



DISCUSSION PAPER

Counting the Cost: Climate Change Economics and Development

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Introduction

Climate change is arguably one of the greatest challenges that humanity faces today. Human activities' impact on the environment is causing serious changes in the climate of our planet which, according to a vast majority of scientists, are likely to create long-lasting effects on many of Earth's physical and biological systems. Some scientists even claim that, to the extent it remains unreformed, rising temperatures can make some parts of our planet uninhabitable for humans in a not so distant future. In fact, we already experience many of the consequences of the climate change in rising intensity of storms, forest fires, droughts, and floods, and rising sea levels affecting millions of lives around the world (IPCC, 2018). So vast has human beings' impact on the climate been that a new epoch has been designated for the time we now live in; the 'Anthropocene'.

There are undeniable connections between climate change and the modern economic system. Both production and consumption patterns are directly responsible for pollution and environmental degradation. The modern industrial economy has literally been fuelled by fossil fuels since its inception. Smokestack manufacturing industries, which were at the root of industrial revolution, are highly carbon intensive, and therefore contribute to accumulating greenhouse gas (GHG) emissions which, in turn, increase global temperature levels. Furthermore, modern production is dependent on natural resources of all kinds, including water, land, and forests. Similarly, changing consumption habits of industrialized economies contribute to water, air, and soil pollution and exhaust the resources at a scale that has never been experienced before in human history.

Climate change has serious reverse effects on economies too. On the one hand, it affects economies through natural disasters such as floods, landslides, storms, and wildfires. In addition to the environmental and human damage, such events disrupt businesses, lead to migration, and cause loss of property. The recent bushfires in Australia, for instance, are expected to cost more than \$3 billion to the Australian economy (Karp, 2020). Rising sea levels are an important source of concern for low altitude countries which would have massive investment requirements for relocating people. On the other hand, climate change leads to increasing economic conflict between countries which compete for the planet's deteriorating resources, such as water, arable land, food, and fossil fuels. Furthermore, even though it is created mostly by world's richest countries, climate change affects the poor countries most, which increases inequality and adds to the geopolitical tension between countries.

This paper provides a short introduction to the ongoing debate over the economics of the climate change. It first discusses the main economic trends in the modern age which contributed to the emergence of an environmental crisis. Second, it investigates the economic implications of increasing environmental degradation, which involves an analysis of asymmetric effects of climate change on developed and developing countries. Lastly, some of the solutions proposed by professional economists to overcome the climate change are discussed. The paper concludes that the economic systems in various geographical settings need to be altered in profound ways, which arguably requires enforcing different solutions in combination rather than depending on only one approach.

Economic Underpinnings of Climate Change

Climate change is mainly caused by high levels of greenhouse gases in the atmosphere. Greenhouse gases trap the heat coming from the sun and increase the global temperature levels. An important greenhouse gas is CO₂. According to NASA, atmospheric CO₂ concentration has increased by 45% since the 19th century (Figure 1). According to Intergovernmental Panel on Climate Change (IPCC), the average global temperature level has increased by 1 C° since the beginning of industrialization and is expected to keep rising unless the CO₂ emission is reduced (Figure 2). Furthermore, the rise in temperature is not symmetric; it has been higher in the Arctic and Antarctica as well as tropical regions, and lower in more temperate areas (IPCC, 2018).

According to the IPCC (2018), if humanity can limit the temperature rise to 1.5 C°, the potential damage of climate change can be managed. There are natural processes such as volcanic eruptions which cause CO₂ emission. However, the main causes of CO₂ emission are human activities such as deforestation and burning fossil fuels. It is also obvious that the dramatic trend in CO₂ accumulation starts with the advent of modern industrial capitalism. Rapid industrialization in the modern era has created a carbon-intensive production economy; modern manufacturing industries first used coal and then oil and natural gas, all of which emit CO₂ to the atmosphere in record-breaking volumes. With the expansion of these industries, atmospheric CO₂ accumulation has also expanded.

