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The Impact of Global Climate Change and Global Warming on Public Health and Welfare Cost From Exposure to Environmental Risks

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The aim of the paper is to presents the impact of global climate change and global warming on public health and welfare cost from exposure to environmental risks. The paper shows the implications of greenhouse gases on the environment with potentially damaging effects on ecosystems, biodiversity and the means of human subsistence. This study attempts to empirically examine the dynamic causal relationships between greenhouse gases, mortality rate and public health and welfare cost from exposure to environmental risks, using the time-series data for the period 1999–2016.

Keywords – greenhouse gases, welfare cost, global warming.

JEL Code: F 64, I 19, O 44.

1. Introduction

Air pollution is a consequence of increasing urbanization and industrialization. Greenhouse gas (GHG) emissions contribute to accelerating climate change. The effect of greenhouse gas emissions on the environment is worrying, especially because in recent years they have had a fulminate development despite international agreements that have taken some decisions on their limitation. Greenhouse gases remain in the atmosphere for a few years to thousands of years and they have a worldwide impact. The global climate change has an impact on mortality rate, public health and welfare cost from exposure to environmental risks. Also, the greenhouse gases have a potentially damaging effect on ecosystems, biodiversity and of human subsistence. It is a dynamic causal relationship between greenhouse gases, **mortality rate** and public health and welfare cost, shows by the time-series data for the period 1999 – 2016.

2. Short literature review

"Ambient air pollution has been associated with a multitude of health effects, including mortality, respiratory and cardiovascular hospitalizations, changes in lung function, asthma attacks, and days lost from work (Bates 1995a; Pope 1996, 2000; Samet et al. 2000a, 2000b; Segala 1999). These studies have been performed in multiple cities around the United States and internationally using various designs and statistical methods." (*Wong, E, Gohlke, J, Griffith, W, Farrow, S and Faustman, E ,* 2004)

Greenhouse gases contribute to global warming because they absorb the sun's energy and prevents the release of harmful gases in space. Thus, while global warming will lead to what will lead to the disappearance of life on Earth.

Eurostat considers that "each greenhouse gas has a different capacity to cause global warming, depending on its radioactive properties, molecular weight and the length of time it remains in the atmosphere.

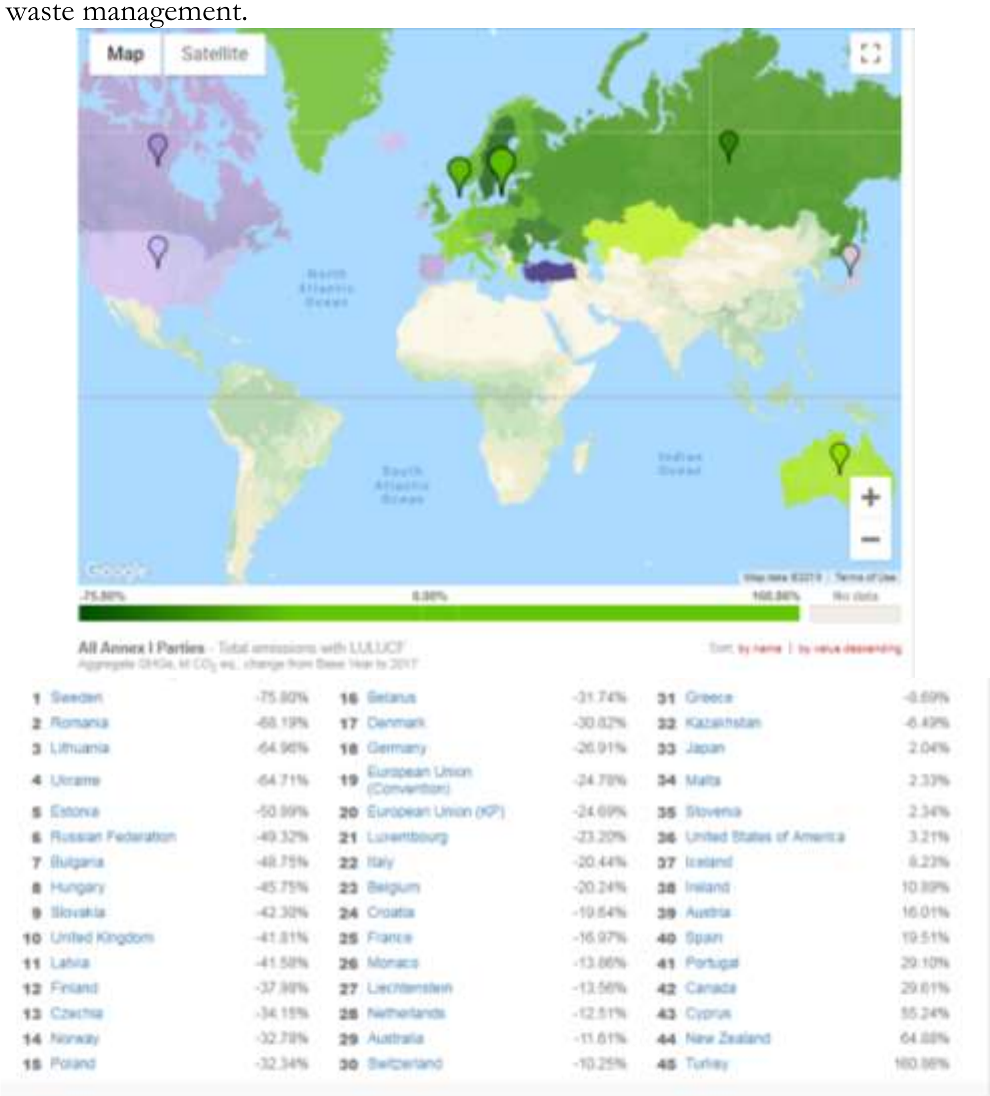
The global warming potential (GWP) of each gas is defined in relation to a given weight of carbon dioxide for a set time period (for the purpose of the Kyoto Protocol a period of 100 years).

GWPs are used to convert emissions of greenhouse gases to a relative measure (known as carbon dioxide equivalents: CO_2-equivalents). The weighting factors currently used is the following:

- carbon dioxide = 1,
- methane = 25,
- nitrous oxide = 298,
- sulphur hexafluoride = 22 800;
- hydrofluorocarbons and perfluorocarbons comprise a large number of different gases that have different GWPs. "(https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1180.pdf)

The biggest emitters and the sector that produces the most emissions are:

• energy, fuel combustion and fugitive emissions from fuels, which also includes transport;
• industrial processes;
• agriculture;
• land use, land use change and forestry (LULUCF);
• waste management.



1	Sweden	-75.80%	16	Belarus	-31.74%	31	Greece	-8.69%
2	Romania	-68.19%	17	Denmark	-30.82%	32	Kazakhstan	-6.40%
3	Lithuania	-64.96%	18	Germany	-26.91%	33	Japan	2.04%
4	Ukraine	-64.71%	19	European Union (Convention)	-24.78%	34	Malta	2.33%
5	Estonia	-50.99%	20	European Union (KP)	-24.69%	35	Slovenia	2.34%
6	Russian Federation	-49.32%	21	Luxembourg	-23.20%	36	United States of America	3.21%
7	Bulgaria	-48.75%	22	Italy	-20.44%	37	Iceland	8.23%
8	Hungary	-45.75%	23	Belgium	-20.24%	38	Ireland	10.89%
9	Slovakia	-42.30%	24	Croatia	-19.64%	39	Austria	16.01%
10	United Kingdom	-41.81%	25	France	-16.97%	40	Spain	19.51%
11	Latvia	-41.58%	26	Monaco	-13.86%	41	Portugal	29.10%
12	Finland	-37.98%	27	Liechtenstein	-13.56%	42	Canada	29.61%
13	Czechia	-34.15%	28	Netherlands	-12.51%	43	Cyprus	55.24%
14	Norway	-32.78%	29	Australia	-11.61%	44	New Zealand	64.88%
15	Poland	-32.34%	30	Switzerland	-10.25%	45	Turkey	160.86%

Figure 1. The evolution of total emissions with LULUCF

Source:https://di.unfccc.int/global_map_content/map/index.html?year=growth_base_final&gas=Aggregate_GHGs&sector=to&zoom=2&lat=30&lng=15

As the figure above shows, CO_2 is the greenhouse gas that is emitted the most, produced by human activities. Most of emissions of carbon dioxide come from burning fossil fuels, with additional contributions from deforestation, generically said LULUCF.

Experts say that if greenhouse gas emissions continue at their rate in 2017, the Earth's surface temperature could exceed historic values from 2047 with potentially damaging effects on ecosystems, biodiversity and the means of human subsistence.

3. Actually problems of global climate change and global warming

Globally, deforestation of the equatorial and tropical forests is so great that specialists say that every minute there is a forest of the size of 36 football fields, and that deforestation contributes about 6-12% of total CO_2 emissions.

In Romania, massive deforestation in recent years has led to irreparable environmental damage. Deforestation causes floods, soil erosion, landslides, and the disappearance of animals from their natural environment. Thus, the Carpathian bears from what was a few years ago, Wild Carpathian, do not find enough food in the forest because of deforestation and often go out to cities like Brasov, Buşteni or Sinaia to eating. The once destroyed ecosystem is hard to recover or even impossible.

Climate change affecting the worldwide in various forms, depending on the region. Greenhouse gases create the greenhouse effect leading to global warming and the appearance of extreme weather events, such as floods, tornadoes in areas where so far no record of such weather events, forest fires and changing seasons.

Also at this adds overuse everything is made of plastic, such as bags, bottles, glasses, packages are found everywhere in the oceans and forests.

It requires the emergence of new industries and factories that do not pollute, because pollution and smog around big cities affect people's health, it can also cause more and more allergic disorders, respiratory, lung, lung cancer and thus to reduce its duration and quality of life.

Also, outdated and polluting industries and very old cars pollute the environment. The solution is to replace them with electric cars, clean, and larger scale use of electricity produced from renewable sources such as wind turbines and giving the energy produced by power plants that are highly polluting.

Many organizations, such as Greenpeace fight for environmental protection, but their efforts should be enhanced and all countries understand that pollution and global warming effects worldwide and they at some point will be irreversible, and the costs for each country will be much higher, both financially and humanely, by affecting the health of the population and the quality of life.

4. Measures to reducing the greenhouses gases emissions

4.1.

Since 2008 the European Union set a target to minimize GHG emissions by 20% by 2020 compared to year 1990. Also, in 2015 there was a decrease of 22% of GHG emissions compared with 1990 levels. Then, in 2014, the EU set a new objective of decreasing GHG emissions by at least 40% by 2030 compared to 1990 levels, but in 2017 it estimates there will be a decrease of about 30% in 2030.

