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Sustainable Development and the Dilemma of Egyptian Economic Growth and Climate Change: 1917-2015

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Abstract

It is forecasted that 250,000 people will die every year because of climate change and that 86.4 percent of the world population will be living in poverty by 2050. Previous literature has highlighted the tradeoff between poverty reductions and eliminating environmental degradation. Improving the livelihood of the poor therefore has to include improving the environment as well; especially that the poor suffer disproportionally from the effects of environmental decline. This paper tests the long term impact of climate change on economic growth in Egypt over a time period of 98 years using the Threshold model.The estimated threshold regression model suggests 22.9^{o} C as the threshold value of temperature rate above which temperature significantly retards the growth rate of GDP. In addition, below the threshold level, there is a statistically significant positive relationship between Temperature and growth.

Keywords

Climate Change; Developing Countries; Environmental degradation; Poverty; Sustainable Development; Economic Growth; Temperature; Revolution; Carbon Emissions

1. Background

> *The 'environment' is where we live, and development is what we all do in attempting to improve our lot within that abode. The two are inseparable.*
>
> *(UNEP, 2007:34)*

Egypt is a developing country located in the African continent although known for its diverse resources yet a main challenge for the country is reaching the balance between proper allocation of the latter and its accelerating population growth at a 2% annual rate, reaching approximately a total of 100 million citizens in 2018 (CAPMAS, 2018). Owning to its desert nature, the whole population is allocated to only 4% of the total area of the country. Unsurprisingly, the Nile valley, from Aswan in the south to Cairo in the north, and the Delta; together represent 2.5% of the aforementioned 4%; as the River Nile is considered the main source of water providing 95% of water needs (Eid, El-Marsafawy and Ouda 2007). From which 80% is consumed in agriculture, making it convenient for intensive agriculture today and through Egypt's history (El-Raey, 1999; El-Shaer et al., 1997). Agriculture is one of the main contributors to the gross domestic product (GDP) with around 14.5% of its total value and provides 28% of all jobs in the market, out of the total women workforce 45% are working in the agriculture industry as per the US Agency for International Development (USAID, 2017).

The growth performance of the Egyptian economy varied significantly over the period 1966-2015. The GDP growth rate averaged 4.86%; while real GDP per capita averaged 2.55%. This period has been mainly characterized by low increases of per capita income and GDP growth if compared to other developing countries in the same period. Egypt has always been a leading country in the Middle East and it has been in the center of events either affecting or being affected by the radical changes caused by profound events such as consecutive wars (1973-74) and/or oil shocks (1979). Some of these events are reflected in Egypt's economy when GDP growth contracted to 0.705% in 1973.

However, from the mid of the 1970s to mid1980's the country witnessed accelerating economic growth with an average rate of 8.53%. The highest recorded GDP growth was in 1976 when it reached 14.62% which was due to remittances, tourism, increased foreign borrowing and high oil prices (Al-Mashat and Grigorian 1998). In 1974 (OPEC 2016) OPEC raised the barrel price from 3.01$ to 11.65$ causing a market shock pushing the prices up to 20$ per barrel (El Beblawi, 2008). High oil prices have caused countries like Egypt, Brazil, India, Malaysia, and Oman to double their oil output to a total of three million barrels per day between 1979 and 1985 (Gately, Adelman and Griffin 1986). Nevertheless, this oil-led economic growth was not sustainable as eventually, oil prices fell in 1991. This resulted in a major decline of GDP growth and per capita GDP from the mid-'80s (1.078%) until 1991 (-0.8%). In the same period, gross fixed capital formation shrank from 15.95% to 7.59%. The percentage of imports to exports of the GDP decreased from 35.79% to 27.81% causing a current account deficit (World Bank online indicator, 2016).

