

The Direct and Indirect Economic Consequences of Climate Damage in Poor Countries

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Abstract. The predictions of the adverse effects of greenhouse gas emissions on climate change are now accepted. Somewhat less attention has been given to the economic, social, and political consequences. The three interact: the former will have social and political effects, which in turn will harm economies and economic well-being. This analysis of poor countries draws on much recent evidence and various projections. Climate damage contributes to internal political instability and conflict. There is a risk that poor countries will be driven down economically, so reducing the capacity of their governments: some will become fragile states. Internal migration is likely to become a central policy issue. However, international migration will also grow. Climate damage will drag countries into both cooperation and conflict with each other. The effects on sending countries, contiguous countries, and destination countries are examined. This scenario presented is predictive but should be taken as a warning.

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1. Introduction

The predictions of the adverse effects of greenhouse gas emissions on climate change are now accepted in general terms by scientists and decision-makers (Intergovernmental Panel on Climate Change [IPCC], 2021a, 2021b). Somewhat less attention has yet been given to the economic, social, and political consequences of that threat. This is partly because the potential effects are not at all clear and partly because experts are skilled at forecasting marginal change but have difficulty foreseeing the consequences of systemic change. The best that can be done is to set out scenarios to which uncertain but positive probabilities can be attached. This peer into the future offers one such scenario.

Pestel and Oswald (2021) scrutinise the economics profession for our relative neglect of the economics of climate change, despite its importance for the world. In explanation, Oswald and Stern (2019) suggest that the neglect is due to poor incentives that are traceable to journal practices. Two other relative lacunae weaken our knowledge of this topic. First, much of the economic literature has been about the effects on developed economies. Relatively less attention has been given to poor countries, yet climate change is likely to hit their economies harder. Second, research has concentrated on the direct economic effects, and less attention has been paid to the indirect economic effects. Economic damage has social and political consequences, which in turn are likely to cause further economic damage. The contribution of this paper is to analyse the economic effects of climate change in poor countries, and to examine not only the direct but also these indirect effects.

We consider the economic (Section 3), social (Section 4), and political (Section 5) effects of global warming on poor countries. However, the effects cannot be compartmentalised because they will interact. The social and political consequences that

ensue from the economic consequences will in turn have dramatic consequences for economies and for economic well-being.

2. Climate Prospects

The global temperature has risen to 1.2°C. above the pre-industrial level. For what it is worth, the full implementation of the promises that the international community as a whole has made in 2021 are expected to keep the rise down to 1.8°C by 2100; however, the full implementation of the formal commitments implies an expected rise to 2.1°C or even 2.4 °C (for instance, Climate Action Tracker, 2021). The effect of a rise of 1.8° or of 2.1/2.4°C on the economic losses caused by droughts, heat, fires, floods, land loss, and rising seas, are uncertain but the harmful consequences over the next few decades could be drastic, even cataclysmic.

The timing between rising temperature and economic harm is very uncertain. Estimation of future economic cost is further complicated by the value judgement implicit in any assumed rate of social time discounting. However, there is already some apparent increase in damaging extreme weather events. The number of recorded weather disasters increased by 71% between the twenty years before and the twenty years after the millennium (Oxford Martin School, 2020). Flooding is the predominant disaster, accounting for 47% of cases.

In its latest report, the IPCC (2023) asserted that adverse impacts from climate change will continue to intensify – in water availability and food production, health and well-being, cities, settlements and infrastructure, and biodiversity and ecosystems. Among the ‘very likely’ outcomes are glacial retreats and global sea level rise, and among the ‘virtually certain’ outcomes upper sea acidification and increase in hot extremes. The

extent of global warming will depend on which of the IPCC'S considered greenhouse gas emission scenarios emerges.

Beyond the political froth, governments are concerned to maintain power. This implies short term policies, to win elections in democracies and to maintain 'social stability' in autocracies. It is arguable that the world will continue to warm despite national and international efforts. There is so much still to be done. Currently, more than 85% of primary energy production in the world is generated from fossil fuels (Ongena and Ogawa, 2016). Response will come from three main sources. One is the adaptation of people's lives to climate damage, for instance by building sea and flood defences, introducing new crops or varieties, and extending irrigation. Another is endogenous scientific research and development to replace carbon-based energy, in three main forms: renewables, nuclear fission, and the possibility that limitless nuclear fusion will ultimately transform the energy sector (Ongena and Ogawa, 2016). The third source is a growing realisation by people of the impending apocalyptic damage from climate change. This might include general acceptance of carbon taxes that reflect the social cost of carbon use, or the playing down of economic growth objectives. It is nevertheless quite possible that the well-being of most people of the developing world will have peaked within a few decades.

Our objective is to sketch out a scenario over future decades and not to confine the paper to the consequences of climate change that have occurred so far. Most of the empirical literature is on the past effects of climate damage. This literature will be drawn upon but its value must be qualified. It might prove to be a poor guide to the consequences of the more severe climate damage that is likely still to come. The article is unusual in its

scope and breadth, not only examining both the direct and the indirect economic effects of climate change but also examining the past and extrapolating into the future.

