The sensitivity of economic growth in developing countries in the tropical climatic zone to climate changes

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Introduction

Climate change has played an increasingly important role in recent years and is now one of the leading political priorities worldwide. Climate change is a result of the phenomena of global warming, which is projected to increase the frequency and severity of extreme weather events. The economic losses caused by natural disasters could also increase significantly with the frequency of occurrence.

The developing nations will be most affected by climate change. Yet, they need more economic growth and more energy today, and nothing should stand in the way of that progress. Ironically, the economies of these countries are exposed to climate-change sensitive sectors such as agriculture, fisheries and are important tourist destinations. Tourism in many developing and least developed countries is the most viable and sustainable economic development option, and in some countries, the main source of foreign exchange earnings (WTO, 2011). Further, agriculture continues to be the main source of employment, livelihood and income for between 50percent – 90percent of the population (Kwa, 2001). Therefore, climate change could immensely affect the economies of these countries in the long-run.

Thus, the main objective of the study is to determine the impact of climate change on economic performance of developing countries and thereby examine the need for those economies to develop policies to withstand shocks arising from climate change. The following research problem is the basis for the study. *"Should Developing countries take Climate change into account when designing their economic policies for development?"*

Sri Lanka is a developing country whose economy consists of sectors significantly exposed and sensitive to climate changes and its effects. A global study of the sensitivity of economic growth of developing countries to climate change and their ability to withstand such shocks to the economy would provide sound foundation for policy makers in Sri Lanka.

Methodology

The present study adopts a combination of both casual and descriptive research designs which analyze the nature of economic behavior to changes in climate

condition. The empirical analysis of the study adopts a Basic Cross-country Regression method based on the seminal work done by Barro (1991), for cross section of 83 developing countries located in the tropical climatic belt; classified according to the UN country classification report and IUCN list of tropical countries. Further, the study employs secondary data collected from reliable data sources and details of the variables is described in appendix. (See appendix 1). The baseline model used in this paper is specified as:

$$Y_i = \gamma_0 + Z_i \gamma_k + \beta C_i + \varepsilon_i$$

Where; Y_i is the level of GDP per capita growth; Z_i is a vector of control variables that are perceived to be potential drivers of economic growth which consist of gross capital formation as a percentage of GDP, population growth, total population, trade openness, initial per capita GDP and initial level of school enrolment (primary and secondary); and C_i is the vector of climatic variables consisting of temperature and precipitation, and ε_i is the disturbance term.

Further, to draw inferences and derive implications for policy recommendations from the study; a number of diagnostic tests are conducted and measurement errors are discussed to ensure the reliability of the results generated from the econometric analysis.

Results and discussion

The main objective of the study was to identify the sensitivity or the degree of influence of climate change on the economic growth of developing countries. The desired objective was successfully captured through the regression model. (See Appendix 3)

Economic growth of developing countries in this region was significantly affected from the level of initial per capita GDP of the year 1990, level of investment, population growth, degree of trade liberalization and market size of the countries. Level of initial per capita GDP and population growth in the region had a negative impact on per capita GDP growth during the period 1990-2014. In contrast, the total population; proxied for the market size has a positive impact on growth suggesting that the economic growth in the region is driven by demand.

The theoretical underpinnings of the Solow growth model were further established from the study through a highly significant positive impact of level of investment; proxied by the gross capital formation as a percentage of GDP, on per capita GDP growth in developing nations. Further, an insignificant level of unconditional convergence was identified in the region. This implied that poor countries tend to grow faster than rich countries.

The statistics indicate that the mean GDP per capita for the countries over the period 1990-2014; was US$ 3755.636, which reflected the middle-income levels

of many countries within the region. Further, the mean per capita GDP growth of 2.07percent is a significant indicator of the low level of development in this region. (See Appendix 2)

On the climate side, temperature averaged 24.71 °C within the period across the sample. The precipitation values recorded corroborate the tropical nature of the sample units as the mean precipitation recorded was 1368.62 millimeters over time and space. The temperature levels in the region have increased significantly, and this rise in temperature over the years is observed in the concept of climate change and global warming. In contrast, precipitation seems to fluctuate around a very insignificantly increasing trend over the period 1990-2014.

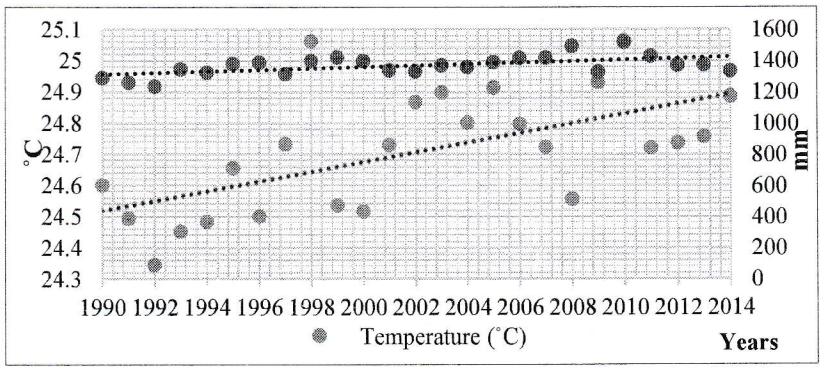

Figure 1 Temperature and Precipitation (1990-2014)
Source: Based on data extracted from CRU database (2017)

The economic activities in the African region are highly vulnerable to climate change, in other words; increase in temperature levels. Compared to Africa, the exposure of countries in the Latin American and Asian region to agricultural activity is low. However, although the value addition is low, this sector cannot be ignored. This sector provides employment to more than 30 percent of those employed in economic activities.