In 1991, with the existence of all the macro imbalances such as the balance of payment and government deficit, along with the high inflation rate, Egypt considered signing an agreement with the IMF and World Bank with the aim of remedying these macro imbalances (Korayem, 1997). This resulted in a decrease in the unemployment rate, budget deficit, inflation rate and a rise in current account surplus and GDP growth rate (Subramanian, 1997). Consequently, that has encouraged the Egyptian government to sign another agreement with the IMF and World Bank aiming at higher economic growth and a better standard of living; this agreement was expected to increase GDP growth rate with 5-6% between the years 1996 and 1998 (Bush, 1999). This hope was shortly crushed with the internal and external shocks that hit the country from 1997 to 2003. It started with the Luxor terrorist attack in 1997 followed by the East Asian crisis and the drop in oil prices in 1998 and ending with the September 11^{th} terrorist attack in 2001 and 2003 Iraq invasion (Khier el Din and El-laithy, 2008).

The year 2011 witnessed the start of a new era when the Egyptian revolution took place on the 25^{th} of January, the revolution caused Egypt to enter an exigent transition stage, as foreign direct investments (FDI) was reduced -from 6.8 to 2 USD Billion-, the budget deficit, debt rate, unemployment rate, poverty rate rose, standards of living fell even further. Moreover, one of the main sources of foreign income to the country –tourism revenues - decreased by 60%, as did foreign currency reserves which plummeted from $36 billion pre-revolution to $15 billion post-revolution. All these factors were bound to have their effect on the value of the Egyptian pound which fell to a historic low against the dollar even with vigorous support from the Central Bank of Egypt. This came on top of (temporary) supply shortages following the uprising and food and fuel price inflation due to higher import prices since early 2011. Although the economic situation of Egypt is easing since the revolution of the 25th of January, the economy still has a long way to recover (Abdou and Zaazou, 2013). There is a consensus among economists that developing countries' economies known to be fragile and unstable (UN 2018; Lekwot, Uchenna and Alfred, 2012; Thorpe and Ogle, 2011; Parry et al., 2007; Korten 1991) Egypt is not any different.

On the economic level, they are largely based on agriculture activities where the environment is an important factor of production (Hughes et al. 2009). On the social level, accelerating population growth is evident. On the institutional level, a high level of corruption or institutional failure was recorded. On the environmental level, they are suffering from a number of environmental problems, for example, an increase in drought, water scarcity, and soil degradation. Thus, the risk of environmental migration is projected in the coming years (Schubert et al. 2007). Similarly, Trainer (1990) asserts that they are surrounded by an increasing level of air, and water pollution and resource depletion, which can be seen in the deforestation, soil erosion, overfishing and damaged marine and coastal ecosystems (Trainer 1990), plus the annual tropical land losses that mainly occupied by the developing

nation (Bonnie et al 2000).

Protecting the environment is vital not only for the interest of the present generations but also for future generations. This could only be possible by tackling the human causes of climate change so that Egyptians can enjoy a sound and livable environment. Climate change started to gain much attention from the international community in recent years. Funds have been dedicated, and solutions have been suggested to face global warming (Fadairo, 2016; Lekwot, Uchenna and Alfred, 2012; Posner and Weisbach, 2010). This aim is supported on the domestic level by the sustainable development strategy: Egypt vision 2030. As well as, on the international level, presented in the United Nations Agenda Transforming Our World: 2030 for Sustainable Development, where 17 objectives and 169 goals of sustainable development in which the need environment protection has been highlighted and the urge for controlling climate change (UN, 2018; Wedy, 2016). Sustainability requires the adoption of environmentally friendly strategies in production activities (Ezemokwe, 1998). Besides, ensuring adequate measure for adaptation and setting stricter targets for greenhouses gasses emission-cutting that is legally binding while aiming at controlling global warming below $2C^{o}$ (COP21 Paris, 2018).

Motive

The importance of this study is originated from the cost that developing countries like Egypt will have to bear in the coming years. Many scenarios have been assumed and probabilities were discussed about Egypt's future with environmental damage and climate change, what received higher probability was the risk of devastation that falls on Alexandria the second largest city in Egypt and the North African countries in general. Government officials have already declared that by 2020 several towns and urban areas in the north of the Nile Delta will face the problem of Mediterranean level rise; rising sea levels are threatening at least 15% of the delta land and groundwater via leakage (Elsharkawy, Rashed and Rached, 2009; Thomas, 2008).