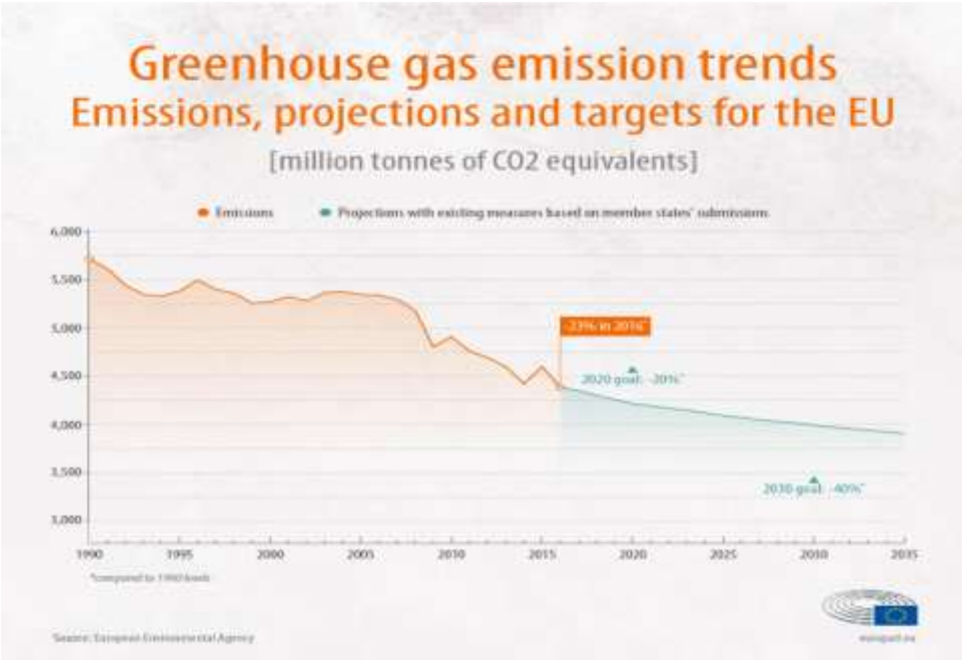
Carbon offsetting by forests

The forests have power to absorb CO_2 and so they fight with climate change and offset carbon from the land use sector.

The EU forests have 182 million hectares, covering 43% of its land area. The forest's surface and their weight can vary from one state to another and they absorb the equivalent of 10.9% of total EU GHG emissions each year.

4.2.

In 2018 the European Commission adopted a strategic long-term vision for minimize GHG emissions by 2050, named "A Clean Planet for all", which aims to create a vision and plan to develop new and innovative industries and businesses and not targets.



Sources: http://www.europarl.europa.eu/resources/library/images/20180709PHT07512/20180709PHT07512_original.jpg

At the beginning of this year, 2019, the European Parliament was adopted for the first time ever regulation on CO_2 emissions for trucks to decreasing the transport emissions. Thus, it follows that to be reduced by 30%, by the year 2030, with an intermediate target of 15%, by the year 2025.

Also by 2025, producers of trucks will be ensuring that 2% market share of the sales with zero-and-low-emission vehicles, as electric or hybrid trucks. This regulation will reduce the pollution and to improve air quality. The future of clean trucks is because this sector produces about 15% of EU CO_2 emissions and road transport is the only sector where greenhouse gas emissions are still higher than in 1990.

5. Methodology

The statistical data have been taken from the Eurostat https://ec.europa.eu/eurostat/, from the United Nations Framework Convention on Climate Change (UNFCCC) https://unfccc.int/ and from OECD https://data.oecd.org/. Data collected about GHG and mortality and welfare costs has been processed with EViews 10, graphically represented and interpreted.

Based on the https://data.oecd.org/ database, the following summary of the GHG emission from 1990-2017 is presented.

Table 1. Summary of GHG emissions

	Emissions, in kt CO_2 equivalent		
	Base year	2000	Last Inventory Year (2017)
CO_2 emissions without LULUCF	4,549,519.8	2,567,085.7	2,655,476.7
CO_2 net emissions/removals by LULUCF	-283,361.2	-752,235.5	-740,044.3
CO_2 net emissions/removals with LULUCF	4,266,158.6	1,814,850.2	1,915,432.4
GHG emissions without LULUCF	5,812,621.3	3,369,786.3	3,489,856.4
GHG net emissions/removals by LULUCF	-243,833.2	-707,459.8	-694,162.0
GHG net emissions/removals with LULUCF	5,568,788.1	2,662,326.5	2,795,694.4
Indirect CO_2	1,889.6	1,185.8	727.6

	Changes in emissions, in percent		
	From Base year to 2000	From 2000 to Last Inventory Year (2017)	From Base year to Last Inventory Year (2017)
CO_2 emissions without LULUCF	-43.57%	3.44%	-41.63%
CO_2 net emissions/removals by LULUCF	165.47%	-1.62%	161.17%
CO_2 net emissions/removals with LULUCF	-57.46%	5.54%	-55.10%
GHG emissions without LULUCF	-42.03%	3.56%	-39.96%
GHG net emissions/removals by LULUCF	190.14%	-1.88%	184.69%
GHG net emissions/removals with LULUCF	-52.19%	5.01%	-49.80%

	Average annual growth rates, in percent per year		
	From Base year to 2000	From 2000 to Last Inventory Year (2017)	From Base year to Last Inventory Year (2017)
CO_2 emissions without LULUCF	-5.56%	0.20%	-1.97%
CO_2 net emissions/removals by LULUCF	10.26%	-0.10%	3.62%
CO_2 net emissions/removals with LULUCF	-8.19%	0.32%	-2.92%
GHG emissions without LULUCF	-5.31%	0.21%	-1.87%
GHG net emissions/removals by LULUCF	11.24%	-0.11%	3.95%
GHG net emissions/removals with LULUCF	-7.11%	0.29%	-2.52%

The base year under the Climate Change Convention is 1990 except for Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989) and Slovenia (1986), as defined by decisions 9/CP.2 and 11/CP.4.

Source: https://unfccc.int/

The evolution of GHG emissions with or without LULUCF in the period 1990-2017 is presented in the followings graphics:

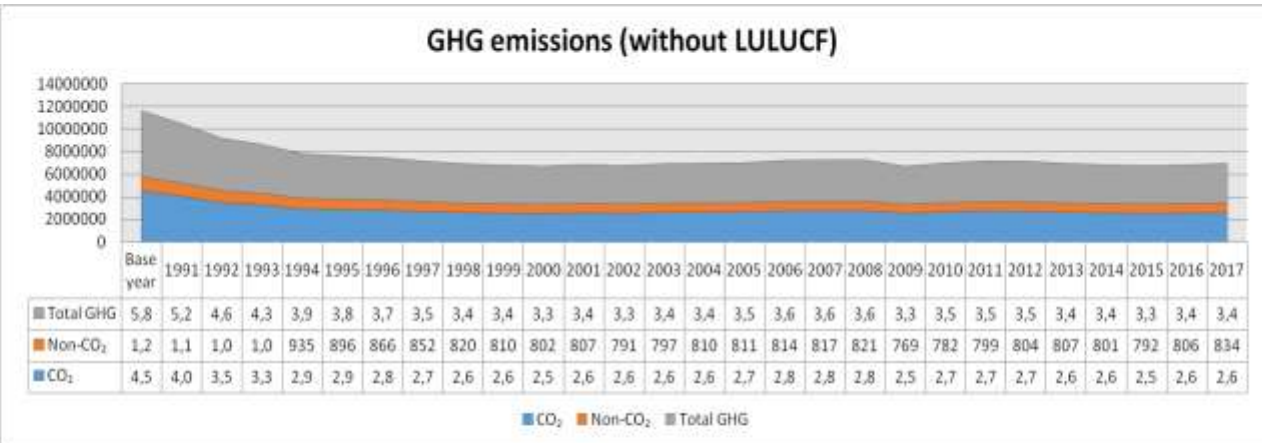
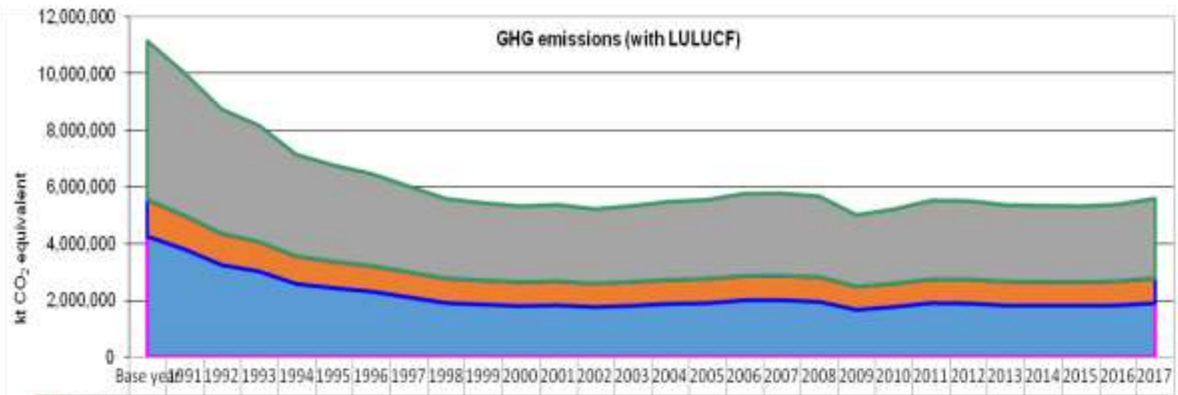


Figure 1. The evolution of the GHG emissions without LULUCF
Source: Author, by using the https://unfccc.int/ data (2019)



	Base year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total GHG	5,5	5,0	4,3	4,0	3,5	3,3	3,2	3,0	2,7	2,7	2,6	2,6	2,6	2,6	2,7	2,7	2,8	2,8	2,8	2,5	2,6	2,7	2,7	2,6	2,6	2,6	2,6	2,7
Non-CO_2	1,3	1,1	1,1	1,0	977	933	908	889	871	852	847	847	833	842	848	860	867	869	875	826	826	843	849	850	847	837	855	880
CO_2	4,2	3,8	3,2	3,0	2,5	2,4	2,3	2,1	1,9	1,8	1,8	1,8	1,7	1,8	1,8	1,9	2,0	2,0	1,9	1,6	1,7	1,9	1,9	1,8	1,8	1,8	1,8	1,9

