Politics of Climate Change in Taiwan and New Zealand

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--Working Paper--

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Abstract:

Climate Change has an increasing policy relevance for the international and domestic policy formations. Governments around the world pay an increasing attention to possible social, economic and political consequences of the climate change. As a result, increasing number of countries device comprehensive political frameworks to address the issue. However, there are structural constraints on some countries due to their geographical locations and powers in the international system. This working paper, thus, survey the ambitions and feasibility of two countries, Taiwan and New Zealand, to tackle the problem while attempting an analytical analysis. As a result, this working paper aims to bridge theoretical debates and policy aims for the two countries, with a particular emphasis on the security consequences.

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Note: Code and the dataset used in this research is openly accessible in this GitHub repository: https://github.com/edbezci/GHGecon

Introduction

International news, and scholars alike, pays growing attention on the implications of Anthropocene. However, there is still seldom attention on the concrete policy related research on what can public and private sector doing to alleviate impact of the new epoch. Exclusion of Anthropocene from the policy related debates undermines serious threats posed on, and shadows feasibility of the required preferences and implications. This research utilizes the related literature from international relations, comparative politics and political economy to demonstrate the feasibility of the climate politics in Taiwan and New Zealand.

Anthropocene is the new human created geological epoch. The human footprint on the Earth has created a telluric impact on the Earth system altering the very fabric of Earth such as its atmosphere and biosphere. The Nobel Laureate atmospheric Chemist Paul J. Crutzen proposed in the annual The International Geosphere-Biosphere Conference in 2000 that we human species now live in the Anthropocene. Since then scholars at the International Commission on Stratigraphy have been constantly debating on the topic to officially declare the new geological epoch. It is still vague what Anthropocene might constitute and when does it has begun. Some argue for the industrial revolution, steam engine and burning of fossil fuels. Other scholars trace it back to the Orbis Spike in 1610 where a mini ice age started due to a drastic fall of CO2 levels in the atmosphere. Scholars pin this drop to the death of millions in American continent and former farmlands recovered by the forests as a result of the vanishing pre-Columbian civilizations by the European conquest marking the beginning of globally interconnected ecology and economy setting Earth to a novel evolutionary course. [1] While the scholarly debate continues, the common ground for this debate is

the human action is causing the Anthropocene epoch. This is a new reality that every nation has to face. Human civilization has emerged and nourished in the previous epoch, Holocene, with mild and stable climate and relatively abundant resources enabling the human population to spread around the globe. The new reality, however, is an unpredictive where humans, as whole species, have never experienced.

Scientists are constantly calling for a political action reduce to the greenhouse gas emission levels drastically and quickly as possible in order to mitigate the global warming levels within 1.5 – 2 Celsius degrees by 2030 within the pre-industrial levels.[2] Otherwise, scientists warn of exceeding the planetary boundaries and tip Earth system into an unhabitable status. Taiwan and New Zealand, both island nations are under significant threat from the Anthropocene. Both countries' have ambitions aims to mitigate the impact of the Anthropocene and reduce their own greenhouse gas emissions. However, the structural limitations that both countries face due to the small state restrictions can pose significant obstacles to pursue their economic growth while mitigating climate change. This paper identifies the specific anthropogenic threats that the both countries are facing. Following by this description, this paper employs methods from political economy and software algorithms used in R Statistical computing to test the feasibility of Taiwanese and New Zealander climate politics.

Small State Trap

Whether we accept that the climate is changing or not, this reality surrounds us. The year 2016 was the hottest ever recorded. So far, 16 of the first 17 years of this century have also broken temperature records.[3] All told, compared to the mid-1900s, global temperatures are now on average nearly one degree Celsius (°C) higher than they were.[4] These changes correspond with increasing amounts of greenhouse gas (GHG) emissions. In 2016, atmospheric carbon dioxide

(CO2) concentrations rose past 400 parts per million (ppm), a stunning figure given that pre-industrial era levels were 280 ppm.[5]

Changing temperatures have already altered weather patterns in dramatic ways that harm human life. In the Bangladeshi capital, Dhaka, rising sea levels have caused soil erosion and flooding fueling fears about social pressures in the world's most densely populated capital.[6] In 2013, the International Food Policy Research Institute argued climate change will turn some West African agricultural lands into nonproductive zones, a troubling claim considering how droughts in Somalia have led to humanitarian crises and spurred conflict.[7]

The ambiguous nature of the climate makes creates another layer of complication for policy makers who are tasked to tackle the issue. The political fragmentation is evident in the process of recognizing climate change as a national threat being fully securitized. In the last two decades, there have been several different securitization theories which identified climate security, but beyond identification of the theories could be systematically integrate climate security at either national or the international level.[8] Climate change was partially introduced in the securitization debate. In 2006, during British Presidency of Group of Eight Foreign Secretary Margaret Beckett accepted the fundamental links between energy, security, climate change and sustainable development.[9] Soon after, United Nations acknowledged climate change as a security threat adding it a prefix multiplier.[10] In their study, Podesta and Ogden emphasize the fact that multiplier effect is a great threat for national and international security and of a monumental importance for national and global security.[11] Different studies tried to open a debate on the topic, but many of their analysis revolved on the consequences of worst-case scenarios or presenting only a role of the organizations that would be involved in responding to challenges emanating from the climate change.[12] Nevertheless, all these fail to integrate climate change into main securitization thought within international relations at large.