Aim

This study aims at contributing through researching the nature of the paradoxical relationships between economic growth and climate change in Egypt. As achieving sustainable development in Egypt requires taking into account the economic-environmental interaction. So far, studies by Alhakimi and Alhagrasy (2015) Ghalwash (2014), El Hamid (2013), Nasr (2008), Kheir-El-Din and Moursi (2006), Bolbol et al. (2005), Galal (1998), and Levy (1986) focused on the low level of Egyptian economic growth; analyzing a limited number of explanatory variables such as government expenditure, trade openness and capital accumulation as main determinants of the economic growth level and neglected other possibly relevant non-economic variables, or including Egypt as one of many countries listed in panel data studies without adequate consideration to its economic condition and special characteristics.

2. Anticipated Consequences of Environmental Degradation

Pollution in Egypt has reached a critical level where Cairo the capital was ranked number one on the most polluted cities list. Egypt's environment helps in manifesting the pollution problem given that the rain pattern and the hot weather is causing pollutant to get stuck in in the foggy air above the city. On an annual basis, different types of pollution (Water, air, etc.) are causing human deaths all around the world more than all other factors such as hunger, natural disasters, war, murder, smoking, AIDS, tuberculosis, and malaria combined. Pollution, of all kinds and its disturbing associated consequences, are creating a real threat for human mental and physical health and wellbeing (Conca, 2018). Over the last 50 years, Egypt carbon dioxide emissions' (CO2) is maintaining an increasing trend as seen in (figure 1) with an average annual CO2 emission of 1.4 metric tons per capita (World Bank, 2018). The increase in CO_2 is claimed mainly to the continued fossil fuels burns which also contribute to ozone layer damage that is responsible for controlling the sun's radiation and water evaporation (IFRC, 2009). The increase of anthropogenic greenhouse gases is mostly driven by the unsustainable production pattern followed all over the world. The continuous rise in anthropogenic greenhouse gases along with deforestation and the use of unsustainable techniques in agriculture industry has led to change in climate (Wedy, 2016).

This view is supported by Oreskes and Conway (2011) and Gerrard (2007) who found that the negative impact

for the retention of these gases is a change in climate, which has severe consequences on human health, causing illnesses and deaths because of the increasing frequencies and intensity of heat waves. Also, on the ecosystem, seen in the increasing doughtiness and fire threats, air pollution and change in rainfall patterns and floods, moreover, it causes an increase in sea-level and coastal flooding. These environmental imbalances are threatening human life and all livings on the planet with a degree and intensity that has never been witnessed before; it contributes to increasing diseases, land and assets' damage which may cost billions of US dollars (Elsharkawy, Rashed and Rached, 2009). Climate change occurrence is no longer a probability but rather a fact that will continue to manifest itself in the coming years (Parry et al, 2007).

As such climate change can, therefore, be defined as; *"Climate change refers to a broad range of global phenomena created predominantly by burning fossil fuels, which add heat-trapping gases to Earth's atmosphere. These phenomena include the increased temperature trends described by global warming, but also encompass changes such as sea level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events" (NGCC 2018).*

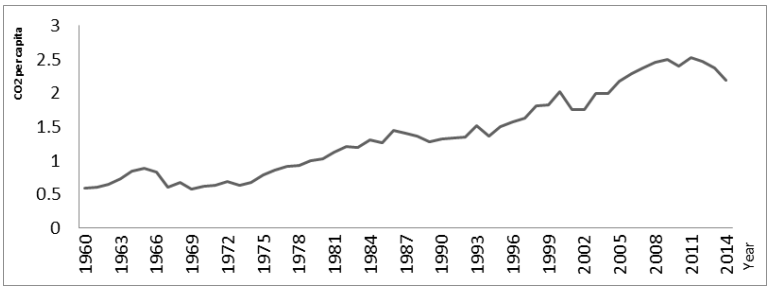

Figure 1. Carbon Dioxide emission per capita in Egypt Source:World Bank (2018)

