The Empirical Possibility of Green Growth:

Evidence of significant relationships between Economic Growth & Job Creation, Poverty Reduction and Resource Constraints & Climate Change during 1990-2014 in Thailand

Photo Credit: United Nations Economic & Social Commission of Asia-Pacific, 2015

Master Thesis

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Master of Science in Sustainable Development, Management & Policy

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AFFIDAVIT

I hereby affirm that this Master's Thesis represents my own written work and that I have used no sources and aids other than those indicated. All passages quoted from publications or paraphrased from these sources are properly cited and attributed.

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ABSTRACT

In light of three critical facts: 1) the new implementation of Sustainable Development Goals, of which Goal 8.4 emphasizes the conscious "decoupling of economic growth from environmental degradation", 2) increasing resource constraints, climate risks, and pollution levels in Asia-Pacific, and 3) the knowledge that Thailand is one of Asia-Pacific's economic development leaders, it is relevant to seek the answer to the following question: *"Is there evidence of significant relationships between: Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"*

The variables constitute UNESCAP's definition of Green Growth which is: "a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises." In essence, we seek to understand whether Green Growth's impacts are present, in Thailand's recent history (1990-2014). Methodology includes cross-correlations, structural equation modeling and inclusion of powerful historical context to result in the finding that: between 1990-2014, there is a strong empirical possibility that Green Growth principles exist and is active in Thailand. This and further discoveries inform recommendations made for the Thai government, United Nations, and Thai corporations.

ACKNOWLEDGEMENTS

“What goals would you be setting for yourself if you knew you could not fail?” (Minister Robert H. Schuller, 1973)

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Last but not least, a sincere thank you to God.

LIST OF ABBREVIATIONS

EE	Ecological Economics
EPI	Environment Performance Index
GDP	Gross Domestic Product
MDGs	Millennium Development Goals
MCED-5	Fifth Ministerial Conference on Environment and Develoment (2005)
NESDP	National Economic and Social Development Plan (of Thailand)
PPP	Purchasing Power Parity
SDGs	Sustainable Development Goals
SSE	Steady-State Economy
STEM	Science, Technology, Engineering, and Mathematics
TCE	Tiger Cub Economies
UN-CHE	UN Conference on the Human Environment

United Nations & Other Prominent Agencies

ASEAN	Association of Southeast Asian Nations
COM	Council of Ministers
ILO	United Nations International Labour Organization
OECD	Organization for Economic Co-Operation and Development
TMAC	Thai Ministry of Agriculture and Co-Operatives
TMD	Thai Meteorological Department
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCAP	United Nations Economic & Social Commission of Asia-Pacific
UNIDO	United Nations Industrial Development Organization

UN ESC	United Nations Economic and Social Councils
UN RC	United Nations Regional Commissions

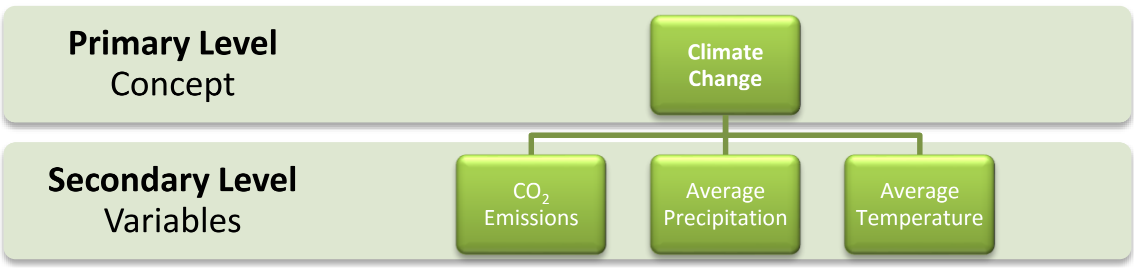
Methodology Concepts

CCF	Cross-Correlation (Function)
CFI	Comparative Fit Index
FIML	Full Information Maximum Likelihood
GOF	Goodness of Fit (Chi-Squared Significance)
MAR	Missing at Random
MCMC	Markov-Chain Monte-Carlo Methodology
MI	Multiple imputations
NFI	Normed Fit Index
RMSEA	Root Mean Square Error of Approximation
RQ	Research Question
SD	Standard Deviation
SEM	Structural Equation Modelling
TLI	Tucker-Lewis Index

A Guide to Interpretation

This Master of Science Thesis works with the complex themes of Green Growth, therefore the following diagram will provide clarification when the terms: concept and variable, are used.

To address what ideas compose the definition of Green Growth, the word: Concept, is used. To address the measurement indicators of concepts, the word: Variables, is used.



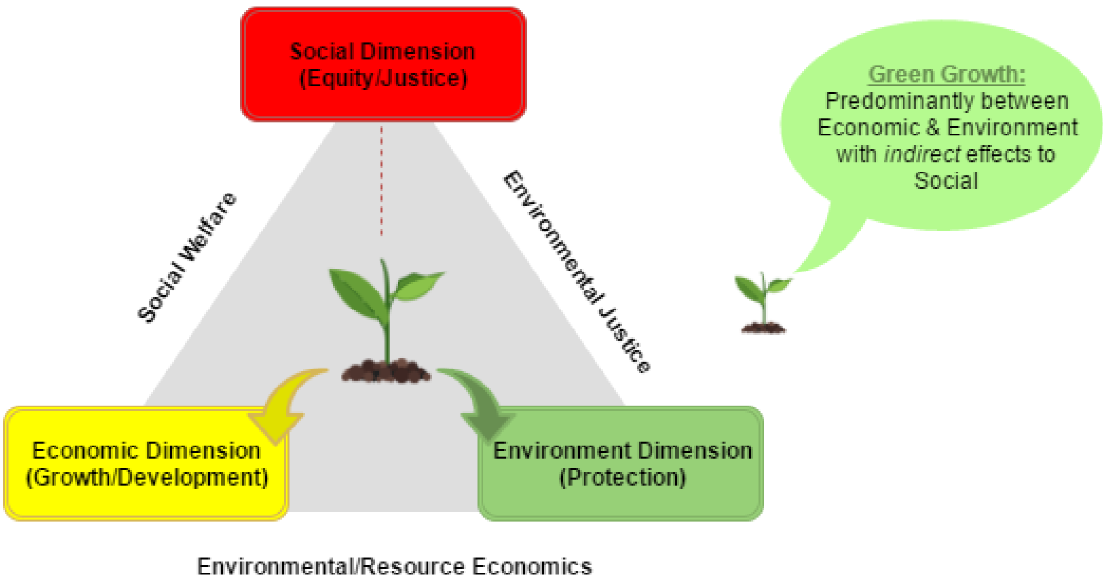
1 PART I: THE EMPIRICAL POSSIBILITY OF GREEN GROWTH

*"A sustainable world is one where people can escape poverty and enjoy decent work **without** harming the earth's essential ecosystems and resources." (United Nations Secretary-General Ban Ki-Moon in "The Road to Dignity by 2030", 2014)*

1.1 Introduction to Green Growth in Thailand

With the conceptual advent of Sustainable Development at the end of the 20th century (Du Pisani, 2007), came the legitimacy of balancing the three pillars of environment, social and economic dimensions (General Assembly, 2010). It is unusual to find a development approach which weighs each pillar equally, and even rarer to find a program whose mission echoes this equilibrium. Green Growth is no exception; it values the preservation of natural resources, while contributing to economic growth and development, and thereby *indirectly* alleviating poverty and its quality-of-life consequences (Ekins, 2002; Hallegatte et al., 2012; Lorek & Spangenberg, 2014). In other words, it emphasizes the relationship between the environment and economic dimension with secondary impacts towards the social element (see *Fig. 1*). Despite clear delineation of Green Growth's foci, there have been little consensus on a universal definition, thus leading to divergent perspectives, approaches, and policy implementations.

FIGURE 1: GREEN GROWTH IN CONTEXT OF SUSTAINABLE DEVELOPMENT



For the purposes of this investigation, we will adopt Green Growth frameworks (including definitions, operational contracts, etc.) from the Regional Commission for Asia-Pacific, United Nations Economic & Social Commission for Asia-Pacific (UNESCAP).

The five Regional Commissions (UN RC) of the United Nations Economic and Social Councils (UN ESC) have independently emerged as leaders of Green Growth (GGKP, 2015), assisted in part by their relationships to Member States. UN RCs initiate research which forms the basis of capacity development support for economic, social, cultural, and health matters (UN DPI, 2008). The Asia-Pacific region, in particular, have had long-standing challenges (UNDP, 2014b) in instituting inclusive and sustainable development, defined as economic activity which mobilizes and targets society's vulnerable groups, while also being ecologically viable (Duran, 2015; SDKP, 2015).

As a result, many governments are depending on Green Growth ideologies, as a means to combat rising global costs of virgin natural resource extraction (Neumayer, 2000; Krautkraemer, 2005; NCD, 2015) and persistent regional poverty (19 of 27 Asian-Pacific economies have nearly 1/3 of their population living below national poverty lines (ADB, 2014a)). Poverty is compounded by a definite trend of decelerating Gross Domestic Product (GDP) growth (IMF, 2014), suggesting an overall unsustainable and harmful model of development for the region.

To assist the world's most developmentally diverse region (ADB, 2013a), UNESCAP, UN RC of Asia-Pacific, officially institutionalized the "Low Carbon Green Growth Roadmap" (UN ESCAP, 2012b) in June 2013 at the Rio+20 Conference. As is often the case, necessity begot ingenuity.

Thailand, where UN ESCAP is headquartered, has especially visible Green Growth knowledge transfers (GGKP, 2013; OECD, 2015). Combined with His Majesty King Bhumbibol Adulyadej's "Philosophy of Sufficiency Economy", formulated in 1974 (Mongsawad, 2010) and mainstreamed in 1997 (Kantabutra, 2007), it is scientifically interesting to regard whether there are potential Green Growth effects historically present in the Thai economy and society. With UNESCAP's proven expertise on the matter, their operational definitions and constructs will be adopted for the purposes of this investigation.

1.1.1 United Nations

UNESCAP defines Green Growth as, "*a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises*." (MCED-5, 2005a; UN ESCAP, 2012). During the Fifth Ministerial Conference on Environment and Development (MCED-5), 91 Member States and non-/governmental bodies convened to discuss economic growth's adverse pressures on Asia-Pacific's environmental sustainability and the consequential delaying development goals cited in the Johannesburg Plan of Implementation (United Nations, 2002a) and Millennium Development Goal 7 (UNDP, 2000). MCED-5 recognized economic growth as a prerequisite to poverty reduction and environmental protection/social development, and therefore coined the term Green Growth as a strategy for Sustainable Development (MCED-5, 2005b).

Since MCED-5, the Green Growth concept has been adopted by OECD (OECD, 2011a) and the World Bank (World Bank, 2013) to represent environmentally-sound economic growth policies, but it is necessary to emphasize that Green Growth was originally operationalized and defined by the United Nations (UN). The specific wording of the Green Growth definition is important as it portrays entwined relationships between the variables (see *1.4 Theoretical Framework*). Therefore, the Research Question (RQ) will attempt to infer the strength and significance of any existing correlations and lead-lag relationships, which will inform the structural equation modeling of Green Growth. The latter is not statistically conclusive without corroborating historical evidence which reinforce statistical results or suggest confounders to be considered and accounted for. Further detail on the precise data analysis procedures can be found in *3.4 Data Measurement & Collection: Methodology Rationale*.

1.1.2 Philosophy of "Sufficiency Economy" in Thailand [1]

Although it is important to recognize the UN's role in perpetrating Green Growth, its ideals were long broadcast through Thailand's governance. The tenets behind His Majesty King Bhumbibol Adulyadej's "Philosophy of Sufficiency Economy" arose against a backdrop of political, economic, and social issues stemming largely from the events of 1974.

In 1974, His Majesty instituted a new national administration emphasizing economic and social justice, triggered ultimately by the 1973 Kasetsart University uprising calling for the resignation of Field Marshall Dhanarajata's dictatorial regime to be replaced by human rights to democracy. Though it is also true that political unrest had been building pressure long before then. Between 1959-1973, Thailand allowed the United Stated to occupy military bases to combat the Vietnam

[1] Unless otherwise specified, *1.1.2 Philosophy of "Sufficiency Economy" in Thailand* is sourced from (NRCT, 2000), (Mongsawad, 2010), and (UNDP, 2010).

War, the American presence facilitated a number of mixed-race children who, along with their Thai mothers, were ostracized by society, and therefore vulnerable to poverty.

As of 1974, Thailand still suffered from economic problems consequence of three National Economic and Social Development Plans (1961-1974), which stressed "economic growth via industrialization for import expansion" (NRCT, 2000, p. 12). In implementing this vision, Thailand invested foreign loans to build economic infrastructure and intended to pay back the loans through agricultural exports. While this strategy facilitated strong growth patterns (7-8% per year), it led to massive deforestation in favor of cash crop production. Additionally, the rapid expansion of industry surpassed the national economic growth rates, leading to widespread unequal income distribution, and higher rates of crime.

With the weight of these issues, His Majesty made a speech asking for collective peace and empathy among the Thai peoples on July 18, 1974, by condemning economic growth as the nation's principal objective. Rather, he prioritizes the building of a stable economic base, envisioning economic sufficiency for the majority, and then moving to higher levels of development. These were the idealistic seeds sown into the Philosophy of Sufficiency Economy. It was only in 1994 when the Philosophy was institutionalized as a strategy to combat economic crises, having been triggered by technological improvements in the agricultural industry which led to foreign trade deficits and increased debt. At the societal level, poor small-scale farmers and their lands were affected most by the crises. Economic issues also gave rise to new social problems such as HIV/AIDS and prevalent use of amphetamine drugs. This solidified His Majesty's view that economic expansion was not the panacea for Thailand's ills.

His Philosophy of Sufficiency Economy stresses:

> *…the middle path as an overriding principle for appropriate conduct by the populace at all levels… Sufficiency means moderation, reasonableness and the need of self-immunity for sufficient protection from impact arising from internal and external changes… In addition, a way of life based on patience, perseverance, diligence, wisdom and prudence is indispensable to create balance and be able to cope appropriately with critical challenges arising from extensive and rapid socioeconomic, environmental, and cultural changes in the world. (NRCT, 2000, p. 3)*

The Philosophy's central message was to build Thailand's capacity for resilience so that it could primarily withstand economic problems, and shift focus towards the three concepts: sufficiency, moderation and living within one's means. They were intended to guide reflective, moral behavior in society and the environment. Already in His Majesty's Philosophy can one recognize elements of Green Growth, of which the most important aspect is poverty alleviation, thus further solidifying empirical cause to appreciate not only whether Green Growth impacts are felt from early 21st century onwards, but also that they existed previously due in no small part to the His Majesty's socialist governance approach, which has since manifested in National Economic and Social Development Plan (NESDP), each lasting four years (Yothasmutr, 2008). As of 2016, Thailand is nearing the end of its 11th NESDP (NESDB, 2012).

1.2 Perspectives on Green Growth

The concept of Green Growth is not without its fair share of controversy, with the biggest initial criticisms stemming from ecological economics and avid proponents from development policy. While this investigation observes the empirical possibility of Green Growth in Thailand, it is necessary to qualify any findings through the perspectives of the aforementioned fields.

1.2.1 Ecological Economics

Ecological Economics (EE) stresses the importance of growing the economy in relation to Earth's planetary boundaries to preserve ecological health – a concept known as the "Steady State Economy" (SSE) (Daly, 2008). SSE depends on maintaining a constant stock of population and natural capital via low rates of material and energy throughput (Krabbe & Heijman, 2012, p. 175), which implies that the rate of economic consumption and production must cease until growth rates are stabilized, and when it is, one should aim for "degrowth" (Victor, 2011) to reduce the economy's size. EE would not approve of Green Growth, as it suggests a decoupling of natural resources from throughput to maintain economic growth rates (Hubbert, 1976). An absolute decoupling is impossible given the Laws of Thermodynamics (Hall, 2001; Daly & Farley, 2010). Moreover, perpetual growth is physically impossible due to diminishing energy, material resources, and ecological space (Zovanyi, 2013, p. 108). EE would categorize Green Growth ambitions as part of the Neo-Classical Economics, and reject it on the basis of "growth-mania".

However, if we reframe Green Growth not as a goal, but rather as a critical first-step towards facilitating the SSE, then EE's criticisms fall apart. To reiterate, UNSCAP defines Green Growth as, "*a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises*." There are approximately 10 prerequisites for a complete SSE, four are of notable mention: 1) limiting resource use and waste production, 2) limit inequality, 3) secure full employment and 4) rethink business and production (Jackson, 2009; O'Neill et al., 2010), all of which are explicit in Green Growth's definition.

Firstly, limiting resource use and waste production is important to bring levels down to within ecological limits, meaning renewables should be harvested slower than they regenerate, and nonrenewables, used slower than their waste products can be absorbed. Green Growth states "worsening resource constraints" to delineate the need to responsible consumption and production of natural capital. Secondly, limiting inequality is important to rectify health and social problems (e.g. mental health, crime). Green Growth states "reduce poverty" in order to build economic resilience for society's most vulnerable. Thirdly, securing full employment is necessary to redistribute wealth in society, however it should be pursue in labour-heavy industries. Green Growth states "job creation" to note the reduction of income inequality, though they do not specify where jobs should be created. Finally, rethinking business and production is necessary to shrink high-output, polluting industries. Green Growth states "climate crises" to bring attention to the linkages between economic activity, pollution and ensuing climate change.

More importantly, SSE occurs through progressive stages, characterized by growths: "business-as-usual", low/no growth, selective growth and degrowth (Victor, 2011), in order to be successful. Green Growth acts as the transitioning buffer between exponential towards a stabilized rate of economic growth (Zenghelis, 2012; UNIDO, 2013). This is why Green Growth states "a strategy for sustaining economic growth", it is intended to reduce overall throughput in the current biophysical system, especially as the Earth is currently in an Anthropocene state. We have surpassed three (climate change, rate of biodiversity loss, and nitrogen cycle) of the eight planetary boundaries (Rockstrom, 2009). Although Green Growth may not fully resolve ailments attributed to standard NCE, it is a viable and crucial first step towards a sustainable economy.

1.2.2 Development Policy

Entities in Development Policy advocate strongly for Green Growth on the basis of expected impacts in Sustainable Development's three dimensions: economy, social and environment (OECD, 2011a). There is a significant amount of empirical research to suggest its lead-lag power in advancing Asian-Pacific development, and policy analysts are confident in solidifying Green Growth's role as advantageous, at least in triggering positive change (ADB, 2012; ADB, 2013b).

From the economy's perspective, adopting Green Growth can lead to substantial increases in wealth via gains in natural capital. Modeling the macroeconomic impact of investing 2% of global GDP annually in renewables, energy efficiency, waste management, and capital-based sectors, it was realized that a "green economy" fared as well as the "business as usual" scenario, while simultaneously avoiding climate-/resource-based risks (UNEP, 2011). Furthermore, in 2013, the global market for environmental goods and services were $1,370 billion, projected to grow to $2,740 billion by 2030, with the strongest potential in green technologies (ABC, 2009). Not only will Green Growth trigger economic activity, it will build its long-term resilience by lowering dependence on non-renewable energy sources (Toman, 2012), and fostering innovation which is proven to reduce production's overall environmental impact (UN ESCAP, 2012c), of which a prime example being resource efficiency in manufacturing. The reprocessing of used material (closed-loop manufacturing) requires 5% of the energy used in primary production (UNEP, 2011). It also has the potential to save 10.7 million barrels of crude oil each year (ibid).

With a growing green economy, a shift from the "brown economy" (one that relies on non-renewable resources) (Fedrigo-Fazio & Brink, 2012) would not translate to job loss. There are no significant differences in employment between "business as usual" and Green Growth scenarios (UNEP, 2011). Although in 2030-2050, a minimum 20% increase is expected as the economy becomes increasingly unrestricted by energy and resource scarcity (Bowen & Kuralbayeva, 2015). The gains are attributed to strong green energy and green technology industries.

Green Growth strategies has prominent bearings on improving social inclusion and mitigating poverty, chiefly in the agricultural sector. In implementing resource-conserving practices (e.g. low-tillage farming, agroforestry, aquaculture, etc.), Asian farmers found an increased average yield of 79% while preserving natural capital integrity (Irz et al., 2001). Additionally, investing in environmental conservation (e.g. GHG emissions, reviving local biodiversity, etc.) can elicit the development of new, local economies via eco-tourism (Tresilian, 2006). There are indirect linkages as well. By maintaining ecological health, particularly in pollution control, indirect climate change impacts can be avoided. In Asia, a warming of 2◦C would result in a 6% reduction in annual per-capita (ADB, 2009) income through increasingly unpredictable weather events.

Poverty is also qualified as the lack of energy security, clean water and sanitation. 28% of the global population who lack access to electricity are Asia's citizens (excluding India) (ADB, 2013b), turning instead to high-polluting oil and dangerous biofuels (ADB, 2012). The latter is projected to cause 1.5 million deaths per year worldwide by 2030 (UNEP, 2011). With Green Growth stimulating renewable energy markets, social welfare can increase substantially. Moreover, improving clean water and sanitation can facilitate the uptake of Green Growth strategies (Hoffmann, 2015). Presently in Asian regions, 33% remain without decent sanitation, and 14%, without clean water access (Wicken & Robinson, 2008). Water access lowers the already-low disposable income of vulnerable groups, while poor sanitation can increase the risk of water-bourne diseases. If green investments in water access occur at 0.16% of global GDP per year, UN-defined development goals (MDGs to SDGs) can be reached by 2030 (UNEP, 2011).

