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Climate Adaptation: Building resilience through structural transformation

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Abstract

Combining longitudinal conventional macroeconomic data with various climate-related variables, we examine macro-dynamics of income, employment, and distribution within the climate change framework by using the Global Policy Model of the United Nations. By focusing on a group of thirty countries, this paper uses a transition analysis method between 1978 and 2018 to understand the trajectory of different countries based on their geographical location, level of economic development, demographic and climate characteristics. Results suggest that adaptation strategies should avoid re-enforcing pre-existing unequal social and economic hierarchies, especially in the context of race and gender. Unless marginalized populations are made partners and locally relevant in the adaptation strategies, there is a risk of adverse outcomes. A positive intervention by the governments as proposed in the SDGs would help in addressing the racial and gender inequalities that have been historical institutionalized. Ensuring domestic social safety nets, guaranteeing employment and building green infrastructure would help them transform structurally to sustainable paths. Unfortunately, development expenditures are the first items that get reduced in fiscal restructuring. New investments must be planned in a manner that ensures a non-declining intertemporal trajectory of comprehensive wealth. International cooperation is critical not only for economic development but also for ecosystem and biodiversity conservation.

Key words: Spatial development challenges, Green structural transformation, climate change, adaptation

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1. Climate Change and Adaptation: The challenges

Climate change will add in a significant way to the existing developmental challenges that most lower-middle-income and poor countries have faced (IPCC, 2014a). Macroeconomic simulations suggest that damages caused by climate change would have a downward impact on aggregate demand (through reduced profitability, investment) and employment (Rezai et al., 2018). If anthropogenic pressures continue to increase, there could be catastrophic impacts on human wellbeing if we cross certain "tipping points" (Westley et al., 2011).

While there is a near-global consensus that there is a need for climate change action, there have been protracted international debates on achieving cooperation. While climate economics was devoted mainly to mitigation in the earlier years (Nordhaus, 1977), it has since engaged with other issues, including adaptation (Vale, 2016). The earth's systems already have to deal with the early effects of climate change. It is quite evident that mitigation efforts may not be adequate in the short run.

1.1 The Paris Agreement and NDCs

The most recent Paris Accord of 2015 was adopted by 196 Parties (https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement). The main objective of the Paris Accord was to achieve a (1) ceiling of 2 degrees centigrade compared to pre-industrial levels and (2) "climate neutral" status by 2050. While setting the global target, this Accord left it to individual nations to decide on their own feasible targets and strategies through Intended Nationally Determined Commitments based on the principle of "common but differentiated responsibilities and respective capabilities." On finalisation of the national commitments, these were submitted to the UNFCCC as the Nationally Determined Commitments (NDCs) to be reviewed every five years starting in 2023. At the time of writing this paper, 190 parties had already submitted their first NDCs, and eight parties had submitted their second NDCs (https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx). Achieving the NDC targets poses multiple challenges and involves lifestyle changes at the household level and production transitions to low carbon methods for industries, among others (Vrontisi et al., 2020).

Since there are no accountability mechanisms in the Paris Accord, one way to trigger NDC commitment compliance by developing countries is for developed countries to signal in their NDCs the extent of funding they will make available for climate finance (Pauw et al., 2019). However, there remains a gap between the projected need and the committed funds (Buchner et al., 2019). Apart from the NDCs, member countries of the UN are also committed to achieving the Sustainable Development Goals (SDGs), many of which deal with reducing vulnerability apart from Goal 13 on climate action (UN, 2015).

1.2 SDGs and NDCs

The fulfillment of NDC commitments and SDG targets by less developed countries (LDCs) and Small Island Developing States (SIDS) is particularly challenging. It may be contingent on receiving international cooperation by way of finance, technology transfer, and capacity building (Pauw et al., 2020). Such cooperation would help developing countries plan their strategies to overcome climate vulnerabilities more effectively. The term vulnerability in this paper is broadly defined as the proneness of a natural or social system to be displaced to an inferior position (including welfare, health, income) by an event or a process (sequence of events). Such displacements may occur due to climate or non-climate-related processes. Climate change may compound existing vulnerabilities and therefore leading to cascading effects, remedied to which would not lie in the domain of climate solutions alone.

Researchers have identified regions (Watson et al., 1998) that will be most adversely affected by climate change – labelled as "hot spots" (Schleussner et al., 2018). Two approaches have been adopted to identify these locations – (a) which region is most vulnerable (Malone and Engle, 2011) and (b) which region will see the most change in climate variables (Giorgi, 2006). While the latter is important from the point of view of spatial climate assessments, the former will be of greater concern to those studying impacts on human well-being due to climate change.