Figure 2. The evolution of the GHG emissions with LULUCF
Source: Author, by using the https://unfccc.int/ data (2019)

The evolution of GHG emissions /removals changes from 1990 to 2017 can be summarized as follows:

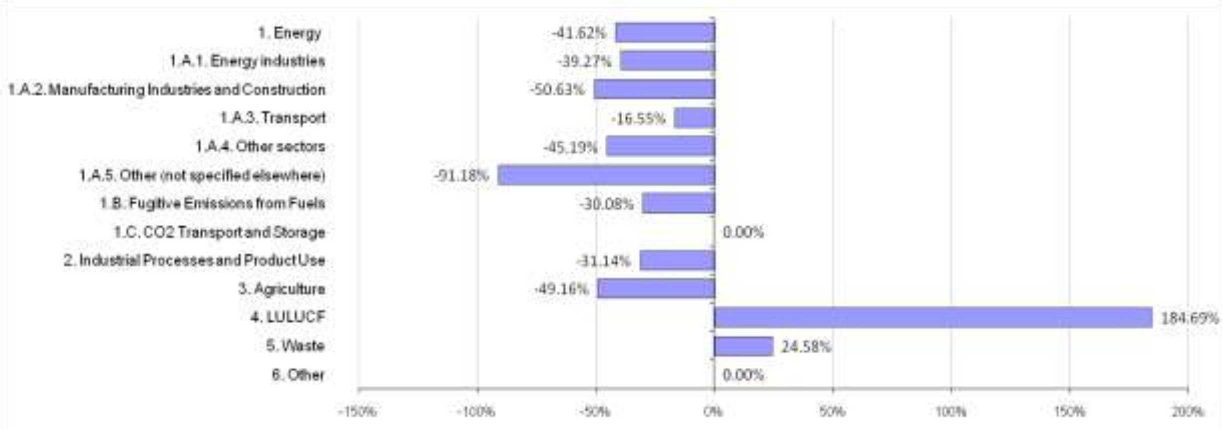


Figure 3. The evolution of the GHG emissions/removals
Source: https://unfccc.int/

Also, the GHG emissions by gas in 2017 compared with base year 1990 are presented in the followings graphics, with or without LULUCF:

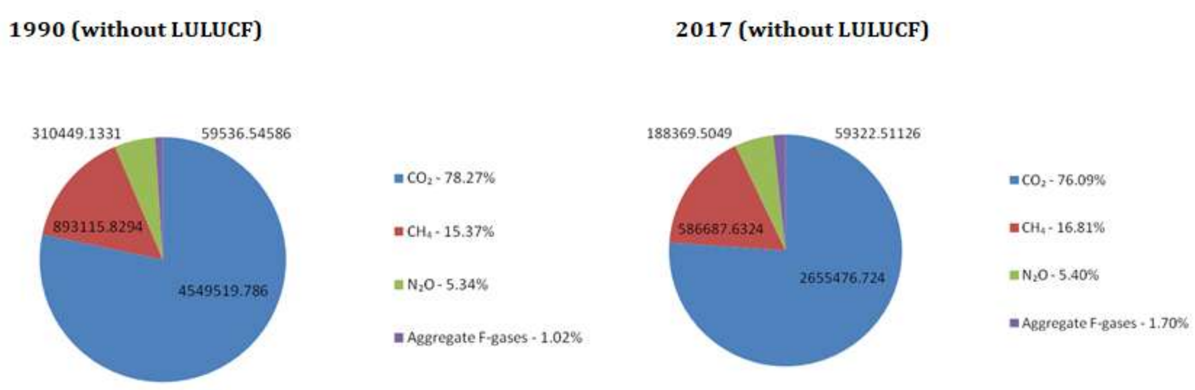


Figure 4. The evolution of the GHG emissions by gas without LULUCF
Source: https://unfccc.int/

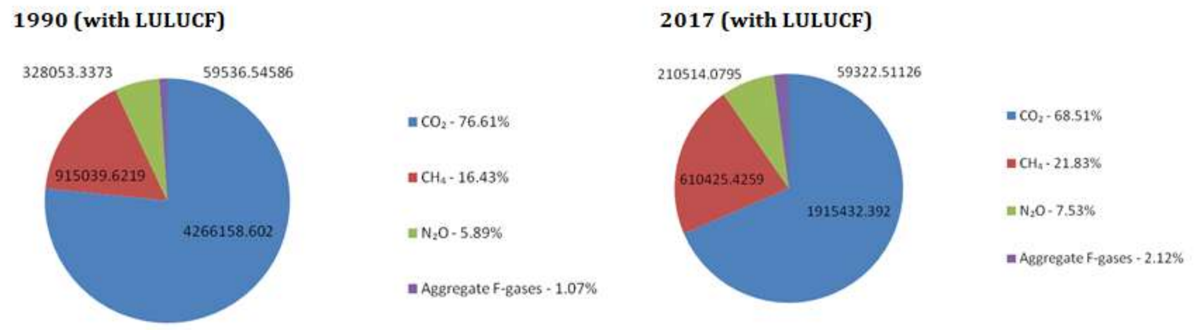


Figure 5. The evolution of the GHG emissions by gas with LULUCF
Source: https://unfccc.int/

And the GHG emissions by sector without LULUCF in 2017 compared with base year 1990 are presented in the followings graphics:

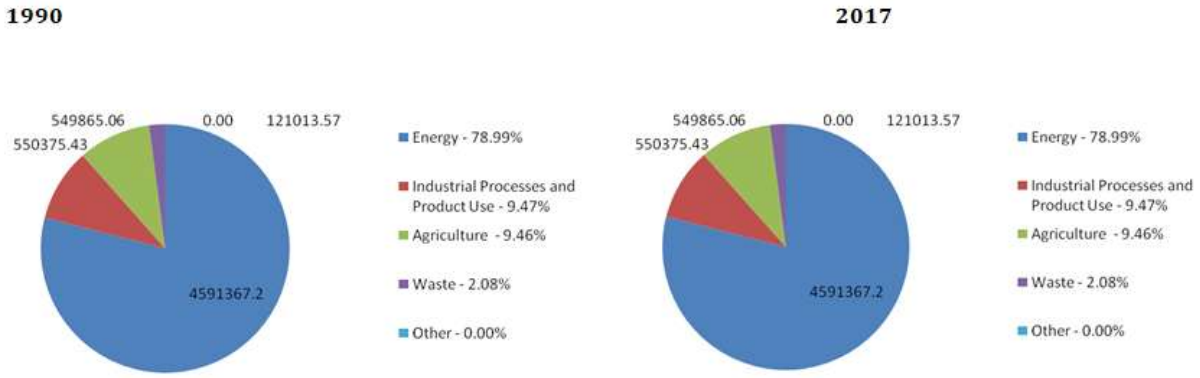


Figure 6. The evolution of the GHG emissions by sector without LULUCF
Source: https://unfccc.int/

6. Results and discussions

The statistical data collected about GHG and mortality and welfare costs has been processed with EViews 10, graphically represented and interpreted.

GHG data series and *mortality and welfare costs* data series are used to determine descriptive indicators and statistical or graphical estimation of econometric models. Evolution of the two variables analyzed in the period 1999-2016 is presented using EViews 10, as follows:

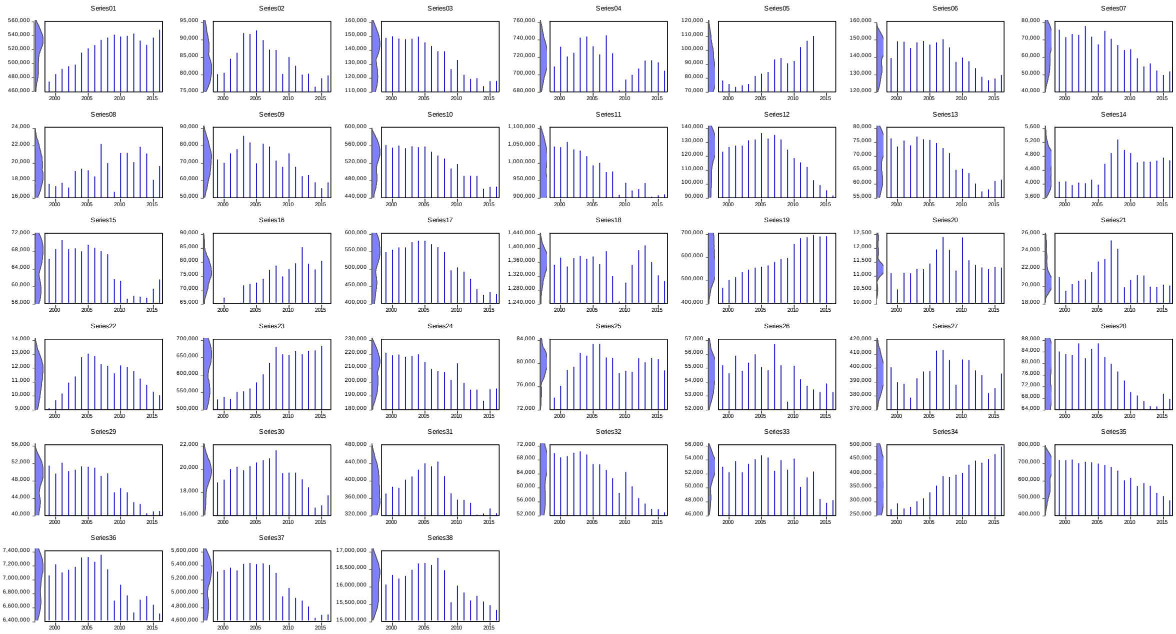


Figure 7. The evolution of the GHG emissions with EViews 10 for OECD statistical data

Source: Author, by using the https://stats.oecd.org/ (2019)