As per the World Bank (2018), Egypt's temperature has also shown an increasing trend over the last years with an average of 22.4C^{o} see (figure2) the hottest recorded year for Egypt was 2010 with an average yearly temperature of 24.8C^{o}. This environmental catastrophe is particularly visible after 1997. It is estimated that by the year 2100 an increase in temperature between 1.8°C to 4°C will take place. Even the minimum estimated increase (1.8°C) will be larger than any variation that occurred over the last 10,000 years. Increase in temperature leads to evaporation of water; reduce in rainfall and consequent increase in salinity putting the livestock and marine-life at risk (UNEP 2007); the risk for marine-life revolve around four axes which is abundance, distribution, migration pattern and availability of fish, which are highly affected by temperature, salinity, wind speed and direction, ocean currents, and strength of upwelling (Lekwot, Uchenna and Alfred2012). Likewise, an expected increase in the sea-level between 18 and 59 centimeters is much higher than the average recorded level of 10 to 20 centimeters over the 20th century (Sachs, 2015; Gore, 2006). It was also recorded that weather-related disasters such as floods, storms, heat waves, and droughts have increased by 57% over the years1990 to 2000. These numbers reflect an increase in the number of humans getting harmed which is an estimated 243 million in 2008 compared to 190 million in the 1990s(IFRC, 2009).

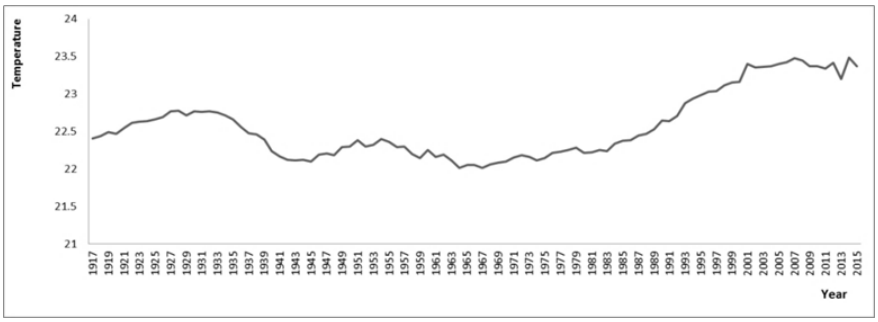

Figure 2. Average Temperatures in Egypt 1917-2015 Source: Climate Change Knowledge Portal World Bank (2018)

2.1. Economic Impact of Environmental Risks

Developmental programs established by world organization and the United Nations Starting 1960s, in response to the severe level of poverty in developing countries especially the newly independent nations of Africa and Southeast Asia that were moving from colonialism took into consideration the environmental aspect (Bandypadhyay and Shiva, 1989). They were aiming at raising the standard of living and alleviating poverty. UN identified poverty "as both a cause and a consequence of environmental degradation". This UN identification was essential in raising awareness about the nature of poverty. In the first era of these programs, economic development or increase in per capita GDP was conceived as the cure for poverty by different countries (Goodland and Daly, 1992). Economic growth was viewed as a chance not only to create job opportunities that help in alleviating poverty but also to create a surplus that could be used in cleaning up the environment (Homer-Dixon, et al 1993). Furthermore, based on the demographic transition theory, achieving a high standard of living would lead to a decrease in the fertility rate and henceforth a decrease in population growth rate. Accordingly, economic development was seen as a solution for poverty, population growth and environmental degradation in developing countries. In general, low-income countries are expected to remain poor unless they receive support to raise their standard of living on a sustainable basis (Tadoro, 1989). This can be explained as low standard of living countries spend a significant percentage of their income on consumption, which implies low saving, and low investment, and hence low production (Solow, 1994; Tadoro, 1989).