3. Direct Economic Consequences

3.1 The Stern review

The most immediate effects of carbon gas emissions will be a rising incidence of climate damage, the likely economic consequences of which were examined comprehensively in the Stern Review (2006). A summary of the economic consequences is provided in order to establish the context for the ensuing analysis. It should be noted that the Review is careful to qualify statements about the economic consequences, often using words like 'may' or 'is likely to' rather than 'will'.

The effects of climate change will be felt unevenly across the globe. Most countries will suffer economic loss. For some of the poorer countries there is a risk of being pushed into a downward spiral of vulnerability and poverty. The more temperate zones will benefit from modest rises in temperature but even these will lose as temperature rises further. Beyond a certain point, global economic growth will slow down and might come to an end as resources are diverted to repair the environment and uncertainty deters investment.

With more frequent droughts and floods, there will be threats to water, food, health, land use and the environment. Melting glaciers – affecting the Himalayas and the Andes – will produce floods in the wet season and reduce water in the dry season. The drier parts of Africa, Latin America and the Middle East will suffer more severe droughts and falling crop yields. An additional Horseman rides in Africa: it is now only in that continent that the rate of population growth, at 2.5% per annum, is high. With the

population of Africa set to double by 2050, this growth poses a serious threat in Africa's drier regions.

Mortality among the poor will rise owing to malnutrition and heat stress. The melting or collapse of ice sheets will threaten shore-line cities and land availability in both poor and rich countries. Some low-lying countries like Bangladesh (with a population of 170 million in 2020, many of whom live on the coastal plain) are at great risk from both floods and rising sea levels. The acidification of the oceans due to rising carbon dioxide in the seawater could disrupt marine ecosystems and fish stocks. Sudden shifts in weather patterns, for instance changes in monsoons and in *El Nino*, might have drastic consequences for water availability or flooding and hence for economic production. It is likely that climate change will require costly relocation of economic activities, and the associated rebuilding of infrastructure.

3.2 Recent evidence

Another review of global warming and its effects was published a decade later (Carleton and Hsiang, 2016). It stressed the research results that had emerged in the intervening period, placing emphasis on the causal effects of climate change. The authors examined how temperature and precipitation affected agricultural output. Temperature was found to be more important than rainfall, causing non-linear losses in crop yield, but low or high seasonal rainfall could be damaging. There was little evidence of adaptation, suggesting a need for research on the obstacles to adaptation, such as incentives and cost. Lobell et al. (2011) found that in cropping regions and growing seasons, temperature trended upwards over the period 1980-2008 in most countries of their study. Overall wheat and maize production declined by 5.5% and 3.8% respectively, compared with the counterfactual without climate trends.

Carleton and Hsiang (2016) also reported results on the effects of climate change on national income or GDP per capita. Low rainfall was found to reduce national income in poor countries, many of them in Africa. Dell et al. (2012) used historical fluctuations in temperature within countries to identify the effects on aggregate economic outcomes. The authors obtained three main results: higher temperatures substantially reduce economic growth in poor countries; higher temperatures may reduce growth rates, not just the levels of output; higher temperatures have wide-ranging effects, on both agricultural and industrial output. They found that, in poor countries, a 1°C rise in a year reduces growth in that year by 1.3 % points. A recent cross-country study by Newell et al. (2021) of the relationship between GDP and temperature found considerable model uncertainty, implying a wide range of forecasts for the end of this century. However, the forecast effect on GDP was greatest for poor countries, via the effect on agricultural output.

Burke et al. (2015) concluded their analysis of the effect of temperature on production with the prediction that unmitigated global warming will reduce average world incomes by 23% by 2100. The authors incorporated into their model measured non-linearities in response to rising temperature. The estimated fall for the poorest 40% of countries was as great as 75%, owing to their higher starting temperatures. This result, arising simply from rising temperature and its correlates, has serious implications: the people of these countries are in looming danger from climate change.

India provides instructive case studies. Gupta et al. (2017) examine the effects of rising temperature on Indian wheat yields. They find that a 1°C increase in average daily temperatures tends to reduce yields by 2-4%, and that yields were about 5% lower than they would have been if temperature had not risen during the study period 1981-2009.

Somanathan et al. (2021) analyse the effects of temperature on productivity and labour supply in Indian manufacturing. On hot days there is reduced work productivity and increased absenteeism. Annual plant output falls by about 2% per 1°C rise. Similar results should apply in non-manufacturing, especially in sectors like construction and agriculture that have less scope for air conditioning. Future heat stress is likely to reduce production further.

The damage done to a poor economy by climate change can generate responses from capital and human capital. Foreign investors (bringing a bundle of resources) is discouraged, and there can be a flight of local capital, both financial and human. These predictable reactions can add to the decline of a poor economy in a process of cumulative causation.

There is a u-shaped relationship between temperature and energy demand, for cooling or heating. Rode et al (2021) argue that global warming will increase the global demand for energy-intensive cooling technologies. However, the authors expect that the currently poor countries will remain too poor over much of this century to substantially increase their demand for cooling. The effects of rising temperatures in poor countries will therefore persist.

