage.of.diesel.during.b
lackout.periods..However,.findi
ngs.confirm.the.positive.relation
ship.between.economic.activity.
and.CO₂.emissions.

6.1. Test of Stationarity:

To.test.f.our.model.vari
ables.we.did.unit.root.Augmente
d.Dickey-Fuller.(ADF)-
test,using.(P-
value.compared.with.0.05).to.tes
t.the.stationarity.hypothesis:

H₀:.the.variable.has.a.unit.root...
.H₁:.the.variable.does.not.have.a
.unit.root
.As.shown.in.the.tables.below,.a
ccording.to.According.to.the.P-
value.of.ADF.statistic,.we.can.re
ject.the.null.hypothesis,.and.our.
explanatory.variable.are.stationa
ry.at.first.differences,.Results.ar
e.shown.in.the.following.tables:

Table.1 Unit.root.test.for.(CO2)

Null.Hypothesis:.D(CO2).has.a.unit.root				
Lag.Length:.0.(Automatic.-.based.on.SIC,.maxlag=6)				
..Prob.*	t-Statistic			
.0.0112	-3.649847	Augmented.Dickey-Fuller.test.statistic		
	-3.699871		1%.level	Test.critical.values:
	-2.976263		5%.level	
	-2.627420		10%.level	



Table.2 Unit.root.test.for.(ELECT)

Null.Hypothesis:.D(ELECT,2).has.a.unit.root

Exogenous:..None

Lag.Length:..2.(Automatic.-.based.on.SIC,.,maxlag=5)

..Prob.*	t-Statistic	Augmented.Dickey-Fuller.test.statistic	
.0.0000	-8.484236		
	-2.685718	1%.level	Test.critical.values:
	-1.959071	5%.level	
	-1.607456	10%.level	

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

Table.(3) Unit.root.test.for.(GDP)

Null.Hypothesis:.D(GDP).has.a.unit.root

Lag.Length:..0.(Automatic.-.based.on.SIC,.,maxlag=6)

Prob.*	t-Statistic	Augmented.Dickey-Fuller.test.statistic	
0.0000	-7.961392		
	-3.699871	1%.level	Test.critical.values:
	-2.976263	5%.level	
	-2.627420	10%.level	

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



Table.(6).6.2.ARD-L-Estimation.results

Dependent.Variable:..LC02

Method:..ARDL

Model.selection.method:..Akaike.info.criterion.(AIC)

Dynamic.regressors.(4.lags,,automatic):..LGDP.ELECT

Fixed.regressors:..C

Number.of.models.evaluated:..100

Selected.Model:..ARDL(1,,1,,0)

Prob.*..	Std..Error	Coefficient	Variable
0.0007	4.064579	0.120828	LC02(-1)
0.0026	3.469039	0.019615	LGDP
0.0012	-3.815902	0.018252	LGDP(-1)
0.0000	-5.457253	0.000681	ELECT
0.0001	4.944978	0.224523	C
1.974451	Mean.dependent.var	0.971755	R-squared
0.105006	S.D..dependent.var	0.965808	Adjusted.R-squared
-4.862311	Akaike.info.criterion	0.019417	S.E..of.regression
-4.616884	Schwarz.criterion	0.007163	Sum.squared.resid
-4.797199	Hannan-Quinn.criter.	63.34774	Log.likelihood
2.158506	Durbin-Watson.stat	163.4193	F-statistic



The error correction coefficient is, statically, significant at level of (5%),

and with negative sign

ARDL Error Correction Regression

Dependent Variable: D(LC02)

Selected Model: ARDL(1, 1, 0)

Case 2: Restricted Constant and No Trend

Sample: 1990-2018

Included observations: 24

ECM Regression

Case 2: Restricted Constant and No Trend

Prob....	t-Statistic	Std..Error	Coefficient	Variable
0.0002	4.542910	0.014978	0.068046	D(LGDP)
0.0000	-9.683880	0.052550	-0.508884	CointEq(-1)*
-0.011764	Mean.dependent.var		0.806299	R-squared
0.040098	S.D..dependent.var		0.797494	Adjusted.R-squared
-5.112311	Akaike.info.criterion		0.018044	S.E..of.regression
-5.014140	Schwarz.criterion		0.007163	Sum.squared.resid
-5.086267	Hannan-Quinn.criter.		63.34774	Log.likelihood
			2.158506	Durbin-Watson.stat

