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DYNAMICS OF URBANIZATION AND TEMPERATURE INCREASE IN MIDDLE EAST-AN EMPIRICAL INVESTIGATION

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ABSTRACT

Growth patterns are the important channels, through which the society and economy interact. Climate change could lead to such disruption, if unsystematic growth has not been controlled to a limit. Recent scientific evidences have shown that Middle East region is in the midst of climate change vulnerability by endangering its oil cashed growth strategy. But economic research has given very scant attention towards such incident by correlating with urbanization. In this context, we argue that the upscale energy demand, industrialization and unbalanced urbanization strategies could potentially impact the region in long run in forms of climate change. We further argue that the behavioral changes in terms of percapita urbanization growth and increasing import have impacted the region unlike never before. Even our cross-sectional dependency test has shown that the region's heat wave problem is worth of deep concerns. From a policy perspective, we suggest that the region as whole should be proactive in terms of starting effective implementation of green energy plan, clean energy investment and production of bio-fuel. In order to counter the negative cost of heat wave as predicted, the region must combinedly put forward and ratify a climate change strategy to monitor the development on an annual basis.

Keywords: Economic development, Climate change, Urbanization. Trade, Middle east, Energy consumption.
JEL Classification: O10, Q54, R5, F10, O53, O13.

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Contribution/ Originality

The present study contributes to the existing literature by analyzing the dynamics of urbanization, growth and energy consumption w.r.t annual temperature change in Middle East economies. By applying estimation technique like Westerlund test, our study documents that unsystematic urbanization, economic growth and energy consumption in any economies may have the profound impact on the region's overall increase in average annual temperature change.

1. INTRODUCTION

Drought in the arid and politically explosive region of Middle East has aggravated the economic problem across the region. Urban induced changes and burning fossil fuels have put significant effect on average increase in annual temperature of the region. Winter storms historically have delivered most of the annual rain to the already arid

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Middle East region. Since 1970s, the trend has been declining due to the temperature inversion. On the other side, the temperature difference appears to set up conditions over the North Atlantic that steer a higher proportion of Atlantic winter storms across northern Europe.[1] Though the region is moreover a hot region during normal times, the ongoing climate change may impact the region's topography and atmospheric conditions over the years. The nasty combination of high temperatures with extraordinarily high humidity have lifted the "heat index" – which factors in both parameters to measure the perception of heat –to more than 70 degrees Celsius (158 degrees Fahrenheit) in the Iranian city of Bandar Mahshahr, the second-highest temperature ever recorded on Earth.[2] Along with the heat wave, the region has been facing constant threat of global sea level rise. Cities like Alexandria, Haifa and Tel Aviv may face flood like situation in the mid century.[3] The region is going to face the unpredictable situation in forms of Mad Max type of world sooner, if environmental disaster is coupled with war like conditions turning the region into inhabitable conditions. In Syria, climate change was a domestic affair. A five-year drought that began in 2006 impoverished farmers and led to a mass exodus to the cities, which were woefully unprepared for the refugees. In both Egypt and Syria, which experienced two of the region's biggest explosions of popular unrest, social discontent from hard-pressed consumers and displaced populations was waiting to be ignited (Please refer to the footnote 2).

Temperature and humidity level have already marked record high in the Middle East region making it unbearable in summer 2015. The heat indexes of major cities like Doha, Dhahran, Dubai, Sharjah and Abu Dhabi have already crossed the threshold point as suggested for the human tolerance level. Eltahir and co-author Jeremy Pal of Loyola Marymount University ran computer simulations of what the Persian Gulf's climate may look like in the last 30 years of the century. They assumed greenhouse gases would continue to accumulate in the atmosphere at the current pace, driving up global temperatures.[4] Their studies have found that major coastal cities in the region could cross 35 wet bulb degree temperatures in future, if the current GHG situation continues. In 2015, a city in S-W Iran has experienced 74 degree, as the hottest temperature ever recorded on earth. If such trend continues, then the number of extremely hot days per year could jump from 16 today, to 80 in 2050, to 118 in 2100, possibly leading to mass emigration from the region. Scientists have long maintained that parts of planets could experience extreme temperature, if the current rates of pollution and industrialization persist. In order to avoid the lethal threshold level of temperature rise, the urban planners must have to initiate sustainable infrastructure planning, which can be helpful in curbing carbon emission intensity.