There is a danger of climate ‘tipping points’ – conditions beyond which change in part of the climate system becomes self-perpetuating (Armstrong-McKay et al., 2022). Such changes could be abrupt, irreversible, and dangerous. For instance, there might be substantial sea level rises from the collapse of ice sheets, or carbon release from thawing permafrosts, or loss of forested areas. The possibility of tipping points makes it more difficult to estimate the size and speed of climate damage. For people, their governments, and international agencies to accept the hardships involved in taking the necessary

mitigation and adaptation actions, they must be sufficiently informed and alarmed. A danger of tipping points is that they will speed up climate damage, so shortening the warning time.

Recent research on the economic effects of climate change is reviewed in Tol (2018). There were 27 published estimates of the total economic impact. They indicate on average that a global mean temperature increase of 2.5° C. would reduce income by only 1.3%. However, that is misleading, for two reasons. First, the many uncertainties involved, the wide confidence intervals, and the possibility of neglected non-linearities and feedbacks lead the author to conclude instead: 'a century of climate change is likely to be no worse than losing a decade of economic growth'. Secondly, the world economy is concentrated on a few rich countries in temperate zones, and this dominates the average result. Poorer countries are more vulnerable to climate change, for three reasons. Most of the world's poor live in hotter, tropical and sub-tropical, zones; they will experience climate damage earlier and moreover will not be able to learn from others. Poorer countries are more exposed to the weather because of the importance of agriculture in their economies. These less developed countries have little adaptive capacity because they have less access to modern technology and to funding for mitigation investments.

Barbier and Orchard (2018) identify two geographical regions as being liable to economic harm from climate change: 'less favoured agricultural areas' and 'rural low-elevation coastal zones'. Locating areas of poverty within them, the authors count 586 million people in the former type of region and 85 million in the latter as being economically the most susceptible to climate damage. It is these – the vulnerable rural poor of the world – who are the subject of this paper.

3.3. Adaptation to economic damage

There are various coping strategies by which households can adapt to the economic consequences of climate damage. These might include investing in irrigation, switching to more resilient crop varieties, or to new crops or livestock, entering other local economic activities, building sea or flood defences, sending just part of the household to migrate, and migrating permanently as a household. Most countries are reasonably adaptive to changes in average conditions, especially if they are gradual, but they are more vulnerable and less adaptive to changes in the frequency and magnitude of extreme conditions.

Evidence for developing countries indicates that irrigation is an effective means of counteracting the harmful effects of either warming or drying (Mendelsohn, 2009). However, irrigation may be constrained by the availability of water. Di Falco et al (2011) analysed a sample of farmers in Ethiopia, some of whom had taken measures to adapt to climate change, for instance by changing crop varieties. The authors found that access to credit, to extension services, and to information about climate change were important determinants of (beneficial) adaptation. In Ghana, cocoa farmers made their crops more resistant to drought through improved seeds and irrigation, and by planting trees to shade the crops (IMF, 2022).

Construction of flood or sea defences is crucial for some countries. In Bangladesh, for instance, a World Bank study estimated that eight million people were vulnerable to sea rises and storm surges, and that, without further protection, an additional 22.5 million would be vulnerable by 2050 (World Bank, 2019). Attempts such as these to strengthen household resilience without moving location will proliferate as the threat of climate damage grows. A common initial adaption is to intensify existing temporary and short

distance migrant patterns, whereas permanent migration is likely to be chosen only later when other coping measures are perceived to fail (Raleigh et al., 2008). However, when irrigation is possible, it offers an alternative adaptation strategy to long term migration (Benonnier et al, 2021). Irrigation and migration interact: the authors find that irrigation helps farmers fund short term migration to survive weather shocks but discourages their permanent migration.

Fankhauser and McDermott (2014) pose the question: why are poor countries more heavily affected by extreme weather events than rich ones? They argue that there are limits in the ability of poor countries to adapt. One reason is that poor people cannot afford to buy climate security. Another is that poor countries have weaker public services and institutions. An increase in income per capita reduces the impact of extreme events: the authors find evidence that poverty prevents adaptation to cyclones and floods.

In its latest report, the IPCC (2023) observed adaptation progress in all sectors and regions but also adaptation gaps that were likely to grow at current rates of implementation. Adaptation policy faces two problems. The need for adaptation resources will grow rapidly as more and more countries face extreme weather events simultaneously. The existence of climate tipping points will shorten the time between the emergence of climate alarm and political will, on the one hand, and the subsequent need, on the other.

4. Social Consequences

The social and political consequences of predicted economic damage have not yet been adequately taken into account by economists despite their economic implications. There is a substantial sociology and political science literature on effects of climate change. We draw on this but recognise two qualifications. First, some of the relevant literature is on

social upheavals and migration in poor countries that have political rather than climatic origins. Second, the available evidence might be a poor guide to the effects of potentially much more serious environmental degradation over the coming decades.