One of the direct consequences of climate change has been the increased frequency of extreme events and increased intensity of extreme weather events (Frame et al., 2020). A recent review comparing disaster events over four decades (UNDRR and CRED, 2020) found that the last two decades have seen a near doubling of disasters and the economic costs of disasters compared to the earlier two decades. The impact on livelihoods due to extreme events is particularly worrisome. Notably, the report points out that floods (44 percent, and associated with it, landslides, 5 percent) and storms (28 percent) are the two most frequently reported climate disasters globally. These are followed by heatwaves (6percent), droughts (5 percent), and wildfires (3 percent). Floods affected the largest number of people (41 percent), followed by droughts (35 percent) and storms accounted for the largest number of deaths due to climate-related events. The top ten countries that reported disasters in the last two decades are (China, the United States, India, the Philippines, Indonesia, Japan, Viet Nam, Mexico, Bangladesh and Afghanistan, in decreasing order). While China's major problem was floods, for India, it was drought. This suggests that climate-related events have varied impacts depending on what we are focusing on -- the type of event, the number of deaths, people affected, among others.

We examine the growth and development challenges of countries ranging from low to high-income countries in the context of climate change. Many of these countries have sections of the population that are already vulnerable due to poverty and lack of social security, uncertain employment, which continue to be development challenges. Their vulnerability would be particularly exacerbated by climate change. The rural economy becomes risk-prone with agricultural unsustainability, and urban areas fail to provide employment and social safety nets to migrant workers. The poor in developing countries face the risk of receding government involvement from the economic and social sphere, thereby accelerating inequality. Such economic and political trajectories would further reduce the possibility of the economy's autonomous structural transformation without endangering the profit-wage shares.

These three factors (climate change, urbanisation, and migration), in addition to technology, have been seen as the most significant factors impacting inequality (UNDESA, 2020). Inequality between countries has reduced over time but has steadily increased within countries and among income deciles. This has social and economic implications which have a direct bearing on sustainability. This could imply increasing vulnerability of groups that are getting economically, socially, and politically marginalised, a process exacerbated by climate change (Olsson, 1993).

1.3 Market failures and fiscal policy

Environmental management failures are typically attributed to the failure of either the market or the government (Hepburn, 2010). However, governments are answerable to their citizens, and most countries have internal mechanisms for course correction when governments deviate significantly from national priorities. Markets on their own are rarely known to have the ability to correct failures in allocation, especially when it deals with equity. Therefore, market failure is a serious problem associated with environmental management and achieving environmental sustainability (Rosenbloom et al., 2020). This creates the need for state intervention, both in environmental management and addressing vulnerability, especially for marginalised groups (Rosewarne, 2010). One of the direct ways to achieve this, especially in developing countries, would be to ensure guaranteed employment, food security and access to affordable public health by the state (Osberghaus et al., 2010). This would help build resilience against loss of livelihood, especially during disasters that are likely to increase in frequency with climate change.

An employment guarantee policy would have multiplier effects on the economy resulting in robust demand-driven growth (Patnaik, 2005). Climate proofing of the economy would require a structural transformation with investments in green sectors. It would need switching to non-fossil fuel production and low-emission industrial strategies on the one hand (Gallagher and Kozul-Wright, 2019) to expanded irrigation networks and guaranteed minimum income for farmers on the other. This may be a pathway for balanced growth and reduced inequality and rural indebtedness. All of this would require a planned development strategy that would use the climate change challenge as an opportunity to meet the economic and social needs of low-income countries. Typically, with growing international trade in goods and services and liberal, volatile international financial flows, the independence of small nation-states to pursue an independent fiscal and monetary policy is fast receding (Izurieta et al., 2018). The pressure of financing climate change adaptation may further reduce this fiscal space for developing countries for other (non-climate) developmental actions.

When developing countries attempt to finance climate change adaptation by borrowing internationally at market rates, their macroeconomy becomes vulnerable. The known macroeconomic threats are exposure to exchange rate shocks and volatile capital flows (Bhaduri, 2009). The borrowing for adaptation would then have to be in addition to financing needs of existing current account deficits. This makes developing economies vulnerable to pressure from international capital to remove capital controls leading to a loss of national autonomy in domestic monetary and fiscal policy (Patnaik, 2011). Under these circumstances, developing country governments would be left with little fiscal independence to pursue their national developmental agenda or pursue adaptation measures optimally. This necessitates the need for international cooperation that would make it possible for developing nations to maneuvre their fiscal balance to meet their national developmental needs and international climate commitments. It has been pointed out that a rising gap on the current account could have an impact on domestic deficits (Rakshit, 2009). This is in contrast to the proposition that the cause of rising current account deficits may be domestic deficits. Therefore, opening up of trade controls, especially financial controls, can impose trade-offs for national governments and limit their freedom to choose national priorities, and allocate development funds to meet both the NDC targets and the SDG goals.