Securitizing climate change is easier said than done. There have been efforts by academics to include environmental security as a part of national agendas by defining it as pre-existing notions of security and integrating it into already exiting realist security paradigm.[13] However, all of these efforts still kept state in the center. Matthews in her article "Redefining Security" explicitly stated that the environment must become a central part of national securitization agenda.[14] The body of literature which examined this issue in the light of securitization debate remained very broad, general and anecdotal.[15] According to Levy the securitization of climate change using classical theories has failed because the theories behind it were rhetorical and did not offer novel definitions nor serious scholarship.[16]

Nonetheless, there has been an effort of establishing a link between climate and security policy. Homer-Dixon empirically tested the link between violent conflict and environmental degradation.[17] Furthermore, Beck introduced the concept of risk society that is explained as "systematic way of dealing with hazards and insecurities induced and introduced by modernization itself."[18] The concept of risk society dwelled deeply into the securitization of the climate change. But most notable work in the sphere was done by Buzan, Wæver and de Wilde of the Copenhagen School of security studies. The novelty of their approach is that their scholarship has moved away from state-centric view of security. They stated that the security policies must be based on addressing existential threats which depend on the "relation to the particular character of the referent object in question."[19] There is no universal standard to define threats and there are threat that are capable of producing multiplier effect to the security.

So why is climate security such as problematic concept to digest in the sphere of national security policies? The answer is to be found in geology rather than international relations. For little bit less than 12,000 years humanity has been living in the geological epoch called Holocene which was characterized by stability of the climate, a fact not attributed to earlier epochs.[20] Human species utilized this period to thrive and development major civilizations resulting in industrialization. Human prosperity driven primarily by global economic activity has caused the Great Acceleration manifested in a subsequent changes in GHG emissions levels, ocean acidification, deforestation and biodiversity deterioration.[21] In early 2000s atmospheric chemist Paul J. Crutzen introduced the Anthropocene, a geologic epoch which correlated human activity to significant global impact on Earth's geology and ecosystems.[22]

In his paper "The geopolitics of climate change" Dalby state that:

> The emergence of this new condition, of life in the Anthropocene, requires us to recognize that the modern assumptions of nature as separate from humanity, of environment as an external element, determining or not, of the human condition were never a very accurate portrayal of life in the biosphere.[23]

Anthropocene is problematic because it destabilizes the core on which modernity exists. Security in the Anthropocene does not focus on the individual parts of international system (i.e., states), but rather the system's (i.e., planet) capacity to develop a response to disturbance and adapt so it could preserve its identity and function.[24] There is no division between human species and environment, they are viewed as one.[25] Anthropocene undermines understandings of space as fixed, climate change is a cross-border issue. Furthermore, it contradicts our understanding of time.

Grove and Chandler explain this in the following lines:

> The complex inter- connections and feedback loops that comprise the Anthropocene's emergent spatiality generate non-linear changes that cannot be predicted from either past experiences or a given arrangement of things in the present.[26]

Most importantly, for the purpose of this paper, the Anthropocene undermines the sense of security that is familiar to the modern society. This means that the notion of safe, confined, predictable space (i.e., national territory) that can be protected from outside influences which can be predicted does not stand. Anthropocene functions through a set of dynamic interconnections, on planetary scale, that are hard to recognize and comprehend through traditional securitization approaches.

In sum, climate change is a non-traditional security threat that threatens the wellbeing of ordinary citizens.[27] Climate change induced challenges such as heightened sea levels, food and water shortage, droughts, climate migrants and increase in air pollution levels have a direct impact on human lives, thus on the nation states.[28] How does New Zealand and Taiwan aim to tackle these issues? Before further elaboration on this, it can be useful to frame the small state restrictions, and relativity of their structural power.

The small states have been overlooked in the study of international relations. Since the small states are believed to have limited if any impact at all on international affairs, international relations scholars have paid limited attention to the topic.[29] The small states are so diverse as to make difficult even a comprehensive definition of which states would be included in such a category.

There are various determinants such as population, economy, size, or military power.[3030] The ambiguity over the definition mostly stems from the fact that small states are diverse. Both newly independent and security prone Baltic countries, wealthy Luxembourg and New Zealand which occupies almost the same landmass as the United Kingdom are considered small states.

One commonality among is that small states have structural size-related problems (sometimes opportunities) due to the deficit in their aggregate structural power[31]. In this paper, the small state does not refer to definite and objective term but refers to a rather relative definition of small states as 'far inferior to great powers or modestly inferior to middle powers in terms of influence at any given time'.[32] This relativist definition works in accordance with the argument of this paper since the examined empirical cases include New Zealand and Taiwan.

Most of the existing literature on small state research dominated by either single-state case studies or particularly focusing on the small states' vulnerability and lack of capacity.[33] There is also growing literature aiming for a comprehensive examination of contemporary security issues for small states such as cybersecurity, and bioterrorism.[34] Besides examining small states' security policies, there are new approaches in small state research seeking to establish a systematic approach to how small states behave in the international arena. Alliance Shelter theory in particular challenges the traditional alliance theories, arguing that small states fundamentally differ from larger states in economic, social and political terms. According to Shelter Theory, small states do not solely seek bandwagoning or balancing when forming alliances. This differentiation does not only refer to a gap between capabilities but considers that small states employ a totally different operational logic. This theory argues, for instance, that there are large and unique domestic incentives for small states, and that 'alliance theory neglects to take into account the inbuilt structural weaknesses of small states and how these affect the day-to-day well-being of their

citizens Shelter theory provides a framework on small state studies highlighting that it is essential to account for domestic, economic, political and social uniqueness of small states in order to understand their need for shelter provided by an external power in order to thrive.