Society is adversely affected by rising temperatures, in the form of increasing interpersonal and intergroup violence (Carleton and Hsiang, 2016). Climate changes – rising temperature and humidity - have been found to cause adverse effects on people's health (Carleton and Hsiang, 2016). Carleton et al. (2022) analysed the effect of temperature on mortality. They found a u-shaped relationship: extremely cold and extremely hot temperatures raise mortality rates, especially for the elderly. This relationship is flattened by rising income or adaptation to local climate. Projecting over a century, they estimated that today's hot, poor countries would be worst affected.

In this section, particular attention is paid to the ultimate response to environmental degradation after local coping strategies become inadequate: the movement of people away from a damaged environment.

4.1 Internal migration

Does rising temperature generate more migration? The consequent fall in income has two effects. One is to increase the incentive to migrate, and the other is to tighten liquidity constraints. Which of these effects dominates? Using late twentieth century data and exploiting differential global warming, Cattaneo and Peri (2016) examined migration out of the country and from rural to urban areas. They found that in poor countries, higher temperatures reduced migration whereas in middle-income countries migration grew.

Cattaneo et al. (2019) argue that migration can be driven by fast-onset climatic events (such as floods and fires) or by slow-onset climatic events (such as more regular

droughts). The former is more likely to cause temporary, short distance migration, whereas the latter is more likely to produce permanent, possibly long distance, migration. The incentive to migrate depends also on the degree of personal and political insecurity. If climate damage leads to conflict, that might push people to migrate. The poor might have greater incentives to migrate but less resources to do so. No well-established relationship between climate damage and permanent migration could be found by Raleigh et al. (2008). However, when eventually climate damage becomes so severe that households feel they can no longer cope, they will increasingly turn to permanent migration.

For these several reasons, forecasts of future migrant numbers cannot be made with any confidence. Nevertheless, Rigaud et al. (2018) have made a serious attempt to do so, using sophisticated methods. In justification, they argued that environment-induced mobility is still inadequately recognised in policy-making and long term development planning (Rigaud et al, 2018: 2). This World Bank team examined parts of sub-Saharan Africa, south Asia, and Latin America. Their model applied demographic, socioeconomic, and climate impact data at a 14 square kilometre grid cell level to estimate likely shifts in population within each survey country, on the basis of three scenarios. Their base forecast was that 143 million people in the three regions would move because of slow impact climate change by 2050; an updating report increased this estimate to 216 million (Clement et al., 2021). The report's argument was that the growing climate-induced need for population movement was itself harmful but that the movement was likely to have both positive and negative consequences for the people – migrants and hosts - involved.

Kaczan and Orgel-Meyer (2020) provide a review of 17 recent empirical case studies which have examined the effect of climate damage on migration in developing countries. They confirm that climate-induced migration depends on both the severity of the shock and the ability of the household to migrate. Four patterns are found: the need for funding means that migration is not more prevalent among poorer households; long-distance domestic migration is more common than local or international migration, both by being a better guide to future climate and by enabling preparation; slow-onset climate change is more likely than rapid-onset change to induce migration; the severity of climate shocks can affect migration in different ways according to whether, in the circumstances, the need to fund or the need to escape will dominate decisions. A qualification is necessary: the future will involve weather damage well beyond that described in these case studies.

As climate damage gradually becomes more persistent in a region, beyond immediate disaster relief, revenue-constrained central and local governments will have to choose among policies repairing and ameliorating climate damage, promoting new local economic activities, managing the transfer of people and resources, and leaving such adjustments to market forces. This last is likely to involve large unplanned and uncontrolled flows of people into the cities. A great and excessive expansion of cities and their slums in countries with much displacement of people will contribute to civil unrest, crime, and social divisions. Internal competition and conflict are likely to generate violence in some badly affected poor countries. The weakness of governments, international organisations, and aid agencies will limit successful internal resettlement. For most people it is international migration, both within their region and to the rich countries, that will eventually beckon.

One cause of permanent migration is heat so extreme that it makes some areas unliveable. For instance, Kang and Eltahir (2018) – by conducting regional climate simulations and assuming a plausible pace of global warming – find that the, heavily populated, north China plain is likely this century to experience temperatures exceeding the tolerable threshold for workers outdoors. The outcome, there and elsewhere, may well be mass migration beyond the affected region.

4.2 International migration

Other countries will become involved when the extent, and even the prospect, of international migration becomes important to them. Both neighbouring countries and distant, rich countries will be affected. That climate change is likely to cause significant international migration in the long term has been recognised by the US and UK governments (The White House, 2021; UK Government, 2011).

The UN Refugee Agency (2021) reports that, in 2020, there were 83 million forcibly displaced persons worldwide, of whom 48 million were internally displaced, 31 million were refugees to other countries, and 4 million were asylum-seekers. The flow of refugees abroad is mainly into developing countries (85%) and neighbouring countries (73%), especially in the Middle East, the exception being the entry of a million people into Germany - with its unique politics and circumstances - in 2015-6. Much of the exodus comes from failed or failing states, in which government functions are impaired and governance is marred by insecurity, corruption, and lawlessness. Most of it is unrelated to climate change. Nevertheless, there is a danger that climate shocks will generate more cases of economic decline, state fragility or even of state failure, and consequently of many more people whose remaining aspirations are to start their family lives elsewhere. The dividing line between political refugees and climate migrants will be blurred in those

countries where climate damage leads to political unrest and violence: increasingly, such migrants will qualify as refugees.