Suppose the economy is in developing stage i.e. in take-off stage of growth. Normally, economies in the take off stage often seem not to take into account several negative externalities arising out of the unsystematic urbanization and industrialization. Investing in the clean industry in the initial stage seems not to be a perfect option for these economies. Such economies continuously undertake the path of speedy economic growth by sacrificing their present and future sustainability. Today's global warming is the necessary by-product of such unevenness arising out of such unbalanced growth. If the region as a whole initiates such a strategy, then it could spell imminent environmental disaster to the economy in terms of natural disasters like heat dome, cyclones, incessant rainfall and drought. If the region already in dry land or in sub-tropical zone further necessitates their growth by fuelling such an unbalanced strategy, then it would add more woes to the existing problem. Such a case is long visible in Middle East oil rich economies. Heat dome is not a new phenomenon to this climatic zone but the recurrence of such at a regular interval

[1] Please refer to http://www.csmonitor.com/Science/2011/1028/Global-warming-Middle-East-s-vital-wet-winters-are-disappearing

[2] http://www.haaretz.com/blogs/david-s-harp/.premium-1.670788.

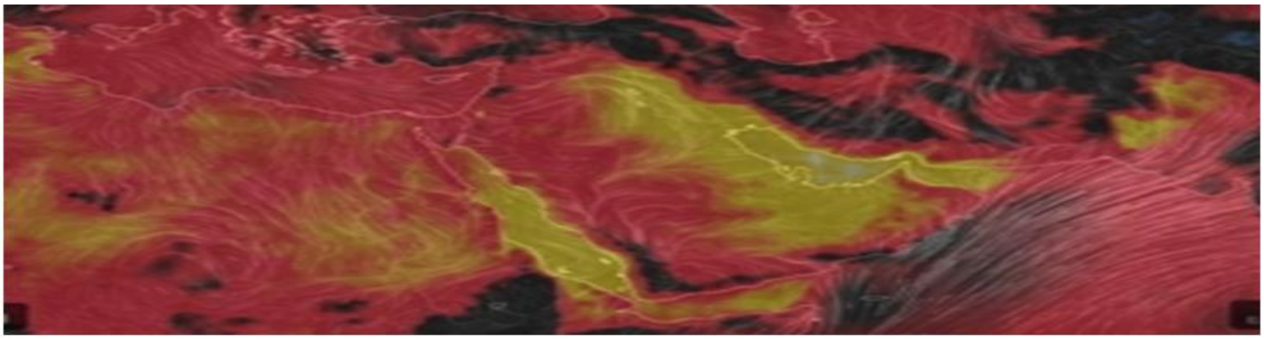
[3] http://www.haaretz.com/blogs/david-s-harp/.premium-1.670788.

[4] Please refer to http://www.bloomberg.com/news/articles/2015-10-26/middle-east-may-suffer-intolerable-heat-climate-study-warns.

could impact the economic lives, work place, and other activities to a significant extent. Urbanization, industrialization, oil drilling and other natural gas exploration have in fact been adding woes to the climate change in the region.

Change in climate change has a far reaching consequence upon the environment and agriculture. The temperature inversion and heat wave have also shattered the economies in terms of disrupting development, shutting down the work places and other physical activities and damaging the agriculture crops. Dell *et al.* (2009) in one of their analyses have shown that one degree change in temperature leads to an average reduction of 8.5% percapita of an economy. Till date, there exists no uniform theory in this context. Even a small variation in temperature exerts profound impact upon the economy. Dell *et al.* (2012) in another paper have revealed that poorer economies suffers maximum out of such climate change perspectives. Every 1 degree rise in temperature has resulted in terms of 1.3% decrease in GDP growth rate. However, rich countries never face any formidable challenges out of such extreme heat wave conditions (Xue, 2014).[5] From this perspective, MENA region is increasingly hot owing to its arid conditions, where the rich economies like Qatar, Saudi Arabia and UAE may withstand such an increasing temperature in the region. But the poor economies like Syria and Yemen will suffer the most in terms of adopting and providing life supporting systems to their citizens. Local food crops are vulnerable to reduced rainfall. The drier it gets, the more sandstorms will force people indoors. These changes are in addition to the global effects of climate change: more severe weather, more war, and rising sea levels.[6] MENA region is facing growing challenges in forms of rural-urban migration and outward migration. Domestic intra city migration has already been reflecting the prospects of urbanization. Outward migration is implying the dangers of climate change and civil war.

The continuous heat wave catastrophe over the years in Middle East has raised possible concern regarding the human survivability in the region after certain years. The researchers and climate scientists have predicted that up to 500 million people from the region could possibly migrate to global north to escape from future heat wave in the region[7](Atherton, 2016). Lelieveld *et al.* (2015) have used one climatic model to predict the average number of hot to very hot days in the region per year. Their estimates have forecast that present hot day in MENA region hovers around 43 c degree, which may increase to 46 degree by 2050 and 50 degree by the end of the century. Further their study found an average increase in the number of hot days – 16 vey hot days per year from 1986 to 2014. If present global warming and energy consumption rate continue, then the number of very hot days may touch 118 y the end of the century.