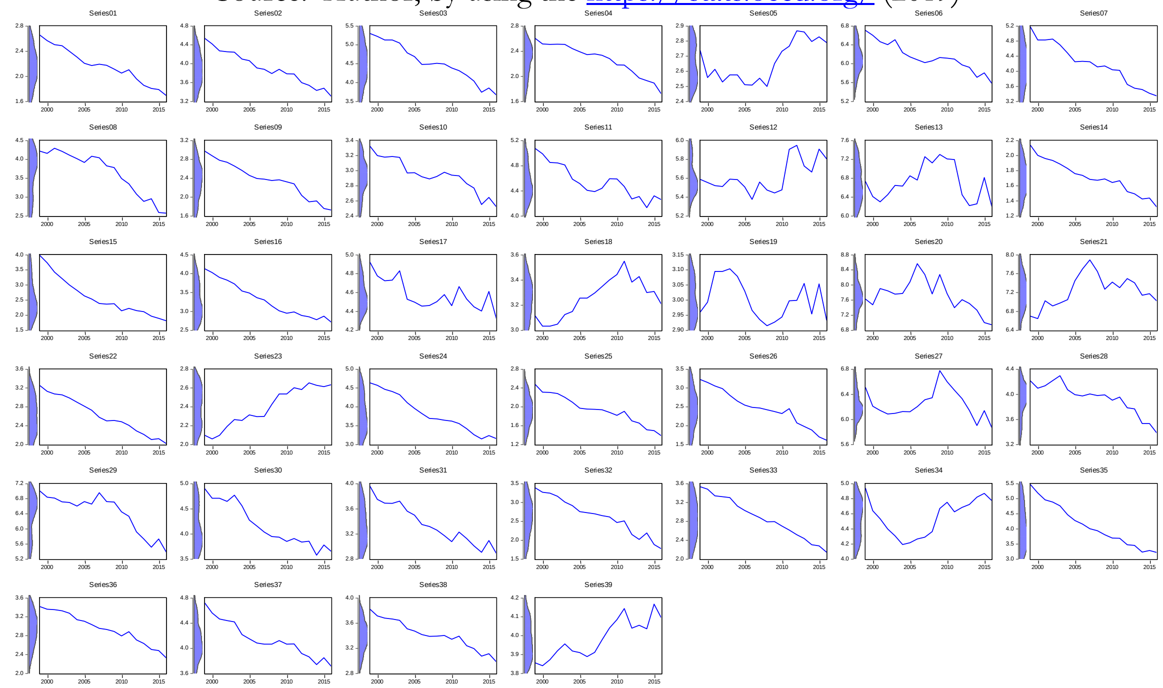


Figure 8. The evolution of the mortality and welfare costs with EViews 10 for OECD statistical data

Source: Author, by using the https://stats.oecd.org/ (2019)

Or if data is analyzed as multiple series, the evolution is following:

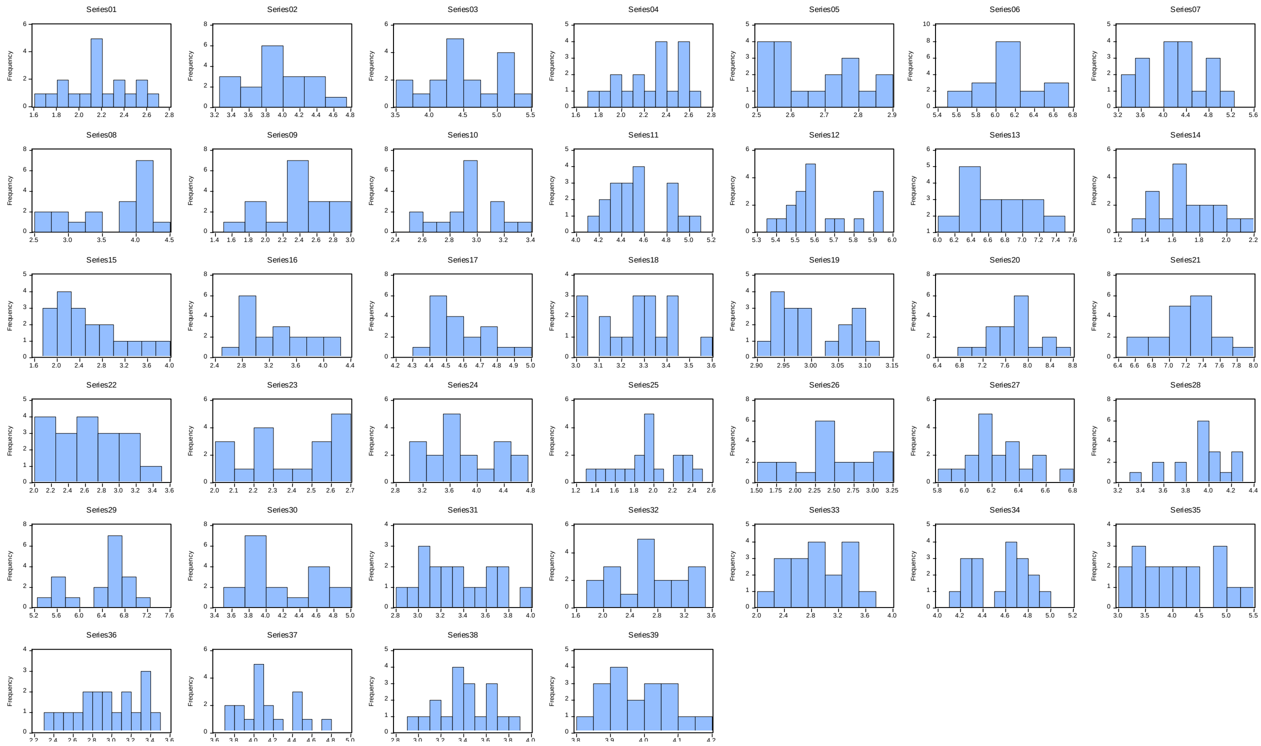


Figure 9. Histogram of multiple series
Source: Author, by using the EViews 10

Descriptive indicators for mortality and welfare costs data series for OECD Europe and OECD Total are those in the following tables:

Table 2. Summary of descriptive indicators for mortality and welfare costs in OECD Europe

Dependent Variable: OECD___EUROPE2
Method: Least Squares
Date: 04/11/19 Time: 00:15
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___EUROPE	7.22E-07	1.63E-07	4.437487	0.0004
C	0.429809	0.837371	0.513284	0.6148

R-squared	0.551711	Mean dependent var	4.139944
Adjusted R-squared	0.523693	S.D. dependent var	0.284714
S.E. of regression	0.196495	Akaike info criterion	-0.311916
Sum squared resid	0.617767	Schwarz criterion	-0.212986
Log likelihood	4.807244	Hannan-Quinn criter.	-0.298275
F-statistic	19.69129	Durbin-Watson stat	0.452208
Prob(F-statistic)	0.000414		

Source: Author, by using the EViews 10

Table 3. Summary of descriptive indicators mortality and welfare costs in OECD Total

Dependent Variable: OECD___TOTAL2
Method: Least Squares
Date: 04/11/19 Time: 00:46
Sample: 1999 2016
Included observations: 18

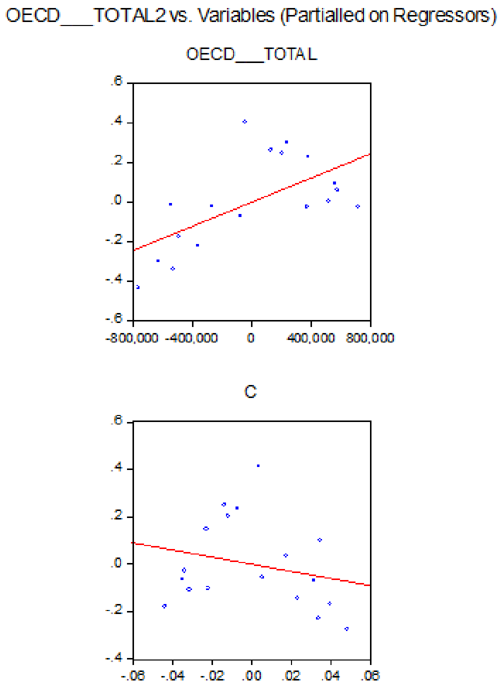
Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___TOTAL	3.05E-07	9.64E-08	3.164128	0.0060
C	-1.497109	1.552867	-0.964094	0.3493

R-squared	0.384892	Mean dependent var	3.414333
Adjusted R-squared	0.346448	S.D. dependent var	0.233968
S.E. of regression	0.189145	Akaike info criterion	-0.388162
Sum squared resid	0.572416	Schwarz criterion	-0.289232
Log likelihood	5.493462	Hannan-Quinn criter.	-0.374521
F-statistic	10.01170	Durbin-Watson stat	0.471592
Prob(F-statistic)	0.006014		

Source: Author, by using the EViews 10

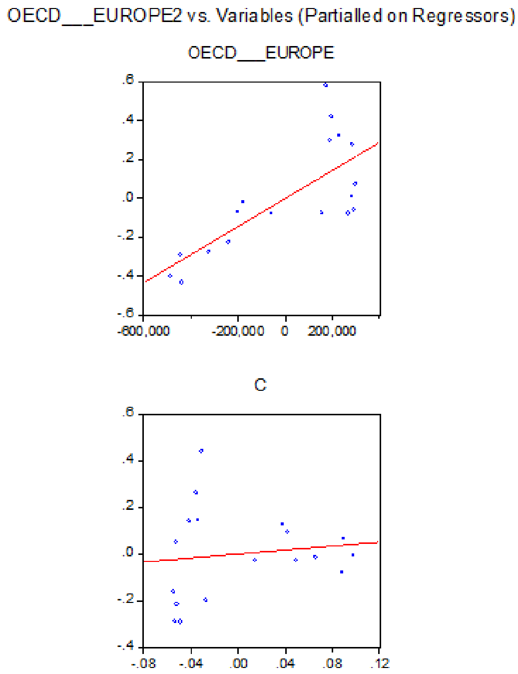
Ordinary covariance analysis between the GHG series and mortality and welfare costs is as follows and we can observe it appears that the two variables are linear correlated.

Figure 10.



Source: Author, by using the EViews 10

Figure 11.