Arguably, the biggest beneficiary of Green Growth strategies would be the environment, as emphasis will be placed on preserving ecosystem health, biodiversity, and sustainable management of natural capital. Green Growth facilitates the key governance of forests (and their regenerative capacity), which are presently depleted at a rate of 1.2% per year in Asia (UNEP, 2015). This not only causes a substantial drop in flora and fauna biodiversity, but also increases Asia's overall level of particulate pollution. Annually, 0.6 million in Asia perish due to air pollution (ADB, 2013b). Mortality rates are higher if including the effects of traffic congestion.

While avoiding desertification and deforestation is important, marine health is a notable issue, especially as 70% of Asia's population live on the coast, and whose livelihoods depend on fishing and aquaculture (Todd et al., 2010). Investing in green energy can assist in removing excess levels of CO_2 in the atmosphere, which then slows the rate of ocean assimilation and acidification, thereby preserving coral reefs, fish and critical phytoplankton (Nellemann, et al, 2008). Further, gains in green innovation are already successful in removing marine pollution (e.g. oil spills, waste: micro plastics, nets), which affect a variety of animals' wellbeing (UNEP, 2009). Above all, Green Growth is able to control for the human impact to the marine ecosystem, largely in the form of overfishing and sustainable farming methods, by providing stable regulatory governance and knowledge transfers, e.g. innovative fishing techniques (DENR, 2001).

It is important to note that this section does not claim to be comprehensive of all development literature and impacts, but rather provides a strong foundation upon which to critically review the high potential of Green Growth to trigger Sustainable Development in Asia and therefore, further appreciate the reasons behind this investigation.

1.3 Research Aim & Objectives

The objective of the thesis is to explore the following RQ: *"Is there evidence of significant relationships between: Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"* The variables constitute the UNESCAP's definition of Green Growth which, to reiterate, is: "a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises." (MCED-5, 2005a). In essence, the aim is to understand whether Green Growth's impacts are empirically possible, in Thailand's recent history (1990-2014).

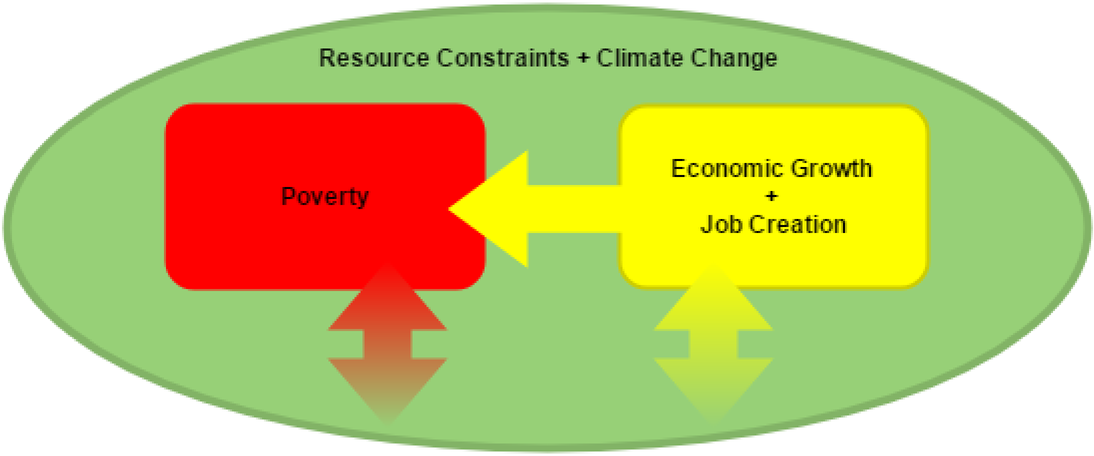
From the overarching aim, there are two objectives. The first being whether there is a lead-lag relationship between the concepts which constitute the defintion of Green Growth, and if so, between which disaggegated variables (within the concepts). It is important to note that UNESCAP's coupling of the concepts (e.g. economic growth and job creation; resource constraint and climate crisis) indicates the likelihood of preexisting relationships. Therefore to minimize validity issues, namely multicollinearity, this investigation will not regress concepts within the same "family," see *Fig. 2*. Additionally with certain variables, literature has shown evidence of lagged effects, and therefore detailed exploration will be undertaken to observe how many years of lag would the effect be of the independent on the dependent variable.

The second objective depends on the statistically significant results of the first, as it includes historical context and literature reinforcing statements made regarding the strength, directionality and significance of the variables. Statistical causality is a very sensitive claim as it is usually reserved for experiments which control for *all* confounding variables, the investigation would probe into the *likelihood of causality via lead-lagged relationships and structural equation modeling,* underscored with empirical results and strong historical context for each year. This would allow us to speak to whether there is empirical evidence of Green Growth in Thailand between 1990-2014, a question of significance in light of the new Sustainable Development Goals, for Thailand and potentially, characteristically-similar countries in the Asia-Pacific region (see *5.2 Applicability to Other ASEAN Countries*).

1.4 Theoretical Framework

Fig. 2 delineates the Green Growth model representing the UN definition which includes the five concepts: Resource Constraints, Climate Change, Economic Growth, Job Creation and Poverty. As aforementioned, concepts which are coupled within the same "family" will not be statistically related to each other. The directionality within the Green Growth Model delineates potential lead-lag relationships in bi-directional and uni-directional relationships.

FIGURE 2: GREEN GROWTH MODEL



1.4.1 Resource Constraints

1.4.1.1 Resource Constraints → Poverty

The short-term link between higher levels of natural resource consumption and lower poverty incidence has been well-documented (Rees, 1992; Scherr, 2000; Lee & Neves, 2009; Shah, 2009; Cushion et al., 2010), especially in less-developed rural regions (Kallonga et al., 2003; USAID, 2006). Natural resources are energy sources which can be used to service the economy (e.g. production material, energy fuel), and ecological economists argue that resource constraints is the biophysical boundary within which economic and human systems reside (Costanza et al., 1997; Hall, 2001; Rockstorm et al., 2009). Therefore, human development is triggered by higher levels of resource consumption.

However as resource constraints emerge due to over-exploitation in the long-term, economic activity slows and poverty may increase. In other words, as the integrity of the natural biosphere falter, the artifical systems (e.g. economy) dependant on it will also suffer. In 1950, Hubbert wrote about a "Model of Resource Exploitation", which showed the effects of consuming natural resources faster than its regenerative rates (Bardi & Lavacchi, 2009). In the short-run, wealth increases exponentially, but as resources are depleted, wealth starts to drop. Hubbert's model mirrors the reality of resource constraints' impacts on poverty, especially in Asia (Muller-Boker, 1990; Giljum et al., 2010).

1.4.1.2 Resource Constraints → Economic Growth

Poverty (or the lack thereof) is the social consequence of economic growth, and therefore resource constraint follows a similar trajectory of influence for economic growth, aligning with

Hubbert' 1950 model. The abundance of natural capital generates a strong profit margin through: 1) low production costs achieved through economies of scale (OECD, 2008) and high revenues through product exports (e.g. China, India) (Gelb, 2010).

However, there are two notable exceptions to this straightforward linkage. Firstly, in 1993, Richard Auty spoke of the "Resource Curse" in reference to resource-rich countries who were unable to translate their natural capital into economic growth (Auty, 2003). Secondly, economies heavily dependent on natural resources may develop slower, inefficient financial infrastructures (Gylfason & Zoega, 2001) and weaker human and knowledge capital (Gylfason & Zoega, 2001).

The Resource Curse is supported by empirical growth studies which confirm the inverse relationship even with controlling for a wide range of confounders (i.e. initial GDP, political openness, trade volatility, etc.) (Sachs & Warner, 1997) and societal factors (i.e. inefficient institutions, unsustainability, war, etc.) (Frankel, 2010), though the inclusion of the aforementioned variables is highly contested (NRGI, 2015). The Resource Curse causes poor economic growth as countries are unable to flexibly invest financial capital (generated from natural resources) productively and diversify their economies to include non-extractive industries (Stevens et al., 2015). They become effectively "locked-in" non-dynamic development paths (Martin & Sunley, 2006) with poor global competitiveness. Therefore, as resource-constraints increasingly appear over the long-term, economic growth rates diminish.

Resource-rich countries may develop poor financial systems as an extractive economy is primarily export-oriented which negates the need for domestic savings, which would have stimulated new industries via domestic investments (Gylfason & Zoega, 2001). Further, banking sectors in general tend to be smaller as countries depend on foreign financing (Kurronen, 2012). Because resource extraction is lower-skilled labor, there is less emphases on developing human and knowledge capital, which is critical to a stable economic base (Polterovich et al., 2010).

1.4.1.3 Resource Constraints → Job Creation

The relationship between resource constraints and job creation is only direct if we consider job creation within resource-extractive industries. There are three channels towards job creation: direct, indirect and induced (UNDP, 2014c; UNCTAD, 2015).

Direct job creation occurs as a consequence of the value chains of extractive industries. The majority of jobs are created in the initial phase of construction, with momentum declining when the resource extraction begins as it is a capital-intensive process. Indirect job creation identifies jobs created by distributors and suppliers within the value chain. These entail production, transportation and distribution, and value addition, typically immediately after resource extraction. Further, they reflect the level of local SME integration into the value chain (Sigam & Garcia, 2012). Finally, the induced channel refers to jobs created by consumers spending income directly or indirectly earned from resource extractive industries. More activity in resource extraction generates more income, which leads to higher spending in the larger economic structure and more created jobs (Bacon & Kojima, 2011). Through this pathway, resource constraints would have an overall negative impact on job creation.

1.4.2 Climate Change

1.4.2.1 Climate Change → Poverty

Although climate change can push vulnerable groups across the national poverty threshold, it is well-documented to worsen the economic, community, and individual resilience of those already in poverty (ADB, 2009) by eroding their adaptive capacity (Pettengell, 2010).

Climate change is triggered most prominently by carbon emissions creating global warming, which is followed with rising sea levels (IPCC, 2011); therefore, affecting coastal areas most by introducing seawater into freshwater sources, land erosion and flooding, and loss of soil fertility (McGuigan et al., 2002; USDA, 2011). Clean water access becomes an increasing threat, corroding the community's health and sanitation by increasing the risk of waterborne disease (e.g. dysentery, malaria) (Brainard et al., 2009). Additionally, loss of individual livelihood and food security is inevitable, especially for farmers dependent on agricultural lands and fisherman, on marine biodiversity. On a larger scale, important economic infrastructure such as ports, sewage systems, and shelter, can be demolished during climate-based natural disasters (IPCC, 2014), which can damage regional industries. Measures to combat climate change may include emissions-reduction, which can substantially increase energy and food prices, leading families to consider relocation, adding to the refugee migration flows of a region (World Bank, 2016a).

Poorer communities are more vulnerable to climate change largely as they lack the economic resources, social "safety nets," infrastructure, and technology to combat the effects of weather risks (CARE, 2011). Furthermore, developing countries may not provide the resources and capacity such as early warning systems, victim relief and recovery assistance as they are burdened with other concerns (e.g. population growth, resource depletion) (Leichenko & Silva, 2014). This augments the impacts of climate change on poverty, and further reinforces the relationship that when climate change effects increase, poverty consequences seem to worsen.

1.4.2.2 Climate Change → Economic Growth

Econometric modeling of climate change impacts has shown that there will be little change (-1.5% to +0.5% GDP change (Tol, 2002)) to worldwide industry as vulnerable sectors (e.g. agriculture, coastal resources, energy, forestry, tourism and water), constitute only 5% of global economy (Mendelsohn, 2009). However, if only the Asian economies are considered, longitudinal studies has shown that growth rates are negatively impacted by temperature and precipitation and that agriculture is the most vulnerable sector (Akram, 2012). This is due in part to 41 out of 53 UNESCAP Member States having substantial coastlines (UN ESCAP, 2014a), a geographical vulnerability for climate hazards. Further, empirical results show climate change affects crop yields, water availability, human health, tourism, and energy demand, all of which factor substantially to regional economic activity and growth (Van der Mensbrugghe, 2010).

Asia's economy is especially strained because of two reasons: 1) its economic growth depends largely on agricultural activities (IFAD, 2011) and 2) the climate ranges from temperate to tropical, with heat stress being the primary hindrance (Westphal et al., 2013). With Asia's primary export being rice, results have shown that yield decreases 10% with every increase of 1◦C (ADB, 2009), with multiple countries reporting economic losses (e.g. Thailand between 1991-2000 suffered $1.75 billion, Philippines between 1975-2002 suffered $55 million) (ibid). Higher incidences of heat waves have also lowered labor productivity in Southeast Asia by aggravating respiratory and cardiovascular disease (ibid). In Asia, climate effects are diverse, but its impact on economic growth is clear. As climate change increases, economic activity suffers.

1.4.2.3 Climate Change → Job Creation

The effects of climate change has already prompted the Asian countries to pursue a "green economy" which complies with limits placed on greenhouse gas emissions. As aforementioned in *1.2.2 Development Policy*, transitioning from a brown economy reliant on non-renewable resources would not cause net job loss because emergent new industries such as green energy and technology will hire the difference (Martinez-Fernandez et al., 2010). Jobs are expected to increase by 20% in 2030-2050 as energy and resource scarcity issues decline (Bowen & Kuralbayeva, 2015). However, this is a trend overview for manufacturing and does not appreciate how job creation might manifest in different, smaller sectors (i.e. agriculture, tourism).

Asia supplies 70% of the world's one billion directly employed in agriculture (ILO, 2008), which is becoming increasingly job-insecure as climate change increases the risks of droughts, floods, soil infertility, variability in rainfall patterns, and temperature, which damage crop yields (ABC, 2009). For an industry sector known for low-skilled labor, climate change may pressure agricultural workers to acquire more marketable skills and change industry profession, or compete for even lower rates of pay (Olsen, 2008). Certainly, there won't be *new* job creation in agriculture.

As for tourism, Asia supplies 27% of the world's 235 million directly employed in tourism (WTTC, 2015). Indirectly, one job in tourism creates 1.5 additional indirect jobs in the wider related economy (Bolwell & Weinz, 2008). Like agriculture, the tourism sector is affected by climate change, chiefly by the rising sea levels which influence tourism towards Asia's island and coastal locations. Additionally, coastal erosion and increased salinity will reduce its livability over the next 30 years (UNWTO, 2003). In Asia's colder north, higher temperatures are expected to reduce visitors for winter activities, though not as severe a rate as in South Asia. Climate change is not likely to contribute to job creation in the existing tourism industry.

1.4.3 Poverty

1.4.3.1 Poverty → Resource Constraints

The direct, negative impact of poverty on natural resource management (referred to as the "Poverty-Environment Nexus") is a well-documented phenomenon due to three reasons: 1) reduced productivity of natural resources, 2) lack of awareness regarding human activity on environment, and 3) time pressures of the extreme poor. Firstly, relative to the privileged, poor households must pay a greater percentage of their incomes to secure energy (Saghir, 2005). Along with deepening wood scarcity (especially in Asia), they have started to depend on biomass fuel, specifically burning animal manure and crop waste (Diaz-Chavez et al., 2013). In doing so, the opportunity cost is damaged soil fertility which further constrains resources (Rahman, 2006). The pollution also indirectly harms natural resource growing conditions (ibid).

Secondly, poor communities also lack training necessary to optimize sustainable consumption of resources and of feedback loops between human activity and the environment. The evidence is clear from their chosen method of land cultivation, i.e. slash-and-burning and forest felling (Tinker et al., 1996). Investing in farming education not only alleviates poverty but preserves ecological health (Nganje et al., 2001), the positive impacts multiply for organic farming (Sarker & Itohara, 2008). Finally, the poor often live "hand-to-mouth", an idiom which here means surviving day-to-day, with no capacity to plan ahead. They are unable to invest in natural resources and reap its medium to long-term return. As a result, they often depend on unsustainable resource consumption to meet present, urgent needs (Rahman, 2006).

There is a negative relationship between poverty and resource constraints, but its strength elicits opposition as it depends heavily on geographical, historical, and institutional factors of each country (Duraiappah, 1996; Dasgupta et al., 2005). Moreover, it varies according to rural versus urban poverty (Eppler et al., 2015). However, the general consensus states that poverty and resource constraints self-reinforce, and can lead to a "poverty trap," defined as self-reinforcing mechanisms which cause poverty to persist (Aghion & Durlauf, 2005, p. 326). A poverty trap based on resource constraints will have effects beyond the social element, for example in compounding the impact of climate change.

On the other hand, lower levels of poverty (i.e. greater wealth) can lead to increased resource constraints due to simple economics: the marginal propensity of consumption increases as income does (Carroll et al., 2014). It is likely that the extremes of affluence influence the level of resource constraints far more than those of middle income, due to their varying circumstances.

1.4.3.2 Poverty → Climate Change

Poverty's influence on climate change varies by the activities undertaken by the urban vs. rural poor. The majority of worldwide manufacturing industries reside in developing countries, where there is a wealth of cheap, low-skilled labor, due to the size of urban poor populations (Tybout, 2000; UNIDO, 2012a). In fact, a strong example of this phenomenon are the "Asian Driver Economies," like Bangladesh and China, characterized by their coastal proximity (for shipping exports), high income inequality, and large population sizes (ADB, 2015a). Unfortunately, even with a vibrant manufacturing sector, poor populations do not reap the economic benefits (Loayza, Raddatz, & C., 2006), as production depends on natural resource depletion and low-technology (UNIDO, 2012a), generating massive amounts of atmospheric waste: CO_2 Emissions (IPCC, 2005). Dependence on fossil fuel generates 60% of global CO_2 emissions (ibid). Other sources of CO_2 include coal and biomass. Therefore, increased incidence of urban poverty may indirectly lead to greater risks of climate change through the activities from the manufacturing industries.

As for the rural poor, household and community energy sources derive largely from burning biomass, fossil fuels and wood (Rehman et al., 2011). Although smaller in scale, the unfiltered "black carbon emissions" represent a significant climate change risk (Sethi & De Oliveira, 2015). More rural poverty may lead to greater risks of climate change, however the relationship may not be as strong relative to that of urban poor. On the other hand, region-specific literature has shown that with increasing affluence, per capita carbon footprint (and by default, increase resource consumption), increases, due to greater reliance on personal transportation (e.g. cars), more product waste, etc. (Heinonen & Junnila, 2011). This implies that lower levels of poverty also increase climate change risks. In both cases, human activity seems to correlate with increasing climate change.

1.4.3.3 Poverty → Economic Growth

Economic growth indicates the “growth of output which will meet the multifarious demands of a modern economy”, (Commonwealth Treasury, 1964), frequently measured as GDP. GDP’s components include: consumption, investment, government spending and net exports (ibid), which increase as affluence rises (Brenner, 1998). In this case, the lower incidence of poverty proliferates economic growth. This is true of aggregated economic growth worldwide, however, differences may vary regionally due to income inequality. Chiefly for developing countries, economic growth is correlated with income inequality as wealth distribution is strategically uneven (Kuznets, 1955). In an economy, wealth rarely trickles down to the poor, yet it is often poor laborers and workers who help drive economic growth through industrialized employment.

Asia’s three main economic sectors are: agriculture, manufacturing and finance, thereby constituting more than 67% of all economic activity (IMF, 2014). Agriculture and manufacturing sectors are serviced by low-skilled, low-wage labor, which implies that should labor costs increase, economic growth may slow in these region-specific industries, with employers shifting to other locations (e.g. Africa) or towards other more profitable activities (ILO, 2010).

1.4.3.4 Poverty → Job Creation

In general, prevalence of poverty does not lead to job creation, given one of poverty’s qualifications is the lack of access to capital markets and knowledge, both of which increase employment opportunities (Ding, 2009). This relationship is partially explained by proximity to jobs, with poor communities typically being located farther away with weak transportation infrastructure (Hu & Giuliano, 2014). However, it is simultaneously true that poor workers are able to secure low-skilled manufacturing jobs more easily than their wealthier counterparts for the sole reason of low wages (ILO, 2010). Strictly for low-skilled industry sectors (e.g. production, constructions, etc.), being poor is indirectly conducive to job creation as low labor costs attract investors, who may trigger further economic development activity that leads to increased regional employment. It is important to note, however, that this is a very specific scenario.

1.4.4 Economic Growth

1.4.4.1 Economic Growth → Resource Constraints

Ecological economists would argue that all economic growth directly involves the depletion of natural resources (Hubbert, 1976), as the economy's artificial system is dependent on the boundaries of its surrounding biophysical limits (Daly, 2008). The idea of absolutely decoupling natural resources from economic growth is impossible because there is no substitute for natural capital. Resource constraints arise when economic growth increases renewable resource consumption at a rate faster than its regeneration (Steer, 2013). In some cases, resource consumption can erode resource fertility past its renewing capacity. For example 36% of Asia's available agricultural land is permanently infertile (Oldeman, 2000) because of overworking. Non-renewable resources such as fossil fuels, will increasingly diminish as the economy grows (ibid), specifically as it is the most common source of energy. Therefore, economic growth influences resource constraints.