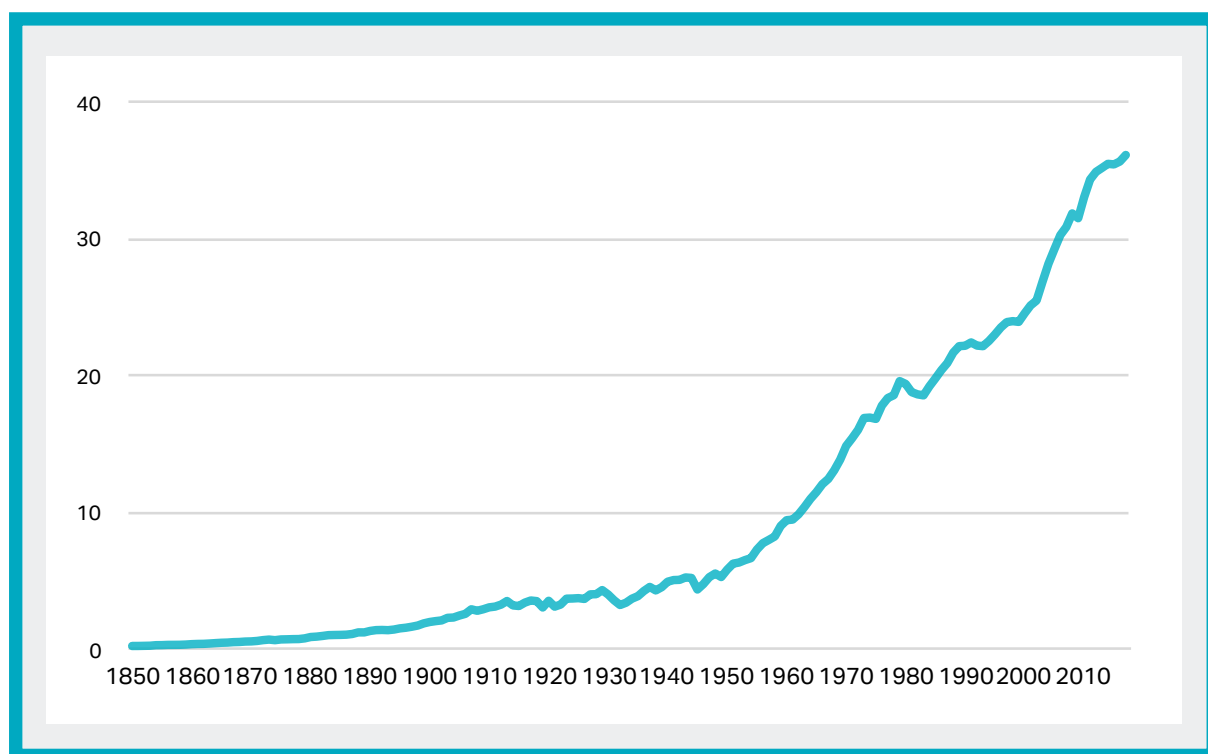


Figure 1. Annual Global CO₂ emission (billion tonnes), 1850-2017 (source: Global Carbon Project)

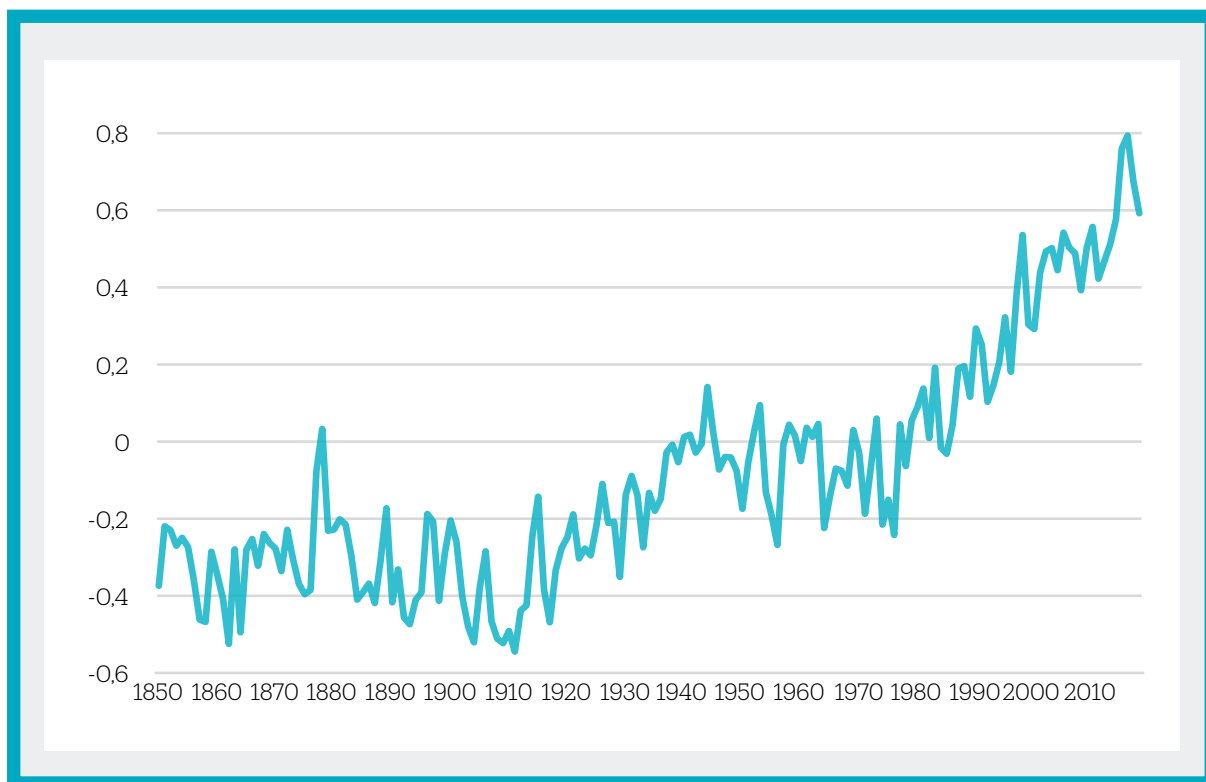


Figure 2, Average temperature anomaly (C°) relative to 1961-1990 average, 1850-2018 (source: Met Office Hadley Centre)

Therefore, the problem and thus the solution lies in the economic system.