Climate change negatively affects natural resources which are seen as a fundamental factor of production in any economy especially in the developing world (IFRC, 2009). The world is losing an estimated $4 trillion annually because of the environmental problems such as pollution which represents 6% of the world GDP (Conca, 2018). Climate change is capable of repudiate years of economic growth (Wedy, 2016; Lekwot et al., 2012; Benson and Clay, 2003) and puts sustainability; the ability to satisfy current needs without affecting future generation's needs fulfillment (Brundtland, 1987), at risk that in turn affects economic growth, social equalities, and poverty eradication plans. Climate change is threatening the achievement of the Millennium Development Goals (MDGs) (UNDP, 2011; UN, 2018; Parry et al, 2007). This argument was supported by Lekwot, et al. (2012) and The International Federation of Red Cross and Red Crescent Societies (IFRC) (2007) who argued that although the United Nation's MDGs is aiming at decreasing poverty in African countries but with the rising environmental problems especially change in climate this seems hard to achieve. Furthermore, conditions might even be worsened by several existing factors in developing countries like Egypt as for instance, poor economic performance, corruption, undesirable human activities, and practices, environmental degradation and its associated risks; fluctuation in rainfalls and projected crop failure. Determining the exact impact of climate change on food availability and affordability requires considerable attention to several factors on top of which are; the level of CO2 emissions, the intensity of floods, the degree of droughts, agriculture system and its adaptive capacity, population growth, and economic condition in the country (Pittock, 2017).

This environmental-economic interaction made it almost impossible or ineffective for local governments and international institutions to isolate economic development issues from environmental issues, many forms of economic activities exploit the environmental resources so that environmental degradation actually weakens economic development. Poverty was also found to be a major cause and effect of many environmental problems (Wedemann and Thielke, 2005; Korten, 1991; WCED, 1987). Though all people around the world whether developed or developing are at risk because of climate change and its associated hazards, poor nations are the utmost vulnerable, especially African countries (Fadairo 2016; Lekwot, Uchenna and Alfred, 2012; Posner and Weisbach, 2010; Graßl et al. 2003)[1]. Social, economic and environmental conditions in developing countries are the main reason behind their high vulnerability to climate change and their failure in coping and/or adapting to climate risks. In developing countries, the natural environment is already severally degraded. Therefore, climate change, poor resource management, environmental degradation and human pressure on lands pose a real threat to human development, welfare, and food security. This worsens, for example, major health problems which are already hard to control given the existing health care system. Accordingly, considering the climate change risks' and its respective mitigation policies are inevitable in developing countries (Elsharkawy, Rashed and Rached, 2009; Leary andKulkarni,

2007; Abou-Hadid, 2006).

In fact, the forecasts reveal a more distressing effect now and in the future because of change in climate and the anticipated global increase in temperature that is declared to be around 2-4^{o}C. Meaning that climate change would be a major contributor to the developing world poor performance now and in the future, as it affects and will continue to affect their key sectors such as agriculture, water, health, energy, and transportation, which are crucial factors to achieve sustainable socioeconomic development (Pelling et al, 2004). Although, many sectors will be affected by environmental imbalance seen in the change in climate, continuous change in rainfall pattern and water resource. Agriculture sector and the animal stock would be the most affected. In particular agriculture production, fisheries, livestock, and industries using agricultural products as raw materials (ex. medical herbs). Also, change in crops' cycle and structure which have a direct impact on productivity, nutritional value, and taste of some fruits and vegetables (UNEP, 2007).

Over and above, Egypt was listed as one of the most affected countries by environmental surges; an increase of 83.6 % is estimated to Egypt surge zones, with the continuous change in climate, Egypt will suffer from storm surges along with the sea level rise putting cropland at risk as well (Dasgupta, et al., 2009). Elsharkawy, Rashed and Rached (2009) claims that the increasing frequency of extreme environmental events including an increase in temperature; a reduction in crop yield, changes in the agricultural distribution of crops, the negative impact on marginal land, increasing desertification, will increase unemployment and income losses ending with probable political unrest. As the anticipated decrease in agriculture productivity, crops yield will cause a direct change in supply and demand pattern leading to increase in goods prices, a decrease in farming profitability, (Lekwot, Uchenna and Alfred, 2012) food availability and affordability in Egypt, with an estimated increase in prices of imported goods (El-Raey, 1999). Industries production cost will even rise due to the assumed environmental damages, a clear example would be clean energy (hydropower) which will diminish with a change in climate. These projected consequences of great concern to Egypt as hydropower made up around 12% of Egypt's total installed power generation capacity (Ibrahim, 2012). The net effect of these environmental problems will be increasing poverty (UN, 2018; Lekwot, Uchenna and Alfred, 2012; Thorpe and Ogle, 2011; Parry et al, 2007; IFRC, 2007). A problem that will be aggravated with the accelerating population growth, urbanization, industrial development, and irrigation intensification, these factors leads to a continuous increase in water demand causing agriculture vulnerability in Egypt (Abou-Hadid, 2006). Meaning that protecting the environment is an essential element in poverty alleviation and the country's social stability (Bandyopadhyay and Shiva, 1989; Hughes et al, 2009).