1.4 SIDS and climate change

The need for such policy cooperation is even more important for the Small Island Developing States (SIDS). The UN has treated such nation-states as a separate group that will face the most significant impact of climate change, including sea-level rise, tropical cyclones, and marine heatwaves (Thomas et al., 2020). The ethical dilemma for the rest of the world remains that these island states, home to about 65 million people, have the lowest ecological footprint contributing to climate change. Nevertheless, they will be the frontline of climate change damages with varying abilities to mitigate or adapt to climate change. This group geographically is spread over three regions the (i) the Caribbean; (ii) the Pacific; and (iii) the Atlantic, Indian Ocean, Mediterranean and South China seas (AIMS) and are considered one of the hot-spots for climate change.

1.5 Gender impacts

Climate change is expected to have a heterogeneous impact with respect to gender. Existing gender gaps in wealth (Deere et al., 2013; Frémeaux and Leturcq, 2020), employment (World Bank, 2014), education (Buchmann et al., 2008), family decisions (Mossman, 1994), health services (Shaw et al., 2017), political representation (Childs and Lovenduski, 2013; Kenworthy and Malami, 1999), and gender violence (Garcia-Moreno and Watts, 2011), among others, are expected to be amplified by climate change due to multi-layered social hierarchies. The need for state intervention to remedy such gaps and international cooperation to build resilience will have an added dimension when discussing gender issues.

The rest of the paper is organised as follows. We describe the scope of the study and the data sources in the next section 2. In section 3, we describe the socio-economic and climate vulnerabilities that different regions face. We discuss these vulnerabilities in the context of geographical location and look at linkages between them. In section 4, we discuss the development and growth challenges that currently exist. We conclude in section 5 with a discussion on some of the potential policy interventions that can address the dual challenges of development needs and climate change adaptation which may seem contradictory in certain situations.

2. Scope and Methods

2.1 Data

In this paper, we use a new version of the database from the Global Policy Model (GPM) of the United Nations (Cripps et al., 2010). This new version combines longitudinal data of conventional macroeconomic variables with various climate variables. It thus permits us to examine macro-dynamics of income, employment, and distribution within the climate change framework.

There are three popular ways in which countries are classified (Nielsen, 2011). The World Bank (WB) classifies countries by per capita income (World Bank, 2020). The International Monetary Fund (IMF) classifies countries by per capita income and trade and financial openness (IMF, 2021). The United Nations (UN) classifies based on income, health, and education (UN, 2020). The WB classifies countries into four groups -- high-income countries, upper middle income, lower middle income and low-income countries. The IMF classifies countries into two groups – advanced economies and non-advanced economies (emerging market and developing economies). The UN classifies countries into three groups, developed economies, economies in transition and developing economies. The WB offers a little more heterogeneity than the IMF and UN classification and uses a single variable (income) that is easily understood even outside academic and policy domain. Despite the limitation of income as a single indicator of development (UNDP, 2019), for the limited purpose of this paper, we have used this variable to group countries.

2.2 Scope of the study

This paper focuses on a group of thirty countries (for convenience called the G-30 countries) similar to McKinley (2021). The G-30 is a cluster of countries across all continents representing different development status, income levels, and geographic locations (high income – Australia (AU), Canada (CA), Chile (CL) France (FR), Germany (DE), Italy (IT), Japan (JP), Saudi Arabia (SA), the Republic of Korea (KR), United Kingdom (UK), United States of America (US); upper middle income -- Argentina (AR), Brazil (BR), China (CN), Ireland (IR), Mexico (MX), the Russian Federation (RU), Turkey (TR), South Africa (ZA); lower middle income -- Bangladesh (BD), the Democratic Republic of Congo (CD), Egypt (EG), Indonesia (ID), India (IN), Nigeria (NG), the Philippines (PH), Pakistan (PK), Viet Nam (VN); and low income -- namely Ethiopia (ET) and United Republic of Tanzania (TZ). These countries differ not only in their income but also in their spatial, climatic, demographic, and development status.

2.3 Transition dynamics method

Our study uses a transition analysis method suggested by Quah (1993, 1997), which examines the distribution of countries in multiple phases of their progression. It checks whether a country that started in a particular cohort ends with the same cohort is relatively worse or better off. This analysis uses the Markov process as a distribution dynamic framework to map the transition of economies and is popular in growth convergence studies (Maasoumi et al., 2007). We rely on a graphical representation for the transition analysis through the paper to keep the arguments accessible to a non-technical audience. The two periods that we compare are 1978 and 2018. Although data for many variables are available from 1975, however, we have used 1978 as the

initial year for our analysis to round off a four-decade change analysis given that the most recent actual data available is for 2018. We use the United States per capita income (PCI) of 1978 ($30646 at $2015 PPP) as the benchmark for change as it was the highest PCI during that period (apart from Saudi Arabia). We refer to this as the aspirational PCI for all other countries (except Saudi Arabia). Saudi Arabia, whose PCI was already higher than that of the United States in 1978, is an outlier and an oil exporter. We have therefore not used Saudi Arabia for comparative purposes here. All monetary values are normalised for 2015 prices in $ purchasing power (PPP) terms to allow for comparability (UNDESA, 2010, updated version).