Indirectly speaking, as the economy grows, GDP per capita increases equaling potential consumption power and demand for more products. Product demand increases production rates, which lead to increased levels of atmospheric waste, which also burdens nature's absorptive and regenerative capacity (SERI, 2009). Even indirectly, economic growth has a negative impact on natural resources, allowing it to become further constrained.

1.4.4.2 Economic Growth → Climate Change

The effect of economic growth on climate change has been investigated since the Industrial Revolution (Keay, 2007). Empirical studies have shown that in Asia, CO_2 Emissions closely follows the upward trend of GDP (World Bank, 2007; Chen & Huang, 2013; Lim et al., 2014), suggesting that energy sources needed to grow the economy also emit harmful atmospheric waste (Karakaya & Ozcag, 2005) which can contribute to climate change (in the form of increased precipitation, temperature, etc.) (Antonakakis et al., 2015). Current energy sources largely take the form of non-renewable energy such as fossil fuels, coal, and natural gas, both at industrial and household levels. This is problematic because the rate and quantity of consumption far exceeds Earth's ability to absorb its pollution, hindering its capacity to self-regulate climate-related mechanisms such as temperature, precipitation, natural disaster incidence, etc. Additionally, economic growth is currently measured quantitatively via GDP, which creates a linear trajectory of resource consumption which cannot be perpetual (Robbins, 2012). In the traditional neoclassical model, economic growth can certainly perpetuate climate change.

On the other hand, Asian countries which follow a qualitative economic growth (i.e. economic development) philosophy, such as Bhutan (World Bank, 2010), South Korea (Chung & Hwang, 2006), and Thailand (Bunnag, 2013), experience a lower risk of climate change. This is partially explained by a reliance on renewable energy, and establishment of low-carbon industries (e.g. green energy, eco-/bio-technology) (UNIDO, 2012b), as well as correcting market failures like inefficient capital, equity distribution, and market structure adjustments (OECD, 2011b). Measurement of qualitative economic growth include Human Development Index (HDI) and GNH (Gross National Happiness), however, GDP's strength is its ability to capture all activity, quantitative and qualitative. Though there are not many empirical examples presently, in the scenario of development, economic growth is able to reduce the risk of climate change (though not completely eliminate it).

1.4.4.3 Economic Growth → Poverty

Economic Growth is the policy tool most frequently used to correct poverty, keeping in mind the theory that since household financial stability (i.e. income) depends on a strong economy, the poor can be uplifted through its trickle-down effects (Kuznets, 1955). There has been mixed efficacy in the literature, with proponents claiming an overall reduction in extreme poverty as countries graduate to higher development levels (Islam, 2004). There is specific reference to more employment opportunities emerging due to economic growth (Roemer & Gugerty, 1997).

However, critics reject this simplistic equation, citing that there are other, external factors which assist in explaining variance in poverty levels. For example, poverty can improve if economic growth is spurred by the innovative development of industry clusters, known as the regional specializations (Gordon & McCann, 2005). Furthermore, initial levels of income inequality can weaken the effect economic growth has on poverty (Son & Kakwani, 2004), as it can constrain the citizen's investment capacity, diminishing government expenditure and, consequently, the provision of public services for the poor (Kniivila, 2007). There is also the question of diminishing rural versus urban poverty. The majority of Asia experiences rural poverty, and as such economic growth by way of agricultural productivity can be especially effective (ibid).

With the dawn of the new Sustainable Development Goals, there is an increasing emphasis on Inclusive Growth, defined as economic activity which creates opportunity, and distributes dividends for all population groups (Duran, 2015). In practice, inclusive growth is difficult to implement and observe its market impacts, but when it is led by government spending (in minimum wage guarantees, health care) it can significantly diminish income inequality and overall poverty levels (Balakrishnan et al., 2013). Therefore, economic growth does reduce poverty levels.

1.4.5 Job Creation

1.4.5.1 Job Creation → Resource Constraints

Job creation has no direct influence on resource constraints, because it is the economic activity of specific industries which causes natural resource depletion (Steer, 2013). Hence, if there are more jobs created in virgin manufacturing, that may signal faster production and consumption of natural resources (Mensah & Castro, 2004). On the other hand, higher job creation in green manufacturing (which uses renewable energies, waste by-products of other industries), for example ISA TanTec Ltd (ISA, 2015), may alleviate *regional* resource constraints.

In general however, job creation is a consequence of increased economic activity and growth, which is positively correlated with increased resource constraints. This is due to the Ecological Economics' understanding that economic growth is supported by Earth's biophysical limits, and there are substantial costs transforming natural capital into monetary wealth (Krautkraemer, 2005; Steer, 2013). Additionally, the energy used to substantiate economic growth derives from resources, with resource constraints increasingly emerging for non-renewable energy sources.

1.4.5.2 Job Creation → Climate Change

Similar to the impact of job creation on resource constraints, job creation has no direct influence on climate change, due high-carbon economic activity causing increased climate risk (Andersson & Karpestam, 2013). If there are more jobs created in known CO_2-emitting industries such as construction or manufacturing that signals greater risks of atmospheric pollution which can lead to higher climate change incidence. The alternative is also true, if there are more jobs created in environmental governance or sustainable development, the integrity of natural capital would be preserved (Martinez-Fernandez et al., 2010), thereby minimizing climate risk.

1.4.5.3 Job Creation → Poverty

One of poverty's many indicators is household financial stability, maintained through a secure income stream; therefore when the economy contracts, and unemployment rises, wages mechanically disappear causing poverty (Page, 2014). This aggregate effect is especially true of vulnerable groups already living close to national poverty lines (ibid). However, when employment rates are measured by a country's economic sector (e.g. industry vs services), they have differential impacts on poverty rates, due largely to divergent labor market structures.

Job creation in the secondary sector (e.g. industry and services) correlated with poverty reduction while in the primary sector (e.g. construction), it is related to increased poverty incidence (Gutierrez et al., 2007). It is a question of labor efficiency, as increased human capital versus productivity gains affect different sectoral mechanisms differently (Sundaram, 2013). For example in industry and services, a diverse set of specializations are required, allowing more employees to seek the post most suitable for them (Melamed et al., 2011). In other words, there is need for advanced education and specific skills, while in primary sectors, employment competition is greater due to prevalence of low-skilled labor. As a result, the increased rivalry for jobs manifests as, generally, lower wages (Hull, 2009) and greater risk of poverty. Therefore, overall job creation lowers poverty rates with the exception of primary economic sectors.

1.4.6 Exploration of Lead-Lag Effects

In economics, there is a phenomenon called the "lead-lag effect", which is when a leading variable is correlated with the values of a second variable, lagged by specific time points (e.g., years, months) (Huth & Abergel, 2012). This is commonly recognized in the lagged impact of economic growth on poverty reduction (Stevans, 2002) and on climate change (GCEC, 2014). What remains unknown is the precise number of years the effects are lagged by. At present, there is a significant gap in the literature regarding years of lag for poverty reduction, climate change, resource constraints, job creation and economic growth as a function of each other. Therefore, there are no pre-defined expectations. The testing ot time-lags will be an exploratory endeavor and should there be lagged effects, the historical context will be observed to understand what might have caused the lagged effect. For detailed information regarding the methodology of analyzing lags, please see *3.5.2 Cross-Correlation Analysis*.

2 PART II: HISTORICAL CONTEXT OF GREEN GROWTH

*"**We are at a rare moment in history**. A moment that will be the turning point for the future of our People and Planet. Our legacy will be how we shaped an ambitious common vision and rallied around a systematic effort to put the world on a path to eradicate poverty and develop sustainably." (Under-Secretary-General Wu HongBo at "The 2015 HLPF")*

2.1 The Beginnings of Sustainable Development (1972 - 1995)

In 1972, the UN Conference on the Human Environment (UN-CHE) in Stockholm convened to outline common principles for humans to preserve and enhance his environment. A statement was made regarding positive economic development at the cost of environmental degradation (Sohn, 1973). As result, a set of 26 principles were institutionalized stressing "prudent care for [our actions'] environmental consequences" (United Nations, 1972, p. 8).

UN-CHE triggered the establishment of the International Union for the Conservation of Natural Resources who published the World Conservation Strategy in 1980, which states that unless the planet's biodiversity integrity is properly safeguarded, there can be no improvement in human development and poverty reduction (IUCN, 1980, p. 18). Two years later, the World Conservation Strategy assembled to approve the "World Charter for Nature" which stated that "mankind is a part of nature and life depends on the uninterrupted functioning of natural systems." (General Assembly, 1982). The Charter is known as the predecessor of the 1987 Brundtland Report and of the ethics behind "sustainable development" (UN RIO+20, 2012a).

The Brundtland Report established and fully integrated the three pillars of sustainable development (social, environmental, and economic), and generated further discussions regarding economic prosperity with protection of the biophysical environment (WCED, 1987, p. 16). Green Growth is a strategy of Sustainable Development, one that jointly mobilizes ecological preservation with economic growth to reduce poverty, a social dimension (UN ESCAP, 2012a). However, this linkage was not specifically referenced until the 1992 Earth Summit in Rio de Janeiro.

The 1992 Earth Summit established Agenda 21 which covered common but differentiated responsibilities among Member States to pursue social and economic progress within a model of sustainable development (United Nations, 1992). More importantly, it recommended the integration of environment and social development in decision making at policy levels making use of economic instruments (United Nations, 1992, p. 64). Agenda 21 was voluntarily adopted by

170 countries, which prompted the establishment of the UN Commission on Sustainable Development (later changed to: Division for Sustainable Development) in 1993 to ensure follow-up, capacity-building and enhance international cooperation (United Nations, 2012).

While emphases have largely been on the preservation of natural resources and economic activity to reduce poverty, the 1995 World Summit for Social Development in Copenhagen asserted that the reverse is true; social development which encourages the poor to preserve environmental resources is a necessary foundation for sustainable development and can assist in job creation (United Nations, 1995).

2.2 Millennium Development Goals (2000 - 2012)

The five concepts which compose Green Growth have largely been mentioned with the exception of climate change. It is an inferred impact of resource constraints and economic growth but did not enter serious discussion until the 2005 Kyoto Protocol. Climate Change was noticeably lacking during the creation and implementation of the Millennium Development Goals (MDGs).

The MDGs were designed in 2000 to be time-bound targets to resolve, among others, extreme poverty and environmental protection (General Assembly, 2000) of which one indicator referred to the reduction of greenhouse gases, a component of climate change (ibid, p. 6). In 2002, countries committed to the Monterrey Consensus, a critical venture to highlight that the MDGs needed all stakeholders to fulfill a framework of shared duties (United Nations, 2002b).

To ensure significant MDG attainment rates, the United Nations Secretary-General commissioned The Millennium Project from Professor Jeffrey Sachs in 2002, as a result of the World Summit on Sustainable Development, to develop a concrete implementation plan (UN Secretary-General, 2002). While MDGs do not reference climate change, Sachs explicitly recommended international mitigation climate change through stabilizing greenhouse gas emission, and reduction of unsustainable patterns of production and consumption (Sachs J. , 2002a, p. 49), a founding sentiment echoed by Green Growth (UN ESCAP, 2012b; Lorek & Spangenberg, 2014).

Furthermore, Sachs recommended for each Member State to develop a national strategy to achieve the MDGs, a departure from previous UN outcome reports which stressed international policy coherence and implementation (Sachs J. , 2002b, p. 23). Implications of his recommendation was that each country had the capacity and agency to create gains and that there were influential differences between even adjacent regional Member States. Therefore, a Green

Growth strategy that worked in one country would not necessarily succeed in a regionally-similar neighbor, even if there were notable similarities.

Under the same principle of common but differentiated responsibilities, the Kyoto Protocol entered into force on 2005, stating detailed rules for developed countries to reduce high levels of greenhouse gasses by 5.2% compared to 1990 levels, for the period of 2008-2012 (UN FCCC, 2014). Furthermore, the Kyoto Protocol also mentions that human activity, namely the economy, has likely affected climate change which can then negatively impact social development (UN FCCC, 1998). This finding legitimized the existence of feedback loops and trade-offs between climate change, social development and economic activity.

In the same year, the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5) pioneered the concept of Green Growth (MCED-5, 2005a), which influenced the 2008 penetration of green economy ideologies into national government strategies on sustainable development and private sector involvement (OECD, 2009). Complementing the ideal of low-carbon production and consumption gaining traction, the concept of "planetary boundaries" and Anthropocene were introduced, which imposed biophysical limits to nine areas including climate change and biosphere integrity (Rockstrom, 2009).

Armed with the knowledge of an increasingly ecologically-"full" world (Daly H. E., 2005), 2012 Rio+20 Conference reconvened to explore the sustainable greening of world economies through a variety of solutions including job creation (UN RIO+20, 2012b), poverty reduction (General Assembly, 2012), sustainable use of natural resources (ILO, 2015), and inclusive and people-centered growth (United Nations, 2014), all concepts composing Green Growth.

2.3 The Sustainable Development Goals (2015 - Present)

At the Rio+20 Conference, Member States decided to establish an Open Working Group, who was entrusted to develop a proposal for Sustainable Development Goals (SDGs) which would go in effect after the MDGs' expiration. (SDKP, 2015b). From 2012-2015, the Open Working Group focused extensively on transparency and stakeholder participation, finally emerging with the pivotal document: The Road to Dignity by 2030, presented at the 2015 UN Summit for Sustainable Development (United Nations, 2014).

It emphasizes six essential themes for delivering the new SDGs: People, Dignity, Prosperity, Justice, Partnerships, and Planet to assist with the overall objective of eradicating poverty by 2030 (ibid). The SDGs were based on the three major objectives of the sustainable development pillars: economic growth, environmental protection and social inclusion (UN SDG, 2015b). As the negotiations on the new SDGs were finalized in September 2015, a new publication emerged, *Transforming Our World: The 2030 Agenda for Sustainable Development* (General Assembly, 2015). In it, the General Assembly details the 17 SDGs which hold 169 specific indicators, of which the most relevant is Goal 8, Indicator 4 (8.4):

> *Improve progressively, through 2030, global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programs on Sustainable Consumption and Production, with developed countries taking the lead.* (General Assembly, 2015, p. 19)

The concept of Sustainable Consumption and Production has been used interchangeably with Green Economy and Green Growth (OECD, 2012, p. 6; GGGI, 2015). While many serve differing interpretations, the central goal has always been to enhance social welfare through the growth of economic systems without overburdening the ecological biophysical resources.

The implications of Goal 8.4 are particularly heavy for developed countries already with an inflexible model of economic growth (Akenji & Bengtsson, 2014). However, the benefits of entrenching economic policy with environmental preservation may outweigh the initial economic costs of re-specialization and capital. Green Growth has the potential to sustainably uplift society's disenfranchised out of poverty through economic development, while simultaneously maintaining a steady rate of Earth's resource renewal (UN ESCAP, 2012a; UN ESCAP, 2012b).

For this reason, it is imperative to observe whether there are possible signs of Green Growth strategies historically (1990-2014) active in Thailand, so that further empirical research can proceed to determine whether Thailand is a successful model of decoupling economic growth from resource degradation.

3 PART III: RESEARCH METHODOLOGY

*"Data are the **lifeblood of decision-making** and the raw material for accountability. Without high-quality data providing the right information on the right things, at the right time; designing, monitoring, and evaluating effective sustainable development policies becomes almost impossible." (United Nations Data Revolution Group in "A World That Counts", 2014)*

3.1 Introduction

To reiterate, the definition of Green Growth is: "a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises." (MCED-5, 2005a).

As such, there are two goals in this investigation. Firstly, to understand whether there is a lead-lagged relationship between the concepts which constitute the defintion of Green Growth, and if so, between which disaggegated variables (within the concepts). The second goal depends on the statistical results of the first, as it interweaves historical context which sheds clarity upon the strength, directionality, and significance of the variables. Undertanding that statistical causality is very sensitive and would involve controlling for *all* confounding variables, the investigation would probe into the *likelihood of causality via lead-lagged relationships and structural equation modeling,* underscored with empirical results and strong historical context for each year. This would allow us to speak to whether there is empirical evidence of Green Growth in Thailand between 1990-2014, a question of significance in light of the new Sustainable Development Goals, for Thailand and potentially, characteristically-similar countries in the Asia-Pacific region (see *5.2 Applicability to Other ASEAN Countries*).

Further detail regarding the rationale and procedure involved with each goal will be explored later in this section. This includes paying attention to any relevant lags between variables, minimizing validity/reliability threats, mobilizing the strengths of the research design, et cetera.

3.2 The Research Question

"Is there evidence of significant relationships between: Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"

3.2.1 Hypotheses

Due to the lack of empirical literature supporting the historical existence of Green Growth in Thailand (especially between 1990-2014), there are no region-specific population parameters to base our hypotheses; therefore, this investigation has an exploratory element. However, international literature (e.g., from policy, science, development) suggests certain relationships between the variables which constitute Green Growth's concepts.

The hypotheses depicted in *Table 1*, are based on the interpretation of Green Growth's concepts (see *1.4 Theoretical Framework*) and its relationships (see *Fig. 3*). It is important to note that each concept's predictor and response designation impacts the response's directionality.

FIGURE 3: GREEN GROWTH MODEL (REPEAT)

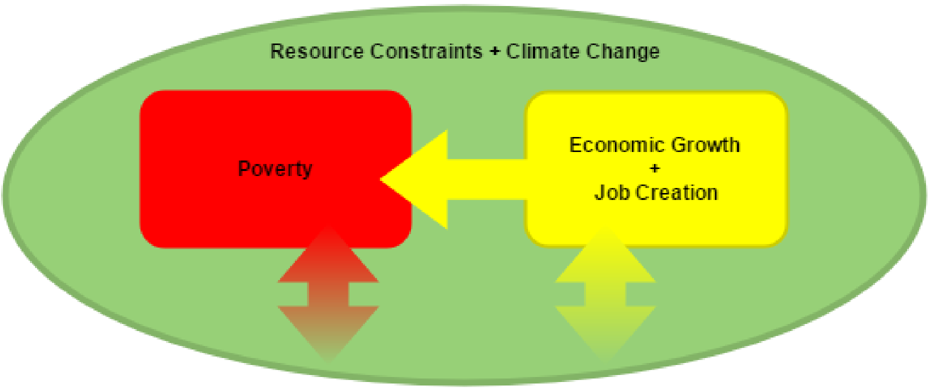


TABLE 1: HYPOTHESES OF GREEN GROWTH'S INTER-RELATIONSHIPS (BASED ON LITERATURE)

Resource Constraints ⇒ Poverty	**Poverty ⇒ Resource Constraints**
↑Resource Constraints = ↓Poverty	↑Poverty = ↑Resource Constraints
Climate Change ⇒ Poverty	**Poverty ⇒ Climate Change**
↑Climate Change = ↑Poverty	↑Poverty = ↑Climate Change
Resource Constraints ⇒ Economic Growth	**Economic Growth ⇒ Resource Constraints**
↑Resource Constraints = ↓Economic Growth	↑Economic Growth = ↑Resource Constraints
Climate Change ⇒ Economic Growth	**Economic Growth ⇒ Climate Change**
↑Climate Change = ↓Economic Growth	↑Economic Growth = ↑Climate Change
Resource Constraints ⇒ Job Creation	**Job Creation ⇒ Resource Constraints**
↑Resource Constraints = ↓Job Creation	↑Job Creation = ↑Resource Constraints
Climate Change ⇒ Job Creation	**Job Creation ⇒ Climate Change**

↑Climate Change = ↓Job Creation	↑Job Creation = ↑Climate Change
Economic Growth ⇒ Poverty	**Job Creation ⇒ Poverty**
↑Economic Growth = ↓Poverty	↑Job Creation = ↓Poverty

3.2.2 Significance for Thailand's Sustainable Development

The investigative potential of Green Growth is most significant in present, in light of the newly implemented Sustainable Development Goals (SDGs), of which Goal 8.4 emphasizes the conscious "decoupling of economic growth from environmental degradation" (United Nations, 2015a). The SDGs are considered the most recent outcome of global sustainable development conversation. Understanding whether Green Growth historically exists (1990-2014) in Thailand will greatly improve their achievement of SDG 8.4 and other associated indicators within Goal 8; especially in regards to understanding how each variable relates to one another, thereby assisting in development policymaking to enhance or decrease the influence of specific variables. Although to a lesser extent, this is true as well for regionally-similar nations which may face comparable development difficulties.

The significance of the time period (1990-2014) is chosen due to three reasons: 1) maximize statistical power and degrees of freedom (further details can be found in *2.3 Study Population*), 2) limitations of quality and consistent data, and 3) to coincide with Thailand's agreement of Agenda 21 at the 1992 Earth Summit (General Assembly, 1992). Agenda 21 stressed four major components: to combat poverty sustainably especially in developing countries, conservation and management of resources for development, strengthening the role of major groups including children, indigenous peoples, and women, and using science, technology and education as a means of implementing sustainable development policies (United Nations, 1992). Thailand's upholding of Agenda 21 points to a commitment to Green Growth principles, although this is not unexpected as the UN regional Economic and Social Council for Asia-Pacific is headquartered in Bangkok. It is important to note that specific data is published on a biennial basis, therefore since 2014 was available, 2015 would not be and is therefore excluded in analysis.

