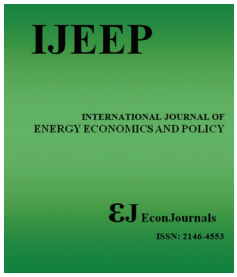
Taher, Hanadi

Article

Climate change and economic growth in Lebanon

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Taher, Hanadi (2019). Climate change and economic growth in Lebanon. In: International Journal of Energy Economics and Policy 9 (5), S. 20 - 24. http://econjournals.com/index.php/ijeep/article/download/7806/4493. doi:10.32479/ijeep.7806.



International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2019, 9(5), 20-24.

Climate Change and Economic Growth in Lebanon

Hanadi Taher*

Beirut Arab University, Beirut, Lebanon. *Email: h.taher@bau.edu.lb

Received: 08 March 2019 **Accepted:** 03 July 2019 **DOI:** https://doi.org/10.32479/ijeep.7806

ABSTRACT

This paper examined the relation between the climate change and economic growth in Lebanon. Time series analysis for the period 1990-2013 based on ordinary least squares estimation technique were used. Changes in annual rainfall, carbon dioxide emission, temperature changes, and forest areas were used to capture climate change, while gross fixed capital formation, labor force and urbanization were used as control variables. The results indicate that two climate variables have negative impact (carbon dioxide emissions and forest areas) and two positive impact on the Lebanese economic growth (rainfalls and temperature changes). However, only rainfalls variable is statistically significant. All the control variables were statistically significant have the theoretical expected signs. These results imply that Lebanese policy makers should implement strategies to minimize the effect of carbon dioxide emissions and forest depletion. Based on this, a specialized national council should be initiated to put series studies to deal with all climate change issues. After testing the stationarity levels, the co-integration tests confirm the existence of co-integrating relationship between the variables.

Keywords: Climate Change, Economic Growth, Ordinary Least Squares, Co-integration Tests
JEL Classifications: Q20, Q43, Q54, O44

1. INTRODUCTION

Until recently, the studies for the relationship between climate change and economic growth were very tight with different conclusions. However, due to the recent awareness for the importance of saving the world from the serious effect of the climate change the research in this area has made considerable progress. Currently the focus is to study the impact of rainfall and temperature changes, and CO_2 emission on the economic growth. These changes proved to cause high socio-economic costs across different countries and regions. Although, the impact of the climate changes on the economic growth varies between developed and developing countries. Whereas, the impact of climate change For the developed countries has less severe than that for the developing countries due to natural advantage, high technology, high adaptation techniques, good health systems, and wealth status. For developing countries like Lebanon, given the rainfalls changes and slight temperature changes with CO_2 emission and forest degradations the impact of climate change is of great importance for better warning system.

Lebanon as emergent economy used to attract tourism mainly from Gulf, which is considered a major sector of its economy because of its favorable climate. Recently with the raise of the current global climate change problems, Lebanon started to be affected by the global climate changes mainly in the changes in it's temperature and rainfalls averages changes. With time, climatic changes are expected to have more deep different effects on the Lebanese socio-economy and environment structure, public heath, agriculture production, and workers productivity.

Theoretically, climate change proved to affects most the economies that highly depend on the natural resources and mainly agriculture. McGuigan et al. (2002) show that climate change have a significant reductions in agricultural productivity in developing countries and thus on their economic growth. Other studies focused on justifying the reason of the reduction in the

agriculture production where they considered that the effect of Climate change on rainfalls and temperature determines crop yields (Thurlow et al., 2009).

The goal of this study to examine the impact of climate change on economic growth in Lebanon. To achieve this goal, we start this study by an overview on the Literature and on the Lebanese climate e change. The third part of this paper is the methodology and results using ordinary least squares (OLS) time series estimation technique and data for the period 1990-2013. Changes in annual rainfall, changes in temperature, carbon dioxide emission and forest areas were used to capture climate change, while gross capital formation, Labor force, and urbanisation were used as control variables in order to obtain the stationarity test and variables co-integration checks. The last part is the conclusions and recommendations.