Source: Author, by using the EViews 10

The previous conclusion is confirmed by the Squared Multiple Correlation shown in following table:

Dependent Variable: OECD___EUROPE2
Method: Least Squares
Date: 04/11/19 Time: 00:15
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___EUROPE	7.22E-07	1.63E-07	4.437487	0.0004
C	0.429809	0.837371	0.513284	0.6148

R-squared	0.551711	Mean dependent var	4.139944
Adjusted R-squared	0.523693	S.D. dependent var	0.284714
S.E. of regression	0.196495	Akaike info criterion	-0.311916
Sum squared resid	0.617767	Schwarz criterion	-0.212986
Log likelihood	4.807244	Hannan-Quinn criter.	-0.298275
F-statistic	19.69129	Durbin-Watson stat	0.452208
Prob(F-statistic)	0.000414		

Dependent Variable: OECD___TOTAL2
Method: Least Squares
Date: 04/11/19 Time: 00:46
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___TOTAL	3.05E-07	9.64E-08	3.164128	0.0060
C	-1.497109	1.552867	-0.964094	0.3493

R-squared	0.384892	Mean dependent var	3.414333
Adjusted R-squared	0.346448	S.D. dependent var	0.233968
S.E. of regression	0.189145	Akaike info criterion	-0.388162
Sum squared resid	0.572416	Schwarz criterion	-0.289232
Log likelihood	5.493462	Hannan-Quinn criter.	-0.374521
F-statistic	10.01170	Durbin-Watson stat	0.471592
Prob(F-statistic)	0.006014		

To determine the regression equation applies Least Squares Method. So, we obtain the following regression equations:

Estimation Command:
=========================
LS OECD___EUROPE2 OECD___EUROPE C

Estimation Equation:
=========================
OECD___EUROPE2 = C(1)*OECD___EUROPE + C(2)

Substituted Coefficients:
=========================
OECD___EUROPE2 = 7.22124994626e-07*OECD___EUROPE + 0.42980919739

And for the OECD Total we are obtained:

Estimation Command:
=========================
LS OECD___TOTAL2 OECD___TOTAL C

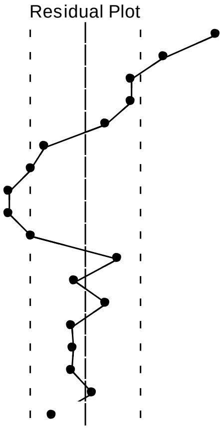
Estimation Equation:
=========================

OECD___TOTAL2 = C(1)*OECD___TOTAL + C(2)

Substituted Coefficients:
=========================
OECD___TOTAL2 = 3.05152799009e-07*OECD___TOTAL - 1.49710899199

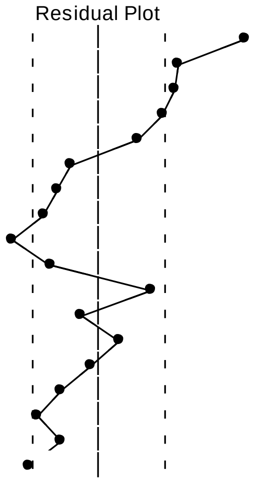
The evolution of actual, fitted and residual plot for OECD Europe It can be summarized as follows:

obs	Actual	Fitted	Residual
1999	4.72200...	4.26620...	0.45579...
2000	4.561	4.28296...	0.27803...
2001	4.46400...	4.30509...	0.15890...
2002	4.439	4.27811...	0.16088...
2003	4.42	4.34588...	0.07411...
2004	4.216	4.35550...	-0.1395...
2005	4.151	4.34396...	-0.1929...
2006	4.083	4.35031...	-0.2673...
2007	4.064	4.33378...	-0.2697...
2008	4.06500...	4.25271...	-0.1877...
2009	4.123	4.01126...	0.11173...
2010	4.064	4.09792...	-0.0339...
2011	4.069	3.99356...	0.07543...
2012	3.918	3.96650...	-0.0485...
2013	3.865	3.90616...	-0.0411...
2014	3.74	3.78751...	-0.0475...
2015	3.848	3.81866...	0.02933...
2016	3.707	3.82282...	-0.1158...

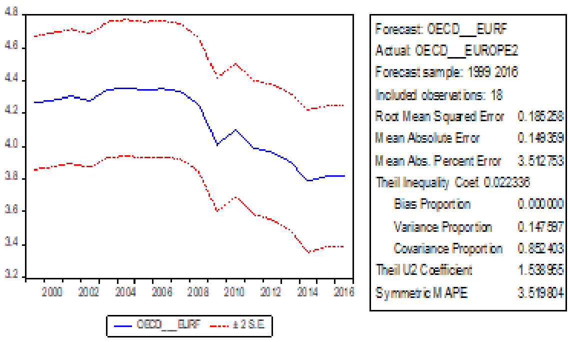


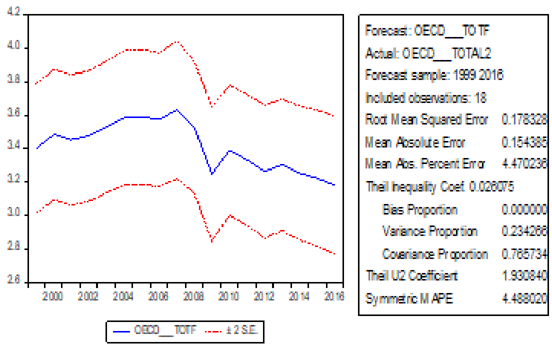
And for OECD Total, the evolution of actual, fitted and residual plot is the following:

obs	Actual	Fitted	Residual
1999	3.821	3.40161...	0.41938...
2000	3.716	3.48620...	0.22979...
2001	3.678	3.45370...	0.22429...
2002	3.664	3.47684...	0.18715...
2003	3.645	3.53091...	0.11408...
2004	3.508	3.58571...	-0.0777...
2005	3.476	3.59098...	-0.1149...
2006	3.419	3.57345...	-0.1544...
2007	3.391	3.63402...	-0.2430...
2008	3.392	3.52757...	-0.1355...
2009	3.402	3.24833...	0.15366...
2010	3.344	3.39130...	-0.0473...
2011	3.394	3.33290...	0.06109...
2012	3.241	3.26392...	-0.0229...
2013	3.195	3.30403...	-0.1090...
2014	3.076	3.25290...	-0.1769...
2015	3.115	3.22275...	-0.1077...
2016	2.981	3.18077...	-0.1997...

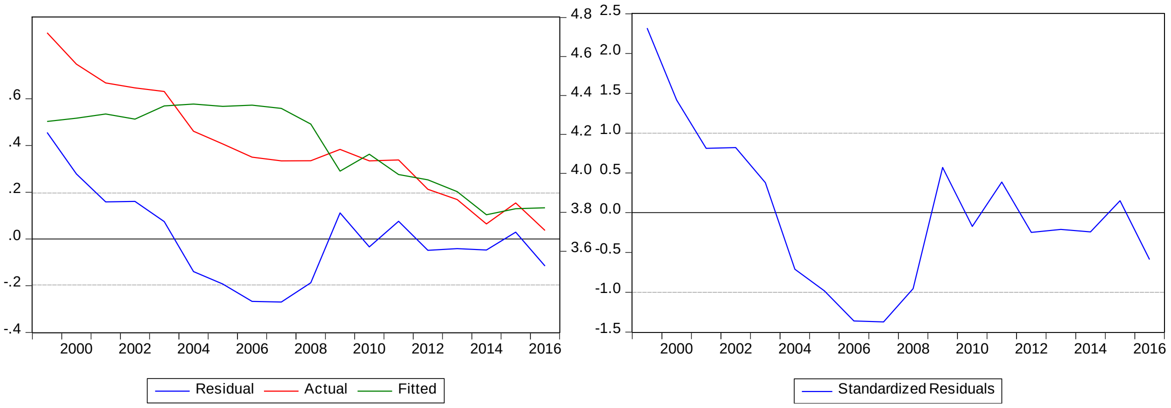


In the graphics bellows are actual and estimated values of the feature analysis and the residual variable values and chart series.





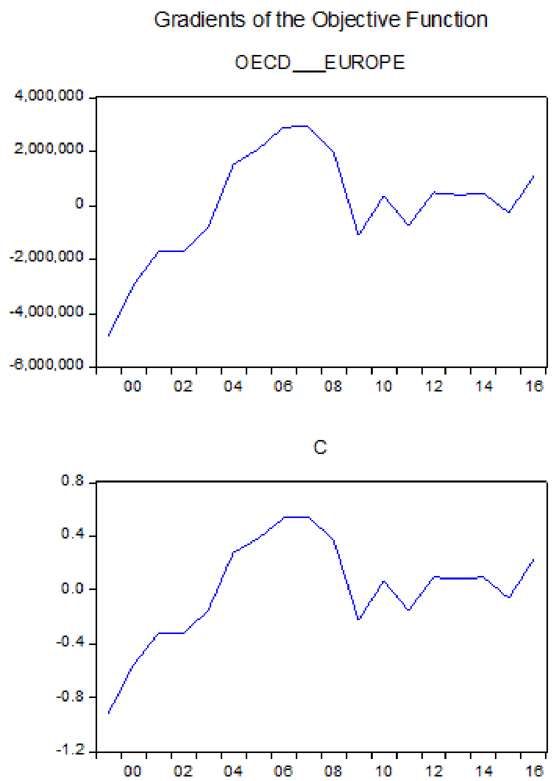
Based on the statistical data provided by OECD we analyzed with EViews and obtained the following results for OECD Europe:

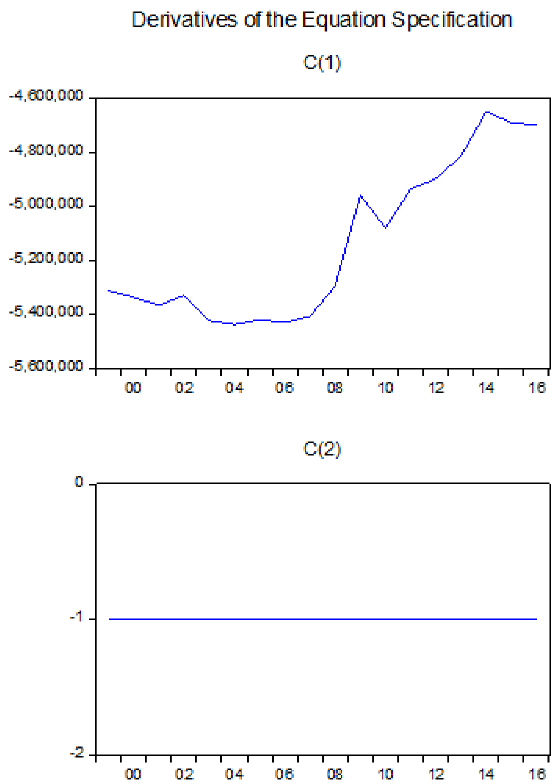


Estimation Command:
=========================
LS OECD___EUROPE2 OECD___EUROPE C

Estimation Equation:
=========================
OECD___EUROPE2 = C(1)*OECD___EUROPE + C(2)

Substituted Coefficients:
=========================
OECD___EUROPE2 = 7.22124994626e-07*OECD___EUROPE + 0.42980919739





Derivatives of the Equation Specification
Equation: UNTITLED
Method: Least Squares
Specification: RESID = OECD___EUROPE2 - (C(1)*OECD___EUROPE + C(2))

Variable	Derivative of Specification
C(1)	-oecd___europe
C(2)	-1

Coefficient covariance Matrix is presented in the below table:

Derivatives of the Equation Specification
Equation: UNTITLED
Method: Least Squares
Specification: RESID = OECD___EUROPE2 - (C(1)*OECD___EUROPE + C(2))