Any early contender for investigative location was the Republic of Korea ("South Korea") as it was indeed its government to pioneer the ideals of the "Green New Deal," an early iteration of Green Growth, at the 2005 MCED-5 (UN ESCAP, 2011; Kim, Han, & Park, 2012). In August 2008, they were the first to launch an official UN-based Green Growth strategy to usher in a paradigm and pattern of development, which set the precedent for Cambodia in 2010 and Kazakhstan in 2011 (UN ESCAP, 2012b). However, Thailand conceived of Green Growth ideals embedded in His Majesty King Bhumbibol Adulyadej's "Philosophy of Sufficiency Economy" already in 1974 (Mongsawad, 2010) with policy mainstreaming occurring in 1997 (Kantabutra, 2007). This would imply that there would be a higher likelihood of finding evidence of Green Growth between the years 1990-2014 in Thailand, relative to the Republic of Korea.

The final rationale behind choosing Thailand rested largely to the presence of UNESCAP. UN is organized via seven levels: General Assembly, Security Council, Economic and Social Council, Secretariat, International Court of Justice and Trusteeship Council (United Nations, 2015b). The Economic and Social Council contains Regional Commissions, whose main objective is convene good development practices, knowledge sharing, technical capacity building support, policy recommendations and communication moderation among its region's Member States (UN ESCAP, 2015a). The Regional Commission of Asia-Pacific, UNESCAP has been situated in Bangkok, Thailand since 1947 and Thailand has benefitted greatly by being, as of 2015, one of the most accountable and data-transparent Member State in Asia-Pacific (World Bank, 2015a).

Additionally, Thailand has investigative potential by having, in 1990, an HDI of 0.572 (UNDP, 2014a) and a Lower-Middle Income World Bank classification (World Bank, 2014), which contradicts standard Neoclassical Economic theory which claim that perpetual economic growth is desirable and is positively related to wealth and therefore, wellbeing and social development (Rynn, 2001). Given Thailand's unique development parameters, there is strong value in exploring whether and how Green Growth functions.

3.3 Research Design: Historical Case Study

3.3.1 Rationale

The rationale behind choosing a historical research design is to utilize valid secondary data sources, primarily from World Bank and Thai Meteorological Department, to explore whether Green Growth has historically existed in Thailand. Results would be used to test our theoretical framework and extrapolate policy implications. Further, a historicavalidil design is unaffected by the act of collecting data, which minimizes standard/systematic error in reliability, associated with research-subject interactions (Howell & Prevenier, 2001). An additional advantage concerns the selection of World Bank as a historical data source. There is no implicit bias associated with multiple data scientists (Lundy, 2008), especially as methodology procedures are published and transparent (World Bank, 2015j), lending to dependable quality and consistency. However, there is a key limitation. The investigation's quality is contingent upon the availability of data and in the absence of it, strong data procedures should be selected to complete missing values (e.g. with Multiple imputations).

Simultaneously, it is called a Case Study because it "investigates a contemporary phenomenon [Green Growth] within its real-life context [Thailand between 1990-2014] (Schell, 1992)." While the investigation is empirically quantitative, the inclusion of Thailand's historical context cautiously explains the strength of statistical outcomes with a qualitative perspective, allowing it be qualified as an "explanatory case study" (Hsieh, 2010). Similar to the historical research design, the case studies are most preferred when tracking longitudinal activity which explains a specific phenomenon, as it is unconstrained by pre-set data analysis methodologies (Yin, 1994, p. 102). While this allows for powerful triangulation methods, it could be a marked weakness in test-retest reliability (replicability), though this is not the case for our investigation.

3.3.2 Type of Contribution

The RQ will be explored by evaluating existing statistical national data collected from the World Bank (WB) and Thai Meteorological Department (TMD). The nature of the RQ necessitates that an emphases on secondary data supplemented with historical information regarding extraneous variables such as political stability, frequency of natural disasters, etc. It is not feasible to utilize first-hand accounts (i.e. interviews or surveys) because 1) respondents are unlikely to remember economic growth rates, poverty gap rates, etc, dating back to 1990, and even if they had unusually strong eidetic memory, 2) it may not be reliable as humans behaviour can be motivated by a variety of confounders including emotions and motivations.

The research approach is multivariate statistical analysis of secondary data. Secondary data published by WB and TMD have the strength of being consistent (established data collection procedures), reliable/verified (reputable organizations), and statistically powerful (minimal response gaps). Therefore, it is already in a state conducive for statistical analysis, which would be cross-correlation and linear regression. Additionally, utilizing secondary data especially for identifying resource constraints and climate change variables can save significant time and financial resources.

3.4 Data Measurement and Collection: Methodology Rationale

3.4.1 Study Population

The significance of selecting only Thailand has been explored in *3.2.2 Significance for Thailand's Sustainable Development.* As such the study population is Thailand, and the sampling frame is 100% of the population. In other words, all data between 1990-2014 in Thailand is collected. The statistical results are confidently generalizable for the sustainable development future of Thailand, and cautiously for characteristically-similar countries in Asia-Pacific.

3.4.2 Sources of Data

Published secondary statistical data will be obtained from two sources, the World Bank (World Bank, 2015i) and the Thai Meteorological Department (TMD, 2015a). For the constructs being measured, the World Bank is considered objective, reliable and consistent as they are able to provide the information yearly and the data is minimally analysed as they are obtained directly from each national government and cleaned (World Bank, 2013). Furthermore, World Bank prides itself on the free and open access to data on each country's state of development:

> *…Transparency and accountability are essential to the development process and central to achieving the Bank's mission to alleviate poverty. [Our commitment] to openness is also driven by a desire to foster public ownership, partnership and participation in development from a wide range of stakeholders* (World Bank, 2015k).

Therefore, it is with great faith that World Bank is reliable and valid for all variables except for: Climate Change (average precipitation per year and average temperature per year). For the two specific statistics, World Bank has a different format for meteorological information which is not usable in time series. Therefore, a special request was made on January 13, 2016 to TMD and to gather the missing two sets of time series data (Undisclosed, 2016). The data arriving from TMD is disaggregated between Thailand's six geographic regions, including: North, Northeast, Central, East, Southeast and Southwest (TMD, 2015b). Fact-checking resulted in the statistical averaging of all regions to produce data for Thailand as a whole.

3.4.3 Measurement of Green Growth

Green Growth is a function of five different concepts: economic growth, job creation, poverty, resource constraints and climate crisis. It has been further disaggregated into 20 variables, each representing a valid and reliable measurement. Further detail regarding construct validity and the literature review behind the selection of each variable (under Green Growth's concepts) can be found on *3.7.1 Construct Validity: Content*.

For Resource Constraints, the original intention was to retrieve disaggregated national data from the Environment Performance Index (EPI), as it takes into account biodiversity and habitat, water resources, overfishing, etc. and creates an index which totals the environmental outcomes of policy goals (SEDAC, 2014a). However, the prime limitation is it systematically publishes data every three years (a condition which can not be rectified through Multiple Imputation) and methodology for collecting EPI (2001-2014) was obtained by improving Environment Sustainability Index (ESI) from 1980-2000 (SEDAC, 2014b), rendering time series from 1990-2014 unfeasible due to differing data collection and analysis strategies. As a result, WB became the next best available option as it was both methodologically consistent and valid.

Because Resource Constraints is quite a difficult concept to operationalize, six statistics were obtained to provide a multi-faceted view of natural resource depletion from the perspective of ecology and environmental economics (quantifying resources in terms of monetary terms).

TABLE 2: RESOURCE CONSTRAINTS (6 VARIABLES)

Resource Constraints					
Arable Land (% of land area)	Marine Protected Areas (% territorial waters)	Adjusted Savings: Energy Depletion (% of GNI)	Adjusted Savings: Mineral depletion (% of GNI)	Adjusted Savings: Natural resources depletion (% of GNI)	Adjusted Savings: Net forest depletion (% of GNI)

For Climate Change, CO_2 emissions have been recorded to influence climate change (Solomon et al., 2008; NAS, 2010; IPCC, 2014), as well as other greenhouse gas emissions such as nitrous oxide, methane (EPA, 2012), etc. However due to lack of data availability on the other greenhouse gases, only CO_2 emissions have been used to observe atmospheric pollution. Additionally, other meteorological variables such as precipitation and temperature changes can certainly be attributed to climate change, however the data is obtained through TMD by request.

TABLE 3: CLIMATE CHANGE (3 VARIABLES)

Climate Change		
CO2 Emissions Per Capital (Metric Tons)	Average Precipitation per year	Average Temperature per year

For Poverty, WB conceptualizes the measurement of poverty as an aggregate of three dimensions: 1) welfare measurement, 2) poverty line/threshold and 3) poverty indicator for the population as a whole (World Bank, 2015b). Furthermore, the welfare measurement can be monetary or non-monetary (World Bank, 2015c) (e.g. health, education poverties), however poverty for the purpose of this thesis construction, is considered a monetary qualifier. Consumption is considered a better outcome indicator than income, as it relates more closely to the wellbeing (Ravallion, 1992), there is no data on consumption patterns in Thailand. The default would be to utilize net income that has been adjusted for macroeconomic fluctuations.

Regarding the poverty line/threshold, relative poverty lines are a better measurement of identifying overall distribution of income (World Bank, 2015d), however between 1990-2004, there is a lack of consistent data regarding “the number of poor at national poverty lines;” as a result, the WB’s absolute poverty lines are taken at $1.90 and $3.10 to measure extreme poverty vs. poverty. The absolute poverty lines are adapted from the 2011 Purchasing Power Parity (PPP), which compiles expenditure values of each country’s gross domestic product (GDP) to generate a statistical estimate of purchasing power (ICP, 2011).

In selecting poverty indicators, there are multiple, including incidence of poverty (headcount index) and depth of poverty (poverty gap), and poverty severity (World Bank, 2015e). The selection of poverty gap and the number of poor at $1.90 and $3.10 is meaningful as it consistent with the poverty line/threshold already established by the 2011 PPP. The GINI Coefficient is included to supplement the measurement of income distribution and poverty gap (World Bank, 2015f).

TABLE 4: POVERTY (6 VARIABLES)

Poverty					
Adjusted net national income (current US$)	Number of poor at $1.90 a day (2011 PPP)	Number of poor at $3.10 a day (2011 PPP)	Poverty Gap at $1.90 a day	Poverty Gap at $3.10 a day	GINI (World Bank Estimate)

For Economic Growth, GDP is a valid and reliable measurement of growth, given that is used in economics to represent the health and size of a country's economy (World Bank, 2015g). Therefore to measure economic growth, only two statistics are adopted: 1) GDP growth, and 2) GDP per capita. The latter measures the average income per person in a country and as income (thereby: consumption) grows, the economy will gross as well. In the framework of the RQ, income is considered purchasing power for consumption purposes, not investment capital.

TABLE 5: ECONOMIC GROWTH (2 VARIABLES)

Economic Growth	
GDP Growth (ann. %)	GDP per capita, PPP 2011

For Job Creation, two statistics are appropriate: unemployment and employment. As unemployment decreases, theoretically job creation as an influencing factor could increase. As job creation increases, so does employment in non-farm sectors. Non-farm usually excludes government, non-profit, and farm employees (BLS, 2015), but its inclusion here delineates inclusive of all industry and services which produce goods/services for profit (World Bank, 2015h).

TABLE 6: JOB CREATION (3 VARIABLES)

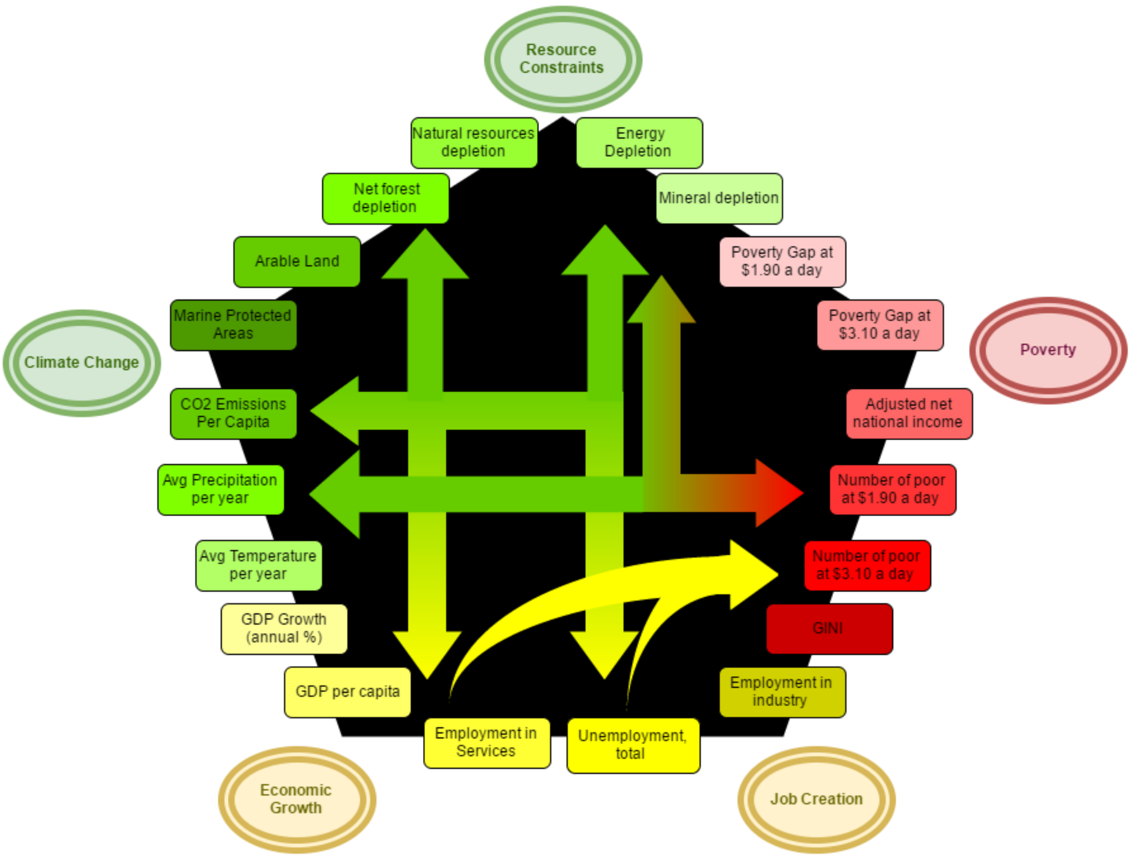
Job Creation		
Unemployment, total (% of total labor force)	Employment in Industry (% of total employment)	Employment in Services (% of total employment)

3.4.4 Statistical Framework

Ultimately we are observing whether concepts are related, therefore variables which fall under the same umbrella concept (e.g. Poverty) will not be cross-correlated nor regressed with each other. The interrelationships below in *Fig. 4* are predefined according to the interpretation of Green Growth (see *Fig.2*). In other words, Resource Constraints & Climate Change influence Poverty and vice versa. Resource Constraints & Climate Change influence Economic Growth & Job Creation and vice versa. Economic Growth & Job Creation influence Poverty. Of particular note, variables grouped together, delineated in *Fig. 4* as the same colour family (i.e. Resource Constraints & Climate Change; Economic Growth & Job Creation), will not be cross-correlated/linearly regressed as the original definition of Green Growth (reproduced below) indicates that there is a pre-existing relationship.

To reiterate, the definition of Green Growth is: “a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises.” (MCED-5, 2005a).

FIGURE 4: NETWORK GRAPH DEPICTING GREEN GROWTH CONCEPTS



3.5 Data Analysis: Methodology Rationale

RQ: *"Is there evidence of significant relationships between: Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"*

For a visualization, please refer *Fig. 4 Network Graph depicting Green Growth Concepts.*

3.5.1 Multiple Imputation

Incomplete data is a common difficulty in longitudinal studies, due in part to attrition and non-response (Goldstein, 2009) but in this case, it is due to variant information publishing schedules. Out of 500 cases spanning 1990-2014 for 20 variables, there are 51 missing values (10.2%), which will be managed with multiple imputations (MI).

All are ideal candidates for MI as they reside between valid cases or have neighboring relevant information (e.g. observed values for year 2013 in Average Precipitations to inform missing values for year 2013 in CO_2 Emissions). The latter condition fulfills the Missing at Random (MAR) clause (Rubin, 1996), to be expounded on later in this section. The rationale behind selecting multiple imputation is based on the selection of SPSS as the analytical vehicle and dataset characteristics (i.e. % missing and randomness conditions).

Firstly, despite the chief criticism of SPSS being unable to perform robust methodologies, especially in structural equation modeling and missing cases management (e.g. MCMC), in comparison to STATA/SAS software (Park, 2009), it is still chosen for its strength in answering multivariate social science questions and because of the researcher's professional familiarity with said software. The implication of this decision is that there are three options in dealing with missing data values in SPSS: MI, full information maximum likelihood (FIML), and trimming.

Secondly, trimming is the practice of eliminating missing values (e.g. outliers), with the assumption that their absence would lead to a greater representativeness (Keselman et al., 2002). It is typically performed for datasets with 10% or less missingness (Ghosh & Vogt, 2012). Trimming is particularly discouraged for longitudinal data, especially when there is only 1 value per year; thereby resulting in the final choice between FIML and MI.

Thirdly, missing values in the dataset are considered Missing at Random (MAR), which means that there is a systematic relationship between missing and observed data (Soley-Bori, 2013), namely for the four variables: # of Poor at $1.90 a day, # of Poor at $3.10 a day, Poverty Gap at

\$1.90 a day, Poverty Gap at \$3.10 a day and the GINI Index. The World Bank has published the four variables' information on a biennial basis, indicating systematic variance in missingness. The other variables are MAR, but do not vary as methodically. This is critical information as it further restricts the decision to either MI or FIML methodologies (Schlomer, Bauman, & Card, 2010; Ibrahim & Molenberghs, 2011).

Finally, while MI and FIML are both regarded highly for achieving accurate standard error estimates (Newman, 2003). Proponents for FIML stress that it provides "near-optimal Type 1 error rates" under MAR simulations (Enders & Bandalos, 2001; Larsen, 2011); however, FIML is largely performed on STATA/SAS, may not yield a complete dataset (Olinsky, Chen, & Harlow, 2003) and is used largely to service nonlinear models (Allison, 2012). This is not to say MI doesn't have advantages. Since it is a Bayesian procedure, SPSS will use the surrounding information to compute likely values (Goldstein, 2009), and the greater number of imputations, the likelihood of accuracy increases, especially when an average of all imputations is created to replace the missing value (Helenowski, 2015).

As for the number of imputations, data scientists have found that between 3-5 will already yield excellent results (based on standard error estimates) (Hippel, 2005; Graham, Olchowski, & Gilreath, 2007). More concretely, a formula has been derived to ensure the least amount of standard error units. Hershberger & Fischer (2003) idealizes that a standard error of 0 is ideal with the following formula:

$$Standard\ Error\ Units = \left(1 + \frac{y}{m}\right)^{0.5} - 1$$

Of course one must keep in mind the notion of marginal gains in relative efficiency and as a result, I will undertake 5 imputations with 10.2% missing information (which can be treated with MI), which will yield the standard error of 0.01 (≤1% significance), an acceptable compromise.

3.5.2 Cross-Correlation Analysis

As clarified by the research question, we are attempting to understand whether there is a relationship between the various concepts which constitute "Green Growth", which would provide a foundation to whether Green Growth might exist statistically, in Thailand.

Cross-Correlation Analysis measures the similarity of two time-series, incorporating lags of one in relation to the other (Lyon, 2010). It utilizes Pearson's Product-Moment R. Lags are important as there is empirical evidence that the activities of one variable (e.g. Employment in the Service

Industry) may have delayed indirect effects on another variable (e.g. CO_2 Emissions) (Grossman & Krueger, 1994; Saidi & Hammami, 2015) . Given that potential lags is rarely covered in literature and often varies according to geographical region, it will be largely an exploratory endeavour. It is also necessary to mention that cross-correlation analysis is merely an explorative tool to help identify where potential lead-lagged relationships might lie, in this case, significance set at 5% will not cause a Type 1 Error inflation.

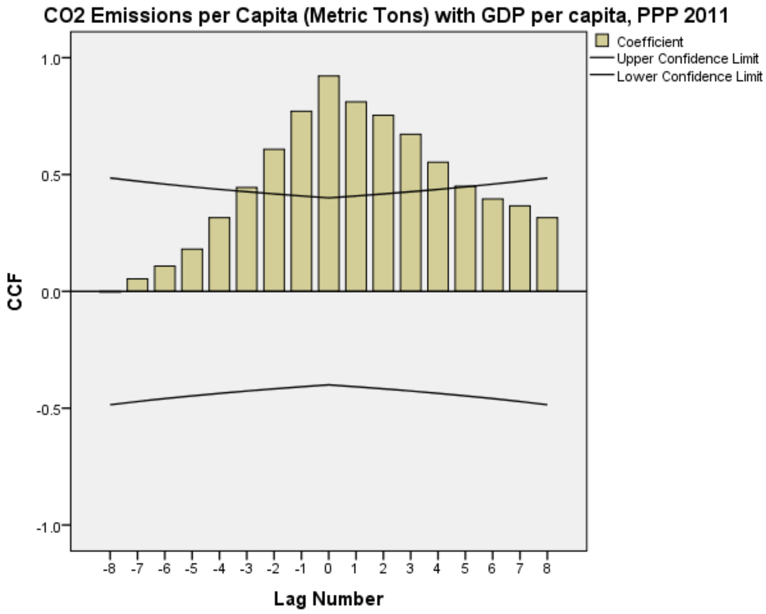
There are two main difficulties in incorporating time lags into this investigation. Firstly, Thailand (relative to a European country) would have different time lag times/effects between the various factors due in part to the confounding impacts of differing development infrastructure (Rietveld, 1989), environmental governance, monetary and environmental policy (Ferraro, 2009), population (Paprotny, 2016) and geographic characteristics, et cetera. As a result, it is exceedingly difficult to obtain Thailand-specific literature regarding potential lag effects and therefore, any methodology selected and analyses undertaken must regard general literature (largely taken from the United States) as points of comparison. This is a potential validity threat.