2. AN OVERVIEW OF THE LITERATURE

The complexity of the climate-economy relationship discussed briefly in the recent literature. The few recent theoretical and empirical studies have confirmed that climatic change have substantial impacts on the overall economy but varies between country and another based on the structure of the economy. In this context, the research focus was directed more toward the impact of climate change on agriculture thus on the economy based on the its structure (e.g.,, Mendelsohn et al., 2001; Deschenes and Moretti 2007; Guiteras, 2007). Other view ibn studying the climatic change took different direction through examining the impact of climatic change impact on storm frequency, migration, tourism and many others, as presented in Panel on Climate Change 4th Assessment Report (Intergovernmental Panel on Climate Change, 2007). Few other studies, discussed the relationship between temperature changes and productivity (e.g.,, Montesquieu 1750; Huntington, 1915). Other direction in research, focused on factors that have economic direct and indirect effects like temperature effect on mortality (e.g., Curriero et al., 2002; Deschenes and Moretti 2007; Deschenes and Moretti 2007) on crime (e.g., Field 1992; Jacob et al., 2007).

Other literature in the climate change and economy, showed that there is degree of vulnerability of climate change based on the economic sectors and social groups that differs from country to another (Nwafor, 2007; Onuoha, 2008). In this context, Gebreegziabher et al. (2011) examined the climate change effect on the Ethiopian agriculture productivity based on general equilibrium (CGE) model. They observed that the climate change impact will be relatively benign until approximately 2030, and thereafter worsen considerably. Onuoha (2009) studied that thread of climate change mainly for developing countries, they concluded that the climate change challenges to improve the sustainable development and economic growth can be overcome by innovative solutions and creative thinking. More recently, Ogbuabor and Egwuchukwu (2017) indicate that both in the long-run and short-run, carbon emissions affect output growth in Nigeria adversely while forest depletion has negative impacts in the short-run economic growth.

3. CLIMATE CHANGE IN LEBANON

Lebanon as a center of Middle East located at the meditation has a favorable climate which is an attracting point for the most of the regional tourist mainly in Gulf. Recently with the raise of the current global climate change problems, Lebanon started to show some sort of changes in it's temperature and rainfalls averages changes as shown in Figure 1, which accompanied with water shortage although the nature of Lebanon is characterised by large number of rivers putting a heavy burden on development. Facing these, challenges need to have a strong institutional structure with good legislations system and policies. Climate change is likely to make these challenges more acute. Some few steps were made by the Lebanese Second National Communication mainly refers to the climate modeling by the United Nations Framework Convention on Climate Change (Ministry of Environment in Lebanon, 2011).

Extensive evidence shows the economic cost for the climate changes on the Lebanese households, government and the community. Lately, Lebanese authority is taking serious policies facing the climate change influences mainly due to the temperature and rainfalls changes through legislation and tax incentives as shown in Figure 1. For example, higher temperatures and the decrease in rainfalls beside the increase in the CO_2 emissions could affect directly the health of children and the elders; reduce workers and the crops productivity. Simply the climate changes factors could affect the wellbeing of the Lebanese thus more steps need to be done for sustainable development in Lebanon as well in the world.

4. METHODOLOGY AND DATA

This study captured climate change using climatic factor such as rainfall, forest areas, and carbon emission. In order to obtain robust estimation, government expenditure, private investment and exchange rate are introduced as control variables. The data were obtained from the World Bank statistics. The data were logged and examined for their time series properties, while the model was also examined to ensure that the underlying assumptions are adequately satisfied. Based on Oghuabor and Egwuchukwu (2017), the baseline model for the study is stated as follows:

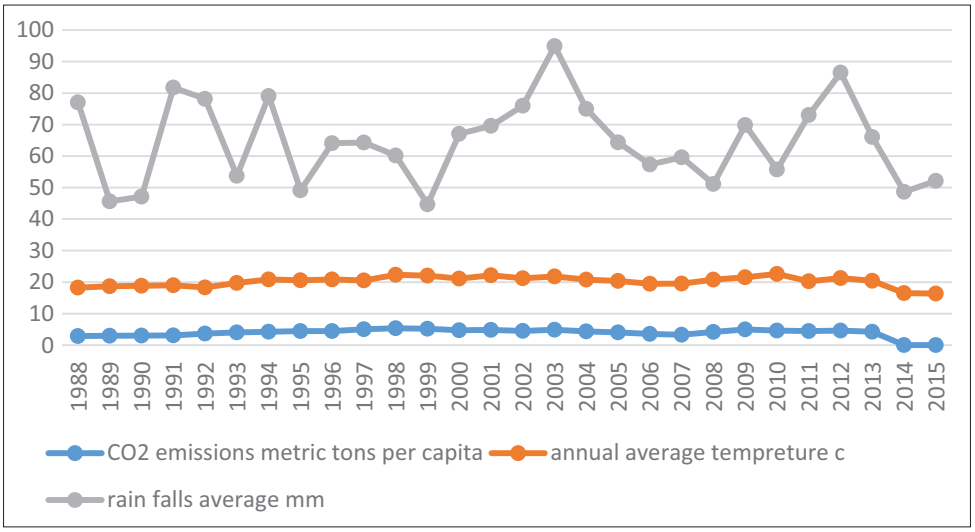
$$GDPt = \beta 0+\beta 1CO2t+\beta 2FAt+\beta 3RFt+\beta 4TPt+\beta 5Kt+\beta 6Lt + \beta 7UBt+ \varepsilon t \quad (1)$$