6.3..Diagnostic tests:

1.Normality test: According to the

P-value of Jarque-

Bera (0.55), we cannot reject the

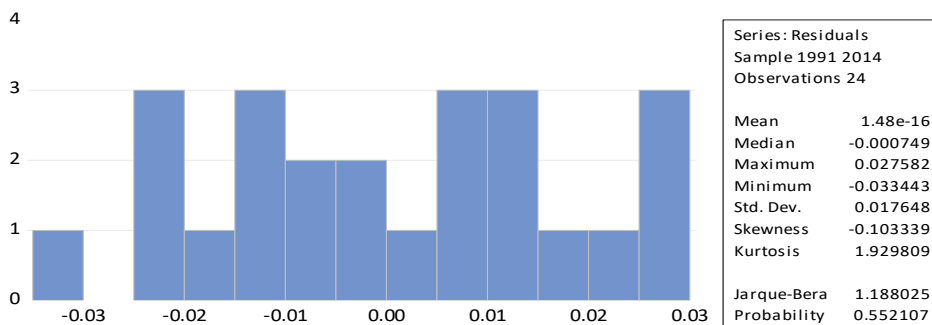
null hypothesis, that the random

error has a normal distribution..

(Table.7)



Table.(7) Normality.test



2.Test.of.heterogeneity:

To.check.that.our.model.is.free.
of.heterogeneity.we.used.Breusc
h-Pagan
Godfrey.test,.as.seen.in.Table.(8

).the.p-
value.is.greater.than.0.05,.theref
ore,. H_0 .cannot.be.rejected,.and.h
eterogeneity.does.not.exist.in.ou
r.model..

Table.(8) Heterogeneity.test

Heteroskedasticity.Test:..Breusch-Pagan-Godfrey

Null.hypothesis:..Homoskedasticity

0.6493	Prob..F(4,19)	0.626614	F-statistic
0.5923	Prob..Chi-Square(4)	2.797066	Obs*R-squared
0.9364	Prob..Chi-Square(4)	0.814988	Scaled.explained.SS

3.Test.of.serial.correlation

A.test.for.autocorrelation.has.be
en.done,.and.results.as.shown...i
n.Table.(9&10).at.there.is.no.ser

Form.the.results.in.table.(8)..wit
h.the.value.of.Prob..Chi-
Square.we.can.conclude.that.the.
model.is.free.of.heterogeneity.



statistic.respectively.are.greater.t
han.5%).

ial.correlation,.because.of.the.va
lue.of.(Prob..Chi-
Square..is.and.Q-

Table.(9)

Breusch-Godfrey.Serial.Correlation.LM.Test:

Null.hypothesis:.No.serial.correlation.at.up.to.2.lags

0.9031	Prob..F(2,17)	0.102480	F-statistic
0.8668	Prob..Chi-Square(2)	0.285907	Obs*R-squared

Table.(10)

Sample.(adjusted):.1991.2014

Included.observations:.24.after.adjustments

.Prob*	.Q-Stat	.PAC	AC.		Partial.Correlation	Autocorrelation
0.159	1.9801	0.270	0.270	1	 **....	 **....
0.283	2.5255	-0.228	-0.139	2	**	*
0.317	3.5305	-0.087	-0.184	3	*	*
0.151	6.7343	-0.307	-0.320	4	**	**
0.200	7.2827	-0.002	-0.129	5		*
0.273	7.5553	0.002	0.089	6		 *....
0.274	8.7094	0.081	0.177	7	 *....	 *....
0.237	10.421	0.085	0.210	8	 *....	 *....
0.279	10.956	-0.224	-0.113	9	**	*
0.219	13.087	-0.050	-0.219	10		**
0.280	13.203	0.057	-0.049	11		