Secondly, lagged effects are often implied in when comparing longitudinal time series (Huth & Abergel, 2012), however it has always been referred to in general terms or as a concept for future research. In other words, empirical research will mention time lags, but not enumerate years (Ravenscraft & Scherer, 1982; Bryan, 1986; Fritsch & Mueller, 2004). This becomes problematic because there is no reference for what is considered an appropriate amount of lag. The decision to perform the lag up to 8 years is made as the electoral cycle in Thailand is every 4 years (Hicken A. D., 2002) and politics is a significant influencing factor in regional sustainable development (Chatterjee & Finger, 1994, p. 77), especially in Thailand (Doner, 2009, p. 65). Eight is ideal as it has been shown that if there are an excessive number of lags implemented, SPSS will generate defective output as there are too few time points (IBM, 2013).

3.5.3 Linear Regression & Structural Equation Modelling

Linear regression analyses is ideally performed when a lead-lagged relationship has been deduced between two variables (independent & dependent). The goal of this investigation is to understand not only if there Is a directional relationship, but also whether there is a possibility of causality being involved (via lead-lagged relationships) and if so, whether it is lagged. Lag indicate that VAR1 causes changes in VAR2 but not at a simultaneous rate. To accomplish this, only significant cross-correlations will be analysed, which would provide the year of lags (observing up to 8 years), the strength of relationship, and the variables themselves. It is important to note that in most cross-correlations, significant relationships have been found, the strongest relationship (interpreted as the tallest bar crossing the upper/lower confidence limits) will be analysed. In other words in *Fig. 5*, regression will be analysed at year 0 as it shows the strongest significant relationship – CO_2 Emissions * GDP per capita will regressed with no lags. For graphs in which there are multiple peaks, analyses will be performed on all highest peaks of equal height.

FIGURE 5: SAMPLE OF SIG. CROSS-CORRELATIONS (CO2 EMISSIONS * GDP PER CAPITA)



The rationale behind this decision is due largely to the time-consuming nature of manually creating new variables reflecting the lags (see the procedure at *3.5.3 Linear Regression & Structural Equation Modeling*). At the same time, our investigation is not considered exhaustive as evidenced by the limited number of variables characterizing each concept within Green Growth, it is meant to anchor the beginnings of further research into the empirical possibility of Green Growth in Thailand, by modeling the different inter-relationships between the concepts.

In the event that zero time lags are identified (due either to immediacy of effect or to data collection nuances), structural equation modeling (SEM) can be attempted to determine a path dependence (i.e. path analysis) of the variables with each other (Hox & Bechger, 2007). Path dependence can be important when observing Green Growth theory because many concepts such as Poverty may be a function of Economic Growth *or* Job Creation-led Economic Growth. The inclusion of multiple dependent variables allow us to investigate multiple regression analysis and determine for example, whether Poverty is influenced by one variable (direct effects) or the interaction of many (indirect effects) (Lei & Wu, 2007).

SEM for this investigation can be implemented under specific conditions (Du Toit & Browne, 2007). Firstly, SEM carried out on time-series occur under the assumption that there are no time-lags between the variables. Further, the variables selected must possess strong and significant cross-correlations with each other. Preferably, variables and relationships chosen should reflect the strongest cross-correlation strength relative to alternate variables. Finally, there should be a model in place which determines likely path dependence, which there is, courtesy of UNESCAP's Green Growth definition. SEM can occur only when the interpretation of cross-correlations have yielded statistical results which fulfil the aforementioned three conditions.

Additionally, the notion of causality via lead-lagged relationships is statistically sensitive, therefore in the interpretation of linear regression analyses will be supplemented with historical context.

3.5.3.1 Inclusion of Historical Context

The inclusion of historical context is necessary to provide geopolitical, social, economic and environmental condition which may explain and further reinforce specific relationships. Significant results will be obtained and with complementary historical data, the possibility of a lead-lagged relationship between the variables can be inferred. This is not to claim causality from the statistical data and analysis alone, but rather using the statistics to observe the real-world historical data to observe and analyse for the "potential" for lead-lagged relatedness. Thereby, being able to conclude whether Green Growth, as an operating sustainable development construct, exists in Thailand and if so, what is the strength and significance of each variable's relationship with each other.

Additionally wherever possible, manual efforts will be undertaken to observe periods in which Economic Growth is not accompanied by an increase in Resource Constraints & Climate Change, as this may further support the existence of Green Growth.

3.6 Data Analysis: Methodology Procedure

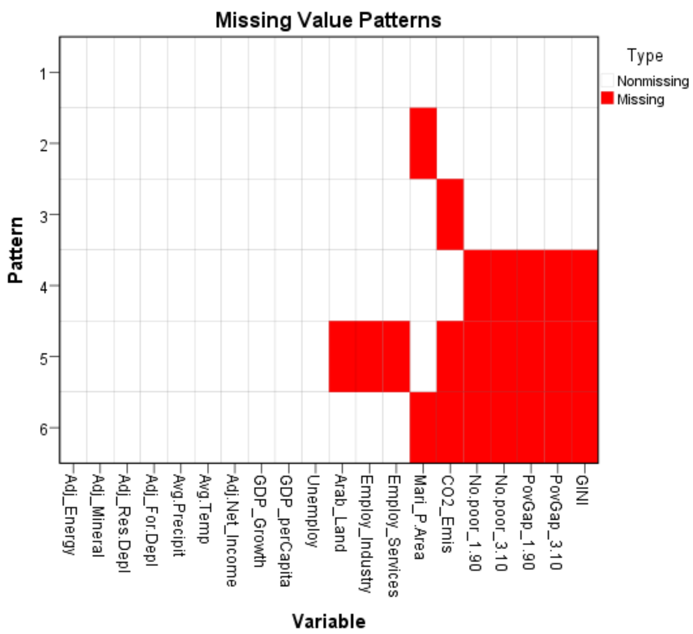
For applied research to possess scientific empiricism, it requires "carefully designed procedures that apply rigorous analysis" which are simultaneously replicable and transmittable (Kumar, 2002, p. 19). The following sections interpret the output necessary to reproduce the research accurately for the next investigator, based on the actions I performed in IBM SPSS v.23.

The RQ is: *"What is the relationship between Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"*

3.6.1 Multiple Imputation

Under the assumption that the incomplete dataset, is coded well (including a date/time variable) and fit to be cleaned, we would first generalize the data to determine if there are patterns to the missingness. Using a less than 0.01% minimum percentage of values to be displayed (i.e., analyse all missing values), the output reveals that there are 10.6% of all values missing, which proves trimming is not an option nor encouraged as it is longitudinal data. Further, as evidenced by *Fig. 6*, there is a small degree of systematic variance in missingness, so Markov-Chain Monte-Carlo (MCMC) is appropriate, but flexibility will be given to SPSS to obtain automatically the best methodology and output for MI, considering relevant min/max constraints for each variable, obtained by considering the range of observed values. Five imputation rounds are undertaken.

FIGURE 6: MISSING VALUE PATTERNS



While SPSS obtains the averages across all imputations when analyses of variance are performed, it is not the case for correlations or linear regressions. As a result, I will manually calculate the value of each missing value and the arithmetic mean across all five imputations, to create a complete and "cleaned" dataset ready for the next step.

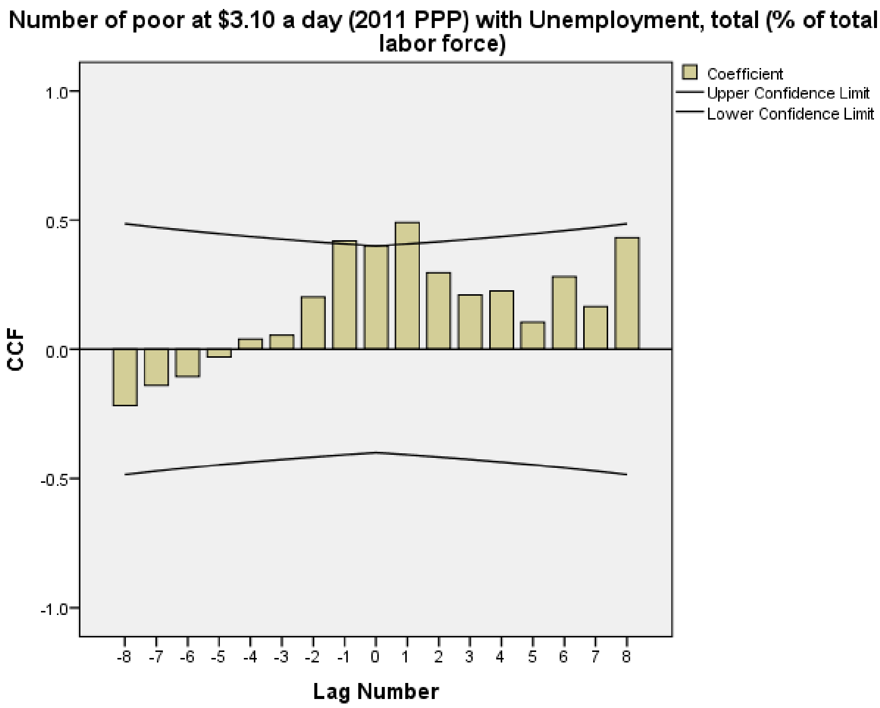
3.6.2 Cross-Correlation Analysis

Using the cleaned dataset, we can perform cross-correlation analysis using a maximum of 8 lags. Significance is set at 5% and can be observed by reading whether the coefficient surpasses either the upper or lower confidence limits, and the strength of the relationship can be read in output labelled “Cross Correlations”. Detailed analyses on outputs will be performed in *4.10 Discussion of Cross-Correlations (Significant & Non-Significant)*. Again, it is important to note that cross-correlation analysis is merely an explorative tool to help identify where potential lead-lagged relationships might lie, in this case, significance set at 5% will not cause a Type 1 Error inflation.

3.6.3 Linear Regression & Structural Equation Modelling

Linear regression analyses and/or structural equation modelling will be undertaken on five of significant representative variables (excluding lags for SEM). For simple linear regressions, which variable is to be lagged depends on the interpretation of the cross-correlation plot. For example in *Fig. 7,* SPSS assumes VAR2: Unemployment Is “white noise”, meaning the lags apply to VAR1: # of Poor at $3.10. At its highest significant peak, VAR1 is lagged +1 year than VAR2, which means that VAR2 has a significant relationship with VAR1, 1 year later.

FIGURE 7: INTERPRETATION OF LAGS IN SIG. CROSS CORRELATIONS (# OF POOR AT $3.10 * UNEMPLOYMENT)



As of 2016, there is no statistical procedure in SPSS which performs linear regression with lags designated to either the independent or dependent variables. It would be necessary to create new variables which manually shift IV/DV lower by the years lagged. Since this procedure is rather time-consuming, this is primary reason for regressing only the highest peak (strongest, most significant relationship) instead of analyzing all significant lags.

However in the absence of lags for the strongest significance cross-correlations, SEM will be undertaken to understand if there is path dependence, thereby analyzing indirect and direct effects with the model of UNESCAP's Green Growth as the guiding beacon. It is important to note that SEM does not replace the role of linear regressions in determining directionality in relationships, but rather it contextualizes it. SEM's key strength is the featuring of multiple linear regressions in the context of a predetermined model. For our five significant variables, SPSS will generate six linear regression pathways. Detailed analyses on outputs will be performed in *4.10 Discussion of Cross-Correlations (Significant & Non-Significant)*

3.7 Validity & Reliability Threats

The investigatory research design is: historical case study (see *3.3 Research Design: Historical Case Study)*, which can claim certain advantages and minimization of the four validity and reliability threats over other quantitative designs. Efforts to minimize all threats, as well as limitations in methodology will also be explored and articulated below.

3.7.1 Construct Validity: Content

Construct validity is defined as the appropriate operationalization of the theories the investigation claims to analyse (Messick, 1989). It includes two components: translation and criterion-related validity, although the latter will not be explored as no new data collection tool was developed to retrieve the data. Face and content validity are the subjective and domain-based means to measure translation validity, respectively (Drost, 2011). More specifically, content validity utilizes the domain of knowledge on a specific concept (in this case, Green Growth) to extract variables which are accurate and representative. In this case, an argument can be made that content validity is relatively strong, as UN's literature[2] defends its representativeness.

Green Growth is comprised of five concepts: Resource Constraints, Climate Change, Poverty, Economic Growth and Job Creation (see *3.4.3 Measurement of Green Growth*), which are systematically interrelated (see *Fig 1*).

Resource Constraints is categorized by UNESCAP under the umbrella term: Resource-Use Efficiency. They define environmental costs (pollution emissions, natural resources-used, and social cost associated with environmental burden) as constraint on resource and depletion of planetary sources (UN ESCAP, 2009, p. 3). As a result Resource Constraints includes: 1) Natural Resources-Used: Arable Land, and Marine Protected Areas and; 2) Social Costs: Adj. Savings Energy Depletion, Adj Savings: Mineral Depletion, Adj. Savings: Natural Resource Depletion, and Adj. Savings: Net Forest Depletion. Pollution emission is concerned with the environmental economics of planetary sinks (Behrens & Randers, 2004, p. 9), also known as the result of resource constraints, and thereby is included in the Climate Change.

As Climate Change is an indirect consequence of many economic activities, the UN considers many variables grouped by their themes: atmosphere, land, consumption/production patterns, natural hazards, biodiversity, health, and freshwater (Bruckner, 2008), to be climate-change related. Due to large patterns of missingness in data and considerable overlap with variables in Resource Constraints, only atmospheric variables were adopted. These included CO_2 Emissions Per Capita (UN DESA, 2007), Average Precipitation Per Year and Average Temperature Per Year (Bruckner, 2009).

Similar to Climate Change, the UN has measured Poverty by many variables including: income poverty, income inequality, sanitation, drinking water, access to energy and living conditions (UN DESA, 2007). While stringent efforts were taken to adequately measure income poverty (Adj. Net National Income, Number of Poor at $1.90 a day, and Number of Poor at $3.10 a day) and income inequality (Poverty Gap at $1.90 a day, Poverty Gap at $3.10 a day, and GINI), there was no complete dataset for all other variables, especially between the years 1990-1999 (World

[2] United Nations is considered a high-quality source for literature regarding the variables of Green Growth as the concept of Green Growth was first pioneered the UN ESCAP at the Fifth Ministerial Conference on Environment and Development (MCED) in March 2005 (Seoul, Korea) ((MCED-5, 2005a).

Bank, 2015a), which is a substantial data gap. As a result, Poverty is operationalized strictly based on income according to World Bank's formulation (World Bank, 2015b).

Conceptually, Economic Growth has been absorbed under the UN term: Sustainable Development, as a result there are few explicit variables which measure the traditional definition of growth. However, with the advent of the new SDGs, Goal 8: Indicator 1 specifically observes per capita economic growth (UN SDG, 2015a) which is included as GDP per Capita. Additionally, GDP Growth % is included according to the World Banks' valuation of Economic Growth (World Bank, 2015g). Economic Growth also involves employment rates, which is included in Job Creation.

Job Creation is measured by the OECD and UN agencies (UNIDO, ILO, UNDP) as including three variables: employment [rates], wages and typologies of employment (United Nations, 2011). As wages are largely covered in Poverty, attention is diverted to including employment rates: Unemployment as % of Total Labor Force, and typologies of employment: Employment in Industry, and Employment in Services.

With the exception of Poverty variables, Construct Validity on Green Growth is quite strong.

3.7.2 Internal Validity

Internal validity is concerned with the statistical effect of confounding variables, especially in analysing a lead-lagged relationship. To maximize internal validity, the following potential confounders will be controlled for in Thailand's historical context: macro-political environment, natural disasters (Setboonsarng, 2012), policies (environmental governance, public administration, economy) (Ruengvirayudh, 2013), infrastructure development & projects, globalization (Gurria, 2006), civil society movements, and crises (terrorism and health (Brookings Institute, 2007)).

Due to the lack of reliable and consistent data regarding all aforementioned factors, controlling for their statistical impact on the dependent variables is not feasible. As a result, the "confounders" will be used to potentially explain the strength of relationships between certain variables and certainly any accompanying lags, to manifest a relatively complete image of Thailand's Green Growth in the years 1990-2014.

3.7.3 External Validity

External validity observes the generalizability of any conclusive statements regarding relationships between variables, which in this investigation is very high because it is made very clear that we are studying the historical possibility of Green Growth (operationalized as 1990-2014), in Thailand (using country-specific data), using UN-defined constructs (Green Growth concepts and variables). The empirical results will not be used to forecast the future trajectory of Green Growth, but rather serve as an empirical foundation to inform social scientists, policymakers, international organizations and government entities in light of the new universal SDGs set forward by the United Nations. In this manner, external validity is very high.

To a lesser power, statements about Green Growth could be suggested of regionally-/developmentally-similar countries located in Asia-Pacific. The criteria for similarity could include: HDI, population size and density, geographic characteristics (access to maritime trade, climate), World Bank income classification, size of economy (GDP, economic growth), and politics. This could primarily assist UNESCAP in streamlining common Green Growth capacity-building policies for developmentally-similar countries as well as future research into overlooked regions.

3.7.4 Statistical Conclusion Validity

Statistical conclusion validity is primarily concerned with whether empirical inferences can be made given statistical power, reliability of measures and treatment, random sampling and the like (Drost, 2011, p. 115). While it is one the four important types of validity, it also pertains largely to traditional experimental and quasi-experimental designs. Statistical power and random sampling are not relevant concerns for the Historical case study research design.

As for reliability of measures and treatment, efforts are taken to minimize the bias of multicollinearity, which can claim large standard error estimates if the independent variables are highly correlated with each other in a multiple regression function (Allen, 1997). To minimize multicollinearity, variables located within under the same umbrella-concept (e.g. variables within Poverty) will not be correlated with each other, but rather they will act as independent variables for all other concepts (see *Fig. 2* for a visual representation).

3.7.5 Reliability

A statistical investigation is qualified as reliable if measurement is stable and consistent, allowing for replicability. Because data is collected from secondary and reputable sources (World Bank & Thai Meteorological Department), it would provide identical datasets from which to start from. However, the nature of MI is its uncertainty, therefore test-retest reliability would likely be problematic because SPSS is unlikely to generate identical imputation each time. To minimize this issue, the average of all 5 imputations was taken to complete each missing value. This lends a degree of stability over time, although not fully eradicating reliability concerns.

There are no consistency issues in this investigation, namely as there are no subjective criterion with which to interpret the data, as is common in survey methodology. SPSS and AMOS are considered a consistently reliable tool to interpret the historical data from Thailand.

4 PART IV: EMPIRICAL RESULTS AND DISCUSSION

*"I see many opportunities existing for Thailand. Opportunities for faster growth, more inclusive growth with improved education and opportunities for all Thais, but most importantly, **environmentally sustainable Green Growth**." (World Bank Country Director for Thailand Ulrich Zachau in "Global Economic Outlook: Implications for Thailand")*

4.1 Introduction

UNESCAP's definition of Green Growth is as follows: "*a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises*" (MCED-5, 2005a; UN ESCAP, 2012). This definition implies that some of Green Growth's composite concepts are already correlated, within the same family (e.g. Economic Growth, and Climate Change) negating the need for further analysis. In other words, variables within the concept of Economic Growth will be statistically related to all other variables, excluding those within Economic Growth and Job Creation. Furthermore, since cross-correlations signals potential lagged linear regressions, the significance is retained at 5% and the order of the variables does not factor into analysis.

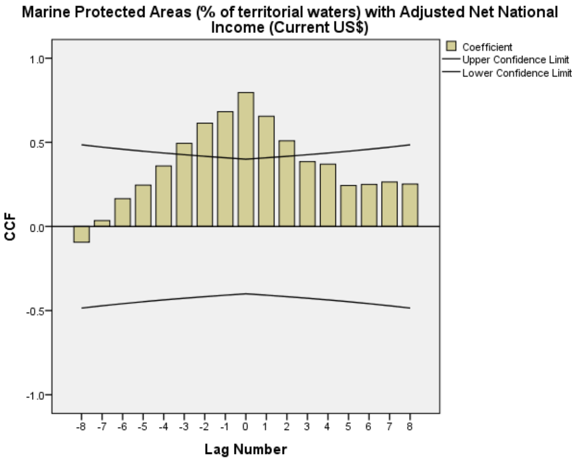
Additionally, due to the quantity of significant results, limited time frame and energy resources, the following Cross-Correlation section will feature each concept related to each other, and discuss the strongest significant cross-correlation function (CCF) between each variable (e.g. Arable Lands vs. variables within Poverty). Finally, the strongest significant relationship between concepts (e.g. Resource Constraints and Poverty) will be linearly regressed with relevant lags, and historical context will be brought in to explain its strength, significance and time frame. The rationale behind this decision is to ultimately deduce whether Green Growth exists historically in Thailand, and the variables are meant to represent Green Growth's composite concepts.