Where, GDP = real gross domestic product, measured in constant 2010 USD, CO2 = carbon emission (kt), FA = Forest areas, RF = rain falls, TP = temperature, GFCF = Gross fixed capital formation, LF = Labor force, UB = Urbanization, β0 = intercept, β1-β6 are the partial slope coefficients, and εt = stochastic error term.

5. RESULTS AND DISCUSSION

The empirical analysis starts with regression simple results for the time series data for Lebanon between the period of 1990 and 2013. Afterwards we test the stationarity of the variables through

Figure 1: Climate changes in Lebanon (1988-2015)



Source: World Bank, 2017

the unit root tests and ARMA. Based on the stationarity results that may suggest the presence of co-integration between variables, we examine the variables co-integration by applying the Johnson co-integration test. We end our test with estimating the error by ECM in order to confirm our results.

5.1. Regression Results

First of all, out of the four climate change variables in this study, two variables have negative impact on the Lebanese economic growth, carbon dioxide emissions and Forest areas, and two have positive impact (rain falls and temperature changes). However, only rainfalls variable is statistically significant at the 5% level due to small sample size, which shows that these climate change variable is important in Lebanon Second, all the control variables were statistically significant at 1% level and have the theoretical expected signs. In other words, both capital formation and Labor have a positive impact on the real gross domestic product (GDP) and statistically significant at 1% while the urbanisation affect the Lebanese economic growth negatively and statistically significant at 1% level (Table 1).

The adjusted R2 shows that the regresses have adequately accounted for the variations in the dependent variable. The Durbin-Watson Statistic is approximately 1.8 is in line with theoretical expectation. Accordingly, we need to check the stationarity of the variables.

5.2. Stationarity Test

We start testing the stationarity of the variables based on Augmented DickeyFuller and Kwiatkowski–Phillips–Schmidt–Shin tests then we apply the ARMA to confirm the stationarity and fitness of the model. The results of the unit root tests are shown in Table 2. The results indicate that all the variables are I(1).

Another method of testing the stationarity is to run the ARMA. The ARMAX results show very similar significant results to the ones on regressed model variable coefficients. The moduli are both roots are greater than and equal to 1 and both AR and MA are stationary. The results in Appendix Table 1 show a good fit for the model.

Based on the table results, since the dependent variable (GDP) has the same order of integration with all other variables we suggest that these variables might be co-integrated.

Table 1: Ordinary least squares, using observations 1990-2013 (T=24)

Variables	Coefficient	Std. error	t-ratio	P value	
Const	32.225	12.0743	2.6689	0.01681	**
CO_2	−0.117568	0.101222	−1.1615	0.26248	
FA	−0.776016	1.63748	−0.4739	0.64197	
RF	0.0666668	0.0279494	2.3853	0.02978	**
Tp	0.0581544	0.240932	0.2414	0.81233	
K	0.202238	0.031135	6.4955	<0.00001	***
L	3.68375	0.770347	4.7819	0.00020	***
Ub	−3.95116	0.939833	−4.2041	0.00067	***

Dependent variable: Real GDP

Mean dependent var	23.91041	S.D. dependent var	0.319502
Sum squared resid	0.021573	S.E. of regression	0.036720
R-squared	0.990812	Adjusted R-squared	0.986792
F (7, 16)	246.4743	P-value (F)	4.42e-15
Log-likelihood	50.11772	Akaike criterion	−84.23544
Schwarz criterion	−74.81101	Hannan-Quinn	−81.73513
rho	0.057487	Durbin-Watson	1.806076