Modern industrial economies provide us with a tremendous capacity to utilise and exhaust world's resources. It had been assumed that natural resources are unlimited in supply and that humans are bound only by their capacity to reach and use them. Advanced technologies which emerged after the industrial revolution meant that we were able to extract and use these resources with higher capacity. The world's fossil fuel reserves that has formed over millions of years became accessible and started to be used as the main source of energy for newly emerging manufacturing production. Similarly, water, air, soil, and forests are considered as inputs in modern production activi-

ties, including agriculture, with little consideration for potential limits to these resources.

Simultaneously, increasing production capacity since the beginning of the industrial revolution has changed and expanded consumption possibilities globally. Increasing consumption means more energy use and pollution. Electricity is now the lifeblood of modern consumption society, and industrial society depends on constantly increasing energy supply mostly generated from fossil fuels. However, consumption has expanded not only in size but also in the variety of its content. New materials such as plastics and cement became widespread only in the 20th century. The reason why plastic is so commonly preferred in daily use is its extreme durability, which also makes it problem-

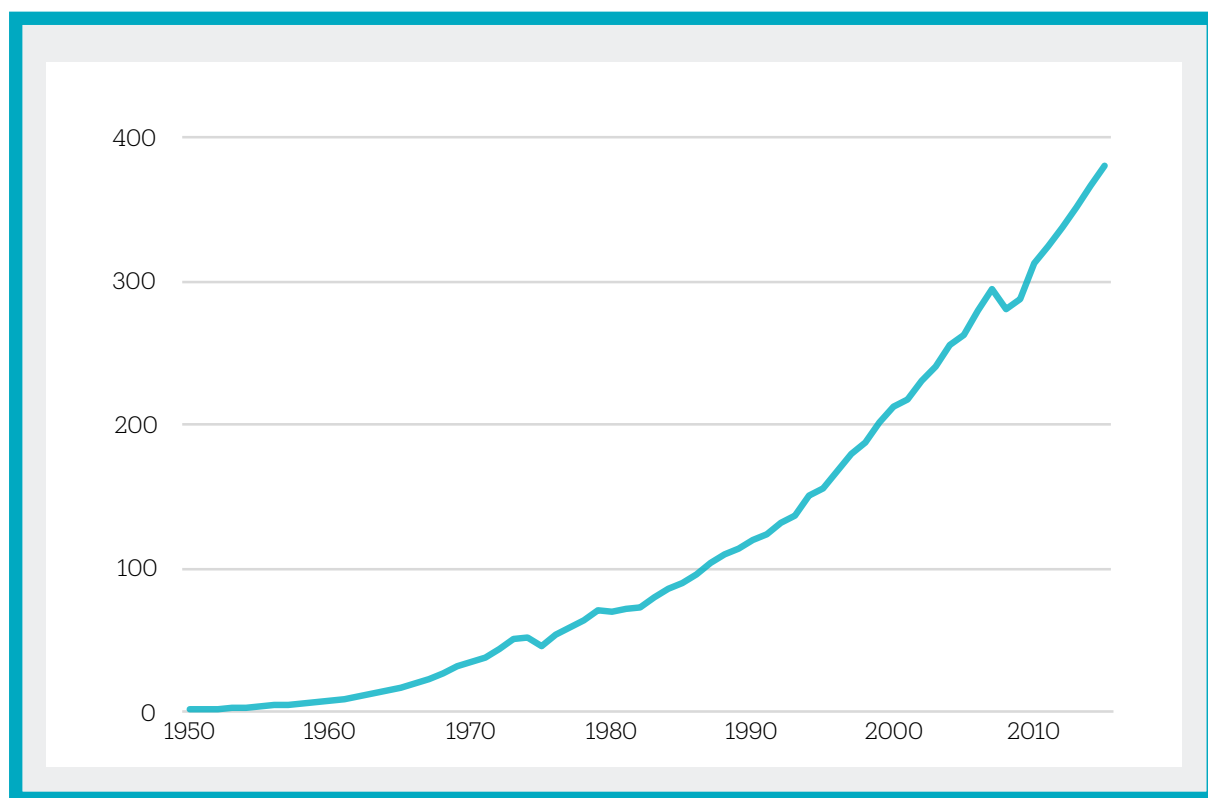


Figure 3, Global plastics production (million tonnes), 1950-2015 (source: Geyer et al. (2017))

atic for the environment. Because plastic is not biodegradable, it remains in nature for too long and have a negative impact on oceans and wildlife by polluting the sea and the soil (Geyer et al., 2017). Cement, is also an important contributor to CO₂ emissions.

Another modern trend which contributed to climate change is the territorial expansion of humans due to urbanization and exponentially increasing population. With rising industrialization, millions of people have moved to cities to join the industrial economy. Cities are, by nature, polluting due to the peculiarities of urban consumption culture and production methods. More importantly, by concentrating millions of people to specific areas, urbanization alters the ecological landscape and leads to higher atmospheric greenhouse gas concentration which, according to scientists, have significant implications for rainfall pat-

terns, heat waves and ecologies around cities (Cai et al., 2019). Moreover, rising population causes deforestation because it incentivizes conversion of forests into agricultural land in order to meet increasing food demand in urban areas. Needless to say, this is also due to unsustainable modern agricultural methods which diminish the soil's long-run yield capacity. Deforestation in the Amazon, for instance, is a continuing process as farmers slash-and-burn to clear more land for agriculture, which leads to pollution of the land, air and water as well as destroying forests, a crucial CO₂ sink.