(**Source:** A snapshot of the conditions that affected the Persian Gulf region at 11 a.m. local time on July 31, 2015, when a heat wave sent the heat index soaring. Credit: earth.nullschool.net, cited and taken from Andrea Thompson, Climate Central, Scientific American, Oct 26, 2015. Red marks represent the extremely hot areas during the day)

[5] Please refer to http://harvardmagazine.com/2014/05/climate-change-s-economic-heat.

[6] Please refer to https://journalworker.wordpress.com/2016/05/03/extreme-heat-could-make-north-africa-and-the-middle-east-uninhabitable-within-a-few-decades/.

[7] Please refer to http://www.ibtimes.co.uk/climate-change-middle-east-north-africa-become-uninhabitable-forcing-mass-migration-1558023.

Heat waves in Middle East tend to reflect the sordid picture of arid landscape with little or no rain areas over the years. However, oil production, pollution, rapid energy consumption and urbanization have aggravated this problem to a greater extent.

1.1. Costs of Rising Heat Waves

Increasing heat waves could potentially threaten the economy in terms of declining workers' productivity, rising heat stress, complaining of headaches, muscle cramps and other heat related illnesses. Now heat wave condition is the most dangerous component of climate change patterns. Cities in the developing economies like Delhi, Kolkata, Manila, Dubai, Doha, Lahore and other metropolises are facing the rising heat wave conditions by making the entire day unworkable. The 2015 summer wave was so intense in Eastern India that the taxi services from 11 A.M to 4 P.M were suspended throughout Kolkata. Urbanization, congestion, automobile usage, oil production and heavy usage of air conditioning across Middle East have made the conditions worsen over the years. If the existing rate continues across all sphere of economic activities in Middle East, then the region will face the average rise in 3 degree by 2050 against the global average of 2 degree. Productivity losses already occur to different degrees across the world, but this is likely to be exacerbated by climate change. Using wet bulb globe temperature, humidity solar radiation level, Costa et al, 2016 have recently forecast the pattern of heat wave stress for the city like London, Antwerp and Bilbao. Their analysis has predicted that future cost to London heat wave could be between 1.9 billion to 2.3 billion Euros. In 2013, Australian economy has already been suffering more than $6 billion through absenteeism and loss of productivity.[8]Zander *et al.* (2015) have estimated the average and potential productivity loss out of future hot days across the globe and have found that rising heat wave could result in 11-27% loss in working productivity across Asia and Caribbean regions, while globally; it may go to 20% loss of productivity by 2050.

Here, our paper is structured as follows. In Section-1, we have discussed the problems, motivation of the study and possible cost involved in terms of heat waves of the region. In the subsequent section, we have developed a theoretical hypothesis, which can potentially explain the core of this paper. In section III, we have discussed review of literature related to this climate change context. In section IV, we have explained our empirical framework of this paper. Conclusion and policy suggestions are discussed in the section V.

2. HYPOTHESIS

Countries with increasing trading activities might face more climate change prospects in future. Industrialization, urbanization induced development lead to more trading activities, thus contributing more to GHG emission. In long run, the climate change will hamper the trading activities thus reducing the labor productivity.

The aspect of inter-relation between climate change and trade is hardly being explored in economic literature. Trade theory suggests that a marginal change in trade impacts emission levels trough scale effect, composition and technique effects.[9] Scale effect implies the higher level of economic activities as responsible behind production of goods in the economy. Composition effect refers to the type of goods produced in an economy. Looking at Middle East, the economies potentially produce more oil and natural gas causing more water and air pollution. Technique effect shows, whether the mode of production follows the clean energy production technique or not. Middle East being the oil rich economies, has invested very small share in clean energy till date. Looking at Middle East economies, it is increasingly perceived that the region promotes trade of goods from industries running on fossil fuel and coal. Even in electricity production, coal has been used as the dominant share of fossil fuel.

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[8] Please refer to http://www.abc.net.au/science/articles/2015/05/05/4229174.htm.

[9] Please see http://voxeu.org/article/what-does-trade-have-do-climate-change.