Source: Author calculation

Table 2: ADF and KPSS tests

Variables	ADF	KPSS	result
GDP	I (1)	I (1)	I (1)
K	I (1)	I (1)	I (1)
L	I (1)	I (1)	I (1)
CO_2	I (1)	I (1)	I (1)
FA	I (1)	I (1)	I (1)
UB	I (1)	I (1)	I (1)
RF	I (1)	I (1)	I (1)
TP	I (1)	I (1)	I (1)

I (0) and I (1) denote stationary at level and after first difference, respectively.
ADF: Augmented DickeyFuller; KPSS: Kwiatkowski–Phillips–Schmidt–Shin.
Source: Author calculation

Table 3: Johansen co-integration test results

Hypothesized number of CE (s) rank	Eigen value	Trace statistic	P value	L_{Max}	P value
None*	0.96565	282.17	0.0000	77.536	0.000
At most 1*	0.93870	204.64	0.0000	64.216	0.0001
At most 2*	0.90440	140.42	0.0000	53.994	0.0003
At most 3*	0.84685	86.425	0.0010	43.156	0.0251
At most 4	0.72206	43.269	0.1259	29.448	0.0251
At most 5	0.38467	13.822	0.8501	11.169	0.6398
At most 6	0.10893	2.627	0.9736	2.6526	0.9571
At most 7	0.0000005	0.00012	0.9913	0.00012	0.9913

Note: The * indicates that the Trace statistic or the lMAX statistic is greater than the corresponding 5% critical value; Number of equations=8 Estimation period: 1990-2013 (T=24).
Source: Author calculation

Table 4: ECM estimation results

ECM	Coefficient	Std. error	t-ratio	P value
e1_1 (dependent: GDP)	−0.733459	0.277761	-2.6406	0.02037**
e2_1 (dependent: GFC)	−0.405349	0.302417	-1.3404	0.20308
e3_1 (dependent: LF)	0.700283	0.415928	1.6837	0.11609
e4_1 (dependent: URB)	−1.26536	0.414188	-3.0550	0.00921***
e5_1 (dependent: CO_2)	−0.98783	0.30216	-3.2692	0.00610***
e6_1 (dependent: FST)	−0.351579	0.12876	-2.7305	0.01717**
e7_1 (dependent: TEMP)	−1.54722	0.548538	-2.8206	0.01445**
e8_1 (dependent: RAIN)	−1.22565	0.847149	-1.4468	0.17164

***.** and * denote significance at 1%, 5% and 10% levels; respectively. ECM is residual from longrun model estimation. Source: Author calculation

5.3. Co-integration Test

The results indicate that all the series are I(1). This suggests that the variables may be co-integrated, since the dependent variable (GDP) has the same order of integration with all the regresses. As a robustness check, we conducted the Johansen co-integration test and the results are shown in Table 3. While the Trace test indicates the existence of at least 3 co-integrating equations, the Max-Eigen test shows the existence of at least 4 co-integrating equations. All told, both tests confirm the existence of co-integration relationship between the variables. After proving the co-integration relationship between variables, we will check the error correction model for the eight equations.

5.4. ECM Estimation

To account for the short-run relationships, we estimated an error correction model and the results are shown in Table 4.

Only three out of eight residuals were not statistically significant which reflect the weak exogenous of these variables with respect to the others as shown in Table 4. However. As per the co-integration tests at least 3 variables were co-integrated, while as shown in ECM test 5 residuals were statistically significant which reflect the strong exogenously of their variables with respect to the others.

6. CONCLUSION AND POLICY IMPLICATIONS

This paper examined the impact of climate change on economic growth in Lebanon. The paper used OLS estimation technique and data for the period 1990-2013. Changes rainfall, temperature, carbon dioxide emission and forest areas were used to capture climate change, while the gross capital formation, Labor force, and urbanisation as control variables. After running the regression, we checked the stationarity of the variables, which proved their stationarity of the same level. Thus the test proved at least three co-integration equations afterwards the paper estimated an error correction model in order to account the short-run relationships. Results indicate that two climate variables have negative impact (carbon dioxide emissions and forest areas) and two positive impact on the Lebanese economic growth (rainfalls and temperature changes). However, only rainfalls variable is statistically significant.

All the control variables were statistically significant have the theoretical expected signs. These results imply that Lebanese policy makers should implement strategies to minimize the effect of carbon dioxide emissions and forest depletion. In other words, the Lebanese government should build a serous strategy combined with strict legislation system or use tax incentives to reduce carbon emissions, especially fossil fuels consumption which can be replaced by renewable energy. Another focus the Lebanese government should work on is the green energy production. Although, the great challenge for the Lebanese policymakers is to establish a link between future climate projections and private investments and to increase the awareness in the community.