Economic Effects of Climate Change

The serious threats climate change pose for humanity are not limited to some potential future day events. In many ways, we are experiencing the results of climate change now, which surely involve economic consequences. Changing climate patterns lead to extreme weather conditions, which adversely impact productive activities. For example, climate change takes its toll on agricultural productivity due to acid rains, low rainfall, loss of biodiversity, extreme heat, changing pests and diseases. Combined with rising population, a two-way relation creates a vicious negative feedback cycle. Modern agricultural methods and deforestation for agriculture contributes to climate change, which reduce productivity and increases the need for more agricultural land. Agricultural productivity is expected to drop further especially in low-altitude regions although the effect in high altitude regions is ambiguous and may even be positive. This gives rise to more concerns about food security (IPCC, 2018).

Climate change also increases the intensity and frequency of natural disasters such as storms, floods, landslides, and wildfires. A poignant example that has captivated global audiences is the Australian bush fires. A long drought which lasted more than 3 years prior to the wildfires left Australian bushland vulnerable to fire. As a result of the wildfires, agriculture and tourism have been affected while a considerable amount of property has been lost. So far Australian government pledged a \$2 billion relief package for the affected areas, but the total cost of the disaster is expected to be around \$3 billion (Karp, 2020). Another such example are the Amazon wildfires which affected Brazil, Bolivia, Paraguay, and Peru in 2019. These fires actually happen every year during the dry season due to the slash-and-burn deforestation mentioned above but they are intensifying because of climate change and drought it. A similar disaster was experienced in California in 2018. Wildfires killed more than 100 people and cost the American economy more than \$3.5 billion.

It is highly likely that we will face increasing budgetary costs in the future due to such climate change induced natural disasters. It should be noted that such events affect the poor more than the rich and contribute to rising inequality. For instance, according to an analyst from Munich Re, the world's largest insurance firm, increasing insurance costs due to climate change may soon become a social issue as well as an economic one. Munich Re blamed global warming for \$24 billion of losses in the Californian wildfires. If climate disasters continue to grow in intensity and frequency, this will force insurers to raise premiums, which will make it too expensive for ordinary people to afford (Neslen, 2019).

According to the International Labour Organization (ILO), climate change will also affect labour productivity. In 2019, ILO published a report titled "Working on a warmer planet: The impact of heat stress on labour productivity and decent work," which claims that even if the rise in global temperatures can be limited to the target level of 1.5 C°, by 2030 this will cause a productivity loss that is equivalent to 2.2% of all the working hours, or 80 million jobs, annually, which amounts to \$2.4 trillion worth of labour supply. 60% of this loss is expected to take place in agriculture. Furthermore, some of the poorest regions of the world, including South Asia, Western Africa, South-East Asia and Central Africa, are expected to suffer the worst losses, while North America and Europe are not significantly affected by heat stress. (ILO, 2019).

Another important issue related to climate change is migration. The United Nations High Commissioner for Refugees (UNHCR) now agrees that climate change is a cause of migration and states that "the links between climate change, disasters, and other causes of displacement are now undisputed." (Goodwin-Gill & McAdam, 2017). According to estimates of the Internal Displacement Monitoring Centre (IDMC), between 2008 and 2018 extreme weather has displaced more

than 20 million people on average annually. Migration mostly takes place after mega-scale disasters such as storms and floods. But it is also related to decreasing agricultural productivity due to the salination of groundwater and soil associated with rising sea level, or longer-term climate variability (IDMC, 2020). All these are highly correlated by climate change. The risk of displacement is particularly high in coastal areas and in poor countries which do not have the tools to deal with changing conditions.

Climate change can also have geopolitical implications by increasing competition over the world's already limited resources such as water, arable land, and fossil fuels. Deteriorating natural resources combined with growing needs of economies creates conflicts between countries. A case in point is the rising tension

between Egypt and Ethiopia over the Nile river. Ethiopia is a fast-growing country with a population of over 100 million. In 2011, Ethiopia began building Africa's largest dam on the Nile. Potentially limiting water flow to Egypt. Egypt also has a population over 100 million and is already concerned about water availability due to climate change. Currently, water supply is already unstable which contribute to intermittent floods and water shortages. Some fear that the current situation may lead to a war between two countries and climate change puts further strain on the dynamics at play (The Economist, 3 August 2017). Other examples include the dispute between the US, Russia and China over Arctic oil and natural gas, the civil conflict in Sudan's Darfur region and the increasing risk of war in the horn of Africa.

Climate Change Inequalities

Climate change is a global problem which should concern everyone. However, this does not negate the fact that there are vast differences between countries in terms of how much they contribute to it and how much they are affected by it. In fact, one of the problems with synchronizing government efforts to face global warming comes from the fact that these two groups of countries, the ones that caused it and the ones that are affected by it, are vastly different from each other.