3. LITERATURE REVIEW

The potential impact of urbanization, industrialization on heat wave and annual temperature studies have been studied to very less extent. Post 1990s have drawn greater attention, when many non-tropical and sub-tropical economies have experienced random changes in the day time temperature patterns and the consequent effects arising out of it. Potential 1995 Chicago heat wave has ripped apart Chicago and Illinois economies. Karl and Knight (1997) have studied the potential reasons behind the Chicago heat wave, out of which they have placed urbanization as the potential agents in causing such climate change. The existing literatures with respect to climate change till dates are moreover scientific and exploratory in nature, whereas the economic effects have been hardly studied elsewhere. Zhang *et al.* (2009) in one of the seminal studies have correlated the upstream urbanization effect with that of urban heat islands for certain cities like Baltimore and Washington D.C. their studies have related industrialization, concentration of pollutants and declining forest cover to that of escalating heat effect in urban space. Poumadere *et al.* (2005) has studied 2003 heat wave condition of France resulting in terms of 20,000 deaths and found that post industrial societies, industrialization, anthropogenic emission, climate change and increase in population have been made vulnerable to such heat wave like condition. Enough evidences of heat wave from Greece, 2007, Europe, 2003, India, 2010, 2011 & 2015, Russia, 2005 have proved that today's heat wave condition is necessarily human induced. MENA regions have been undergoing some of the worst heat waves in their history, prompting region to be sooner becoming inhabitable by the end of the century.

The paper here further takes evidence from the series of scientific and economic studies with respect to climate change induced temperature rise. Our developmental pattern, industrialization, urbanization have been embedded with the average increase in temperature across the continents over the years. No economy is immune from such problem. Temperature shocks in forms of heat wave and other heat related aspects have both economic and social costs. Dell *et al.* (2012) have found three key results out of such heat wave shock across the globe in terms of reduction in economic growth, level of output and plummeting agriculture output leading to food security and price rise of agriculture goods. Campbell-Lendrum and Corvalan (2007) have found the reasons behind the climate induced vulnerabilities including temperature shock in forms of rampant urbanization, high population density, and high levels of outdoor and indoor air pollution later resulting to an escalating public health cost. Chrysanthou *et al.* (2014) have discovered such a trend with respect to Europe, where the urbanization has been directly responsible for increasing annual average temperature from 1960 to 2006. Their results show that urbanization explains 0.0026°C/decade of the annual-averaged pan-European temperature trend of 0.179°C/decade. This trend has a strong seasonality, being the largest in summer.

Though a lot of evidences have shown relation with respect to effect of heat wave with that of economic growth, the effect of heat wave with respect to other economic parameters have been studied hardly in economic literature. Hübler *et al.* (2008) have forecast the climate induced heat days for the period of 2071 to 2100 using a high resolution climate scenario. Based on the current heat wave, their result has predicted that by 2070, heat related stress could induce six fold increases in the public health costs and could rag the economy by 0.1%-0.5% GDP owing to the loss of productivity. The heat frequency and intensity rise overall but more in the south compared to the north part of Germany. Certain literatures have pointed out the negative impact of heat wave on the agricultural productivity of the affected region. However, Gornall *et al.* (2010) has disagreed with this by stating that it is still cumbersome to quantify the amount of loss arising from heat wave condition. Zander *et al.* (2015) have analyzed the occupational health hazard problem with respect to Australia during summer days their analysis has found that annual burden from heat wave is $6.2 billion across the Australian provinces due to the increasing absenteeism and loss of productivity, which amounts to 0.33%-0.47% of GDP.

3.1. Challenges for Middle East

Countries across Middle East have been quite dismissive of ideas of climate change over the years. It has well been visible from Dec Paris 2015 talk on Climate Change, where some Key economies of the region like Saudi Arab, Qatar, Jordan and UAE have responded very slowly in terms of signing agreement to control carbon emission rate. These economies are over the years suffering from the concentration of heavy pollutants in atmosphere, low rainfall, dust storm and scorching heat. Researchers from Max Planck have predicted that the climate change in region will make the life simply worse. In future, the climate in large parts of the Middle East and North Africa could change in such a manner that the very existence of its inhabitants is in jeopardy. Above 40 degree centigrade has now turned into a normal phenomenon in Middle East. If the current carbon emission rate takes place, it would drastically increase the number of hot days to 200. Regions where outside activity is likely to be most hazardous in future include the coastal plains along both sides of the Gulf, and the cities of Abu Dhabi, Dubai, Doha and Bandar Abbas plus the Yemen coast of the Red Sea (*Source- Kieran Cooke, 12 May, 2016, The Middle Eastern Eye*).[10] Levels of humidity and dust storms have set to rise in future in the region. Rise in number of hot days is now treated to be one of the most extreme weather events after tropical storms and sea level rise. The region has already experienced severe depopulation trend due to the rising strife in civil war. By the mid of the century, the region will face the climate change refugee crisis in terms of immigration of the population to the west.