Another valuable contribution to our understanding of is Tom Long's argument that small states have a more distinct way of power projection in international affairs, and this projection can be nalyzed three different ways: particular-intrinsic, derivative, and collective power.[35] Long challenges the conventional wisdom that small states do not have much significance compared to larger countries, and argues small states may have other channels to project their power disproportionately the lack of their aggravate power. Small states lack traditional resources such as a large military or economy that their larger counterparts have. Long argues that small states may have intrinsic resources which are 'not commonly understood as power, the resource fades from view until it is given means and applied to a specific goal or scope'.[36] This resource can be a strategic location or existence of a particular good such as hydrocarbon assets, or other crucial capacities enabling a small nation to amplify its influence.

One important feature of the small states is that they are highly dependent on international trade and limited in their economic steering where they are prone to changes in economic structures. This feature is associated with the relative structural limitations that the small states have. For instance, the trade-off between economic growth vis-à-vis greenhouse gas emissions poses more challenging policy issue for small states than their larger counter-parts. Again, if such an environmentally sustainable policy to be formed, there needs to be shelter over the small states to prevent them from economic stagnation and unsustainability. Therefore, as argued by Thorhallson,

small states need shelter not only for traditional security issues but also to sustain their international trade and economic growth which they are highly depended on.

Climate Breakdown and Consequences

Literature arguing for an earlier date of the Anthropocene marks the changes of how people live and organize themselves in the communities. For instance, agrilogistics marks the shift from hunter-societies to the agricultural societies, and lies at the origins of the Anthropocene, paradoxically nurtured human dominance of the planet Earth.[35] Approximately somewhere between %30-50 percent of the Earth's surface is transformed by human action, and much of this land transformation aims to create further agricultural land, or other human created biomes called as anthromes.[36] As a result of this anthropogenic transformation, Earth's greenhouse gas observation capacity, as well as the amount of the nitrous oxide (N_2O) has been altered.[37] Adoption of agriculture by homo sapiens with the onset of Holocene in 13000 years ago by "intensive and extensive mobilization of natural resources toward the imperative of surplus production" triggered the population boom and enabled the alterations of planet's biochemical properties. [38]This process increased concurrently with the increase in the human population and emergence of the new technological, albeit not sustainable, innovations such as syntactic fertilizers to feed the increasingly urban world population. As a byproduct of this biosphere alterations through human agriculture, forests are replaced with dry grass lands leading to more frequent wild fires, and an additional stress on the Earth system by causing additional amounts (1.7. GtC/yr) of another potent greenhouse gas, Carbon dioxide (CO_2). Following Tim Morton's conceptualization, one can define the agriculture in the Anthropocene as a weird concept, one that enabled the human population boom and global existence, yet it is the same culprit that altering the biochemistry of the Planet Earth that provides habitat for homo sapiens and other species on Earth.

The anthropogenic pollutions further accelerate the alteration of the planet's biochemical structure and further causes the extinction of species, which is called the sixth mass extinction. The great acceleration that marks the post-World War II global economic development. The neoclassical economic theories that proposes unlimited Earth capacity or does not see the Earth system as a part of the economic modelling is another culprit behind the Anthropocene. There is not an equal responsibility among the nations causing this great acceleration. Same argument is also valid for the negative consequences of Anthropocene where poorer nations and communities are more vulnerable to the shocks of the Anthropocene. [39]Although the national responsibilities vary, the stress on the Earth system in terms of water usage, pollution production, greenhouse gas emissions, species extinction and natural stock depletion shows increasing warning signs, and sometimes leading to the four folds increase from their pre-1950 levels. This point creates the weirdness of the concept of the agrilogistic and the Anthropocene.

Apart from the empirical data informing us about the increase in average global temperature, it is a political question regarding the human relation with the rest of the world. There is a new realization raised by scholars and other stakeholders that after experiencing a stable climatic condition for ten thousand years enabling civilizations to form, technology to advance and humans to get wealthy, the earth system and planetary boundaries are stressed to its limits. The survival of current planetary boundaries, and if so how, that enables a human civilization to thrive in are depended on political choices. [40] Such a realization challenges the dualist view of humans being separate from the rest of the world, and the Earth's feedback systems can find an equilibrium to return to its "natural" state.

This realization closes the divide widened after the industrial revolution between nature and people combining two split timelines: One is Earth's geological timeline, the other is human civilization's

history. The new reality is a turning point where Earth system is altered with human action causing an geohistorical timeline where human and non-human world acts in a single timeline.[41] However, this realization of seeing humans as the product of the environment does not necessarily mean that humans also can prevent damaging the environment they live in. Scholars describe this as the schizophrenic nature of modernity. [42] The nature of Anthropocene is complex with layers of social, natural and technological actions reinforce and affect each other. Such a reinforcement exceeds the spatial and temporal boundaries. Northern American costumer behavior can destroy Orangutans in Indonesia, social inequalities could change the atmospheric composition. This new reality of constant reinforcement and feedback in the globally connected epoch of Anthropocene requires an equally connected and transdisciplinary approach. Clive Hamilton identifies this problem as:

> Many intellectuals in the social sciences and humanities do not concede that Earth scientists have anything to say that could impinge on their understanding of the world, because the "world" consists only of humans engaging with humans, with nature no more than a passive backdrop to draw on as we please.[43]

However, Hamilton's call falls short. There are valuable attempts on the trajectory between science, technology and politics such as Allenby and Sarewitz's techno-human concept arguing that technological developments may have higher incalculability, complexity and ramifications can pose the danger of being elusive for comprehension. However, elusiveness and higher complexity does not block further analysis of the Anthropocene's constantly reinforcing "socio-bio-geosphere". Therefore, Fressoz and Bonneuil calls for "a dialogue of disciplines with varying levels of analysis, from the molecular level of environmental effects on our heredity through to the global level of flows of matter and capital organized by the WTO, by way of local scenes at

industrial sites or socio-environmental mobilizations."[44] Anthropocene requires a transdisciplinary approach to answering this question. It provides an opportunity to nurture communication between the epistemic communities and to co-generate knowledge. A transdisciplinary approach centers around a method driven scientific principle aiming at the solution or transition of societal problems, and related scientific problems by differentiating and integrating knowledge from various scientific and social epistemic communities.[45] First, thus, it is useful here to briefly summarize the challenges that the Anthropocene poses for Taiwan and New Zealand.