Eid, El-Marsafawy, and Ouda (2007) have supported this view as they estimated that agriculture sector in Egypt will be suffering in the coming years because of a decrease in available water and subsequently irrigation water that is caused by climate change. Especially that Egypt is suffering already from water stress along with the continuous population growth that it mainly concentered along the Nile valley and delta pressured by increasing urban demand (Leary et al, 2008). The aforementioned industries will be forced to reduce their operations and downsize employees to accommodate these changes in the short-run. However, this could be reversed in the long-run if adequate measures are taken or shutdown of major industries is projected in the medium to long-run (Schubert et al, 2007).

Another major environmental problem is the change in sea level, which is mainly driven by ocean thermal growth, in addition to other factors such as glacial melt from Greenland and Antarctica and a lesser effect is attributed to terrestrial storage (Dasgupta et al. 2007). By 2050, a rise in the global average sea level from 7 to 35 cm is anticipated and this will continue to accelerate to an average level of 9-69cm in 2080 (Roaf, Crichton, and Nicol 2005). This increase in sea level, for instance, the Atlantic ocean will have a destructive impact on Egypt large coastal areas more precisely Alexandria governorate (Anthoff, Nicholls, Tol, and Vafeidis 2006). This sea level rise will cause lowlands along the coast and agriculture area to drawn, causing socio-economic and socio-cultural problems. Accordingly, climate change will increase the opportunity cost of resource utilization and thus making resources allocation decisions more difficult. As a result, social conflicts may rise and supply will fail satisfying demands and needs in addition to other problems such as continued population growth (Ozor, 2009).

2.2. Sustainability and the Need for Controlling Change in Climate

Wedy (2016) argues that a clear direct link between human, environment and the economy exists and cannot be ignored while planning for economic development; environmental protection must be taken carefully into consideration. For instance, carbon emissions of economic activities must be controlled, not only for the sake of the microclimate but also the macroclimate. Climate change can be mitigated by applying the appropriate sectoral plans, that establish a low carbon economy by gradually reducing carbon emissions while considering the special nature of each sector; such as health services, agriculture, electricity generation and distribution, national transportation systems of freight and passengers, public transportation in the urban area, production of durable goods, chemicals, pulp and paper, and mining and construction. This means economic growth must be achieved by new sustainable agriculture production methods and natural resource management to go in line with climate change control (Ezemokwe, 1998). This can explain why economic growth alone might not be the ultimate solution for problems of developing nations, like Egypt as it may depend on other factors as well (UNDP1999). The vast majority of the countries which applied aggressive economic development policies to maintain their existing standard of living, while ignoring any environmental considerations, have failed in the long-run and ended up with deepening poverty level and increasing environmental degradation (Hussen, 2012; Goodland and Daly, 1992).

Hence, it could conceivably be assumed that a sustainable social and economic development in any country is nearly impossible with the presence of climate change. Climate change is a problem that gained that attention of governments, United Nations, NGO'S, and many concerned entities who acknowledge the imperative need for world strategies, policy framework and assessment techniques for all countries to tackle climate change problem and its related consequences. In an attempt to formulate a sustainable community climate, which makes it vital for countries to control their local environment related activities', work toward containing the existing problem and adopt a preventive measure for the future. Such efforts shall support poverty reduction endeavors and create a better livelihood community (Lekwot, Uchenna and Alfred, 2012). So far the contingency plans followed in Egypt for climate change was mostly reactive adopting the impact rather than active eliminating the source (Thomas, 2008),it could be seen in the $300 million concrete sea wall that they are building in an attempt to protect the beach area from the rising sea level, or the vulnerability index to identify the regions at utmost risk (Batisha, 2012), beach nourishment (putting sand onto the beach), building of breakwaters, restricting development in endangered areas, and adjusting land use (El-Raey, Dewidar, and El-Hattab 1999; El-Raey, 2009).