4. DATA AND EMPIRICAL FRAMEWORK

Here, we have developed two separate cases by employing both urbanization and average temperature as the explained variables under which we have examined the impact of heat wave effect in the region as a whole. For this, we have taken data over the period 1990 to 2012 for 23 years. In order to avoid the problem of spurious regression, we have transformed all the data into the logarithmic format. Urbanization data are taken from the world development indicator database, which signify the annual addition in urban population across the economies. Trade openness data are being compiled by adding both export and import data and getting divided by GDP growth rate. Primary energy consumption and energy production in terms of oil are taken from the Energy Information database of USA government. Most important variables temperature and rainfall data are being compiled by the authors. Actually, these data are there in the monthly format. So we have averaged the data for each year for each economy in the region with similar logic applied for the rainfall data as well. Data with respect to rainfall and temperature are collected from world climate change knowledge database of World Bank.

The estimation model in this part does not control for any country specific effects and omits the lagged dependent variable of average temperature across the country I at time t. here, we have employed panel simple OLS to know the effect of average temperature upon concerned economics

$$ATit = \alpha\, ARit + \beta\, GDPit + \gamma\, URPit + \rho\, PECit + \vartheta\, EOit + \sigma\, EXit + \delta\, TRit + €it \qquad (1)$$

The above equation takes average temperature as the explained variable. The concerned coefficients represent the values for their respective variables. Coefficient of average rainfall is negatively and statistically significant to the average temperature of the region.

[10] Please refer to http://www.middleeasteye.net/columns/soaring-temperatures-make-much-middle-east-north-africa-unlivable-755427127.

Table-1. Empirical Estimation Table with average temperature being the dependent variable

Average Temperature	I	II	III
AT(-1)		0.960*** (0.014)	
AR	-0.252*** (0.012)	-0.009**(0.004)	-0.255*** (0.012)
GDP	0.005 (0.010)	-0.002 (0.002)	0.004 (0.010)
URP	0.005*** (0.002)	-0.000 (0.000)	0.006*** (0.002)
PEC	0.056 (0.036)	-0.002 (0.008)	
EO	-0.052 (0.034)	0.002 (0.008)	
TR	0.000 (0.005)	-0.000 (0.001)	0.000 (0.005)
EO	-0.004 (0.003)	-0.000 (0.000)	-0.004 (0.003)
PEO (Inter)			-0.001 (0.002)
Constant	1.784*** (0.148)	0.055 (0.044)	1.557 (0.023)
R squared	0.618	0.977	0.615
Adjusted R squared	0.609	0.976	0.608
Observations	322	322	322

Source: Author's own compilation. The explained variable is average temperature, which is being shown on the top of the table. Standard errors are reported in parentheses. Models 1, ii and iii represent panel OLS, OLS with lagged dependent variable and panel OLS with interaction variable. ***, ** and * represent the 1%, 5% and 10% levels of significance respectively. Here the interaction variable is PEO, which is the multiplication of PEC and EO. All variables are logarithmically transformed. Trade openness is obtained by dividng the summed up value of exports and imports with that of GDP.

It implies that the rainfall annually is reducing with the onset of more hot conditions. Every 1% rise in hot condition leads to 0.25% fall in average annual rainfall. Looking at the coefficient of GDP, we have found insignificant and positive association with the average temperature of the region. Urbanization coefficient is positively correlated with that of average temperature. But here, we have found positive relation to urbanization; still the empirical analysis has found hardly any positive increase in average temperature owing to the urbanization exclusively. It means to us that several other factors besides urbanization play major roles in influencing region's temperature rise. The regression results further indicate significant associations of energy consumption and oil production with that of temperature increase. Even our coefficients for trade openness and exchange rate never exhibit any formal significant association with temperature increase in the region.