Policy Challenges

Politics of Anthropocene require a further dialogue between different scientific and extra-scientific communities to move beyond merely identifying the various ramifications in a disconnected way. The current research though mostly stems from the natural and life sciences provides a valuable contribution on the complexities of Anthropocene in Taiwan and New Zealand. Climate scientists discover that average daily and annual temperatures in Taiwan rose 1.0C to 1.4C over the last century.[46] This is, although affecting the island nation more, is not an independent issue but a part of the changing regional and global weather systems.[47] However, the scientists project a warmer summer and increasing anomalies in the precipitation levels throughout the country over the next couple of decades.[48] Similarly, for New Zealand, "a currently experienced extreme rainfall (e.g., 24-hour extreme with a 100-year return period) could occur approximately twice as often (i.e., 50-year return period) under a local warming of about 2°C. Conversely, increases in dry spells are also possible."[49]

The rising temperature and weather anomalies will directly impact the sustainable Food security in Taiwan. In a study produced by executive yuan identifies the Taiwan's food self-sufficiency at 34.1 percent, one of the lowest among the East Asian nations.[50] Although the government has

plans to increase this level to 40%, there are already existing and anticipated future challenges on the food security. Experts at Executive Yuan identifies these challenges as: " low level of food self-sufficiency, aging farmers, large acreage of set-aside farmlands, small scale farming, soaring price of fertilizers, natural disasters accelerated by climate change, and rapid changes in the world food economy."[51] The Anthropocene effects causing precipitation anomalies are projected to have "devastating" impact on the farmers.[52] The increase of the average temperature in Taiwan does not only impact the agriculture and food security but also threatens the endemic species, such as Taiwan Trout, for extinction.[53] New Zealand is subject to a similar concern as well.

Anthropocene also poses additional challenges for Taiwanese public policy in terms of disaster management and preparation. Taiwan is already on a difficult climatic and spatial location. Taiwan is on the tropics and subtropics where tropical cancer passes at the south of the island. This causes high temperature and abundant rainfall. Moreover, the mountains and rugged hills cover two-thirds of the island. The island is also on the seismic fault lines around the Pacific Ocean known as the Rim of Fire. These conditions make the country additionally prone to natural disasters. The anthropogenic affects, however, puts creates additional stress. Typhoons are major disruptive events causing damage to a large spectrum of activities ranging from agriculture to the international commerce and transportation, let alone daily lives of people. Due to the Anthropocene scientists points out that New Zealand cyclone frequency is disrupted and subject to Niño-Southern Oscillation phenomenon with "changes in wave climate are projected for the tropical Pacific due to anthropogenically-forced changes in atmospheric circulation"[54].Scientists point that between 1970 and 1999, on average there were around 3 typhoons affecting Taiwan. However, since 2000, this number has almost doubled since then. The according to a recent study "observational analysis and model simulations, warm sea surface temperature anomalies over the equatorial western and central Pacific appear to be a major factor contributing to a northward-shifted typhoon track".[55] The increased number of typhoons have multiplier affect on floods and

landslides. Taiwan is already the world's one of the most prone regions for the landslides. However, it is estimated that, due to anthropogenic increase of the severity of typhoons, "average total unstable area is expected to increase from 1135 ha in 1960–2008 to 1280 ha in 2010–2099, a 12% increase".[56] Projections show that due to global warming and increased annual temperatures, Taiwan will weather extremities of more frequent droughts and floods, regardless of the variations of the greenhouse gas emissions, and efforts to minimize global warming:

> Regarding seasonal variations, precipitation will increase in wet season and decrease in dry season, as well as the surface runoff. Significantly greater evapotranspiration will be the case for both seasons due to rising temperature. As a result, infiltration will slightly increase in wet season and greatly decrease in dry season causing a decline in the annual infiltration. The possible outcomes of such climate changes will present a higher chance of devastating floods in wet season, and severe droughts in dry season, which require effectively adaptive measures for future water resources management in Taiwan, especially the southern district.[57]

Global warming would cause rising sea levels in Taiwan that can devastating floods particularly in the Western part of the country.[58] The more worrying revelation is that the sea levels around Taiwan has been significantly larger (5.7 mm/yr) than global values (3.1 mm/yr).[59] Researchers identifies the temperature anomalies at the upper layers of the surrounding seas to be highly correlated with the rising sea levels. Similarly, for New Zealand, as well country's coastal communities with "extensive public and private investments, as well as many traditional Māori assets and cultural values, are in areas increasingly at risk of flooding and sea level rise."[60]