2.3. Model Specification and Data

To carry out an estimation procedure of the relationship between climate change and economic growth we employ annual data covering the period 1917–2015. The data is extracted from the World Bank's World Development Indicators and Climate Change Knowledge Portal World Bank (2018). The variables used in the estimations are the following: • GDP Growth Rate (GDPGR). This is the dependent variable used in the regressions. Real GDP per capita is gross domestic product divided by total population. The method adopted in the study is threshold regression. The threshold autoregressive (TAR) model developed by Howell Tong has been vastly influential in economics.

Accordingly, we argue to include environmental factors such as change in climate as a main contributor to the Egyptian economic growth performance, to obtain a unique unpinned view. The approach suggested in this research is intended as a preliminary step towards constructing a better understanding for the dynamics between the environment and economic performance relative to the other driving forces in a developing country such as Egypt. It is also necessary to understand how these impacts vary given the economic, environmental and institutional setting of a country like Egypt. Economic problems cannot be resolved by looking at them separately. It also requires having a stable local government, a tenure system that supports the efficient utilization of natural resources. This research aimed at contributes by providing a comprehensive understanding of the interrelationships among Economic growth and climate change in Egypt. To enable Egypt to achieve a level of economic progress that is considered to be environmentally sustainable. Thus, sustaining any progress in Egypt requires environmental con-

sideration. This will contribute to solving the current problem of poor economic performance and environmental degradation. This result shows that if GDP one year ago was less than 24% then the impact of temperature is negative and will cause a reduction of 1%, this result represents most of the observed sample. On the other hand, if GDP is greater than 24%, the temperature impact will turn to be bigger with almost 16%. For this time period 1917-1945, Egyptian GDP was mainly agriculture driven which is why temperature will have a much bigger impact if compared to an industrialized country.

$$GDP_t = \alpha + \begin{cases} \beta 1\, Tempgr_t + u_t & if\ GDP_{t-1} < 24.6 \\ \beta 2\, Tempgr_{t+U_t} & if\ GDP_{t-1} > 24.6 \end{cases} \quad (1)$$

Table 1. **Environmental-Economic Growth Threshold Model**

Dependent Variable: GDPGR				
Threshold type: Bai-Perron tests of L+1 vs. L sequentially determined thresholds				
Threshold variables considered: GDPGR(-1) GDPGR(-2) GDPGR(-3) GDPGR(-6) GDPGR(-7) GDPGR(-8)				
Threshold variable chosen: GDPGR(-1)				
Threshold selection: Trimming 0.15, Max. thresholds 5, Sig. level 0.05				
Threshold value used: 24.66636				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPGR(-1) < 24.66636 – 24 obs				
TEMPGRPR	-0.947441	0.692926	-1.367305	0.1837
24.66636 <= GDPGR(-1) – 4 obs				
TEMPGRPR	-15.67293	2.858535	-5.482852	0.0000
Non-Threshold Variables				
C	3.679790	1.861473	1.976816	0.0592
R-squared	0.379256	Mean dependent var		5.268097
Adjusted R-squared	0.329597	S.D. dependent var		11.41974
S.E. of regression	9.350276	Akaike info criterion		7.409646
Sum squared resid	2185.691	Schwarz criterion		7.552382
Log likelihood	-100.7350	Hannan-Quinn criter.		7.453282
F-statistic	7.637127	Durbin-Watson stat		1.065589
Prob(F-statistic)	0.002579			

Studying the economic environmental interaction over a longer time period 1917-2015 using threshold model reveals a more interesting and unique relationship. If the temperature is between 22.4 - 22.9 GDP per capita is following a positive trend while if the temperature is below 22.4^o C and above 22.9^o C GDP per capita will follow a negative trend. The negative trend is bigger with a higher temperature than with the lower one. What we learn from this threshold regression is that the economy needs an "optimal" temperature which is in between $22.4C^o$ and

22.9C^o. of course, this result is country specific and may be different for other countries. However, as far as Egypt is concerned, Egypt has the interest to limit the temperature increase to 22.9^{o}C.