3. Development challenges and Geography

3.1 Spatial Vulnerability

Climate change will have differentiated impacts on different countries -- depending on their geographical location, their per capita income, level of development, demographic characteristics, among other characteristics.

It is well-recognised among economists now that space matters in economic outcomes (Krugman, 1991). Climate science too confirms that geographical location is an essential determinant of the nature and extent of the impact of climate change (Husnain et al., 2018). It would therefore be a natural extension to ask how geographical location impacts economic outcomes in the context of climate change (Arnell et al., 2019).

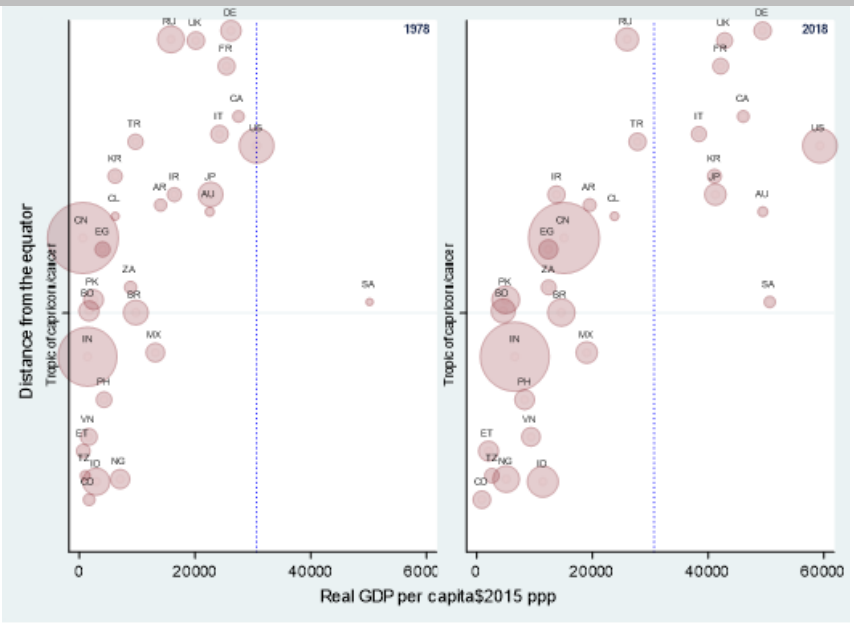
Let us start by placing countries with respect to their distance from the equator with a separation at the Tropic of cancer and Tropic of Capricorn. It has been pointed out that weather patterns and ecosystems differ between the tropic and temperate zones (Welcomme and Berkowitz, 1991). Since countries lie on either side of the equator, for convenience, we have taken the absolute difference in latitude (so all distances are positive). Further, some countries are spread over many latitudes and may have both tropical and temperate weather in different parts. We have taken the capital as the central location and accordingly determined its location.

We start by plotting a scatter of distance (vertical axis) and PCI (horizontal axis) for the start year (1978) and end year (2018) for comparison (Figure 1). There are two reasons why this mapping has important implications in the context of climate change. First, temperatures in the tropics are expected to rise slower than in the polar zones (IPCC, 2014a). However, the adverse impact on human populations will be much greater in tropical regions due to complex climate dynamics and exposure of populations.

This implies that heatwaves and droughts will become more prevalent in the tropics. Consequently, it will have direct adverse impacts on the population residing in the tropics and increase their vulnerability and adaptation costs. For urban populations, climate-induced mortality and morbidity are attributed to heat waves and heat islands (Campbell et al., 2018; Wong et al., 2013).

Over these forty years, there has been considerable growth in PCI for most countries under consideration. By 2018, many countries have achieved and overtaken the aspirational PCI. Interestingly, none of these countries belong to the tropics. They all belong in the temperate zone. However, one must add that not all countries in the temperate zone have achieved the aspirational PCI yet.

Figure 1. Distance from the Equator and PCI



This trend is reflected in the relation between PCI and maximum temperatures. If we compare the 1978 and 2018 scatter plots (Figure 2), we find that countries with lower maximum temperature forged ahead in the last 40 years in comparison to others among G-30 countries. No country with a maximum above 30C has reached the aspirational PCI yet. Since climate change is expected to raise temperatures, relatively hot countries will face a greater challenge in ensuring healthy working spaces (ILO, 2019; Kjellstrom et al., 2016). It will lead to a larger burden of mortality and morbidity as well as add to the costs of adaptation. On the production front, maintaining efficient work conditions, productivity and growth would be a challenge for these countries.

Figure 2. PCI and Maximum Temperatures