In order to study the impact of urbanization w.r.t different economic parameters as taken by us, we have developed an empirical framework

$$URPit = \alpha_0 + \alpha_1 AT\,it + \alpha_2 ARit + \alpha_3 GDP\,it + \alpha_4 PEC\,it + \alpha_5 EO\,it + \alpha_6 EX\,it + \alpha_7\ TR\,it + \gamma\,t + €\,it \quad (2)$$

Here URP represents the urban population growth annually in the region. All α coefficients are associated with their respective parameters. Here the I represent 14 economies of Middle Eastern economies with t from 1990 to 2013. Here γ_t represents the year fixed effects to control for any time specific effects that shift the level of URP for all the economies. In our context, the substantial volatility in urbanization process and related unsystematization have led to certain impeding disasters in terms of affecting the annual temperature, average rainfall in the region. Looking at our empirical result, we have found that every 1% increase in temperature indicates the 2.8% rise in urbanization. Urbanization along with the arid conditions has led to a steep rise in the average annual increase in temperature. There exists an inverse and significant relation between average annual rainfall and urbanization rate in the region. Industry induced urbanization; declining forest cover areas, pollution and aridity have contributed heavily towards the declining average annual rainfall in the region. The region's oil wealth has also induced urbanization and industrialization to certain extent. For every 1% rise in oil production, there exists 0.07% rise in urbanization. Urbanization and investment cycle in Saudi Arabia, U.A.E, Qatar and Bahrain are associated with the oil wealth.

Table-2. Empirical Estimation Table with urbanization being the dependent variable

URP	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
URP(-1)			1.001* (686.25)		
AT	2.345** (2.01)	3.638* (2.63)	0.075* (2.11)	0.459 (1.88)	0.706*** (1.68)
AR		1.138* (2.42)	0.016 (1.35)	-0.050 (-1.11)	-0.124* (-2.35)
GDP		2.597* (12.12)	0.004 (0.71)	0.030* (2.48)	0.036* (2.68)
PEC		-0.502 (-0.56)	0.024 (1.10)	0.387* (6.12)	0.111 (1.26)
EO		2.178* (2.54)	-0.025 (-1.15)	0.074*** (1.67)	0.020 (0.43)
EX		-0.024 (-0.31)	-0.0006 (-0.32)	0.002 (0.25)	-0.012 (-1.45)
TR		-0.050 (-0.34)	0.0002 (0.08)	0.037* (4.73)	0.036* (4.54)
Constant	2.530 (1.64)	-7.788** (-1.76)	-0.004 (-0.04)	4.720* (9.12)	4.574* (7.67)
Country Effect	No	No	No	No	No
Time Effect	No	No	No	No	Yes
R squared	0.0125	0.465	0.999	0.168	0.0344
No of Obs.	322	322	308	322	322
Prob Value	0.0450	0.000	0.000	0.000	0.000

Note: T statistics are reported in parentheses. *,** and *** represent 1%, 5% and 10% levels of significance respectively.

We estimate the above model by taking urbanization as the explained variable. In order to make our analysis more robust, we have even taken into account the exchange rate mechanism and trade openness. The above table presents OLS and fixed effect estimation results along with no controls and controls to see the effective change w.r.t urbanization. In our model 1, we have seen a positive and significant association between urbanization and average temperature in the region. In model 2, we have also found positive and significant association between urbanization and temperature rise. However, GDP has seen a positive trend with rise in urbanization despite the element of unbalanced and unsystematization involved. In case of Model III, we have found positive association with that of lagged value of urbanization and average temperature. In subsequent model of fixed effect estimation without any country specific and time specific variation, we have found positive correlation between urbanization to those of GDP, primary energy consumption and energy production in terms of oil. Due to the rising energy consumption and oil production, the region's trading has also been performing well in many parameters. In Model V, we report the fixed effect estimation with the introduction of year specific effect. Considering such a condition, we have obtained positive relation between urbanization and average temperature rise. However, urbanization has led to the declining rainfall over the years in the region due to the loss of green cover and heavy industrialization. The time specific effect has also captured the positive relation between urbanization to those of GDP and trade openness in the region as a whole.

Table-3. Empirical Estimation with average temperature being the explained variable

Average Temperature	Model I	Model II	Model III	Model IV
Average Rain	-0.261* (-21.91)		-0.009 (1.26)	0.007 (0.319)
GDP			-0.004** (-1.99)	0.000 (0.373)
URP		0.005** (2.01)	0.012 (1.32)	0.014*** (1.93)
PEC			0.048* (4.54)	0.013 (1.04)
EO			-0.009 (1.31)	-0.006 (-0.95)
EX			0.003* (2.57)	0.002** (1.96)
TR			-0.000 (0.05)	-0.000 (-0.44)
Constant	1.598* (118.35)	1.287* (79.27)	1.301* (21.33)	1.245* (22.12)
Time Effect	No	No	No	Yes
Country Effect	No	No	Yes	No
R Squared	0.600	0.012	0.020	0.003
No of Obs	322	322	322	322
Prob Value	0.000	0.045	0.000	0.000

Notes: Author's own compilations. All variables are transformed into natural logarithmic. The above table represents the panel fixed effect models. T statistics are represented in parentheses. Models I, II, III, IV and V represent the panel OLS models with average rain, urbanization, panel fixed effect model, panel fixed effect models with time effects and country effects respectively. *, ** and *** represent 1%, 5% and 10% levels of significance respectively. Average temperature is the explained variable, placed on the top side of the table.