Common perception is that rich countries are responsible for the most of the global carbon emissions. This is not strictly true. In the second half of the 20th century, emerging economies, especially of East Asia, took the leadership in carbon emissions. Specifically, while the US and Europe were indeed responsible for the overwhelming majority of carbon emissions until a few decades ago, today China and India are responsible for one-third of total global carbon emissions (Le Quéré, 2018). This is obviously due to the fact that these

countries have rapidly growing economies, and their growth is largely depended on manufacturing industries, such as iron and steel works, automotive industry, chemicals, and electronics. Developed economies, on the other hand, have fast moved into so-called post-industrial sectors, such as software, design, finance, or engineering, which contribute much less to carbon emission.

However, the question of who causes climate change is a bit more complicated. First, increasing carbon emission in developing countries is related to the fact that beginning in the 1980s, major global companies moved their production lines to developing countries. In this way, carbon emitting industries still support the economies of rich countries and the changing trend is merely an illusion due to relocation. This fact is also visible in consumption-based carbon emission statistics. Carbon emission statistics presented in Figure 4 are production-based, but they do not take into

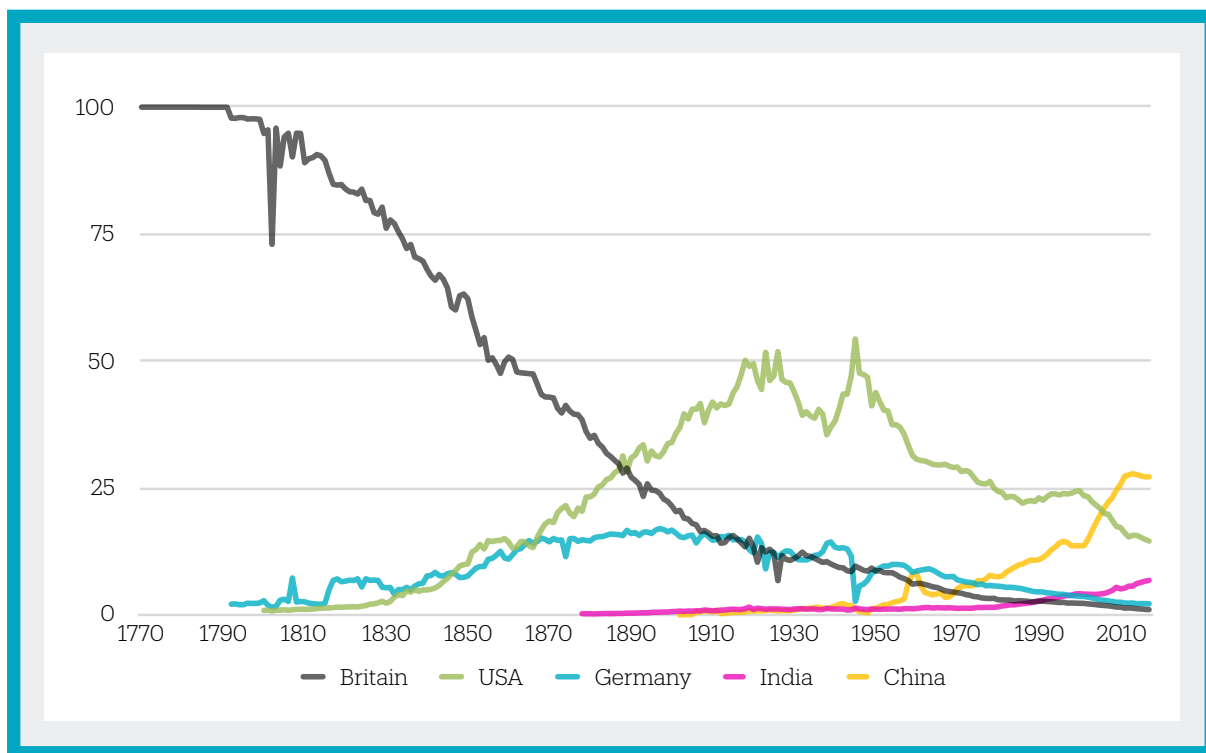


Figure 4. Annual Share of global CO₂ emissions (%), 1770-2017 (source: Global Carbon Project)

account the fact that most of these products are traded and usually end up being consumed in developed countries. In short, rich countries' companies get their goods produced in poor countries, only to be consumed in higher quantities in rich countries.

Second, the main cause of global warming is not the current emission rates but the already accumulated CO₂ in the atmosphere (IPCC, 2018). In other words, it does not matter who emits the highest amount of carbon today as much as who has contributed to it historically. From this perspective, current climate consequences cannot be blamed on developing countries because almost all of today's atmospheric CO₂ concentration has been historically generated by rich countries. Even as late as the 1970s, rich countries such as the US, the UK, Germany, and France were responsible for 75% of global carbon emission (Le Quéré, 2018). Therefore, it is plausible to say that rich countries developed via environmentally polluting production

methods and carbon emitting sectors before switching to the post-industrial economies that they enjoy today.

Arguably, this observation is also at the basis of the so-called 'South-North conflict' in regard to climate change. Developing countries accuse rich countries of taking advantage of the unexhausted natural resources in their earlier phases of economic development but refusing the same opportunity to the developing economies. In other words, today's rich countries developed by polluting the world and exhausting its natural resources, but now that they are at a higher stage of technological sophistication and do not need old-style smokestack manufacturing industries as much, they are refusing the same opportunity to today's developing countries. Developing countries demand their 'right to develop' following the same path and blame developed countries for kicking away the ladder.