Changing temperatures may create more habitable ecosystems for virus and bacteria, with their carriers, to spread more quickly before humans could develop immunization or a treatment. One particular issue Taiwan could face with the warming temperature is the increase in the severity of Dengue Fever, particularly in the island nation's southern cities. Dengue Fever is a possible fatal and highly contagious virus carried by a mosquito species called, Aedes aegypti. The vaccination for dengue is still not widespread and currently under licensing procedures in several countries, such as Brazil. Taiwan's southern cities, particularly Kaohsiung has experienced several major dengue outbreaks with severe ones in 1988 and 2002. Researcher identified that rising winter temperatures and humidity in Taiwan enables Dengue carrying mosquitos to survive through winter increasing their population and their infectious effect.[61] Similarly changing climate patterns in New Zealand, although never had a mosquito borne disease, put the country under high risks "by chikungunya virus…because of the transmissibility of this virus in subtropical climates".[62] Although Taiwan and New Zealand's scope of security understanding differs from each other, New Zealand's 2016 Defence White Paper accordingly highlights the NZDF's responsibilities in the wake of "environmental challenges" in the Pacific region. Violent conflicts are more likely when food security lowers, which aggravates social grievances and increases recruitment opportunities for illicit groups such as criminal or terror networks. Criminal networks in the Pacific are already a concern for New Zealand, and climate change will likely increase their outreach and scope. The NZDF will need to help build its Pacific neighbors' capacities to ensure regional security is not undermined. Although the NZDF's Humanitarian Assistance and Disaster Relief guidelines are already comprehensive, future pressure on the coordination of these missions may prove overwhelming due to a climate change-induced rise in the frequency of natural disasters. Violent conflicts are more likely when food security lowers, which aggravates social grievances and increases recruitment opportunities for illicit groups such as criminal or terror networks. Criminal networks in the Pacific are already a concern for New Zealand, and climate change will

likely increase their outreach and scope. The NZDF will need to help build its Pacific neighbors' capacities to ensure regional security is not undermined.[63]

Ambitions and Economic Growth

Both countries have ambitious goals to reduce their Greenhouse Gas Emissions and be exemplary for others planning to do so. However, Taiwan and New Zealand have different economic structure coupled with different priorities. For instance, New Zealand have more flexibility to dedicate resources to mitigate the impact of the Anthropocene. Due to its geographically isolated location protects country from other hard security issues. On the contrary, Taiwan growingly feeling the pressure from the People's Republic of China. Therefore, Taiwan has less flexibility to dedicate resources mitigating the Anthropocene rather than defense spending. Moreover, both countries, as pointed in the small state literature, structurally limited to sacrifice economic growth for the sake of preventing environmental damage.

Political Economy literature provides tools to test the feasibility of these two countries' ambitious aims for reducing greenhouse gas emission while keeping economic development. [64] [61] Environmental Kuznets Curve hypothesis provides a conceptual framework proposing that the graph of the relation between the environmental damage and economic development has a reverse U shape. This relationship explains that after the economic development of a country reaches a certain level, the environmental damage created by the economic development begins t

decrease.[65] Environmental Kuznets Curve hypothesis provides a frame of reference to assess the feasibility of New Zealand and Taiwan's ambitions. If both countries are on the right track to achieve their goals, the economic intensity of their greenhouse gases should be on a decreasing trend while their economies continue growing. In order to demonstrate whether such a trend exists, empirical data on Greenhouse Gas Emissions, Economic Growth and Population is analyzed and visualized using R Statistical Software. The source of the data is Statistics New Zealand and National Statistics Taiwan.[66] Calculated Greenhouse gases are the annual sum of emitted CO2, CH4, N2O, HFCS, PFCS, SF6, and NF3 measured in 10^3 tones.[67] Gross Domestic Product is measured in USD equivalent in real terms. Indexing of greenhouse is measured in through this mathematical formula:

$$E_i = \frac{\frac{G_i}{GDP_i}}{\frac{G_0}{GDP_0}}$$

Gi – Greenhouse gas emissions in that year; GDPi – Gross Domestic Product in that year; Go - Greenhouse gas emissions of the base year; GDPo – Gross Domestic Product of the base year; Ei – Index (Percentage) Change Economic Intensity of Greenhouse Gases

	Year	Country	GDP	GHG	Population	GHG_Econ	GHG_Capita
1	2007	New Zealand	100	100	100	100	100
2	2008	New Zealand	97.1	87.3	101.	89.9	86.6
3	2009	New Zealand	88.4	85.9	102.	97.3	84.4
4	2010	New Zealand	107.	85.4	103.	80.0	82.9
5	2011	New Zealand	123.	93.1	104.	75.9	89.7
6	2012	New Zealand	128.	99.1	104.	77.2	95.0
7	2013	New Zealand	139.	103.	105.	73.9	97.5
8	2014	New Zealand	146.	98.9	107.	67.6	92.6
9	2015	New Zealand	129.	99.8	109.	77.2	91.7
10	2016	New Zealand	138.	97.0	111.	70.4	87.3
11	2017	New Zealand	149.	102.	113.	68.4	89.6

	Year	Country	GDP	GHG	Population	GHG_Econ	GHG_Capita
1	2007	Taiwan	100	100	100	100	100
2	2008	Taiwan	102.	94.5	100.	92.5	94.1
3	2009	Taiwan	96.0	89.4	101.	93.1	88.8
4	2010	Taiwan	109.	95.2	101.	87.1	94.4
5	2011	Taiwan	119.	97.0	101.	81.6	95.9
6	2012	Taiwan	121.	95.3	102.	78.5	93.8
7	2013	Taiwan	125.	95.5	102.	76.2	93.8
8	2014	Taiwan	130.	96.6	102.	74.3	94.6
9	2015	Taiwan	129.	96.1	102.	74.7	93.9
10	2016	Taiwan	130.	97.3	103.	74.8	94.9
11	2017	Taiwan	141.	95.7	103.	68.0	93.2

GHG – Changes in the Greenhouse Gas Emissions; GHG_Econ – Changes in the Economic intensity of Greenhouses; GHG_Capita – Changes in the Greenhouse Gas Emissions per Capita.