Here in the above table, we have drawn results based on four empirical models. In first model, we have found inverse and significant association between average temperature and rainfall in the region. In 2nd model, we have obtained a positive association between average temperature and urbanization in the entire region. Model III employs the country specific fixed effect criteria, under which, we have obtained inverse relation between GDP and average temperature in the region. Primary energy consumption has also led to the sharp rise in the temperature increase in the region. Industrialization in the region has put an upward pressure in terms of increasing fuel consumption. While controlling for time specific effect, we have obtained positive and significant association between urbanization and increasing average temperature. More surprisingly, we have obtained positive and significant association between exchange rate appreciation and rise in temperature in the region as a whole. Though very few literatures have focused on this issue in particular, still we predict that exchange rate appreciation in the region as a whole promotes more import. It solely implies the rising economic and trading activities in such a cash rich region indirectly implying more industrialization process. Such a scenario could fuel the global warming tension in the region in long run.

Table-4. Panel WesterlundCointegration test

	Lags(0)	G_t	G_a	P_T	P_a
Full Panel	*Without trend*	-3.554 (0.000)	-5.666 (0.901)	-8.682 (0.002)	-4.068 (0.547)
	With trend	-5.100 (0.000)	-9.426 (0.794)	-14.128 (0.000)	-6.602 (0.646)
	Lags(1)	G_t	G_a	P_T	P_a
Full Panel	*Without trend*	-2.667 (0.000)	-3.844 (0.991)	-6.834 (0.073)	-3.938 (0.578)
	With trend	-3.992 (0.000)	-6.210 (0.994)	-10.109 (0.003)	-4.726 (0.941)
	Lags(0)	G_t	G_a	P_T	P_a
Full Panel	*Without trend*	-2.579 (0.001)	-5.701 (0.897)	-10.167 (0.000)	-7.411 (0.031)
	With trend	-3.896 (0.000)	-9.681 (0.753)	-13.055 (0.000)	-11.323 (0.014)
	Lags(1)	G_t	G_a	P_T	P_a
Full Panel	*Without trend*	-1.659 (0.573)	-2.589 (0.999)	-5.398 (0.360)	-2.525 (0.849)
	With trend	-2.634 (0.056)	-6.531 (0.991)	-6.281 (0.804)	-4.222 (0.968)

Note: Probability values are reported in parentheses.

Here, we apply the panel 2nd generation Westerlund test to test the cross-sectional dependency by applying across various model specifications. The null hypothesis here implies that there exists no cross-sectional dependency in the panel. By asserting from the results of panel and group statistics, we can conclude, whether a cross-sectional dependency among variables exists or not. In this model, we have checked the dependency among the variables like urbanization, average temperature, primary energy consumption and energy consumption in oil requirement. We have analyzed the cases using both at lags 0 and 1 through the methods without and with trends. At lag 0 without trend, we have got significant cross-sectional dependency across the panel suggesting that the null hypothesis can be rejected. Out of four statistics, three statistics reject the null hypothesis of no cross-section dependency. Similarly at lag 0 with trend cases, we are obtaining sufficient cross-section dependency aspect across panel framework. However, the opposite case occurs at lag 1 at both trend and without trend cases implying that no cross-section aspects are present there. In the next model of Westerlund test, we have incorporated four variables like GDP, average temperature, primary energy consumption and energy in terms of oil requirement with GDP being an explained variable. The empirical evidences at lags 0 in both cases of with and without trends imply that cross-sectional dependency is present in the model specification. This solely implies that rising GDP in any one of the economies may have profound impact in terms of increasing average temperature condition. Primary energy consumption across region coupled with oil production may have increased the region's GDP along with the heat wavelike condition. However, at lags 1 case, no such cross-sectional aspect is found from the empirical results.