Variable	Derivative of Specification
C(1)	-oecd___europe
C(2)	-1

Scaled Coefficients
Date: 04/11/19 Time: 00:21
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Standardized Coefficient	Elasticity at Means
OECD___EUROPE	7.22E-07	0.742773	0.896180
C	0.429809	NA	0.103820

Coefficient Confidence Intervals
Date: 04/11/19 Time: 00:21
Sample: 1999 2016
Included observations: 18

		90% CI		95% CI		99% CI	
Variable	Coefficient	Low	High	Low	High	Low	High
OECD___EUROPE	7.22E-07	4.38E-07	1.01E-06	3.77E-07	1.07E-06	2.47E-07	1.20E-06
C	0.429809	-1.032143	1.891762	-1.345338	2.204957	-2.015969	2.875587

Variance Inflation Factors
Date: 04/11/19 Time: 00:22
Sample: 1999 2016
Included observations: 18

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
OECD___EUROPE	2.65E-14	326.8914	1.000000
C	0.701190	326.8914	NA

Coefficient Variance Decomposition
Date: 04/11/19 Time: 00:23
Sample: 1999 2016
Included observations: 18

Eigenvalues	0.701190	8.10E-17
Condition	1.16E-16	1.000000

Variance Decomposition Proportions

Variable	Associated Eigenvalue 1	2
OECD___EUROPE	0.996941	0.003059
C	1.000000	4.35E-30

Eigenvectors

Variable	Associated Eigenvalue 1	2
OECD___EUROPE	-1.94E-07	-1.000000
C	1.000000	-1.94E-07

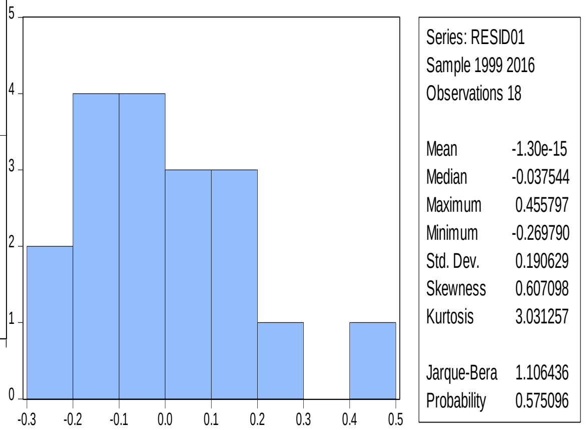
Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.02E+15	(2, 16)	0.0000
Chi-square	6.05E+15	2	0.0000

Null Hypothesis: C(1)=-0.7, C(2)=0.4298
Null Hypothesis Summary:

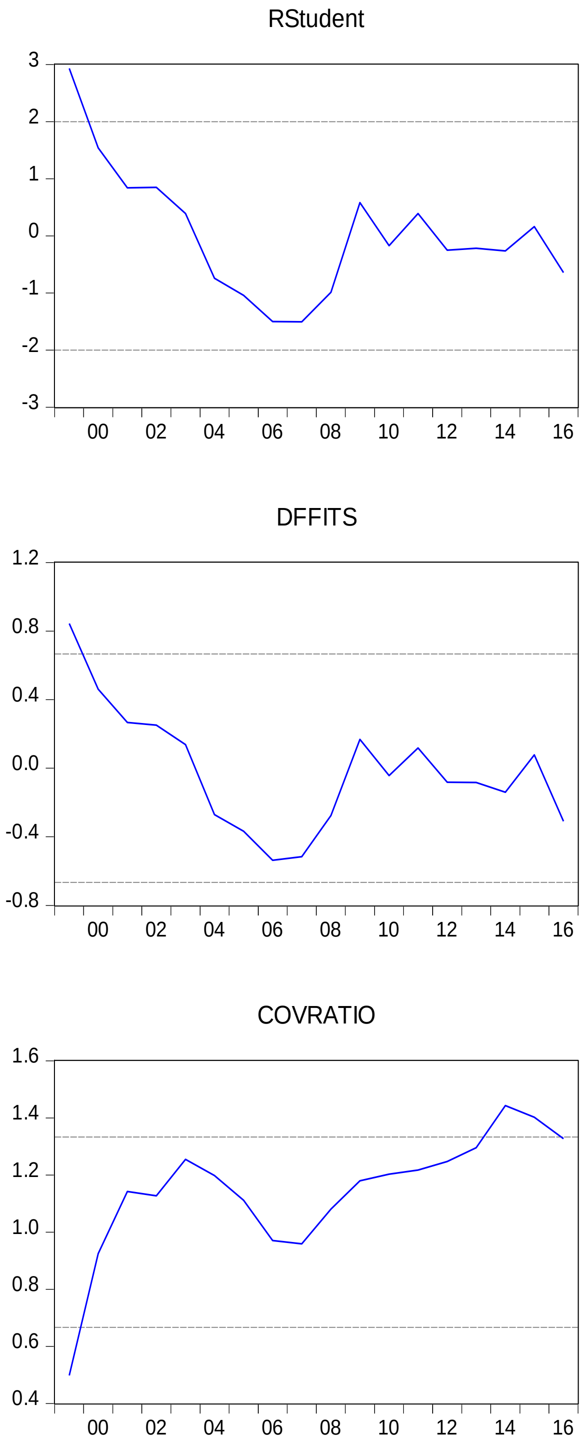
Normalized Restriction (= 0)	Value	Std. Err.
0.699999999999999992 + C(1)	0.700001	1.63E-07
-0.4298 + C(2)	9.20E-06	0.837371

Restrictions are linear in coefficients.



	RESID01
Mean	-1.30E-15
Median	-0.037544
Maximum	0.455797
Minimum	-0.269790
Std. Dev.	0.190629
Skewness	0.607098
Kurtosis	3.031257
Jarque-Bera	1.106436
Probability	0.575096
Sum	-2.35E-14
Sum Sq. Dev.	0.617767
Observations	18

Influence Statistics



Hypothesis Testing for RESID01
Date: 04/11/19 Time: 00:33
Sample: 1999 2016
Included observations: 18
Test of Hypothesis: Mean = -1.30e-15
Assuming Std. Dev. = 0.190629

Sample Mean = -1.30e-15
Sample Std. Dev. = 0.190629

Method	Value	Probability
Z-statistic	7.12E-17	1.0000
t-statistic	7.12E-17	1.0000

Test of Hypothesis: Variance = 0.190629

Sample Variance = 0.036339

Method	Value	Probability
Variance Ratio	3.240678	0.0001

Test of Hypothesis: Median = -0.037544

Sample Median = -0.037544

Method	Value	Probability
Sign (exact binomial)	9	1.0000
Sign (normal approximation)	-0.235702	0.8137
Wilcoxon signed rank	0.391953	0.6951
van der Waerden (normal scores)	0.541665	0.5880

Median Test Summary

Category	Count	Mean Rank
Obs > -0.037544	9	10.5555556
Obs < -0.037544	9	8.44444444
Obs = -0.037544	0	
Total	18	

Empirical Distribution Test for RESID01
Hypothesis: Normal
Date: 04/11/19 Time: 00:34
Sample: 1999 2016
Included observations: 18

Method	Value	Adj. Value	Probability
Lilliefors (D)	0.126170	NA	> 0.1
Cramer-von Mises (W2)	0.032044	0.032934	0.8047
Watson (U2)	0.028021	0.028800	0.8397
Anderson-Darling (A2)	0.240673	0.252372	0.7369

Method: Maximum Likelihood - d.f. corrected (Exact Solution)

Parameter	Value	Std. Error	z-Statistic	Prob.
MU	-1.31E-15	0.044932	-2.91E-14	1.0000
SIGMA	0.190629	0.032693	5.830952	0.0000

Log likelihood	4.792818	Mean dependent var.	-1.30E-15
No. of Coefficients	2	S.D. dependent var.	0.190629

Tabulation of RESID01
Date: 04/11/19 Time: 00:35
Sample: 1999 2016
Included observations: 18
Number of categories: 5

Value	Count	Percent	Cumulative Count	Cumulative Percent
[-0.4, -0.2)	2	11.11	2	11.11
[-0.2, 0)	8	44.44	10	55.56
[0, 0.2)	6	33.33	16	88.89
[0.2, 0.4)	1	5.56	17	94.44
[0.4, 0.6)	1	5.56	18	100.00
Total	18	100.00	18	100.00

BDS Test for RESID01
Date: 04/11/19 Time: 00:35
Sample: 1999 2016
Included observations: 18

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.145329	0.018613	7.808120	0.0000
3	0.231343	0.030947	7.475379	0.0000
4	0.281990	0.038625	7.300625	0.0000
5	0.278068	0.042286	6.575836	0.0000
6	0.228340	0.042941	5.317510	0.0000

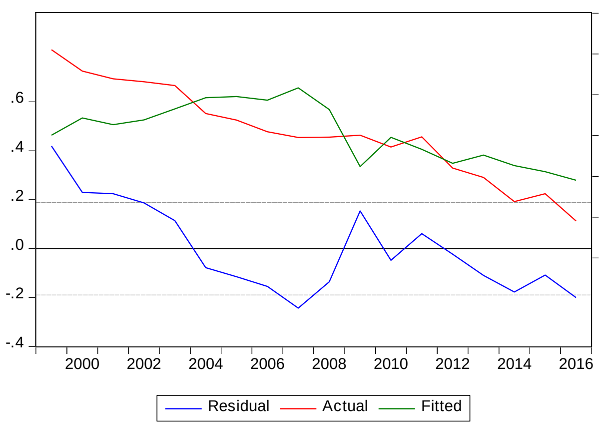
Raw epsilon	0.284651		
Pairs within epsilon	232.0000	V-Statistic	0.716049
Triples within epsilon	3214.000	V-Statistic	0.551097

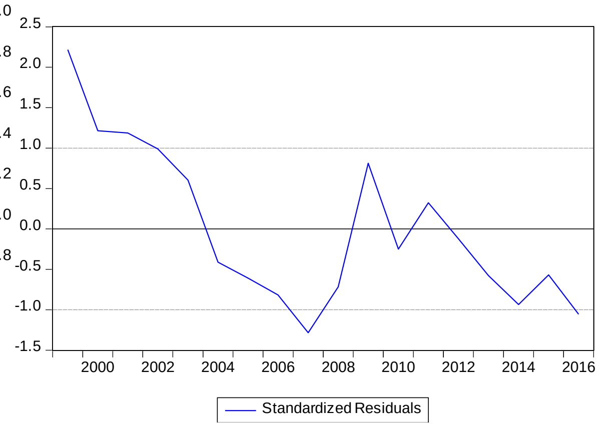
Dimension	C(m,n)	c(m,n)	C(1,n-(m-1))	c(1,n-(m-1))	c(1,n-(m-1))^k
2	82.00000	0.602941	92.00000	0.676471	0.457612
3	62.00000	0.516667	79.00000	0.658333	0.285323
4	46.00000	0.438095	66.00000	0.628571	0.156106
5	32.00000	0.351648	54.00000	0.593407	0.073580
6	20.00000	0.256410	43.00000	0.551282	0.028070