It is important to note that in analyzing the strong significant correlation relationship, it does not negate or minimize the importance of other weaker, albeit significant relationships. The objective is to observe an overview of Green Growth's existence in Thailand, not necessarily deduce the detail of each relationship between the variables between 1990-2014.

4.2 Cross-Correlations: Resource Constraints * Poverty

4.2.1 Marine Protected Areas (% of territorial waters) * Poverty

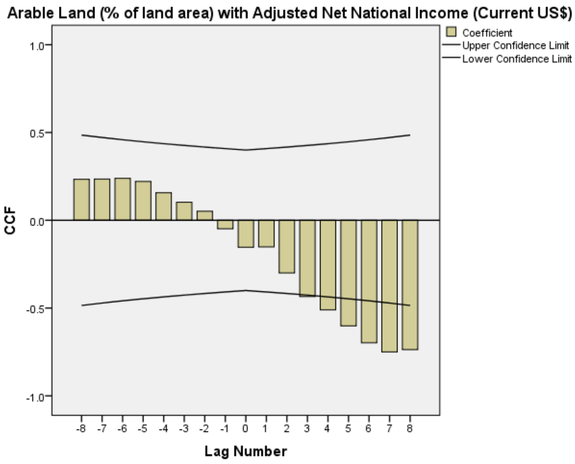
FIGURE 8: CCF MARINE PROTECTED AREAS * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Marine Protected Areas and Adj. Net National Income, at 0 years lagging (r=0.796, n=24, p=0.05, SE=0.200). This suggests that both variables rise at concurrent rates.

4.2.2 Arable Lands (% of Land Area) * Poverty

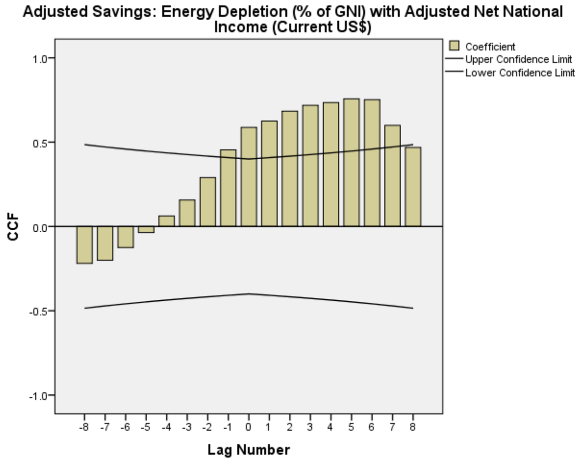
FIGURE 9: CCF ARABLE LANDS * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a strong negative Pearson's correlation between Arable Lands and Adj. Net National Income, with 8 years leading (r=-0.737, n=24, p=0.05, SE=0.200). This suggests that rises in Adj. Net National Income may influence lower availability of Arable Lands eight years into the future.

4.2.3 Adj. Savings Energy Depletion (% of GNI) * Poverty

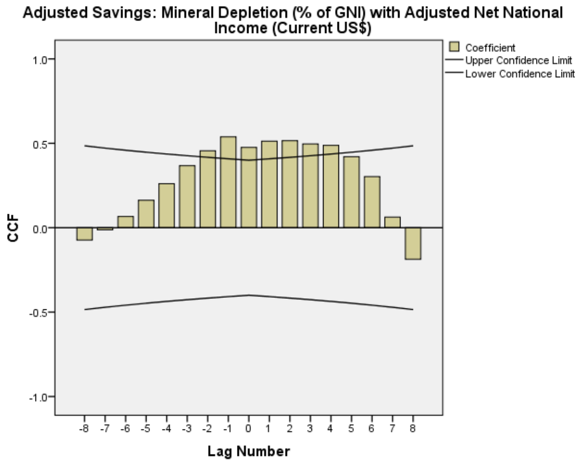
FIGURE 10: CCF ENERGY DEPLETION * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Energy Depletion and Adj. Net National Income, with 5 years leading (r=0.765, n=24, p=0.05, SE=0.224). This suggests that rises in Adj. Net National Income may influence higher rates of Energy Depletion five years into the future.

4.2.4 Adj. Savings Mineral Depletion (% of GNI) * Poverty

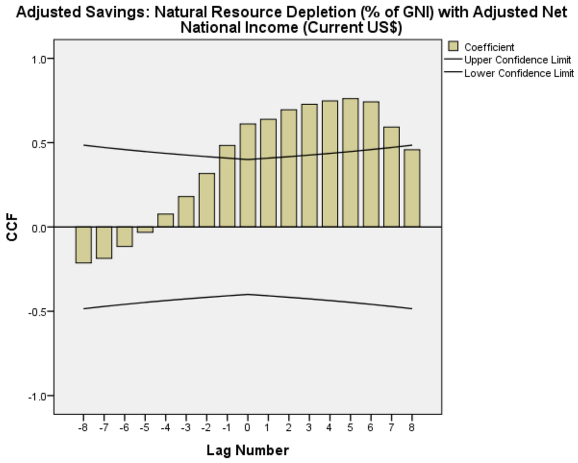
FIGURE 11: CCF MINERAL DEPLETION * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a moderate positive Pearson's correlation between Mineral Depletion and Adj. Net National Income, with 1 years lagging (r=0.538, n=24, p=0.05, SE=0.204). This suggests that rises in Mineral Depletion may influence higher Adj. Net National Income one year into the future.

4.2.5 Adj. Savings Natural Resource Depletion (% of GNI) * Poverty

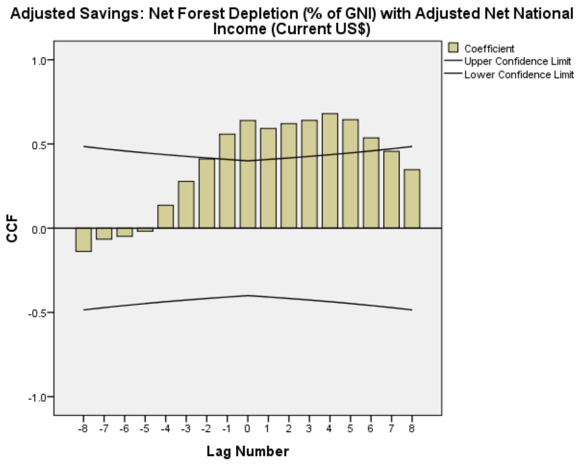
FIGURE 12: CCF NATURAL RESOURCE DEPLETION * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Natural Resource Depletion and Adj. Net National Income, with 5 years leading (r=0.761, n=24, p=0.05, SE=0.236). This suggests that rises in Adj. Net National Income influence higher rates of Natural Resource depletion five years into the future.

4.2.6 Adj. Savings Forest Depletion (% of GNI) * Poverty

FIGURE 13: CCF NET FOREST DEPLETION * ADJ. NET NATIONAL INCOME

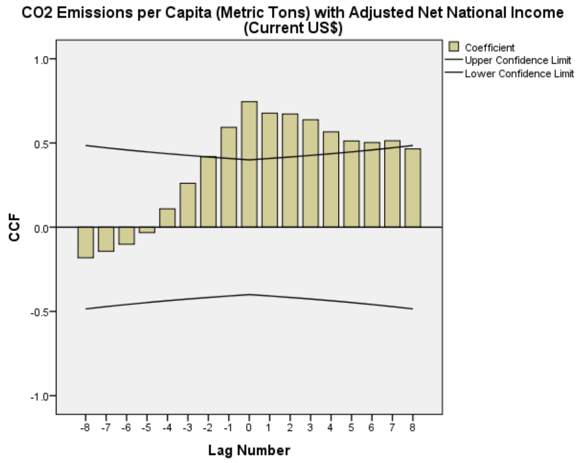


CCF analysis reveals the strongest relationship is a moderate-strong positive Pearson's correlation between Net Forest Depletion and Adj. Net National Income, with 4 years leading (r=0.680, n=24, p=0.05, SE=0.218). This suggests that rises in Adj. Net National Income influence higher rates of Net Forest Depletion four years into the future.

4.3 Cross-Correlations: Climate Change * Poverty

4.3.1 CO2 Emissions Per Capita * Poverty

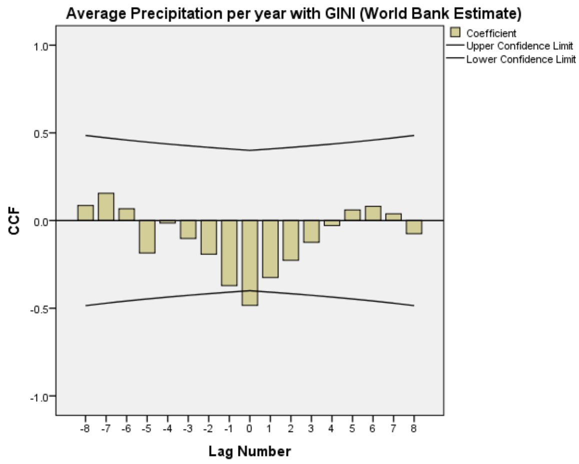
FIGURE 14: CCF CO2 EMISSIONS * ADJ. NET NATIONAL INCOME



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between CO_2 Emissions and Adj. Net National Income, with 0 years lagging (r=0.745, n=24, p=0.05, SE=0.200). This suggests that both variables rise at concurrent rates.

4.3.2 Average Precipitation per year * Poverty

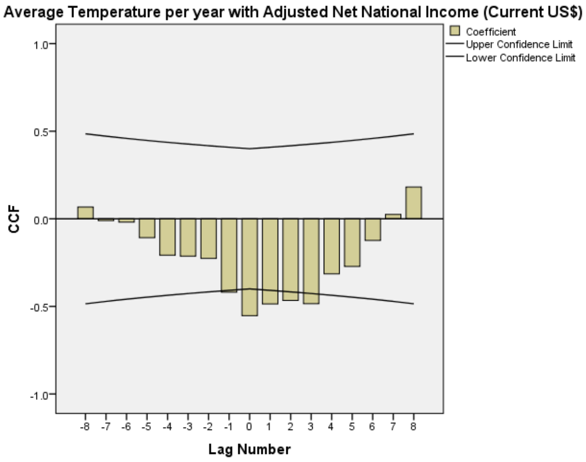
FIGURE 15: CCF AVERAGE PRECIPITATION * GINI



CCF analysis reveals the strongest relationship is a moderate negative Pearson's correlation between Average Precipitation and GINI, with 0 years lagging (r=-0.484, n=24, p=0.05, SE=0.200). This suggests that rises in Average Precipitation and declines in GINI occur at concurrent rates.

4.3.3 Average Temperature per year * Poverty

FIGURE 16: CCF AVERAGE TEMPERATURE * ADJ. NET NATIONAL INCOME

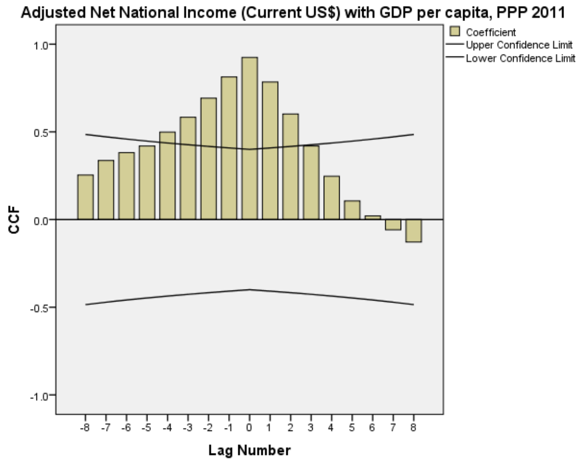


CCF analysis reveals the strongest relationship is a moderate negative Pearson's correlation between Average Temperature and Adj. Net National Income, with 0 years lagging (r=-0.553, n=24, p=0.05, SE=0.200). This suggests that rises in Average Temperature and declines in Adj. Net National Income occur at concurrent rates.

4.4 Cross-Correlations: Poverty * Economic Growth

4.4.1 Adj. Net National Income * Economic Growth

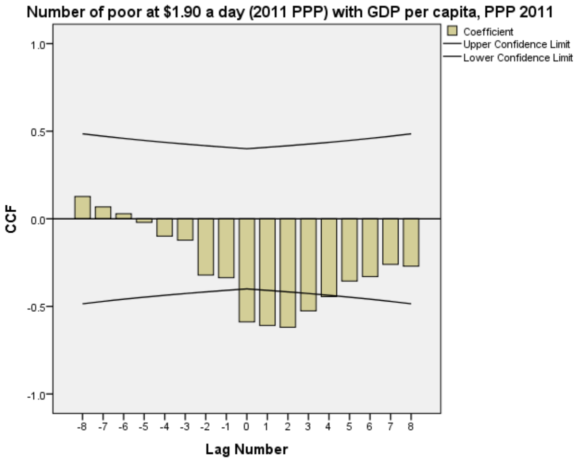
FIGURE 17: CCF ADJ. NET NATIONAL INCOME * GDP PER CAPITA



CCF analysis reveals the strongest relationship is a very strong positive Pearson's correlation between GDP Per Capita and Adj. Net National Income, with 0 years lagging (r=0.925, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.4.2 No. Poor at $1.90 a day (2011 PPP) * Economic Growth

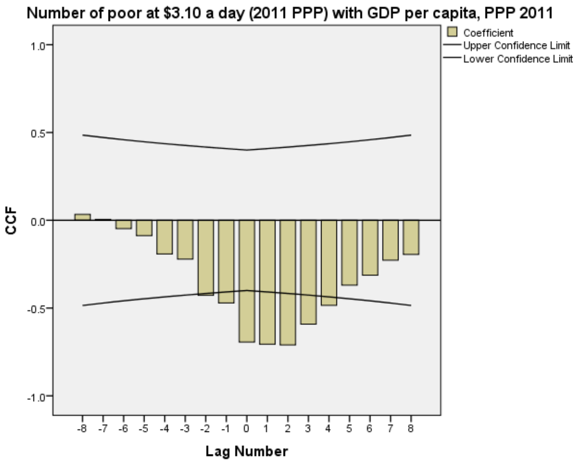
FIGURE 18: CCF # OF POOR AT $1.90 A DAY * GDP PER CAPITA



CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between No. of Poor at $1.90 a day and GDP per Capita, with 2 years leading (r=-0.619, n=24, p=0.05, SE=0.209). This suggests that rises in increased GDP Per Capita influence declining rates of No. of Poor at $1.90 a day two years into the future.

4.4.3 No. Poor at $3.10 a day (2011 PPP) * Economic Growth

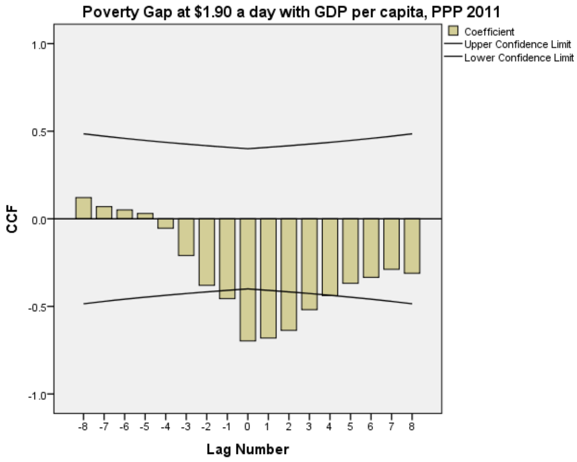
FIGURE 19: CCF # OF POOR AT $3.10 A DAY * GDP PER CAPITA



CCF analysis reveals the strongest relationship is a strong negative Pearson's correlation between No. of Poor at $3.10 a day and GDP per Capita, with 2 years leading (r=-0.710, n=24, p=0.05, SE=0.209). This suggests that rises in increased GDP Per Capita influence declining rates of No. of Poor at $3.10 a day two years into the future.

4.4.4 Poverty Gap at $1.90 a day * Economic Growth

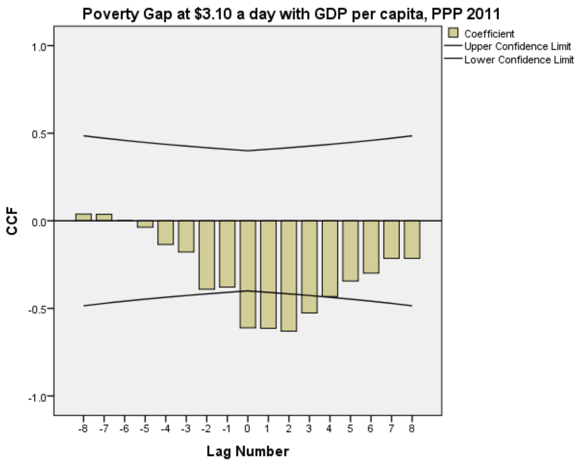
FIGURE 20: CCF POVERTY GAP AT $1.90 A DAY * GDP PER CAPITA



CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between Poverty Gap at $1.90 a Day and GDP Per Capita, with 0 years lagging (r=-0.697, n=24, p=0.05, SE=0.200). This suggests that rises in GDP Per Capita and declines in Poverty Gap at $1.90 a Day occur at concurrent rates.

4.4.5 Poverty Gap at $3.10 a day * Economic Growth

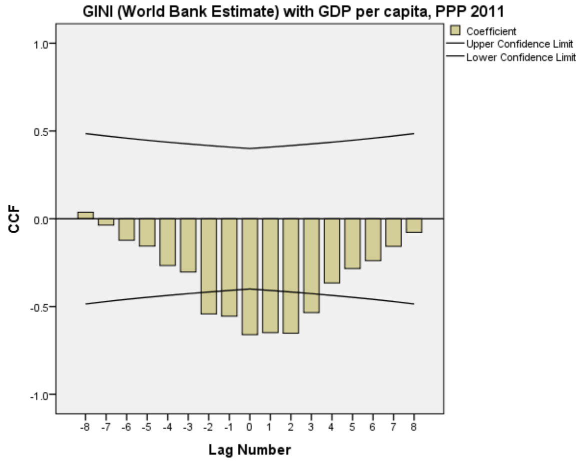
FIGURE 21: CCF POVERTY GAP AT $3.10 A DAY * GDP PER CAPITA



CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between Poverty Gap at $3.10 a Day and GDP per Capita, with 2 years leading (r=-0.630, n=24, p=0.05, SE=0.209). This suggests that rises in increased GDP Per Capita influence declining rates of Poverty Gap at $3.10 a day two years into the future.

4.4.6 GINI (World Bank Estimate) * Economic Growth

FIGURE 22: CCF GINI * GDP PER CAPITA

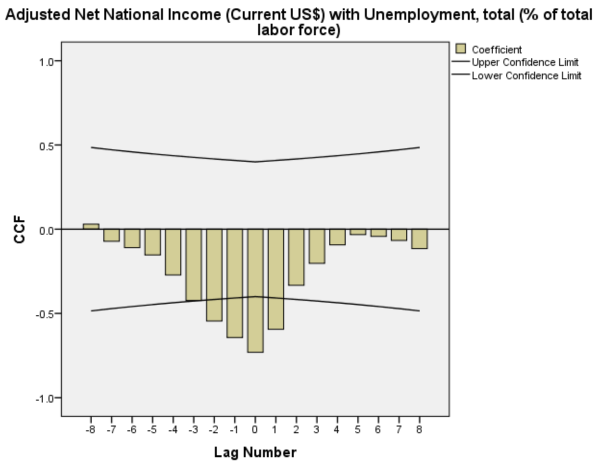


CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between GINI and GDP Per Capita, with 0 years lagging (r=-0.660, n=24, p=0.05, SE=0.200). This suggests that rises in GDP Per Capita and declines in GINI occur at concurrent rates.

4.5 Cross-Correlations: Poverty * Job Creation

4.5.1 Adj. Net National Income * Job Creation

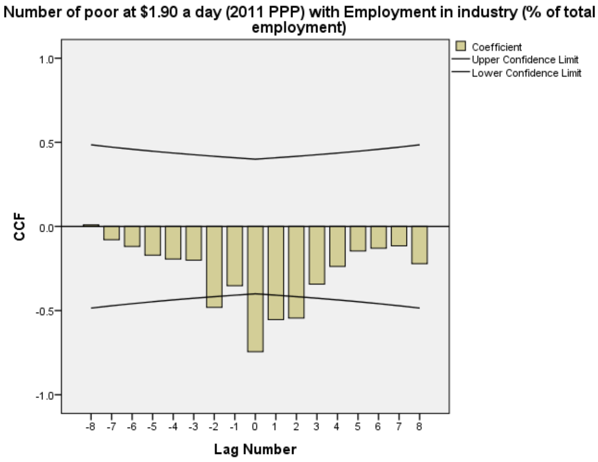
FIGURE 23: CCF ADJ. NET NATIONAL INCOME * UNEMPLOYMENT



CCF analysis reveals the strongest relationship is a strong negative Pearson's correlation between Adj. Net National Income and Unemployment, with 0 years lagging (r=-0.731, n=24, p=0.05, SE=0.200). This suggests that rises in Adj. Net National Income and declines in Unemployment occur at concurrent rates.