As in this decade, in coming decades the vast majority of international refugees are likely to move to neighbouring rather than to distant countries. There are several reasons. Many will prefer to live in a familiar society and culture. Some will retain hope of returning home. Many will be unable to afford a more distant move. In some cases, refugees will be confined to a neighbouring land because rich countries have paid its government to host the refugees. However, at some time in the future, internal displacement and intra-regional migration will reach crisis points, and the flows to rich countries will grow in importance.

Politically induced migrants in fear of harm are referred to as refugees. Although exceptions might be made for those whose political situation resembles that of refugees, climate-induced migrants (climate migrants for short) are likely to be regarded as economic migrants. However, if economic damage leads to social conflict and violence, climate migrants, also, might be in fear of harm if they remain. Martin (2010) has argued that there is an urgent need to introduce an international system of governance for climate migrants. No doubt there will be some resistance from destination countries to expanding the definition of refugees to include climate migrants.

It is likely that the numbers of migrants streaming to rich countries – still quite trivial and manageable in relation to rich country populations and the economic and social costs and benefits that the migrants pose – will increase greatly within a few decades. Three factors will govern this growth (Collier, 2014: 38). First, it is the income gap between the sending and the receiving countries that will provide the incentive to migrate. Climate damage is likely to widen the gap and so to strengthen the incentive.

Second, migration is an investment: the level of income in the sending countries will determine the ability to fund migration. A fall in their income will further impede international movement. It is unlikely that the poorest and starving of the suffering regions will aim for the rich countries because they lack the funds for long journeys; it is mainly the better-off in poor countries who will be attracted to the rich world. There is likely to be a disproportionate representation of young people with smartphones, relatively well educated in their countries, sent as outriders and role models by their kin. Climate-induced national economic decline and resultant social and political instability might be important for their migration decisions. The success of the few will be the spur of the many. Nevertheless, climate damage is likely to restrict the ability to fund travel abroad.

Third, the costs of migration will be eased by the diaspora from the country of origin who are resident in the country of destination – providing information and support for the migrants. The greater the size of the diaspora, the better the support networks, and the higher the migration rate. The supportive diaspora might wither over time if immigrants are easily absorbed into the national society. In the case of migrants who came from poor countries, however, absorption is likely to be held back by differences in culture as well as in language, by their relatively poor education for the host country, and by the preference of immigrants to settle in their own communities.

Climate damage in poor countries will encourage migration by increasing the income gap but discourage it by reducing the funds available for travel abroad. Nevertheless, with the support of the diasporas already in the host countries, it is entirely plausible that international migration will grow unless it can be dammed.

The World Bank (2023) in its *World Development Report 2023*, which is concerned with migrants and refugees, takes an optimistic view of international migration. Migrants are divided into four categories: with good and poor matches to the employment needs of destination countries, and with and without legal rights to migrate. The most difficult group is those who do not match needs and have no legal rights. The report views the migration of such people as a benefit to the sending countries and a responsibility of the destination countries, at national and international level, in an unbalanced world. The report does not discuss the likelihood that this responsibility will be shouldered, now or in the future as climate migration grows. With little supporting evidence, the report plays down the cost to sending countries who lose human capital needed by destination countries (for instance, professionals and managers) in the form of negative externalities for those remaining. Extensive loss of human capital will lower the quality of governance and economic management

A case study illustrates how climate damage might play out in one of the world's poorer regions. Southern Africa is prone to drought because its wet summer season is sometimes at risk from *El Nino* events. The reliance on agriculture, mainly cereal crops and livestock, makes it vulnerable to food insecurity. Climate change has increased the variability of both temperature and rainfall. Extreme weather conditions – causing both droughts and floods - are becoming more common. There is a particular threat to water resources, on which some agriculture depends. However, climate change has not so far led to notable permanent displacement of people.

By contrast, political instability, violence and civil war in African countries south of the equator had produced 6.5 million internally displaced persons and 1.1 million refugees and asylum seekers by 2020. The only upper-middle income country of this poor

region, South Africa, was one magnet, drawing refugees mainly from Zimbabwe, in some ways a failed state. Unlike most other African countries, South Africa's policy and law applying to refugees and asylum seekers is largely progressive, for instance, providing rights and permitting freedom of internal movement. However, in practice, the migrants find it difficult to access their rights, being up against some public resistance and an unsympathetic and overwhelmed bureaucracy. Should climate damage generate a great flow of climate-induced refugees in future decades, it is very likely that, as well as other countries in the region, South Africa, with its huge unemployment, will be unable to cope. The quality of governance will suffer from climate damage itself and the consequent uncontrolled migration flows, the more so for those countries in which social instability is already endemic. Support from beyond the region is the best hope for the displaced people of southern Africa.

5. Political Consequences

We start with the political implications of climate change in the directly affected countries, then in the countries that are indirectly affected through migration, and finally among different states, whether sending, or transferring, or receiving migrants.