Equation 2

$$GDP_t = \alpha + \begin{cases} \beta 1\ Trend + \beta 2\ GDP_{t-1}\ if\ Temp > 22.4 \\ \beta 3\ Trend + \beta 4\ GDP_{t-1}\ if\ 22.4 < Temp < 22.9 \\ \beta 5\ Trend + \beta 6\ GDP_{t-1}\ if\ Temp \geq 22.9 \end{cases} \quad (2)$$

Table 2. **Environmental-Economic Growth GDP per capita Threshold Model**

Dependent Variable: RGDPPC				
Threshold type: Bai-Perron tests of L+1 vs. L sequentially determined thresholds				
Threshold variable: TEMP				
Threshold selection: Trimming 0.15, Max. thresholds 5, Sig. level 0.05				
Threshold values used: 22.40362, 22.90669				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
TEMP < 22.40362 – 36 obs				
TREND	-3.001981	2.925292	-1.026216	0.3078
RGDPPC(-1)	1.252926	0.028749	43.58150	0.0000
22.40362 <= TEMP < 22.90669 – 39 obs				
TREND	10.00091	3.303288	3.027562	0.0033
RGDPPC(-1)	1.045207	0.028916	36.14680	0.0000
22.90669 <= TEMP – 15 obs				
TREND	-55.35832	17.09311	-3.238634	0.0017
RGDPPC(-1)	1.389468	0.084192	16.50361	0.0000
Non-Threshold Variables				
C	-5.783884	1.507539	-3.836640	0.0002
R-squared	0.998851	Mean dependent var		1031.837
Adjusted R-squared	0.998768	S.D. dependent var		2019.096
S.E. of regression	70.87020	Akaike info criterion		11.43416
Sum squared resid	416874.6	Schwarz criterion		11.62859
Log likelihood	-507.5374	Hannan-Quinn criter.		11.51257
F-statistic	12026.13	Durbin-Watson stat		1.571736

Continued on next page

Table 2 continued

Prob(F-statistic)	0.000000			

3. Conclusion

In summary, the paper presented what climate change is all about. It adopted the definition of climate change as accumulated continues increase in temperature observed over the period of time that is claimed to human activities which change the composition of the world atmosphere. We do not want only to quantify the parameters of our suggested variables but also be able to forecast the future of Egypt accordingly. In order to contain climate change, create awareness and better ability in tackling the climate change problem in Egypt certain measures need to be addressed and taken into consideration. Climate change strategies need to be incorporated in economic development plans and resources use, to ensure sustainability. Meaning that public policies, goals, guidelines, and developmental social and economic programs must be in line with the objectives, guidelines, and instruments of environment protection. This includes reducing emissions by using environmentally-friendly production methods, infrastructure, and technology. On the micro-level adjustment to citizens, lifestyle to a more environmentally friendly life is crucial. Developing countries more preciously Egypt is vulnerable to projected climate change risks' given its economic, social and environmental conditions, as for instance poverty, population growth, corruption. The general increase in temperature known as global warming, Leads to flooding, drought, erosion, desertification, sea level rise, heat stress, pests and diseases, unpredictable rainfall pattern inter alia. These negative outcomes do have an impact on the country long-term developmental plan. A clear negative outcome would be a decrease in agriculture productivity, food shortage, diminishing of natural resources, health problems, increase in poverty and unemployment, In addition to environmentally induced migration. The paper underpinned the impact of climate change on economic growth. The evidence from this threshold regression suggests that the economy needs an "optimal" temperature which is in between 22.4 Co and 22.9 Co. obviously, this result is country specific and may be different for other countries. However, as far as Egypt is concerned, Egypt has the interest to limit the temperature increase to 22.9o C. Acknowledging the importance of tackling such a problem is done via applying proper solutions. Given that pre adaption plan for climate change will be of less cost than post-event expenses.

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