4.5.2 No. Poor at $1.90 a day (2011 PPP) * Job Creation

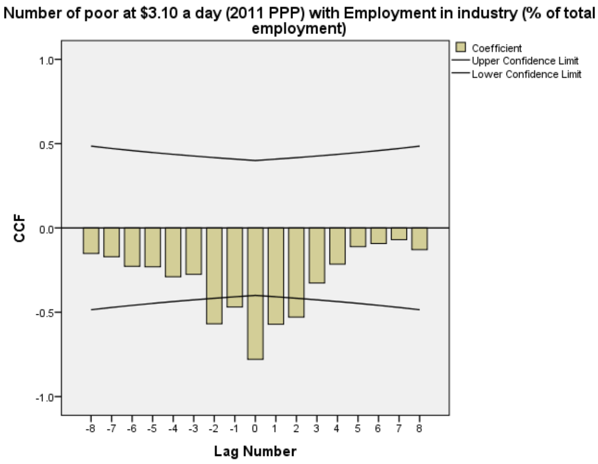
FIGURE 24: CCF # OF POOR AT $1.90 A DAY * EMPLOYMENT IN INDUSTRY



CCF analysis reveals the strongest relationship is a strong negative Pearson's correlation between No. of Poor at $1.90 a Day and Employment in Industry, with 0 years lagging (r=-0.744, n=24, p=0.05, SE=0.200). This suggests that rises in Employment in Industry and declines in No. of Poor at $1.90 a Day occur at concurrent rates.

4.5.3 No. Poor at $3.10 a day (2011 PPP) * Job Creation

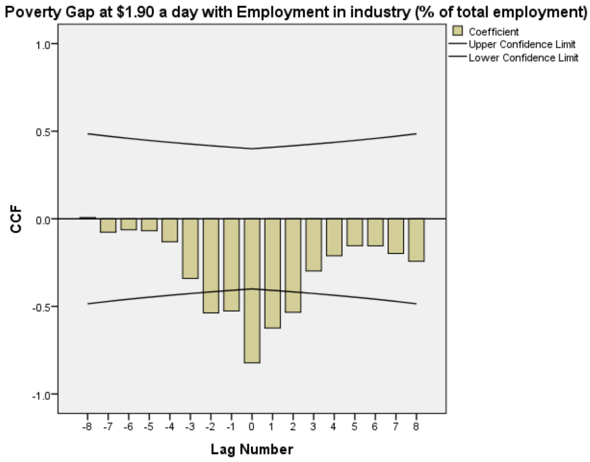
FIGURE 25: CCF # OF POOR AT $3.10 A DAY * EMPLOYMENT IN INDUSTRY



CCF analysis reveals the strongest relationship is a strong negative Pearson's correlation between No. of Poor at $3.10 a Day and Employment in Industry, with 0 years lagging (r=-0.779, n=24, p=0.05, SE=0.200). This suggests that rises in Employment in Industry and declines in No. of Poor at $3.10 a Day occur at concurrent rates.

4.5.4 Poverty Gap at $1.90 a day * Job Creation

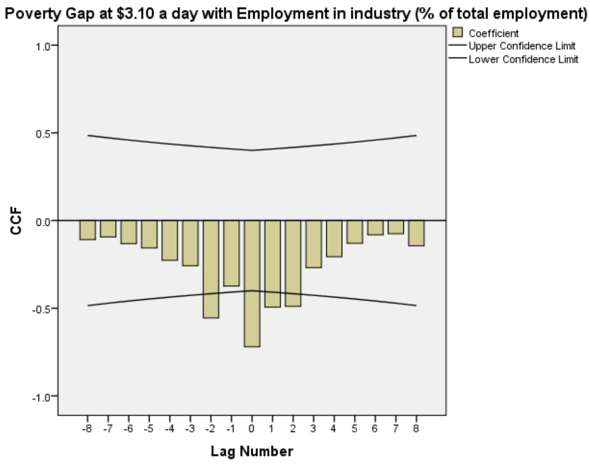
FIGURE 26: CCF POVERTY GAP AT $1.90 A DAY * EMPLOYMENT IN INDUSTRY



CCF analysis reveals the strongest relationship is a very strong negative Pearson's correlation between Poverty Gap at $1.90 a Day and Employment in Industry, with 0 years lagging (r=-0.822, n=24, p=0.05, SE=0.200). This suggests that rises in Employment in Industry and declines in Poverty Gap at $1.90 a Day occur at concurrent rates.

4.5.5 Poverty Gap at $3.10 a day * Job Creation

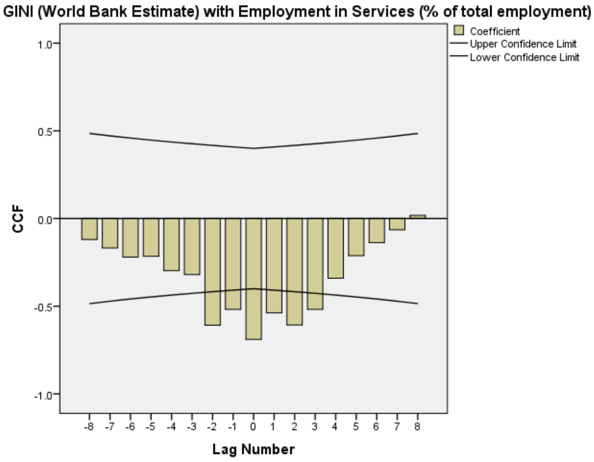
FIGURE 27: CCF POVERTY GAP AT $3.10 A DAY * EMPLOYMENT IN INDUSTRY



CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between Poverty Gap at $3.10 a Day and Employment in Industry, with 0 years lagging (r=-0.650, n=24, p=0.05, SE=0.200). This suggests that rises in Employment in Industry and declines in Poverty Gap at $3.10 a Day occur at concurrent rates.

4.5.6 GINI (World Bank Estimate) * Job Creation

FIGURE 28: CCF GINI * EMPLOYMENT IN SERVICES



CCF analysis reveals the strongest relationship is a moderate-strong negative Pearson's correlation between GINI and Employment in Services, with 0 years lagging (r=-0.689, n=24, p=0.05, SE=0.200). This suggests that rises in Employment in Services and declines in GINI occur at concurrent rates.

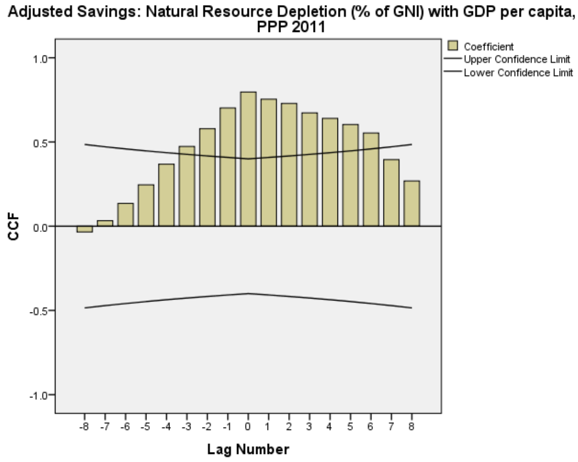
4.6 Cross-Correlations: Economic Growth * Resource Constraints

4.6.1 GDP Growth (annual %) * Resource Constraints

There are no significant cross-correlations between variables within the concepts GDP Growth and Resource Constraints. The implication of this finding will be further discussed in *4.10 Discussion of Cross-Correlations (Significant & Non-Significant).*

4.6.3 GDP per Capita (PPP 2011) * Resource Constraints

FIGURE 29: CCF GDP PER CAPITA * NATURAL RESOURCE DEPLETION

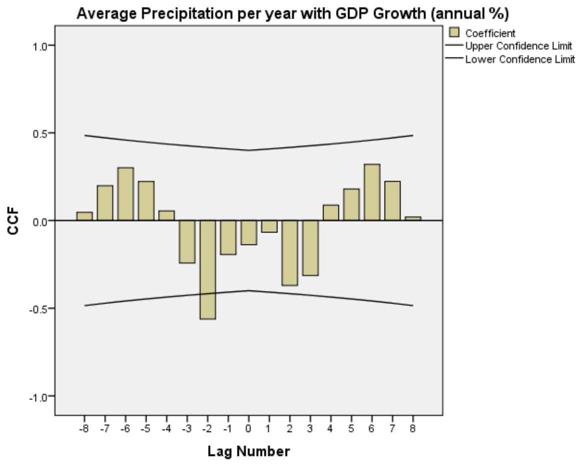


CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between GDP Per Capita and Natural Resource Depletion, with 0 years lagging (r=0.796, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.7 Cross-Correlations: Economic Growth * Climate Change

4.7.1 GDP Growth (annual %) * Climate Change

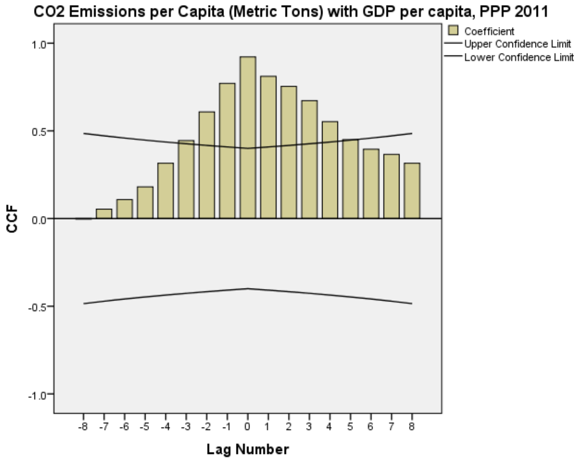
FIGURE 30: CCF GDP GROWTH * AVERAGE PRECIPITATION



CCF analysis reveals the strongest relationship is a moderate negative Pearson's correlation between GDP Growth and Average Precipitation, with 2 years lagging (r=-0.562, n=24, p=0.05, SE=0.209). This suggests that rises in GDP Growth may influence lower Average Precipitation two years into the future.

4.7.2 GDP per Capita (PPP 2011) * Climate Change

FIGURE 31: CCF GDP PER CAPITA * CO2 EMISSIONS

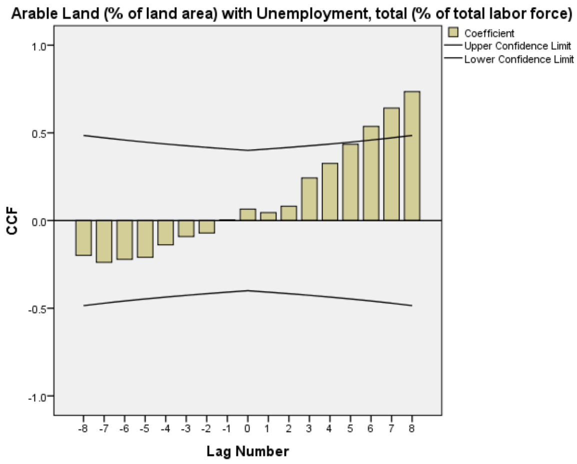


CCF analysis reveals the strongest relationship is a very strong positive Pearson's correlation between GDP Per Capita and CO_2 Emissions, with 0 years lagging (r=0.921, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.8 Cross-Correlations: Job Creation * Resource Constraints

4.8.1 Unemployment (% of Labor Force) * Resource Constraints

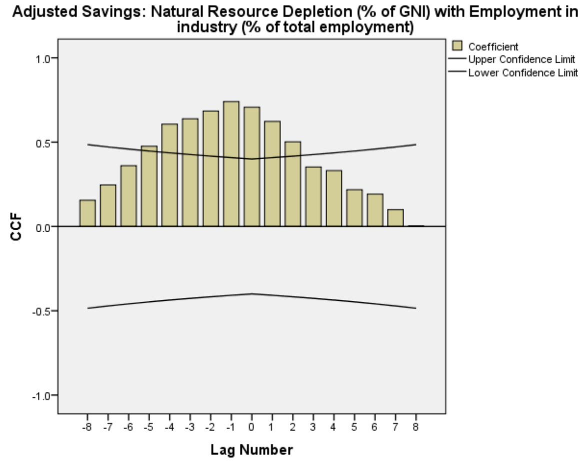
FIGURE 32: CCF UNEMPLOYMENT * ARABLE LAND



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Unemployment and Arable Land, with 8 years leading (r=0.735, n=24, p=0.05, SE=0.243). This suggests that rises in Unemployment may influence higher availability of Arable Land eight years into the future.

4.8.2 Employment in Industry (% of Labor Force) * Resource Constraints

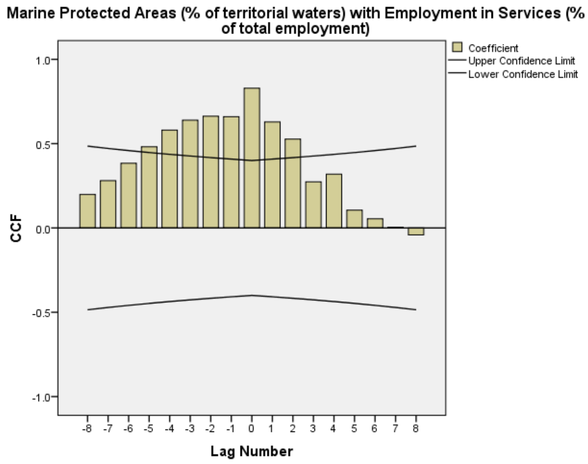
FIGURE 33: CCF EMPLOYMENT IN INDUSTRY * NATURAL RESOURCE DEPLETION



CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Employment in Industry and Natural Resource Depletion, with 1 years lagging (r=0.740, n=24, p=0.05, SE=0.204). This suggests that rises in Employment in Industry may influence higher Natural Resource Depletion one year into the future.

4.8.3 Employment in Services (% of Labor Force) * Resource Constraints

FIGURE 34: CCF EMPLOYMENT IN SERVICES * MARINE PROTECTED AREAS

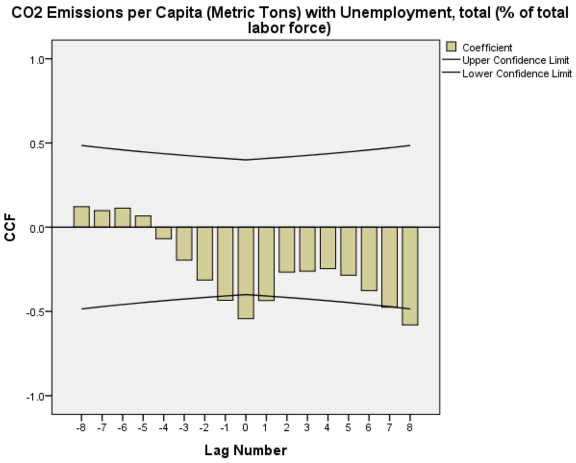


CCF analysis reveals the strongest relationship is a strong positive Pearson's correlation between Employment in Services and Marine Protected Areas, with 0 years lagging (r=0.829, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.9 Cross-Correlations: Job Creation * Climate Change

4.9.1 Unemployment (% of Labor Force) * Climate Change

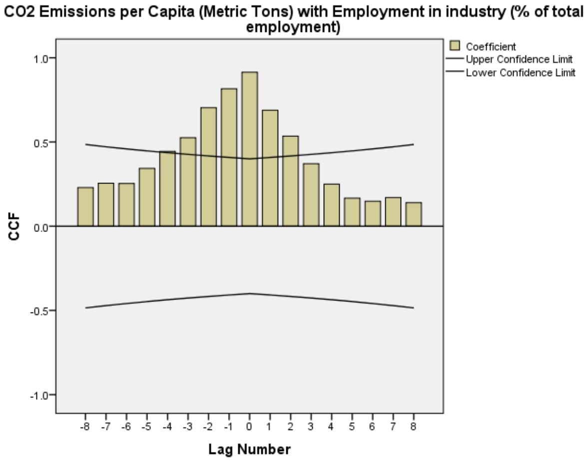
FIGURE 35: CCF UNEMPLOYMENT * CO2 EMISSIONS



CCF analysis reveals the strongest relationship is a moderate negative Pearson's correlation between Unemployment and CO_2 Emissions, with 0 years lagging (r=-0.543, n=24, p=0.05, SE=0.200). This suggests that rises in Unemployment and declines in CO_2 Emissions occur at concurrent rates.

4.9.2 Employment in Industry (% of Labor Force) * Climate Change

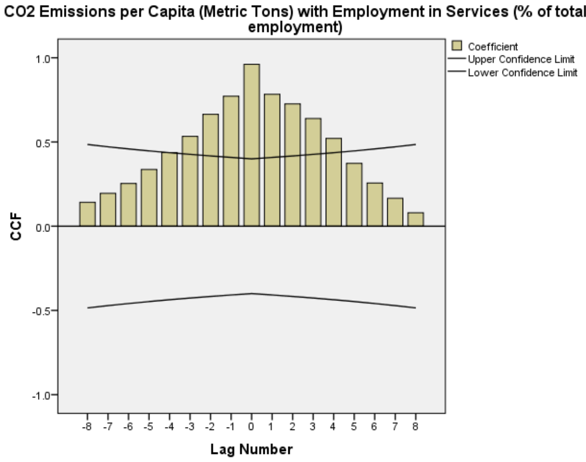
FIGURE 36: CCF EMPLOYMENT IN INDUSTRY * CO2 EMISSIONS



CCF analysis reveals the strongest relationship is a very strong positive Pearson's correlation between Employment in Industry and CO_2 Emissions, with 0 years lagging (r=0.914, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.9.3 Employment in Services (% of Labor Force) * Climate Change

FIGURE 37: CCF EMPLOYMENT IN SERVICES * CO2 EMISSIONS



CCF analysis reveals the strongest relationship is a very strong positive Pearson's correlation between Employment in Services and CO_2 Emissions, with 0 years lagging (r=0.961, n=24, p=0.05, SE=0.200). This suggests that rises in both variables occur at concurrent rates.

4.10 Discussion of Cross-Correlations (Significant & Non-Significant)

The cross-correlations highlighted in the previous section is intended to provide an indicator of one possible scenario of the complex interrelations between Green Growth's concepts. Therefore, significance and strength were highlighted. Within the significant cross-correlations, the vast majority are in alignment with the literature on Green Growth's concepts, with a few key divergent exceptions. Though all will be mentioned, discussions will focus on unusual relationships, and where an expectation of significance was violated (i.e. GDP Growth * Resource Constraints). Furthermore, one significant cross-correlation representative of each of Green Growth's concepts will be linearly regressed, assisted by the location of lead-lags, and including historical context to explain the possibility of Green Growth in Thailand, between 1990-2014.

4.10.1 Alignment with Literature

4.10.1.1 Lower Poverty related to Higher Resource Constraints

This investigation yielded results which states, in no uncertain terms, that an increase in affluence (measured in an increase of Adjusted Net National Income), facilitates an increase in resource constraints, namely availability of Arable Land and depletion rates of Energy, Natural Resources, and Mineral. This statistical finding is in alignment with the literature (see *1.4.3.1 Poverty →Resource Constraints)*. More remarkably is the presence of lead-lag effects. Since the cross-correlations are performed on 24 years' of historical data, these effects provide a glimpse into the order of the variables and the directionality of potential influence.

For example, Arable Land leads Adj. Net National Income by 8 years, implying perhaps the higher level of affluence has a slower, but strong (r=0.737) declining effect on the availability of Arable Land 8 years into the future, which is fascinating given the largest industry sector in Asia is agriculture. This relationship could be explained through the low level of wages typical in agriculture, which dissuade market entrants, and the risk of overworking soil fertility (implying slower consumption).

Another longer-term effect: Natural Resource depletion levels leads Adj. Net National Income by 5 years, which implies that higher levels of affluence may strongly (r=0.761) influence the increased consumption of Natural Resources 5 years into the future. At present, there is no published regenerative rate in the literature for natural resources, so it is difficult to gauge whether affluence-led consumption is above or below the regenerative rate. This would provide an indicator for sustainable consumption and production in Thailand. This would be the rationale and opportunity towards future ecological research regarding the regenerative capacity of a "basket" of Thai natural resources. Additionally, evidence from the literature states that Natural Resources are typically converted into sources of energy (Diaz-Chavez et al., 2013) which explains why Energy depletion levels lead Adj. Net National Income by the similar rate of 5 years, which implies that higher levels of affluence may strongly (r=0.765) influence the increased consumption of Energy 5 years into the future, by way of Natural Resources.

Similarly, Forest depletion levels lead Adj. Net National Income by 4 years, which implies that higher levels of affluence may moderately (bordering on strong, r=0.680) influence the increased consumption of Forests 4 years into the future. The moderate relationship is likely linked to the consumption rate of Arable Land in Thailand. In Thailand, Arable Land is realized by deforestation. Presently, 40% of Thailand's total geographical area (~513,115 km^2) is protected (Ongprasert, 2010). Therefore affluence has a weaker effect on Forest depletion, for the simple reason of governance policies in place which are not swayed by wealth. This would delay the consumption rates of Arable Land, potentially explaining the 8 year lead.

In contrast, a short-term effect is Mineral depletion levels leading Adj. Net National Income by 1 year, which implies that higher levels of affluence may moderately (r=0.538) influence the increased consumption of Minerals. This is in alignment with Thailand's country profile in which extractive industries make up only 2.5% of the country's export-led GDP (Katz et al., 2013). The moderate influence may be explained via the maturation of Thai extractive industries, leading to lower marginal profits, and therefore lower incentive to increase consumption of minerals.