5.1 The most affected countries

McKay and Thorbecke (2019), in a cross-country analysis of developing countries, found a negative association between measures of state fragility and both level and growth rate of income per capita. Causation might run from state fragility to poverty, from poverty to state fragility, both of these, or neither. Nevertheless, their finding provides a potential link in a chain from climate-induced economic damage to state fragility. Climate damage can reduce income and state revenue, and redirect resources to repair the damage. The fall in government revenue that is left available for public services and infrastructure

investment is likely to reduce the quality of governance. This might aggravate state fragility, measured as an index derived from such indicators as weak rule of law, weak property rights, lack of public sector accountability, poor public services, the state's inability to respond to challenges, and its weak ability to manage conflicts. That in turn will reduce income and economic well-being, so creating a vicious circle.

There are reasons why greater resource scarcity, brought about by climate damage, generates conflict. For instance, there can be aggressive competition for the dwindling quantity and quality of resources, or grievances arising from new inequalities. However, the empirical debate on the issue is unsettled.

Burke et al. (2009) examined the relationship between temperature and civil war in Africa, using a twenty-year panel for many countries. The authors found that warmer years led to a significant increase in the likelihood of armed conflict. Their model, combined with projections of future trends in temperature, suggested a 50% increase in the incidence of armed conflict by 2030. It is likely that civil war will reduce state capacity and the quality of governance.

A systematic meta-analysis of the relationship between climate change and human conflict was conducted by Hsiang et al. (2013). Conflict was defined to include inter-group violence, political instability, and civil war. The authors used 45 different conflict time-series data sets that could infer causal associations from climate change to conflict outcomes. They found that divergences from normal precipitation and mild temperature increased the risk of conflict: one standard deviation change in temperature or in rainfall increased the frequency of inter-group violence by 14%. They concluded that a plausible rise in global warming would have a large impact on conflict by 2050. However, a comment on their analysis by Buhaug et al. (2014), written by 25 scholars in this field,

criticised the paper for its assumptions, and argued - more in line with the mixed results found in the literature - that its strong conclusion was not reliable.

The consensus seems to be that the evidence for a causal link between climate change and conflict is weak and cannot be generalised (Buhaug et al, 2009, Peters et al., 2020). There is an association between climate damage and violence but this might be the result of common factors such as poverty and weak government (Koubi, 2019). Maybe environmental degradation has generated conflict only when other conditions were present. However, the controversy continues. Carleton et al (2016) reviewed 29 panel data studies examining the effect of climate damage on violent conflict and social instability. High temperature and irregular rainfall were causally linked to a range of conflict outcomes. Whatever the past evidence reveals, it is plausible that a causal effect will emerge generally in future decades as environmental degradation is intensified.

Mach et al (2019) examined whether climate is a risk factor for armed conflict, based on the judgement of experts across disciplines. They agreed that climate change has increased organised armed conflict within countries. However, other drivers – such as low social development, low state capacity, inter-group inequality, and a history of violent conflict - were judged to be more influential. The World Bank (2023) reached the same conclusion. It mentioned the Sahel region as one where climate vulnerability, rising temperature, and resultant competition for dwindling resources, along with poverty, state fragility, and population growth, had contributed to political instability and violence.

Badly affected nations are likely to have at least to deal with internal protests and social instability. For instance, faced with endemic floods or chronic droughts or persistently rising sea levels, governments will encounter pressures coming from those

who suffer directly, pressures arising from a national sense of unfairness at the sharp relative changes in well-being and in wealth, but also backlashes from tax-payers. How well they can manage such pressures will depend on their available resources. Some poor countries with stricken economies are likely to become more fragile and more rudderless: economic well-being will suffer.

It is possible, nevertheless, that climate damage will have very different political consequences in some countries. Ciccone and Ismailov (2021) examined the relationship between rainfall and democratisation in the world's most agricultural countries, many of which were initially non-democratic. They found it to be u-shaped in the short run, and to persist in the long run. Extreme rainfall, both lower and higher than normal, reduces agricultural output, so causing social instability and conflict. This might start a process of democratisation so as to encourage cooperation rather than rebellion. However, that process depends on various predetermined factors, referred to as democratic tipping points, which are less likely to be present in poor economies. The authors found theoretical support in Acemoglu and Robinson (2001) and Besley and Perrson (2019). There is suggestive historical support in Benatti and Gueriero (2021) and Bugge and Durante (2020)

5.2 Indirectly affected countries

Both neighbouring countries and distant, rich countries will become involved as international migration grows. Both reports of the US and UK governments on this subject (The White House, 2021; UK Government, 2011) make proposals for national and international strategies and policies to manage immigration from abroad. The US report notes that its government does not have an obligation to protect people fleeing from the impacts of climate change, but notes also that it is in the national interest to create a legal

pathway for people fleeing serious threats to life as a result of climate damage. The UK report emphasises poor country policies to mitigate climate damage and policies to manage internal migration as alternatives to international migration.

The natural human tendency to sympathise with other people, especially when their plight is understood and felt, will be challenged by the natural human tendency to protect oneself and one's people against new adversity. There is a danger that, in self-defence, societal attitudes in the rich countries will become less high-minded, for example, towards responsibility for others, survival of the fittest, and rights of asylum, and doing no more than "one's bit". The responses in rich countries are therefore likely to be a mixture of humanitarian absorption and assistance on the one hand, and hostile opposition and rejection on the other.