Visualizations below provide a summary confirming that both countries' Greenhouse gas economic intensity is decreasing.

Figure.1. New Zealand: "New Zealand has committed to reduce greenhouse gas emissions by 30 per cent below its 2005 levels by 2030".

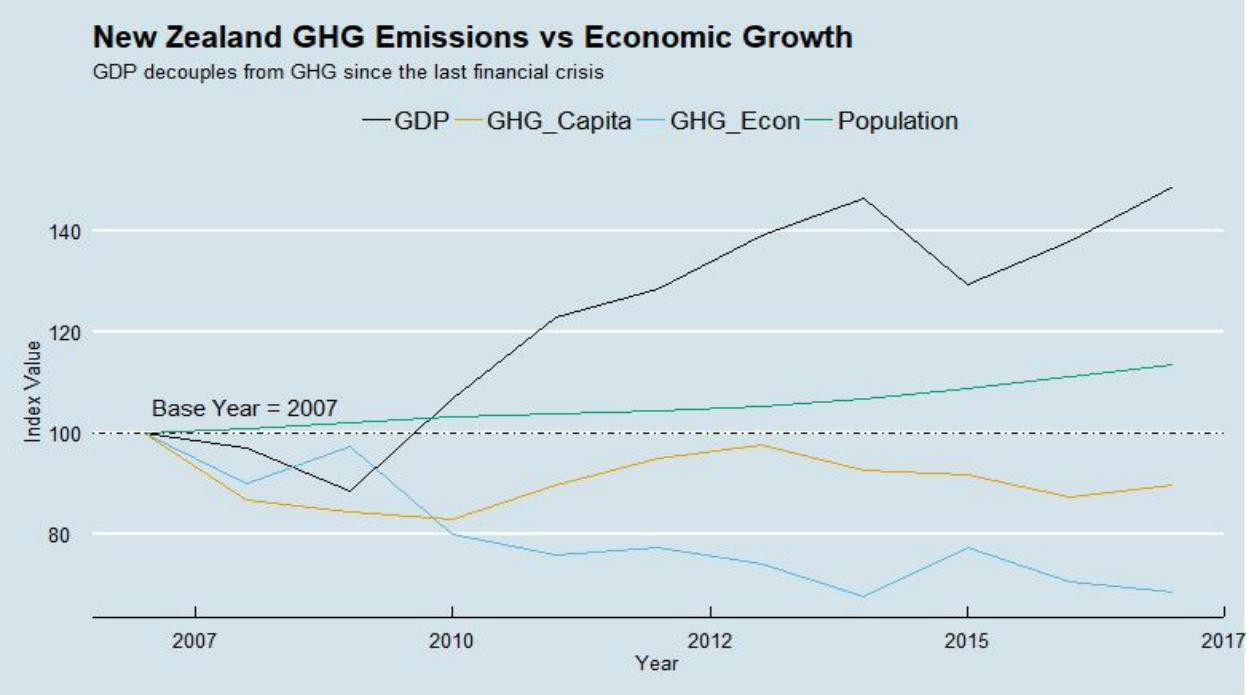


Figure2. Taiwan: "Taiwan has a target of cutting carbon emissions by 2030 to a level equal to 80 percent of the nation's total carbon emissions in 2005."