In some developing countries, notably small island states, tourism account for over 25 percent of GDP, while on the other hand, tourism is the first or second source of export earnings in 20 of the world's 48 least developed countries. The tourism sector of countries in the area under study is highly sensitive to climate change. During the time period 1990-2014, a clear increase in tourist departure was identified. This illustrated the negative impact climate change; the rise in temperatures can have on tourism.

All in all, the study concluded the need for developing countries located in the tropical climatic belt to incorporate the concept of climate change into policy planning. The study concludes that climate variation in the region has direct and

indirect impacts on economic growth as supported through previous studies and the empirical study. While previous studies done on the effects of the climate change were focused on direct channels through which it is transmitted to the economy, scholars are now encouraged to study the impact of climate change on the entire economic stability of nations as the concept of global warming has already taken ground in the twenty-first (21st) century and there is no turning back.

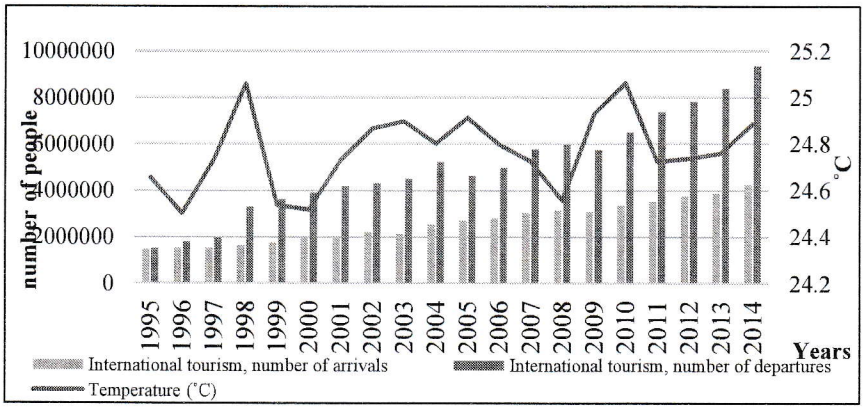

Figure 2 Temperature and Tourism 1995-2014.
Source: Based on data extracted from World Development Indicators and CRU database (2017)

Conclusion and recommendations

In reality climate change cannot be eliminated from any society, economy, country, or region. Instead measures should be taken to minimize the acceleration of climate change. Further, steps to build resilience in economies to withstand shocks arising due to climate change can better safeguard the economy of developing nations. Developing tropical countries are already in the process of putting their economy together. Therefore, these countries could only be rescued from worsening conditions if the recovery process due to climate change can be shortened.

Prioritization of action is the key to development. The study established climate variation to be a potential factor in determining the economic growth in developing tropical countries. All in all, the first step to be implemented through the findings of the study is to incorporate the significance of climate in policy planning for economic development.

Keywords: *Climate Change, developing countries, economic growth, tropical climatic belt.*

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Appendix 1

Definitions of Variables

GPER9014 : Log Average GDP per capita growth (annual %)
LNPER90 : Log Initial GDP per capita of 1990(current US$)
PRIM90 : Initial School enrollment, primary of 1990(% gross)
I_Y9014: Gross capital formation (% of GDP)
GPOP9014 : Population growth (annual %)
TRD9014 : Trade Openness (%) = (Imports + Exports)/GDP*100
LNTEMP9014 : Log Mean Temperature, degrees Celsius 1990-2014
LNPREC9014 : Precipitation, mm/year
LNPOP9014 : Population, total geometric average 1990-2014

Appendix 2

Table 1 Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
TEMP9014	83	24.71084	3.430376	7.72	28.904
PREC9014	83	1368.622	862.2042	25.624	3118.74
TRD9014	82	83.04793	56.37132	22.40931	360.6203
GPOP9014	83	2.145727	0.9569063	0.2022053	6.676078
GPER9014	83	2.076565	2.631198	-2.047577	18.32747
I_Y9014	82	22.55337	10.0166	5.651219	89.61407
PRIM90	82	96.65096	20.29553	29.2021	141.0814
PER90	79	2073.1	4037.226	98.03187	27989.3
SEC90	55	36.65707	24.84015	5.21859	89.10972
POP9014	83	50800000	182000000	144485	1270000000

Appendix 3

Table 2 Impact of climate change on economic growth

Dependent Variable	Model I	Model II	Model III	Model IV	Model V
LNPER90	-0.489**	-0.417**	-0.342**	-0.356**	-0.410**
	(0.162)	(0.164)	(0.160)	(0.161)	(0.157)
PRIM90	-0.005	-0.007	-0.009	-0.006	-0.007
	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)
I_Y9014	0.191**	0.195**	0.194**	0.199**	0.190**
	(0.020)	(0.019)	(0.018)	(0.018)	(0.018)
GPOP9014	-0.603**	-0.451**	-0.471**	-0.531**	-0.619**
	(0.183)	(0.199)	(0.191)	(0.190)	(0.175)
TRD9014	0.004	0.002	0.006	0.005	0.007*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LNTEMP9014	-1.629*	-1.832**	-1.382		-1.180
	(0.888)	(0.883)	(0.868)		(0.868)
LNPREC9014		0.295*	0.284*	0.250	
		(0.168)	(0.161)	(0.161)	
LNPOP9014			0.280**	0.313**	0.285**
			(0.104)	(0.103)	(0.106)
_cons	7.747**	5.740*	-0.629	-5.439**	1.203
	(3.213)	(3.368)	(4.009)	(2.685)	(3.929)
R Squared	0.69	0.71	0.73	0.72	0.72
F-Statistic	30.72**	27.53**	27.11**	29.95**	29.65**
Observations	78	78	78	78	78

*Note: Std. Errors are in parentheses. * and ** denote significance at 10% and 5% level, respectively.*