Migration might eventually be perceived to threaten economic wellbeing and social cohesion on a scale great enough to generate wide hostility in the rich countries. It is not only the economic costs but also the social costs that will motivate voters. Cultural differences can create divisions. that might be perceived to alter the norms of society for the worse. The indigenous people will resent the weakening of their national identity in a rapidly diversifying society. Hostility will be strongest from selfish nationalists and from the indigenous poor, who most fear the competition of migrants for jobs, housing, and facilities. Identity politics might be intensified as people seek safety in numbers from the new insecurities and threats.

However, the extent of political resistance to migrant inflows will depend on several factors. One is whether they come as severely distressed refugees or as relatively unharmed economic migrants. Another is the ease with which they can be assimilated into society. This will depend on similarity or difference in characteristics such as

ethnicity, religion, culture, and human capital. Third, attitudes will be influenced by the extent of internal climate damage already experienced or feared. Fourth, the great majority of refugees in the world today are there because of politically-related rather than climate-related damage, but the two are related. There is a danger that the more political refugees are, or have been, accepted by host countries, the fewer climate refugees will be welcomed.

As the flow of international migrants increases, two main state responses can be predicted. One concerns the rights of migrants to claim asylum. Although many climate migrants will meet the same criteria for refugee status as political migrants, they might continue to be treated as economic migrants. The other is the erection of powerful barriers at land and sea borders, with enforcement of exclusion policies. There might be an accumulation of humanitarian crises at or near the borders of rich countries. More and more migrants will be turned or sent back.

There is yet another murky forecast which, as it plays out, is likely to influence the acceptable size of migration from poor to rich countries. It may well alter the attitudes of people and governments in ageing societies. These include the countries of Europe and some Asian countries, like Japan, China and Russia. It can be illustrated by reference to Europe.

According to Eurostat (2021), the EU-27 had a population in 2020 of 497 million, of which 291 million, or 65%, were of working age (15-64). With the population expected to age rapidly, the rate of natural increase in population (births minus deaths) is projected to be negative, and to fall to 333 million by the year 2100, of which the working age population will constitute 183 million, or 55%. Assume that migrants, all of working

age, are permitted to enter the EU so as to restore the working age proportion to 65%. This would involve a migrant influx of 37 million over the 80 years.

In 2020 the dependency ratio, defined as the number of dependents per worker, was 0.54. Without migration into the EU-27, in 2100 it is expected to reach 0.69. This will represent a rising financial and resource burden on households, tax-payers and governments. The economic advantages of migration in those circumstance will be weighed up against the social and political disadvantages in the evolution of policy on migration into rich countries.

Those governments that are receptive to the acceptance of refugees for humanitarian reasons or because of their rising dependency ratios can look for support to the experience of Germany. In 2014, 7% of the German population were foreign nationals; in 2019, the figure was 10%. Germany has been the most welcoming country in the European Union in its policies towards refugees, and the greatest magnet for them. After the migrant flood of 2015-16, the German government has pursued strong policies for integration, which in the main have been successful.

The degree of expressed social discontent has been low. In the national elections of 2021 refugees were a major issue; each political party set out its policies for migrants. The incoming ruling coalition of three parties proposed new policies that would be more generous towards migrants and refugees. They would make it easier for families to reunite, for foreign nationals eventually to acquire citizenship, and through incentive payments for unsuccessful asylum applicants – 60% in 2021 – to return home voluntarily without deportation. The national election and ruling coalition would probably have turned out differently had public opinion been more against a welcoming policy on

migrants. Good integration policies offer scope for accepting more refugees without evoking the resistance or refusal of the indigenous population.

5.3 Interaction among states

Climate damage will also drag states into both cooperation and conflict with each other. Cooperation will take the form of amelioration of global warming via the COP institutions and relief of the new poverties via aid agencies, both national and international. The financial and operational inadequacy of the international organizations will become more apparent as many poor countries simultaneously need assistance. The international organizations will need to extend their remits, for instance by spearheading and developing ways of creating resilience to climate change, and will require more resources for that purpose. Greater world leadership and leverage will be needed than has so far been mustered. Ill-feeling is most likely to arise between countries with competing interests - target countries, transit countries and sending countries. The competition will be greatest between sending countries and their neighbours, and between target countries and contiguous transit countries. Competition will intensify among countries that share major rivers if their water flows diminish.

A brief case study of refugees and refugee policy in Turkey is provided because that is the best country with which to illustrate future interaction among states on climate migration. Turkey has the largest population of refugees in the world. In 2021 it hosted 4 million refugees, of whom 3.6 million were 'Syrians under temporary protection'. The inflow is of course political and not climate-driven. Turkey adopted an open door policy towards Syrian migrants in 2011, at the start of the Syrian civil war. It was viewed as temporary support which would disappear as the civil war ended and people returned to their homes in Syria. Turkey supported the refugees financially with health care,

education, and housing. Only a small proportion were held in refugee camps; most were spread throughout the country, many in cities.