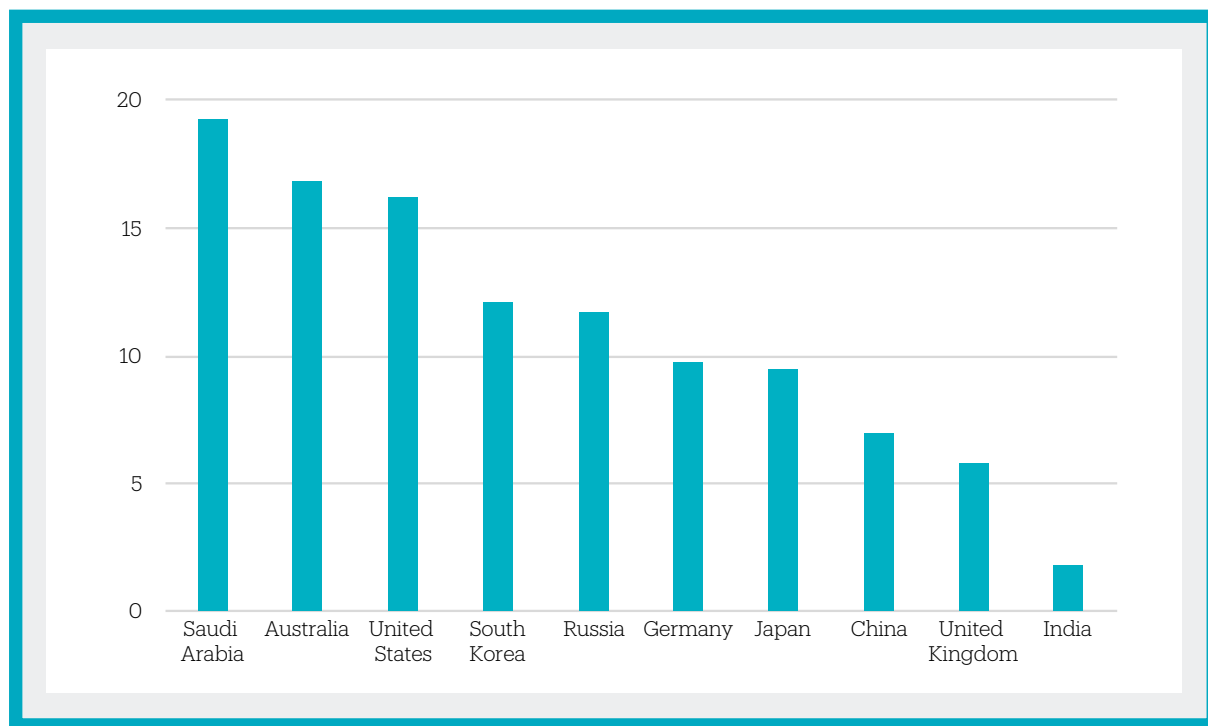


Figure 5, Annual emissions of CO₂ per person (tons), 2017 (source: Global Carbon Project)

Needless to say, this approach is also problematic. If the world is headed toward major catastrophes due to climate change, then it cannot be reasonable and ethically acceptable to follow the path developed economies followed. This would surely be a race to the bottom and, in the end, benefits no one. Some have argued that instead developing countries should demand retributions from today's rich countries for the environmental pollution they caused. This would also contribute to these nations' economic development and make up for the disadvantage they are facing in their early economic development. However, given the unequal power relations between actors, the viability of this proposition is debatable.

Last but not least, it should be noted that in per capita terms, developing countries still fall behind developed countries in carbon emission. China and India rank high in carbon emissions by gross values because they have huge populations. In other words, an average cit-

izen in both countries still has a considerably smaller carbon footprint. This is of course due to low GDP per capita levels in these countries. The worrying issue with this observation is that if these two giant countries continue to grow on their current trajectories and they reach similar levels of per capita carbon emission as other rich countries, then the global carbon emission level will multiply. Given that climate change affects first and foremost poor developing countries, the necessity for inventing alternative growth paths becomes salient. Otherwise, the cost of alleviating poverty in these countries will be the suffering of people in other poor countries.

Economics-based Solutions

There are a number of approaches to deal with climate change through market-oriented solutions. According to these proposals, it is possible to limit and reduce greenhouse gas emissions and pollution through market-based incentives such as taxes or subsidies. A market-based approach may have important advantages over other approaches such as legal restrictions because they are less costly and easier to apply. What all these proposals have in common is that they involve a plan to increase the cost of carbon emitting economic activities or the reward of environmentally sustainable ones.

Pollution (e.g. carbon emission) is what economists call an externality. Some economic activities have direct effects on third-parties or the society in general, but these effects are not taken into account by the parties involved in the economic transaction. For instance, a factory site may be creating air pollution which harms society and the environment, but the producer does not normally incur the environmental cost because production is not affected by it. Similarly, consumption of polluting products (e.g. transportation), has environmental consequences for society in general but neither the supplier nor the consumer incurs the cost. In such economic transactions, public finance economists say, government should step in and find a way to internalize the environmental externalities.