Date: 04/11/19 Time: 00:40
Sample: 1999 2016
Included observations: 18
Method: Holt-Winters No Seasonal
Original Series:
Forecast Series: SMOOTHED

Parameters:	Alpha	0.9400
	Beta	0.1100
Sum of Squared Residuals		0.278293
Root Mean Squared Error		0.124341
End of Period Levels:	Mean	-0.108282
	Trend	-0.026317

Based on the statistical data provided by OECD we analyzed with EViews 10 and obtained the following results for OECD Total:





Gradients of the Objective Function
Gradients evaluated at estimated parameters
Equation: UNTITLED
Method: Least Squares
Specification: OECD___TOTAL2 OECD___TOTAL C

Variable	Sum	Mean	Weighted Grad.
OECD___TOTAL	8.01E-08	4.45E-09	-5.17E-24
C	3.20E-14	1.78E-15	8.33E-17

Derivatives of the Equation Specification
Equation: UNTITLED
Method: Least Squares
Specification: RESID = OECD___TOTAL2 - (C(1)*OECD___TOTAL + C(2))

Variable	Derivative of Specification
C(1)	-oecd___total
C(2)	-1

	OECD___TOTAL	C
OECD___TOTAL	9.3009382245218...	-1.4969884...
C	-1.496988453311...	2.41139440...

Coefficient covariance Matrix has determined

Scaled Coefficients
Date: 04/11/19 Time: 00:53
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Standardized Coefficient	Elasticity at Means
OECD___TOTAL	3.05E-07	0.620397	1.438478
C	-1.497109	NA	-0.438478

as:

Coefficient Confidence Intervals
Date: 04/11/19 Time: 00:53
Sample: 1999 2016
Included observations: 18

		90% CI		95% CI		99% CI	
Variable	Coefficient	Low	High	Low	High	Low	High
OECD___TOTAL	3.05E-07	1.37E-07	4.74E-07	1.01E-07	5.10E-07	2.35E-08	5.87E-07
C	-1.497109	-4.208233	1.214015	-4.789039	1.794821	-6.032693	3.038475

Variance Inflation Factors
Date: 04/11/19 Time: 00:54
Sample: 1999 2016
Included observations: 18

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
OECD___TOTAL	9.30E-15	1213.247	1.000000
C	2.411394	1213.247	NA

Coefficient Variance Decomposition
Date: 04/11/19 Time: 00:54
Sample: 1999 2016
Included observations: 18

Eigenvalues	2.411394	7.67E-18
Condition	3.18E-18	1.000000

Variance Decomposition Proportions

	Associated Eigenvalue	
Variable	1	2
OECD___TOTAL	0.999176	0.000824
C	1.000000	1.23E-32

Eigenvectors

	Associated Eigenvalue	
Variable	1	2
OECD___TOTAL	-6.21E-08	-1.000000
C	1.000000	-6.21E-08

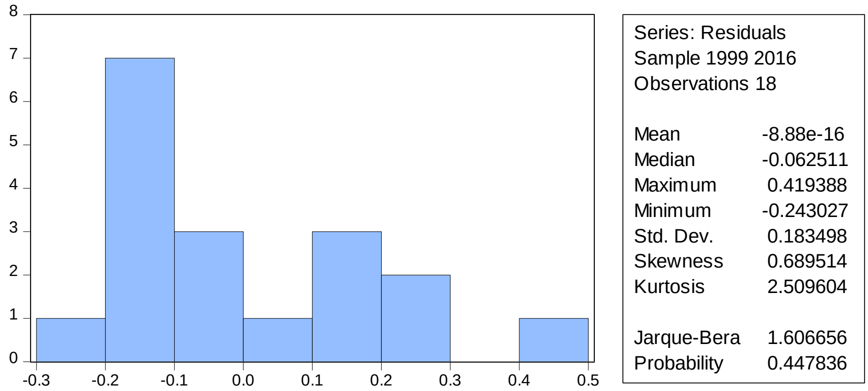
Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.20E+16	(2, 16)	0.0000
Chi-square	6.39E+16	2	0.0000

Null Hypothesis: C(1)=-0.7, C(2)=-1.4971
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
0.69999999999999992 + C(1)	0.700000	9.64E-08
1.4971 + C(2)	-8.99E-06	1.552867

Restrictions are linear in coefficients.



Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	4.431753	Prob. F(2,14)	0.0323
Obs*R-squared	6.978068	Prob. Chi-Square(2)	0.0305

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/11/19 Time: 00:59
Sample: 1999 2016
Included observations: 18
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___TOTAL	-6.53E-08	8.62E-08	-0.757431	0.4614
C	1.042035	1.386632	0.751486	0.4648
RESID(-1)	0.572565	0.267346	2.141664	0.0503
RESID(-2)	0.151072	0.282874	0.534062	0.6017

R-squared	0.387670	Mean dependent var	-8.88E-16
Adjusted R-squared	0.256457	S.D. dependent var	0.183498
S.E. of regression	0.158228	Akaike info criterion	-0.656425
Sum squared resid	0.350507	Schwarz criterion	-0.458565
Log likelihood	9.907824	Hannan-Quinn criter.	-0.629143
F-statistic	2.954502	Durbin-Watson stat	1.293951
Prob(F-statistic)	0.068930		

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.084874	Prob. F(1,16)	0.7745
Obs*R-squared	0.094980	Prob. Chi-Square(1)	0.7579
Scaled explained SS	0.056645	Prob. Chi-Square(1)	0.8119

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/11/19 Time: 01:00
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.067019	0.339341	-0.197498	0.8459
OECD___TOTAL	6.14E-09	2.11E-08	0.291332	0.7745

R-squared	0.005277	Mean dependent var	0.031801
Adjusted R-squared	-0.056894	S.D. dependent var	0.040205
S.E. of regression	0.041333	Akaike info criterion	-3.429868
Sum squared resid	0.027335	Schwarz criterion	-3.330937
Log likelihood	32.86881	Hannan-Quinn criter.	-3.416226
F-statistic	0.084874	Durbin-Watson stat	0.793522
Prob(F-statistic)	0.774541		

Heteroskedasticity Test: Harvey
Null hypothesis: Homoskedasticity

F-statistic	0.680847	Prob. F(1,16)	0.4214
Obs*R-squared	0.734690	Prob. Chi-Square(1)	0.3914
Scaled explained SS	0.258712	Prob. Chi-Square(1)	0.6110

Test Equation:
Dependent Variable: LRESID2
Method: Least Squares
Date: 04/11/19 Time: 01:00
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.37937	11.24233	-1.190088	0.2514
OECD___TOTAL	5.76E-07	6.98E-07	0.825135	0.4214

R-squared	0.040816	Mean dependent var	-4.106753
Adjusted R-squared	-0.019133	S.D. dependent var	1.356446
S.E. of regression	1.369361	Akaike info criterion	3.571005
Sum squared resid	30.00241	Schwarz criterion	3.669935
Log likelihood	-30.13905	Hannan-Quinn criter.	3.584646
F-statistic	0.680847	Durbin-Watson stat	1.024941
Prob(F-statistic)	0.421428		

Heteroskedasticity Test: Glejser
Null hypothesis: Homoskedasticity

F-statistic	0.267490	Prob. F(1,16)	0.6121
Obs*R-squared	0.295978	Prob. Chi-Square(1)	0.5864
Scaled explained SS	0.181362	Prob. Chi-Square(1)	0.6702

Test Equation:
Dependent Variable: ARESID
Method: Least Squares
Date: 04/11/19 Time: 01:00
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.244097	0.770787	-0.316685	0.7556
OECD___TOTAL	2.48E-08	4.79E-08	0.517194	0.6121

R-squared	0.016443	Mean dependent var	0.154385
Adjusted R-squared	-0.045029	S.D. dependent var	0.091840
S.E. of regression	0.093885	Akaike info criterion	-1.789053
Sum squared resid	0.141030	Schwarz criterion	-1.690123
Log likelihood	18.10148	Hannan-Quinn criter.	-1.775412
F-statistic	0.267490	Durbin-Watson stat	0.781161
Prob(F-statistic)	0.612096		

Heteroskedasticity Test: ARCH

F-statistic	5.627708	Prob. F(1,15)	0.0315
Obs*R-squared	4.637987	Prob. Chi-Square(1)	0.0313

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/11/19 Time: 01:01
Sample (adjusted): 2000 2016
Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015998	0.005022	3.185569	0.0061
RESID^2(-1)	0.233931	0.098610	2.372279	0.0315

R-squared	0.272823	Mean dependent var	0.023325
Adjusted R-squared	0.224344	S.D. dependent var	0.018537
S.E. of regression	0.016326	Akaike info criterion	-5.281997
Sum squared resid	0.003998	Schwarz criterion	-5.183971
Log likelihood	46.89697	Hannan-Quinn criter.	-5.272253
F-statistic	5.627708	Durbin-Watson stat	1.938800
Prob(F-statistic)	0.031483		

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	0.312540	Prob. F(2,15)	0.7362
Obs*R-squared	0.720089	Prob. Chi-Square(2)	0.6976
Scaled explained SS	0.429451	Prob. Chi-Square(2)	0.8068

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/11/19 Time: 01:01
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.17235	15.07967	-0.740888	0.4702
OECD___TOTAL^2	-4.30E-14	5.84E-14	-0.736636	0.4727
OECD___TOTAL	1.39E-06	1.88E-06	0.739858	0.4708

R-squared	0.040005	Mean dependent var	0.031801
Adjusted R-squared	-0.087994	S.D. dependent var	0.040205
S.E. of regression	0.041937	Akaike info criterion	-3.354293
Sum squared resid	0.026380	Schwarz criterion	-3.205898
Log likelihood	33.18864	Hannan-Quinn criter.	-3.333831
F-statistic	0.312540	Durbin-Watson stat	0.931759
Prob(F-statistic)	0.736237		

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	3.511358	Prob. F(3,13)	0.0462
Obs*R-squared	7.609361	Prob. Chi-Square(3)	0.0548
Scaled explained SS	0.961373	Prob. Chi-Square(3)	0.8106