As the civil war continued, many migrants wanted to settle in Turkey or migrate to Europe. In fear of a flood, in 2016 the EU signed an agreement with Turkey to prevent migrants from leaving the country towards Europe in exchange for economic aid; Turkey would accept the return of migrants from Greece and do more to control its borders. As the numbers increased and social tensions grew, there were anti-migrant riots and violent protests against Syrians; local people felt greater competition, e.g. for jobs and for housing. The general feeling grew that Turkey had reached its absorptive capacity. The government has three permanent solutions in mind: integration into society, assisted voluntary return, and resettlement in other countries.

Turkish policy is to be understood in terms of the initial perception that the refugees would be temporary and the fact that most refugees share ethnic, religious, and cultural links across the border. Despite the likely differences in speed of change and in affinity with migrants, some of the same experiences, pressures, and policies may well be found in future climate-driven flows of refugees into neighbouring countries. The case studies of Turkey and of Germany above suggest how rich countries will try to provide funds and resources to refugees, to sending countries and to transit countries, in order to manage international migrant flows. Political interventions of that sort will reduce the harm caused by climate change.

6. Conclusion

The objective of this paper has been to provide a scenario - based on the available evidence and logically plausible projections - of the likely direct and indirect economic consequences of climate damage. The apocalyptic scenario that has emerged envisages

poor countries at some time in the future that are economically more distressed and worse off, socially more disturbed and insecure, and politically more unstable and divisive. It involves two causal relationships: the effects of carbon gas emissions on climate change and of climate change on humanity. Both require forecasts not only of severity but also of timing. Climate damage will build gradually and sometimes imperceptibly, perhaps noticed by the rising frequency of extreme events. We know the direction of change but we do not know how great the harm will be after one decade, three decades, or eight decades. The technical reviews, summarised above, of case studies examining the effects of climate change on the economy, on migration, and on conflict yield generalisations about the recent past but cannot be at all precise about the future.

The harm that climate-induced economic damage will do to fiscal resources and to social and political stability will reduce the quality of governance and public services in poor countries. That will in turn have indirect adverse effects on the economy and economic well-being. Climate-induced migration will help to spread the economic pain and might even provide an economic benefit to rich, ageing countries. However, beyond a certain point migration is likely to meet political resistance or hostility from host societies in fear of the increasing costs that it will impose. Development economists should recognise the indirect economic effects of climate change. on poor countries.

This is one scenario. Other, more optimistic, scenarios are possible. For instance, Khanna's book *Move* (2021) accepts that future decades will require vast migration from poor to rich countries but argues, contentiously, that they will be accepted by rich countries because of population ageing, technological progress and economic growth. Another scenario would assume that the target of limiting the rise in global temperature to 1.5° C degrees will be achieved but would also have to assume, contentiously, that

governments and their people will accept the sacrifices needed, i.e. that public opinion and government policies will get far enough ahead of climate change to stop it. Optimistic scenarios denying human-induced climate change can be found (for instance, Koonin, 2021; Lomborg, 2020) but both these books have been critically reviewed (for instance, by Yohe, 2021 and Stiglitz, 2020 respectively) and such authors have not attracted a strong scientific following.

Yet our bleak scenario need not come to pass. That might be because climate change with its great uncertainties, and economic loss with its still greater uncertainties, will turn out to be less serious or will provide more time for response. It is possible that technological progress induced to address climate damage will forestall the scenario, or that the world's policy response will avoid it. Maybe the Apocalypse can yet be averted.

Our account is value-free speculative prediction but it has been presented as a warning. People have to be persuaded that present pain is justified to avoid worse future pain, despite the incentive for personal and national 'free-riding'. Each country's own incentive not to free-ride - because climate change will create domestic economic losses and costs - is inadequate without global collective action. Governments, in turn supported by international agreements, need to lead their people. Increasingly powerful fiscal incentives must ease human suffering, achieve carbon neutrality, and advance new technologies.

The scenario that has been outlined carries implications for research. The effects on climate change of greenhouse gas emissions are heterogeneous. Generalisations must therefore be based on meta-analyses of the burgeoning case studies that reveal differences as well as similarities. It will be necessary to separate poor and rich countries, or tropical and temperate areas, into sub-samples. Research methodologies should be

sufficiently similar for valid comparisons to be drawn. Nevertheless, it is unlikely that evidence of past experience, however recent, can be accurately projected into a future of more serious global warming. Different areas of the world have experienced different rates of warming. Some have encountered more serious consequences than others. It might be helpful, therefore, to project the direct and indirect economic effects in other areas on the basis of the experience of the front-runners.

Economic research on climate damage is underfunded. Between 1990 and 2018, of all research grants globally on climate change, only 0.12% were spent on the social science of climate mitigation (Overland and Sovacool, 2020). Economists can help to raise public concern by conducting more research on the economic effects of global warming, especially in poor countries. Perhaps the process will be helped along by a series of blockbuster novels and films (maybe *Come High Water and Hell*, or *Dust and Exodus*) which depict the scenario in human terms – ones which do not have happy endings.

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