The simplest way to internalize pollution costs of certain economic activities is to tax them. Governments can detect polluting production and consumption activities and tax them to increase their costs for the parties involved in these economic transactions. The result should normally be a reduction in their use because of increasing prices. Nordhaus (2017) for instance, estimates that as of 2015 'the social cost of carbon' is \$31 per ton of CO₂ (in 2010 USD value). This should give a guideline to the government about how much CO₂-emitting economic activities should be taxed per unit so that the cost of pollution to the society can be internalized and such economic activities can be reduced to their optimal level.

Such a tax-based regulatory system provides incentivizes for the polluters to reduce their emission levels to avoid taxes either by limiting their polluting economic activities or using cleaner methods. However, according to many, putting a price tag on pollution is problematic from a moral standpoint (Silvertown, 2015). If the world is headed towards some major catastrophes, then we should probably be looking for more direct ways to limiting the carbon emission. From this perspective, taxing carbon emission is like taxing drivers for extra units of speeding above the speed limit, but it should not be acceptable to put a price on such life-and-dead actions. In any case, it is not certain if the tax will substantially eliminate the overall CO₂ emission either.

Furthermore, there are political limitations to a tax-based system. It should be remembered that a fuel tax (i.e. eco-tax) in France, which was aimed to reduce carbon emission in line with the Paris climate accord, led to a wave of mass protests known as 'Yellow Vests'. Low- and middle-income people rejected the tax because of rising prices. In the end, the French government was forced to cancel the tax. Taxation is a contentious issue also because governments around the world compete with each other to attract businesses, and tax rates is an important battlefield. It is questionable if governments would be willing to raise tax rates on businesses which will surely undermine their competitive position. Developing countries are especially weak in that regard as they are desperate for income and employment generating business investments.

Another solution proposal is a Carbon Credit Market. This is a simple but equally smart idea of creating a limited number of tradable certificates (i.e. permits) which give to its owner the right to emit a unit of greenhouse gas. Then, these permits can be globally traded in the carbon market between producers, and their price will be decided by supply and demand forces. The benefit of this is that it limits the total amount of carbon emission regardless of who owns the permit and at what price. Also, those who emit carbon in the most efficient

way will pay the highest price for the tradable permit, which will maximize the economic value created per unit of carbon emission. In this way, there is no need for enforcing any uniform rules or limitations on all countries either, which can also meet developing countries' demand for 'right to develop' through manufacturing. However, note that this approach can also be criticized from the moral standpoint mentioned above and there are problems regarding enforcement as well.

Just like it is possible to punish polluters through taxation, it is also possible to use subsidies as reward for those who come up with new ideas, technologies, methods which can help reduce pollution. This is another way of internalizing externalities but in this example, externality is a positive one and the policy target is to encourage it. Government can introduce subsidies and conditional financial support for R&D and innovation efforts directed at reducing carbon emission and improving sustainable technologies. This techno-centric approach can incentivize scientific efforts to alleviate the consequences of the climate

problem as well as changing consumption habits and production methods in the right direction. This approach is favoured especially by those who believe in the creative capacity of the private businesses and individual action.

There are solution proposals from the demand-side as well. So-called Green Consumerism, or Green Economy approaches emphasize the power of civil society and political participation and offer bottom-up solutions. They believe that informing the community about potential consequences of the environmental crisis can alter consumption culture in an effective way, which will induce a change in the production patterns as well. People can learn to consume in a way that is compatible with a target of reducing their carbon footprint and demand products that are produced in a responsible way that protects the natural environment. Furthermore, corporate social responsibility and government support can also contribute to this approach (Mol, 2006). However, this approach is also criticized for its ineffectiveness and not being enough.



Do We Need a More Fundamental Change?

It is claimed that market-based economic solutions still operate on the same ground which led to climate change in the first place and place the emphasis on issues such as technology, management, or externalities while disregarding more fundamental political and social problems (D'Alisa et al., 2014; Kothari et al., 2014). In this reasoning, the current situation requires us to reconsider the previously assumed relationship between economic growth and living conditions. For a long while, with the exception of a few figures, economists and economic models have had little consideration for the vital role the natural environment plays for human life but instead took it as an economic asset. However, the commodification of nature is what we should be dealing with in order to overcome climate change.

One policy suggestion coming from those who demand a more radical approach is to end our obsession with economic growth. All countries aim for increasing growth rates in order to improve income levels and consumption possibilities. However, given that increased production and consumption adds to climate change and natural disasters that comes with it, it does not hold true anymore that high growth rates lead to better living standards. Instead, accelerated growth potentially leads to more human suffering and higher risks for the vast majority of world's population. Infinite growth with finite resources should be impossible in any case. Then, we need a fundamental change in the way we understand growth and development. Governments should focus on sustainability and environmental compatibility instead of increasing growth rates. Moreover, some rich countries should consider de-growth (reducing the average income), to release pressure from the planet's carbon emission (D'Alisa et al., 2014).

Some environmentalists take an even more radical approach and suggest dropping the dominant capitalist model of development all together. According to them,

what the world needs is not a cosmetic intervention to the capitalist economic system but a revolution in the way economic system operates. In particular, proponents of this approach suggest that we need a revival of pre-capitalist production and consumption cultures and a total abandonment of modern industrial capitalism. Many traditional cultures depend on a balance between the nature and human life which should be restored; otherwise, the current paradigm will drive us further into the environmental crisis (Kothari et al., 2014).