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/11/19 Time: 01:02
Sample (adjusted): 2000 2016
Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.27923	6.196047	1.981784	0.0691
RESID^2(-1)	0.297487	0.101919	2.918850	0.0120
OECD___TOTAL^2	4.76E-14	2.40E-14	1.987968	0.0683
OECD___TOTAL	-1.53E-06	7.71E-07	-1.983675	0.0688

R-squared	0.447609	Mean dependent var	0.023325
Adjusted R-squared	0.320135	S.D. dependent var	0.018537
S.E. of regression	0.015285	Akaike info criterion	-5.321617
Sum squared resid	0.003037	Schwarz criterion	-5.125567
Log likelihood	49.23375	Hannan-Quinn criter.	-5.302130
F-statistic	3.511358	Durbin-Watson stat	2.045095
Prob(F-statistic)	0.046249		

Heteroskedasticity Test: Harvey
Null hypothesis: Homoskedasticity

F-statistic	1.985455	Prob. F(3,13)	0.1660
Obs*R-squared	5.341647	Prob. Chi-Square(3)	0.1484
Scaled explained SS	1.613328	Prob. Chi-Square(3)	0.6564

Test Equation:
Dependent Variable: LRESID2
Method: Least Squares
Date: 04/11/19 Time: 01:03
Sample (adjusted): 2000 2016
Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	522.7823	439.6592	1.189062	0.2557
LRESID2(-1)	0.442146	0.223463	1.978607	0.0694
OECD___TOTAL^2	2.05E-12	1.70E-12	1.203077	0.2504
OECD___TOTAL	-6.56E-05	5.47E-05	-1.199040	0.2519

R-squared	0.314215	Mean dependent var	-4.246096
Adjusted R-squared	0.155956	S.D. dependent var	1.258413
S.E. of regression	1.156127	Akaike info criterion	3.330353
Sum squared resid	17.37619	Schwarz criterion	3.526403
Log likelihood	-24.30800	Hannan-Quinn criter.	3.349840
F-statistic	1.985455	Durbin-Watson stat	2.252704
Prob(F-statistic)	0.166007		

Heteroskedasticity Test: Glejser
Null hypothesis: Homoskedasticity

F-statistic	3.819468	Prob. F(3,13)	0.0366
Obs*R-squared	7.964251	Prob. Chi-Square(3)	0.0468
Scaled explained SS	2.487632	Prob. Chi-Square(3)	0.4775

Test Equation:
Dependent Variable: ARESID
Method: Least Squares
Date: 04/11/19 Time: 01:03
Sample (adjusted): 2000 2016
Included observations: 17 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	42.66594	21.15907	2.016438	0.0649
ARESID(-1)	0.471562	0.156100	3.020896	0.0098
OECD___TOTAL^2	1.65E-13	8.18E-14	2.017750	0.0647
OECD___TOTAL	-5.31E-06	2.63E-06	-2.015268	0.0650

R-squared	0.468485	Mean dependent var	0.138797
Adjusted R-squared	0.345828	S.D. dependent var	0.065684
S.E. of regression	0.053126	Akaike info criterion	-2.829975
Sum squared resid	0.036691	Schwarz criterion	-2.633925
Log likelihood	28.05479	Hannan-Quinn criter.	-2.810487
F-statistic	3.819468	Durbin-Watson stat	2.214290
Prob(F-statistic)	0.036632		

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: OECD___TOTAL2 OECD___TOTAL C

	Value	df	Probability
t-statistic	3.936943	15	0.0013
F-statistic	15.49952	(1, 15)	0.0013
Likelihood ratio	12.77390	1	0.0004

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.290895	1	0.290895
Restricted SSR	0.572416	16	0.035776
Unrestricted SSR	0.281520	15	0.018768

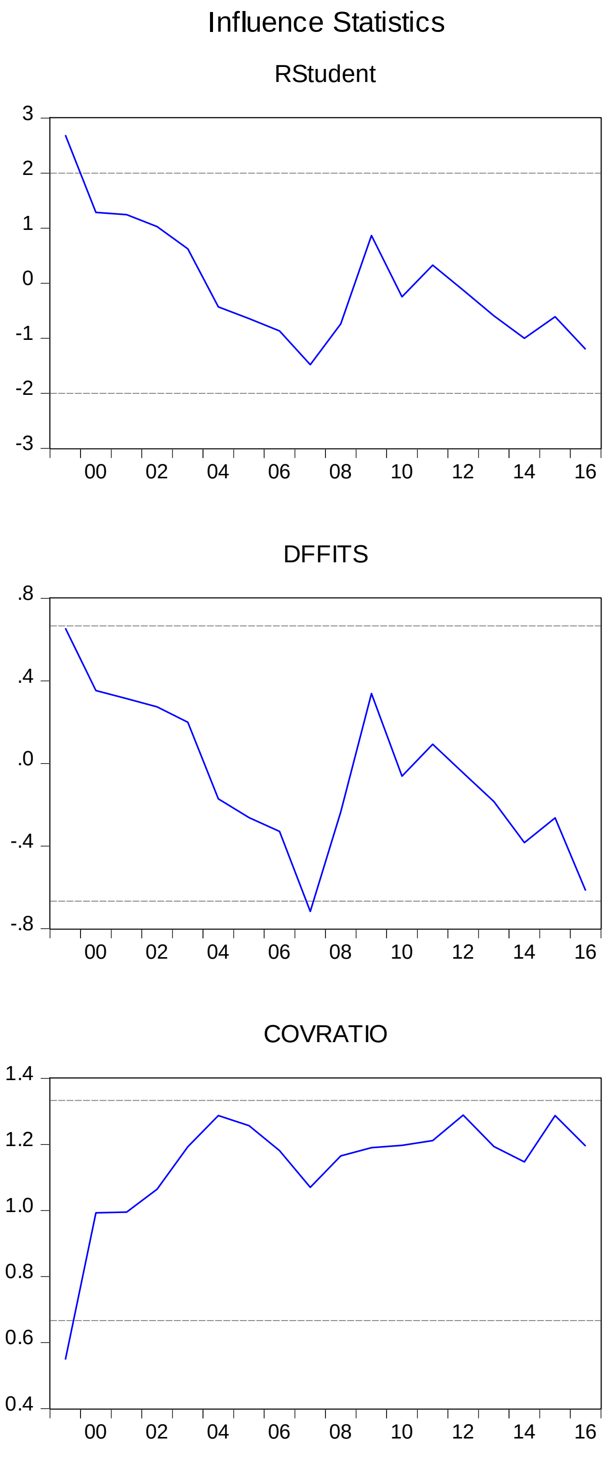
LR test summary:

	Value
Restricted LogL	5.493462
Unrestricted LogL	11.88041

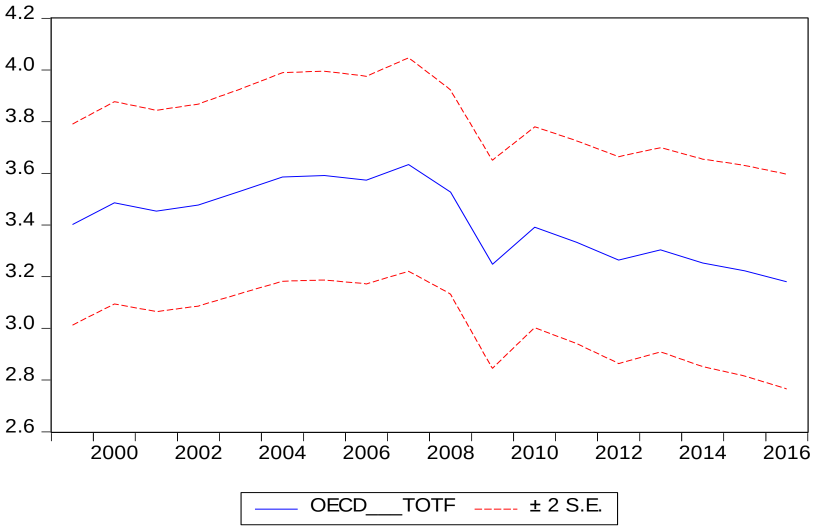
Unrestricted Test Equation:
Dependent Variable: OECD___TOTAL2
Method: Least Squares
Date: 04/11/19 Time: 01:04
Sample: 1999 2016
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OECD___TOTAL	1.71E-05	4.26E-06	4.008017	0.0011
C	-177.3042	44.66990	-3.969210	0.0012
FITTED^2	-8.067122	2.049083	-3.936943	0.0013

R-squared	0.697483	Mean dependent var	3.414333
Adjusted R-squared	0.657148	S.D. dependent var	0.233968
S.E. of regression	0.136996	Akaike info criterion	-0.986712
Sum squared resid	0.281520	Schwarz criterion	-0.838317
Log likelihood	11.88041	Hannan-Quinn criter.	-0.966251
F-statistic	17.29202	Durbin-Watson stat	1.644629
Prob(F-statistic)	0.000128		



The estimation for OECD Total for mortality and welfare costs is the following:



Forecast: OECD___TOTF	
Actual: OECD___TOTAL2	
Forecast sample: 1999 2016	
Included observations: 18	
Root Mean Squared Error	0.178328
Mean Absolute Error	0.154385
Mean Abs. Percent Error	4.470236
Theil Inequality Coef.	0.026075
Bias Proportion	0.000000
Variance Proportion	0.234266
Covariance Proportion	0.765734
Theil U2 Coefficient	1.930840
Symmetric MAPE	4.488020

Date: 04/11/19 Time: 01:08
Sample: 1999 2016
Included observations: 18
Method: Holt-Winters No Seasonal
Original Series:
Forecast Series: SMOOTHED

Parameters:	Alpha	0.8800
	Beta	0.0100
Sum of Squared Residuals		0.254604
Root Mean Squared Error		0.118931
End of Period Levels:	Mean	-0.197424
	Trend	-0.057501

7. Conclusions

Global climate is in constant change which affects both the health of the world population, and the level of public expenditure. Greenhouse gases have implications on the environment with potentially damaging effects on ecosystems, biodiversity and the means of human subsistence. Air pollution is a consequence of increasing urbanization and industrialization. Also, greenhouse gas (GHG) emissions contribute to accelerating climate change.

The global climate change has an impact on mortality rate, public health and welfare cost from exposure to environmental risks. It is a dynamic causal relationship between greenhouse gases, **mortality rate** and public health and welfare cost, shows by the time-series data for the period 1999 – 2016.

Experts say that if greenhouse gas emissions continue at their rate in 2017, the Earth's surface temperature could exceed historic values from 2047 with potentially damaging effects on ecosystems, biodiversity and the means of human subsistence.

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