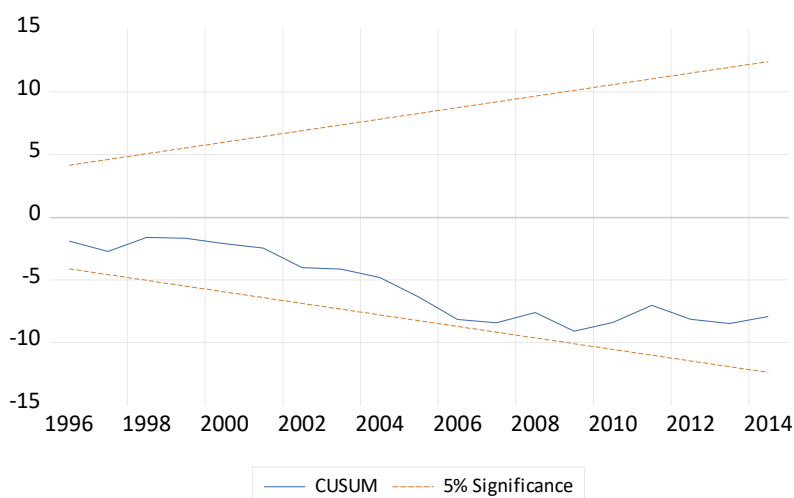
0.344 13.355 -0.048 -0.054 12|.....||.....|

*Probabilities.may.not.be.valid.for.this.equation.specification.

4.Test.of.model.stability:

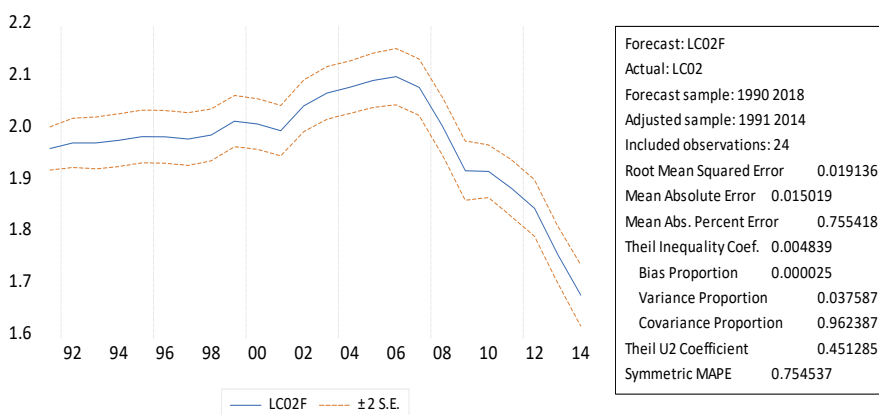
The.cumulative.Sum.Chart.(CU
SUM).reveals.that.the.model.is.s
table.

Table.(11) Stability.test





5..Test.for.Forecasting:.measur ements.of.forecast.quality



7..Conclusions.and.Recommen dations:

This.study.examined.the.e
nvironmental.issues.in.Libya..T
he.paper.tested.the.relationship.
between.CO₂emissions.and.the.
main.factors.affecting.the.enviro
nment..Our.results.suggest.a.pos
itive.relationship.between.incom
e.and.pollution,.in.other.words,.
economic.activity.leads.to.more.
pollution.in.Libya..However,.the

Results.satisfy.the.diagnos
tic.tests.and.show.forecasting.ac
curacy.coefficients.(Theil.U2,.R
MSE.&.MAE).are.within.the.ac
cepted.range.

Hence,.and.according.to.th
e.results.of.the.previous.tests,.w
e.can.conclude.that.the.model.is.
fit.and.free.of.econometric.probl
ems:.autocorrelation,.heterogene
ity,.and.has.normal.distribution.



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he.Libyan.government.to.make.
more.effort.at.financing.renewab
le.projects.in.the.future.and.take.
serious.steps.towards.low.carbo
n.emissions,.especially,.since.Li
bya.has.the.potential.to.use.frien
dly.energy.resources..However,.
there.is.a.serious.need.for.furthe
r.empirical.studies.regarding.cle
an.energy.and.renewable.energy
.resources.in.Libya..

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A..Albarghathi,.R...Zakari
a,.A..Tahir,.A..khalil,.A..Alferga
ni.and.F..Mohamed..(2018)..Eco
nomic.Feasibility,.Design,.and.S
imulation.of.Centralized.PV.Po
wer.Plant..The.9th.International.
Renewable.Energy.Congress.(IR
EC.2018).

A.Wajahat,.A..Azrai.and.
A..Azam..Re-
visiting.the.environmental.Kuzn
ets.curve.hypothesis.for.Malaysi

.findings.show.that.the.EKC.rela
tionship.does.not.exist;.which.it.
can.be.due.to.the.slow.growth.in
.the.Libyan.economy..Therefore,
.Libya.still.far.from.the.turning.
point.in.the.EKC.theory..Moreo
ver,.results.indicate.that.the.elect
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