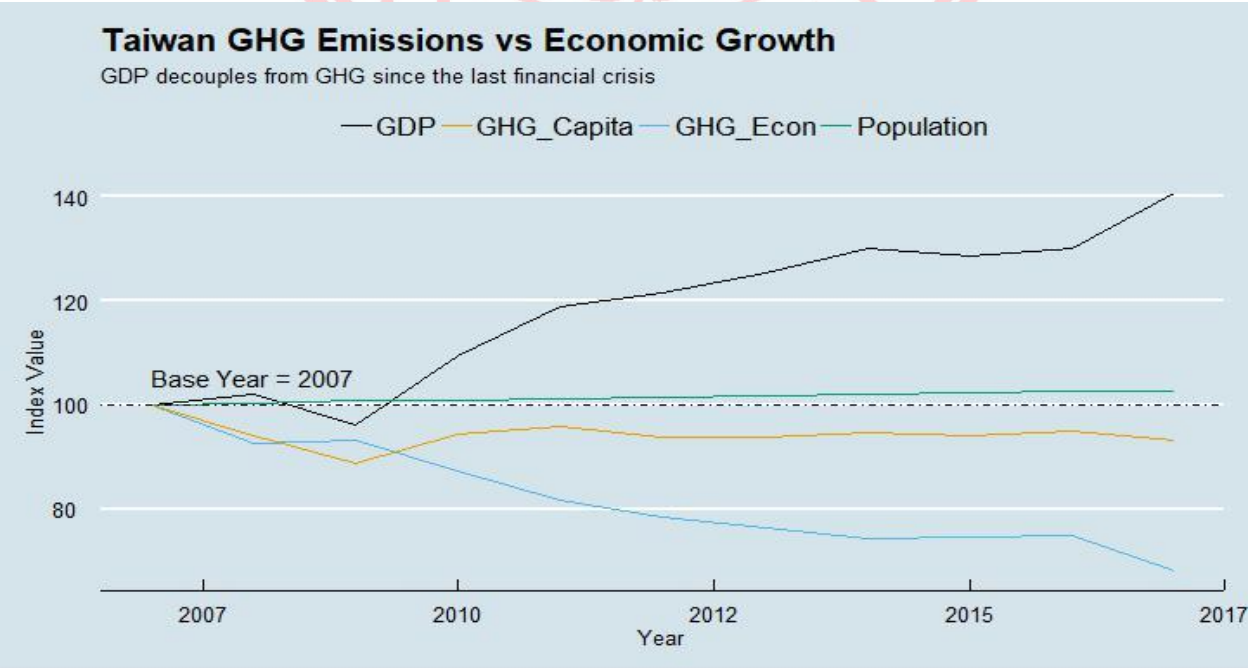


Figure3. Taiwan: Economic Growth and Emissions

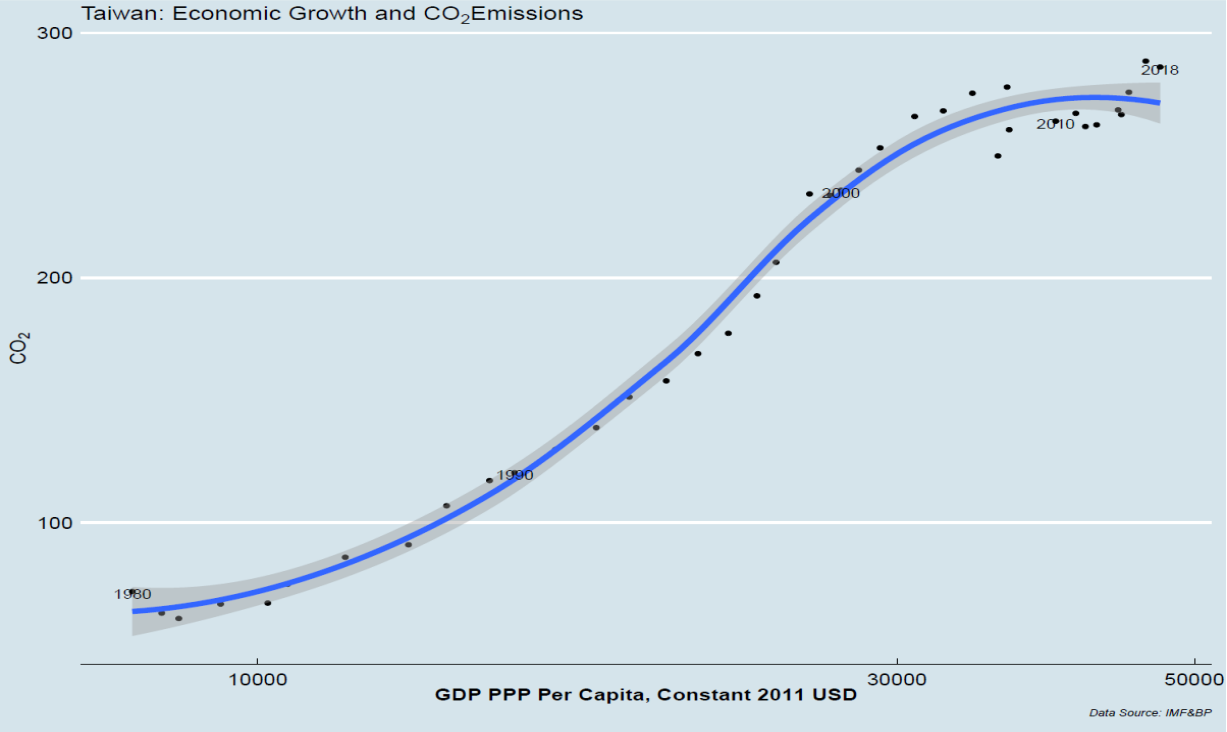


Figure4. New Zealand: Economic Growth and Emissions

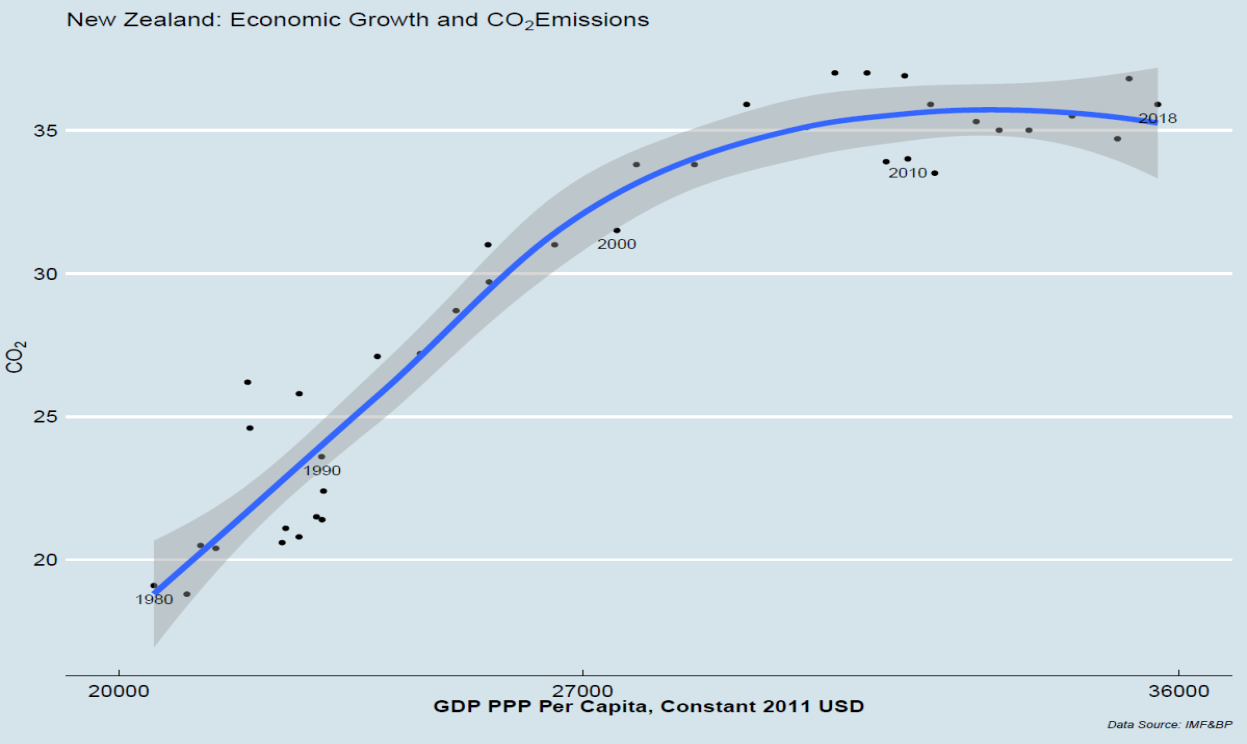
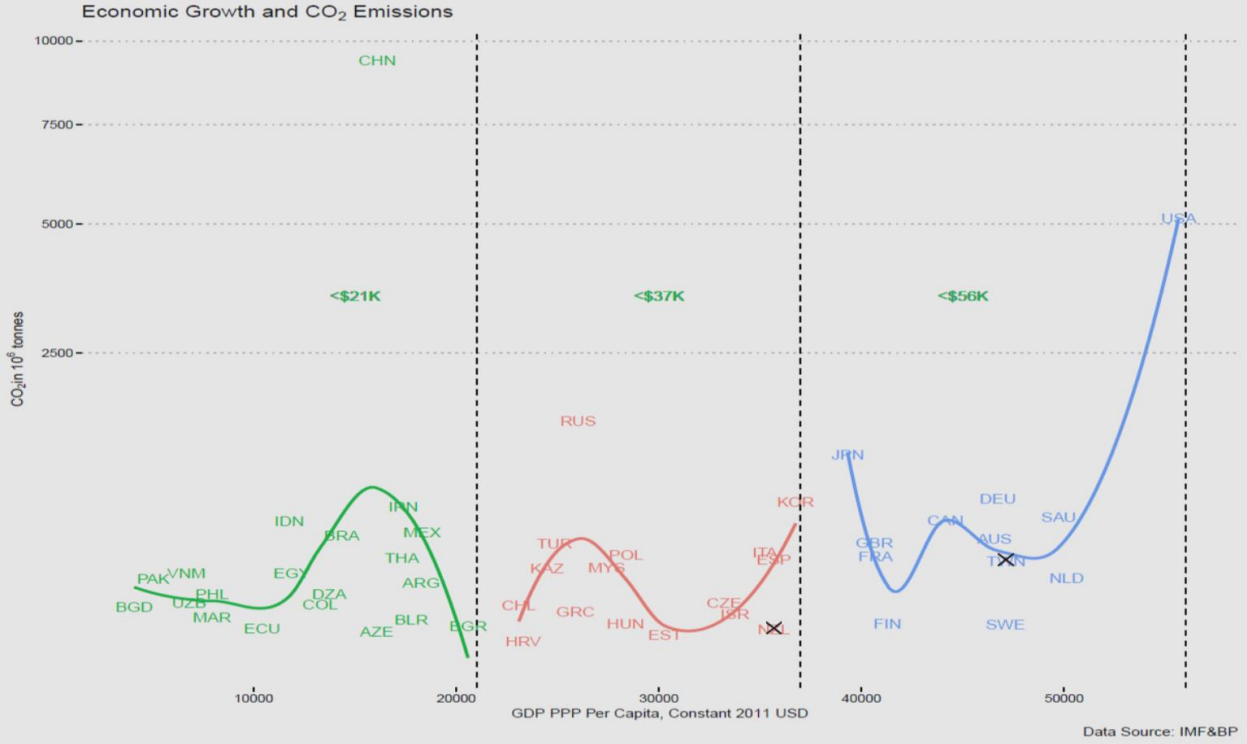


Figure5: World Comparison



Further Steps

This study is far from providing a conclusive statement. However before elaborating on the future directions, it is important to point out a warning statement from Clive Hamilton highlighting the paradoxical nature of economic growth, innovation, and environmental damage:

> Some Prometheans, the geoengineers, are convinced that humans can use their technological might to subdue the restless forces of the Earth System. Yet the unleashing of the Earth's powers has barely begun. Humans may or may not yet have pushed the system beyond the major tipping points that would trigger unstoppable feedback processes, including a melting West Antarctic ice-sheet, thawing Siberian permafrost, and dieback of Amazon rainforests, although perusal of the latest studies suggest we inevitably will. When that point of no return is crossed, if it has not been already, we will face a different kind of Earth, one that will increasingly render humans and their technologies feeble by

> comparison. At some far distant point in the future, after a life-or-death lottery for the Earth's biological inhabitants, the Earth System will settle into a new equilibrium. The new "basin of attraction" will be marked by little or no polar ice, a world congenial for insects and reptiles but inhospitable for large mammals like us.[68]

It is crucial to keep in mind that the impact of Greenhouse Gases, environmental damage and economic growth. Although the empirical results demonstrate a downward trend in economic intensity of the greenhouse gases for both countries, the decrease is only proportional does not reflect the actual amount of change in the greenhouses. Further analysis using the tools from political economy is required to include the other variables such as land-use changes and renewable energy production. The proportional trend points that the both countries are on the right track to achieve their aims but further data exploration including time-series regression analysis, sectoral analysis and if possible integrating interviews with stake-holder are necessary to further tests the feasibility of their policy aims.

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