At the other extreme of the discussion, some claimed that what we need in order to face climate change is not a restrain from technological advancements and capitalist expansion. On the contrary, they argue, we need to focus our efforts into developing sustainable industrial technologies. Spaargaren and Mol (1992), for instance, said "the only way out of the environmental crisis is by going further into industrialisation, toward hyper- or super-industrialisation". Those who follow this reasoning point to the fact that this is how the world overcame its limitations on agriculture. At the beginning of the industrial revolution, some, including famous economist Robert Malthus, claimed that the growing urban population is bounded by the limitations of agricultural production because ever-increasing numbers of people cannot be fed forever (Malthus, 1798).

However, the famously pessimistic Malthusian population theory has been proven wrong thanks to the improvements in agricultural technologies and productivity levels. So, according to the proponents of this approach, we should follow the same path in overcoming the climate challenge. In that regard, the world is already making progress in improving sustainable energy sources such as wind and solar as well as developing more energy-saving production methods; electric cars are replacing conventional internal combustion engine automobiles and reduce the emis-

sion levels and pollution substantially. Obviously, this optimistic approach is heavily criticized by the people who demand more radical actions. But it should also be said that governments around the world seem to be keen on this ecological modernisation approach and continue to invest in renewable energy and sustainable technologies.

At this point, the difference between zero carbon emission and carbon neutrality should also be mentioned. Zero carbon emission means that no carbon is released from a production or consumption activity. For instance, an electric car may run with zero carbon emission. However, the IPCC and most governments seem to aim for carbon neutrality, which means that the amount of carbon released is matched by an equal amount of carbon that is offset somewhere else making the overall net emissions zero. In other words, carbon emission does not need to be eliminated entirely but merely reduced and matched by negative emission activities. Although it is considered as an improvement, some criticized carbon neutrality approach because it combines emission reductions and negative emissions into a single target of reaching 'net-zero'; By

doing so, it leads to insufficient focus on and delays improvements in both fields (McLaren et al., 2019).

McLaren et al. (2019) claim that a more important problem with the commonly held carbon-neutrality approach is that most negative emission technologies are prospective, and we do not really know if they will work or be economically viable in the long run. So, according to them, humanity should not be relying on investments in these prospective technologies with unforeseeable results because this reliance comes with a more relaxed approach to emission reductions. For instance, even limited success in negative emission technologies ironically leads to overly optimistic expectation from the future and reduces focus on emission reductions. To put it differently, actors tolerate current emission levels because they build trust in potential future negative emissions. According to these critics, we should aim for radical improvements in both fields, without assuming any success from the other (McLaren et al., 2019).



Conclusion

The world economy has been through an incredible transformation since the beginning of the industrial revolution which led to significant changes in population, urbanization, consumption, and production patterns. Consequently, human societies have largely experienced an unprecedented material progress and improvement in living conditions. However, this also caused problems and crises which have never been experienced before. Climate change is probably the biggest of these challenges. Increasing greenhouse gas emission due to highly carbon-intensive modern economies increases the global temperature levels, which destabilizes our planet's ecological systems and puts millions of human at risk.

In the last few decades, changing climate conditions have led to a higher frequency of natural disasters, decreasing agricultural productivity, more migration and military conflict, which, in turn, caused tremendous economic costs along with immeasurable human and environmental tragedies. Moreover, these costs are unevenly shared between the world's rich and poor nations. Poor developing countries are more heavily affected by catastrophes because of their geographical location and higher dependence on agriculture as well as their limited capacity to adapt to changing conditions. Unless counteracted by serious policy measures and reforms in economic culture, climate change is likely to cause more human suffering and misery in the coming decades.

Given the trends, it is plausible to say that the currently dominant economic system is unsustainable due to its environmental consequences. Economic growth has been largely driven by highly polluting industrial activities. We need to reform our production methods towards less carbon-emitting, less polluting, and energy-saving technologies. We also need to replace fossil fuels with sustainable energy resources such as solar and wind energy. Furthermore, consumption habits need to change towards a culture that is more com-

patible with a vision to protect natural resources and reduce our carbon footprint. Put simply, all economic systems need to be redesigned with a new vision which incorporates formerly lacking consideration for the environmental effects at the local and global scale.

The major transformation requires serious government leadership. Arguably, governments should use a combination of market-oriented and legal-based policy measures to limit carbon emissions. Fiscal policies can be designed in a way to internalize externalities involved in relevant economic activities. Furthermore, cooperation between governments is paramount for successfully limiting the global temperature rise to the target level of 1.5 C°. Developing and especially the least developed countries should be supported through financial aid in their attempt to modernize their energy systems and production lines. However, there are admittedly serious structural obstacles for cooperation between rich powerful nations which are expected to be least affected by climate change and poor countries that are already experiencing the costs at a larger scale.

All in all, at least for the time being, the reversal of climate change seems to be within possibilities. It surely requires a radical approach and cooperation at a global scale. Ironically, modern societies' great dynamism and capacity for change, which led to the current crisis in the first place, may be the most important advantage humanity has in this battle. However, mobilization of this power for the right end first requires a reformation in the political economy of powerful industrialized nations. The fact that the planet's future depends on the political leadership in rich nations contributes to the pessimism surrounding the climate change crisis.

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