Table-5. Panel FMOLS and DOLS Analysis

AT		**FMOLS**	**DOLS**	**FMOLS**	**DOLS**	**FMOLS**	**DOLS**	**FMOLS**	**DOLS**
		Without time dummy		**With time dummy**		**Without time dummy**		**With time dummy**	
Full Panel	AR	-0.281* (-10.35)	-0.23* (-5.18)	-0.002 (-0.23)	-0.06** (-1.84)	-0.350 (-1.030)	-0.274* (-5.97)	0.001 (0.130)	-0.05*** (-1.677)
	URP	-0.025 (-1.324)	-0.019 (-0.61)	0.008 (0.534)	-0.006 (-0.13)	0.205* (8.758)	0.257 (35.22)	0.008 (0.464)	0.026 (0.596)
	GDP	-0.017 (-0.784)	-0.009 (0.585)	-0.007* (-2.96)	0.002 (0.343)				
	PEC	-0.414* (-20.12)	-0.39* (-13.9)	0.067* (4.265)	0.123 (1.321)	-0.249* (-2.542)	-0.189* (-7.85)	0.047* (3.167)	-0.001 (-0.050)
	EO	0.416* (14.41)	0.406* (8.824)	-0.012 (-1.37)	-0.051 (-0.61)				
	EX					-0.001 (-0.055)	-0.015 (-3.43)	0.003** (1.787)	0.001 (0.495)

Notes: Author's own compilation. All variables are logarithmically transformed. *, ** and *** represent the 1%, 5% and 10% levels of significances respectively. T statistics are reported in parentheses. AT is the annual average temperature, which represents the explained variable of the model. Here in above table, we have taken two model specifications. In model I, we have taken average rainfall, urbanization, GDP, primary energy consumption and energy in terms of oil requirement. In model II, we have taken variables like average annual, urbanization, primary energy consumption and exchange rate. Average temperature is acted as the explained variable for both these models. In full panel analysis, we have taken 14 economies of Middle East region.

Since the variables are cointegrated, the Full modified OLS and dynamics OLS will be utilized. The above table reports the FMOLS and DOLS estimated results of the panel cointegrated model. In a full panel of 14 economies, we have reported the FMOLS and DOLS results for two models. The first model takes into account average temperature, average rainfall, urbanization, GDP, primary energy consumption and Energy in oil requirement with the average temperature being explained variable. The 2nd model also reports average temperature, average rainfall, urbanization, primary energy consumption and exchange rate. We have taken two different models to see how average temperature has impacted the entire region. The first model shows the negative and significant association between average temperature and rainfall in the region. But we never find any significant relation between urbanization and average temperature in the region. In case of time dummy, we have found that there exists positive and significant relation between primary energy consumption and average temperature. In case of 2nd model, it can be seen that there exists an inverse and significant relation between average rainfall and temperature. Furthermore, the results from 2nd model reveal that the long run positive relation between exchange rate and temperature is more significant in case of entire panel. Exchange rate appreciation is more positively associated with the average temperature increase in the region as a whole. Temperature rise i.e. heat dome effect has resulted in terms of profound decline in labor productivity, which has impacted there region's export in the long run. The results from 2nd model reveal that there exists negative relation between primary energy consumption and average temperature.

5. CONCLUSION AND POLICY SUGGESTION

Recent scientific evidences have proved that present day urbanization in developing economies is highly unsustainable. Such unsustainability in growth path may lead to many natural extreme weather conditions in future. Middle East economy has already been starting experiencing the impact of heat wave effect. Many policy analyses in developing region seem to have swayed by the lack of policy measures towards the anticipatory climate change impacts. Such monotonic lack of effectiveness could potentially trigger negative impacts in the long run by taking away the positive growth achieved in the previous years. In this paper, we have explored certain possible results over the period 1990 to 2012, which directly shows that the climatic vulnerability in the region is well visible. In a geographically proximity region, even the regional development in one economy could put negative impacts on the neighborhood economy, which has been shown in our 2nd generation Westerlund test. Over the various empirical models, one interesting finding has confirmed that excessive dryness in the region has to a greater extent has declined the rainfall in the region by making the condition quite unlivable after certain years. We even find evidence from our empirical discussion that GDP change, urbanization rate, swelling energy demand and exchange rate appreciation have directly implied the positive correlation with that of average temperature increase.

The main policy implication of this paper is that the region being the oil rich economy should start investing more in clean energy sector. Wind energy and solar energy sectors are remained untapped over the years in the region, which may fuel more growth in future. Rather tan abandoning the traditional fuel consumption, the region must slowly shift towards the biofuel production pattern, and effective alternative for fuel and natural gas. Further, effective climatic agreement and co-ordination must be initiated across these 14 economies of Middle East to control and regulate the excessive oil exploration and industrialization process. For the poor economies in the region, the rich economies should step forward in terms of making effective start up in clean energy investment, in this paper; we find ample evidence of linear and non-linear relation among various economic growth parameters and temperature change. Still the future research in this approach could potentially develop various strategies to address such problem occurring in the developing regions across the globe.

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