REFERENCES

Curriero, F., Karlyn, H., Jonathan, S., Scott Z., Lisa S., Jonathan P. (2002), Temperature and mortality in 11 cities of the Eastern United States. American Journal of Epidemiology, 155(1), 80-87.

Deschenes, O., Michael G. (2007), The economic impacts of climate change: Evidence from agricultural output and random fluctuations in weather. American Economic Review, 97, 354-385.

Field, S. (1992), The effect of temperature on crime. The British Journal of Criminology, 32, 340-351.

Gebreegziabher, Z., Stage, J., Mekonnen, A., Alemu, A. (2011), Climate Change and the Ethiopian Economy: A Computable General Equilibrium Analysis. Environment for Development, Discussion

Paper Series, EfD DP. 11-09.
Guiteras, R. (2007), The Impact of Climate Change on Indian Agriculture, Mimeo, MIT Department of Economics.
Huntington, E. (1915), Civilization and Climate. New Haven, CT: Yale University Press.
Intergovernmental Panel on Climate Change. (2007), IPCC Fourth Assessment Report, Working Groups I, II, and III. Available from: http://www.ipcc.ch.
Jacob, B., Lars, L., Enrico, M. (2007), The dynamics of criminal behavior: Evidence from weather shocks. Journal of Human Resources, 42(3), 489-527.
Mcguigan, C., Reynolds, R., Wiedmer, D. (2002), Poverty and Climate Change: Assessing Impacts in Developing Countries and the Initiatives of the International Community. London: School of Economics Consultancy Project for the Overseas Development Institute.
Mendelsohn, R., Ariel, D., Apurva, S. (2001), The effect of development on the climate sensitivity of agriculture. Environmental and Development Economics, 6, 85-101.
Ministry of Environment in Lebanon. (2011), Lebanon's Second National Communication to the United Nations Framework Convention on Climate Change. Available from: http://climatechange.moe.gov.lb/viewfile.aspx?id=19.
Nwafor, J.C. (2007), Global Climate Change: The Driver of Multiple Causes of Food Insecurity in Sub Saharan Africa. Paper Presented at the International Conference on Climate Change and Economic Sustainability. Awka: Nnamdi Azikiwe University. p12-14.
Ogbuabor, J., Egwuchukwu, E. (2017), The impact of climate change on the nigerian economy. International Journal of Energy Economics and Policy, 7(2), 217-223.
Onuoha, C.M. (2008), Understanding climate change in Africa economies. The Green Economist-International Journal of the Green Economics, Institute, UK, 3(2) Autumn. Available from: http://www.greeneconomics.org.uk.
Onuoha, C.M. (2009), Climate Change and Sustainable Development in Nigeria: The Mitigating Role of Green Wall Sahara Nigeria Programme. African Institute for Applied Economics (AIAE), Enugu Forum Policy Paper 10.
Thurlow, J., Zhu, T., Diao, X. (2009), The Impact of Climate Variability and Change on Economic Growth and Poverty in Zambia. IFPRI Discussion Paper. 00890. Washington, DC: International Food Policy.
World Bank. (2017), World Development Indicators. Washington, DC: World Bank.

APPENDIX

Table 1: ARMAX, using observations 1990-2013 (T=24)

Variables	Coefficient	Std. error	z	P value
Const	31.929	10.8749	2.9360	0.00332***
phi_1	−0.110763	0.715395	-0.1548	0.87696
theta_1	0.27772	0.660282	0.4206	0.67404
K	0.207324	0.0290931	7.1262	<0.00001***
L	3.61357	0.695802	5.1934	<0.00001***
CO_2	−0.132882	0.0886907	-1.4983	0.13406
FA	−0.801441	1.47213	-0.5444	0.58616
UB	−3.86913	0.841511	-4.5978	<0.00001***
RF	0.0597411	0.0266155	2.2446	0.02479**
TP	0.124577	0.215166	0.5790	0.56260

Variables	Real	Imaginary	Modulus	Frequency
AR				
Root 1	−9.0283	0.0000	9.0283	0.5000
MA				
Root 1	−3.6007	0.0000	3.6007	0.5000

Dependent variable: l_ real GDP, Standard errors based on Hessian