The only divergence from the literature on the relationships between Poverty and Resource Constraints is Marine Protected Areas, in which it was discovered that higher affluence led to higher preservation and governance of Marine Protected Areas, to be discussed further in *4.10.2 Divergent from Literature*.

4.10.1.2 Lower Poverty is related to Higher risk of Climate Change

Regarding the relationships between Climate Change and Poverty (measured as Adjusted Net National Income or GINI), strongest significant values indicates that there is 0 lead-lag effects for CO_2 Emissions, Average Temperature Per Year, and Average Precipitation Per Year. This, however, does not indicate the complete lack of lagged effect. When analyzed in the context of correlation strength, it suggests that perhaps a tertiary variable is responsible for the effects we are statistically "seeing" with cross-correlations. Also, the lack of observed lead-lag effects also indicates that weaker statements are made regarding the variables' order of influence.

CO_2 Emissions and Adjusted Net National Income have a strong (r=0.745) relationship, which can theoretically be explained with the inclusion of Resource Constraints. However if, hypothetically, we assume directionality that affluence (or lack of poverty) increases CO_2 Emissions, an indicator of climate change risk, then this statistical finding is in alignment with the literature (see *1.4.2.1 Poverty → Climate Change*), which suggests that those of wealthier means often consume more which is an economic signal to increase industrial production, thereby increase emissions. The lack of lags may be explained through the method of measuring CO_2 Emissions. World Bank measures emissions through the combustion of energy needed to sustain the economic activity of Thailand (World Bank, 2015m). This implies that CO^2 measurement is calculated based on the energy used, it may not reflect the actual level of CO^2 Emissions in the air at one time, which requires much more specialized data collection methodology.

Average Temperature and Adjusted Net National Income have a moderate (r=0.553) relationship, which is in alignment with the literature which states that as poverty increases, so does the risk of climate change because poor typically deplete their surrounding natural resources, which can often serve as a buffer towards mitigating climate change risk. The moderate strength of the relationship suggests that a tertiary variable might be Natural Resource Constraints, which bridges the gap between higher levels of temperature and affluence.

The GINI Index does not measure the level of poverty, but rather contextual poverty, which in other words: income inequality in a society. GINI inequality provided the only significant cross-correlation to Average Precipitation, and in fact it is with moderate strength (r=0.484). This signals that perhaps a tertiary variable is influencing both income inequality and climate change risk, for example one potential pathway could be: increased Natural Resource Depletion allowed through permits purchased by wealthier citizens, which allows the wealthy to receive the dividends from natural resources, worsening income inequality. Simultaneously, the depletion of natural resources weakens the biosphere's capacity to maintain a conducive climate, facilitating to increased Climate Change through increased Precipitation.

There is no divergence from the literature on any of the relationships between Poverty and Climate Change.

4.10.1.3 Higher Economic Growth is related to Lower Poverty

Given that the Green Growth model states one-way directionality from the concepts Economic Growth towards Poverty, then the following statistical results are interpreted in this contextual light. This investigation yielded results which states that an increase in economic growth (measured in an increase of GDP per Capita), facilitates an decrease in Poverty, namely Adj. Net National Income, No. of Poor at $1.90 a Day, No. of Poor at $3.10 a Day, Poverty Gap at $1.90 a Day, Poverty Gap at $3.10 a day, and GINI. This statistical finding is in alignment with the literature (see *1.4.4.3 Economic Growth → Poverty*). However, there is a mixed presence of lead-lag effects. Since the cross-correlations are performed on 24 years' of historical data, these effects provide a glimpse into the order of the variables and the directionality of potential influence.

Adj. Net National Income and GDP Per Capita have a very strong (r=0.925) relationship, which is in alignment with the literature which states that economic growth tends to improve poverty incidence. At face value, one might be quick to judge this as a violation of multi-collinearity both variables are framed very similarly. Its inclusion here is to understand whether a country's economic activity (i.e. GDP) is inclusive in that it provides Thai citizens with stable income sources. This implies that there is no leakage of income which can leave Thailand and benefit other citizens. The strong relationship and 0 lags indicate that Thailand's economic growth seems to be rather inclusive, an important characteristic of Green Growth.

Furthermore to support this inclusivity argument, GINI and GDP Per Capita have a moderately strong (r=-0.660) relationship, which is in alignment with the literature which states that economic growth has the potential to reduce income inequality if targeted towards the most vulnerable group (thereby economically "including" them). The negative relationship implies that as GDP per capita increases, GINI tends to decline, at zero lags. Zero lags is an important finding because it can signal the inclusion of a tertiary variable which redistributes income (e.g. Adj. Net National Income) or it gestures towards the immediacy of the effect, both of which serve as powerful evidence for Thailand's inclusive economic growth at present and historically.

No. of Poor at $1.90 a Day and Poverty Gap at $1.90 a Day measures the absolute and relative levels of extreme poverty, measured using the 2011 PPP set at $1.90 a Day. Therefore they will be discussed together in relation to GDP Per Capita. No. of Poor at $1.90 a Day and GDP Per Capita have a moderate-strong (r=-0.619) relationship which is in alignment with the literature which states that economic growth has the potential to reduce absolute *and* relative levels of poverty, especially for the extreme poor. Poverty Gap at $1.90 a Day and GDP Per Capita have similar findings with a moderate-strong (r=-0.697) relationship, and also align with literature.

The differences surface in the time lags. With respect to relative poverty, there is zero time lags, which indicate that effects are rather immediate. However, with absolute poverty, there is a time lag of two years, which suggests that GDP per Capita declines absolute levels of extreme poverty two years into the future. The difference is remarkable, as it suggests that while Thailand's economic growth is argued as inclusive, their policies still does not fully target the extreme poor to rectify their financial situation, with respect to time.

No. of Poor at $3.10 a Day and Poverty Gap at $3.10 a Day measures the absolute and relative levels of general poverty, measured using the 2011 PPP set at $3.10 a Day. Therefore they will be discussed together in relation to GDP Per Capita. No. of Poor at $3.10 a Day and GDP Per Capita have a strong (r=-0.710) relationship which is in alignment with the literature which states that economic growth has the potential to reduce absolute *and* relative levels of poverty. Poverty Gap at $3.10 a Day and GDP Per Capita have similar findings with a moderate-strong (r=-0.630) relationship, and are also in alignment with the literature. Both have zero time lags, which suggest either immediacy of the effect or a facilitating tertiary variable which redistributes income well enough to reduce poverty, e.g. job creation.

The key difference is in the correlation strengths of the relationships (i.e. $3.10). There is a stronger relationship between absolute poverty and economic growth which may shed light on the priorities of Thailand's pro-poor policies which seems to be translating extreme relative poverty ($1.90) into general absolute poverty ($3.10). This would imply that Thailand could be working towards improving overall socioeconomic levels, especially at society's lower rungs.

There is no divergence from the literature on any of the relationships between Poverty and Economic Growth.

4.10.1.4 Higher Job Creation is related to Lower Poverty

Given that the Green Growth model states one-way directionality from the concepts Job Creation towards Poverty, then the following statistical results are interpreted in this contextual light. This investigation yielded results which states that an increase in job creation (measured as unemployment, employment in industry and employment in services), facilitates a decrease in Poverty, namely Adj. Net National Income, No. of Poor at $1.90 a Day, No. of Poor at $3.10 a Day, Poverty Gap at $1.90 a Day, Poverty Gap at $3.10 a day, and GINI. These statistical findings are in alignment with the literature (see *1.4.5.3 Job Creation → Poverty*). For each of the six relationships, there are zero lags identified.

Adj. Net National Income and Unemployment have a strong (r=-0.731) relationship, which is in alignment with literature which states that the lack of job creation (i.e. unemployment) translates to lower levels of income, thereby higher poverty. However, it is incredible that this relationship isn't stronger. Typically, unemployment and income are directly related, which suggests that unemployed Thai citizens still receive income each month, pointing towards the potential existence of unemployment social benefits. Furthermore, the zero time lags indicate that likely as soon as employment is terminated, the compensation benefits are automatically activated. In fact, Thailand has a strong "Unemployment Social Security" which communicates that registration for the program must occur within 30 days of employment termination, and the benefits are 50% of the monthly wage, distributed for up to 180 days (SSO, 2009). This diminishes the effect of unemployment on level of poverty.

No. of Poor at $1.90 a Day and Poverty Gap at $1.90 a Day measures the absolute and relative levels of extreme poverty, measured using the 2011 PPP set at $1.90 a Day. Therefore they will be discussed together in relation to Employment in Industry. No. of Poor at $1.90 a Day and Employment in Industry have a strong (r=-0.744) relationship which is in alignment with the literature which states that employment decreases absolute *and* relative levels of poverty, for the extreme poor. Poverty Gap at $1.90 a Day and Employment in Industry have similar findings with a very strong (r=-0.822) relationship, and also align with literature.

No. of Poor at $3.10 a Day and Poverty Gap at $3.10 a Day measures the absolute and relative levels of general poverty, measured using the 2011 PPP set at $3.10 a Day. Therefore they will be discussed together in relation to Employment in Industry. No. of Poor at $3.10 a Day and Employment in Industry have a strong (r=-0.779) relationship which is in alignment with the literature which states that employment has the potential to reduce absolute *and* relative levels of poverty. Poverty Gap at $3.10 a Day and Employment in Industry have similar findings with a moderate-strong (r=-0.650) relationship, and are also in alignment with the literature. Both have zero time lags, which suggest either immediacy of the effect or a facilitating tertiary variable which redistributes income well enough to reduce poverty.

Similar to the relationship between easing extreme/general poverty through economic growth, the findings' implications still hold true. For extreme poverty, emphasis is directed at resolving relative poverty while for general poverty, priorities are focused towards resolving absolute poverty. This seems to be the upward shifting of socioeconomic classes.

GINI and Employment in Services have a moderately strong (r=-0.689) relationship, which is in alignment with the literature which states that job creation/employment has the potential to reduce income inequality. The negative relationship implies that as employment in the service industry increases, GINI tends to decline, at zero lags. Though objectively, the correlation strength to be rather weak, it is the strongest relationship among all other viable variables (i.e. Unemployment, Employment in Industry). This suggests that while employment may improve income inequality by a small measure, it is, by no means, the deciding force behind equity. Rather, it is likely that a tertiary variable is at work bridging the gap between income inequality and employment in services, e.g. Adj. Net National Income. This could also explain the evidence of zero lags, as income inequality is known as a long-term problem.

There is no divergence from the literature on any of the relationships between Poverty and Job Creation.

4.10.1.5 Higher Economic Growth is related to Higher Resource Constraints

In investigating the relationships within the concepts of Economic Growth and Resource Constraints, results yielded one significant relationship. GDP Per Capita and Natural Resources Depletion have a strong (r=0.796) relationship, which is in alignment with the literature which states that when economic growth increases, so does the rate of natural resource depletion. Although GDP Per Capita tends to affect the consumption-side of the economy, therefore it is likely that increased affluence raises aggregated demand which encourages production and therefore depletion of natural capital. There were no significant relationships found in regards to GDP Growth and Resource Constraints, to be discussed in *4.10.2 Divergent from Literature*.

4.10.1.6 Higher Economic Growth is related to Higher risk of Climate Change

Economic Growth and Climate Change, on the other hand, yield one significant relationship in alignment, and the other divergent from the literature. GDP Per Capita and CO_2 Emissions have a very strong (r=0.921) relationship, aligning with literature which states that as economic activity increases, so does the risks of climate change, via CO_2 Emissions produced by resource consumption. The presence of zero lags is likely due to the methodological conditions of collecting emission data (linking it to the expected emissions from fuel/energy combustion), however it could also be due to the inclusion of tertiary variables, namely from Resource Constraints.

4.10.1.7 Higher Job Creation is related to Higher Resource Constraints

Job Creation and Resource Constraints yield two significant relationships in alignment, and one divergent from the literature. Unemployment and Arable Land have a strong (r=0.735) relationship, aligning with literature which state that as unemployment increases, so does the availability of Arable Land, as there is no economic activity being performed on it. The presence of lags allows us to interpret the relationship with respect to the order of the variables and the directionality of potential influence. In this case, Unemployment seems to influence higher availability of Arable Land eight years into the future.

The statistical results here are very similar to the relationship between Arable Lands and Adj. Net National Income with similar strength (r=-0.737) and identical time lags. This signals that all three variables are likely from the same pathway of dependence, e.g. Unemployment decreases the levels of Adj. Net National Income, which increases the availability of Arable Land 8 years into the future. Additionally, a lead of 8 years is considered quite long-term, therefore it is likely that a tertiary variable is confounding the relationship, for example, increased environmental governance and regulation over deforesting to increase availabilities of Arable Land.

Employment in Industry and Natural Resource Depletion have a strong (r=0.740) relationship, aligning with literature which state that higher levels of employment in industry may cause increased rates of natural resource depletion, 1 year into the future. The order of the variables are confirmed through the presence of lead-lag effects. Although it is surprising that the strength of this direct relationship is not stronger. Industry is composed of construction, manufacturing and production, all of which depend on the extraction of natural resources, with the rare exception of recycling natural capital. One theory behind the weak(er) relationship is the productivity of the industry. In the view of Ecological Economics, it is possible to substitute labor for natural capital (up to an extent), therefore as employment in industry increases, it can actually diminish slightly the reliance on natural resources and reduce resource constraints.

4.10.1.8 Higher Job Creation is related to Higher risk of Climate Change

The statistical results states that an increase in employment (measured as Unemployment, Employment in Industry, and Employment in Services), facilitates an increase in the risk of climate change (measured in CO_2 Emissions). This finding is in alignment with the literature (see…), with all three relationships revealing zero time lags.

Unemployment and CO^2 Emissions have a moderate (r=-0.543) relationship with zero time lags, aligning with literature which state that declines in employment may cause decreased level of CO^2 Emissions. Unemployment does not necessarily indicate economic recession. It can also serve as a signal of more efficient production processes; therefore the lack of employment and job creation does not necessarily diminish emissions strongly.

Employment in Industry and CO^2 Emissions have a very strong (r=0.914) relationship, and Employment in Services and CO^2 Emissions are equally strong (r=0.961), both with zero time lags. This aligns with literature which state that employment and economic activity may increase CO^2 Emissions and by default, climate risk. The correlation strengths may serve as evidence of a potential causal relationship. This is not unusual, given CO^2 Emissions are largely created through the energy needs of large-scale economic activity. The presence of zero lags is likely due to the methodological conditions of collecting emission data (linking it to the expected emissions from fuel/energy combustion). The inclusion of tertiary variable would not provide additional statistical information to explain the variances in emissions.

4.10.2 Divergent from Literature

There are four cross-correlations which prove divergent from the existing literature: 1) Marine Protected Areas and Adj. Net National Income, 2) GDP Growth and the concept of Resource Constraints, 3) GDP Growth and Average Precipitation, and 4) Employment in Services and Marine Protected Areas.

4.10.2.1 Lower Poverty is related to Lower Resource Constraints

Marine Protected Areas and Adj. Net National Income have a strong (r=0.796) relationship at zero time lags, indicating that when the percentage of Marine Protected Areas increase, so does the Adjusted Net National Income, and vice versa. World Bank defines Marine Protected Areas as coastal regions (including biodiversity) which are protected from human activity by law (World Bank, 2015n); therefore it is implausible that the lack of access to marine resources increases regional affluence and vice versa. Literature states that as the economy grows, pressures on natural resources begin to heighten and would reduce marine protected areas. It is more likely that in this case, the two variables are correlated because a tertiary variable is in play.

Thailand has a strong “Marine and Coastal Protection Plan” which was reinvigorated in 2004 due to significant pressures on natural capital by industrial development, tourism, fisheries, extractive industries, etc. As of 2010, 25.5% of Thailand’s marine waters were earmarked for protection (Nateewathana, 2010). The tertiary variable in this case seems to be one which decreases poverty without growing the economic pressures on natural capital, which means it is likely to be the presence of social programs and/or the introduction of sustainable governance of marine resources which encourages sustainable aquaculture and tourism (Nara et al., 2014).

4.10.2.2 Higher Job Creation is related to Lower Resource Constraints

To further strengthen this theory, Employment in Services and Marine Protected Areas have a strong (r=0.829) relationship with zero time lags, indicating that when the percentage of Marine Protected Areas increase, so does Employment in Services, and vice versa. Employment in services is labor-intensive, including tourism and hospitality, community services, etc. (World Bank, 2015o). Since there is a high correlation strength between the two variables, the likely path is: employment in services increases adjusted net national income, while also increasing the percentage of marine protected areas in Thailand. Certainly, it is divergent from standard literature, which claims economic growth must always be at the cost of the environment.

4.10.2.3 Higher Economic Growth is related to Lower risk of Climate Change

GDP Growth and Average Precipitation have a moderate (r=-0.562) relationship with a time lag of two years. This suggests that rises in GDP Growth may influence lower Average Precipitation two years into the future. The interpretation of divergence should be adopted skeptically. Literature states that as GDP increases, the risk of Climate Change also increases. However in Thailand, precipitation is rather capricious and does not follow a linear trend, therefore the difference of two years for lower precipitation may not make a dramatic difference, reflected in the relatively weak correlation strength. At present, there is a substantial lack of literature regarding rainfall patterns in Thailand, therefore historical context can't shed much light on the matter.

4.10.2.4 Economic Growth is not related to Resource Constraints

Finally, regarding GDP Growth and the concept of Resource Constraints, there were absolutely no significant relationships detected during cross-correlations. This is a fascinating finding provided that there is *generous* literature claiming that since the economy is reliant on natural resource consumption (thereby increasing resource constraints), there should be a marked decrease in natural capital. At face value, this may indicate that Green Growth is alive and well in Thailand, however an intelligent criticism can be made that economic growth is not measured solely by GDP increases, as this indicator can be affected by external factors such as international financial climate, investment confidence, etc. The lack of relationship between the economy and natural resources may be explained by Thailand's national greening of the economies which reduce reliance on the consumption of resources for energy (OECD, 2015), thereby easing resource constraints. On the other hand, perhaps there is no significant relationship due to the weakening of government spending, investments and net exports because for the relationship of GDP Per Capita and Natural Resource Depletion, there is a strong positive correlation.

4.10.3 Goals Proceeding Ahead with Structural Equation Modeling

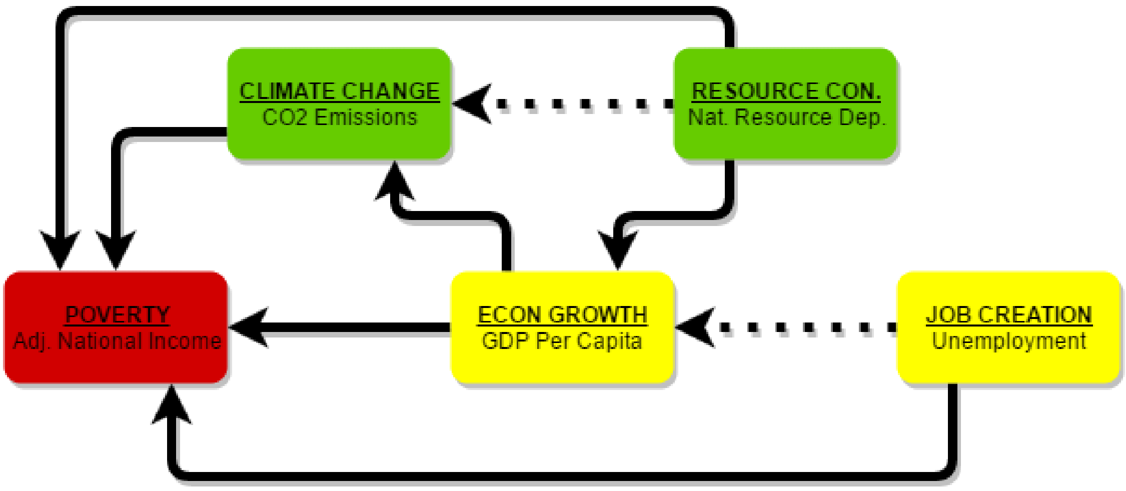
As aforementioned, in the absence of lags, SEM can be undertaken to appreciate the path dependence of indirect and direct effects between the concepts/variables of Green Growth. All of the selected variables possess zero time lags.

Although only the strongest significant cross-correlations were featured, a 20 unique variables created a total of 210 relationships. There were 20 variables selected to represent five concepts in order to maximize concept validity, but it was never the investigation's intention to retain and analyze all variables. Rather, cross-correlations would yield relationship strength which would assist in narrowing down analysis to one variable per concept.

The additional challenge was to ensure that the five variables produced the strongest significant relationships (with zero time lags!) with each other, thereby increasing the odds of a strong and valid model for explaining Green Growth. *Fig. 38* depicts the ultimate selection of the five variables. For your reference, sections 4.1 to 4.9 contain empirical output which supports their being chosen for further analysis in SEM. Thick, black lines indicate relationships which are deduced during cross-correlations. Dashed, black lines indicate relationships which are intrinsically connected through UNESCAP's definition of Green Growth, but have not been analyzed.

4.11 Structural Equation Modeling of Green Growth

FIGURE 38: GREEN GROWTH VISUALIZED WITH PATH DEPENDENCIES



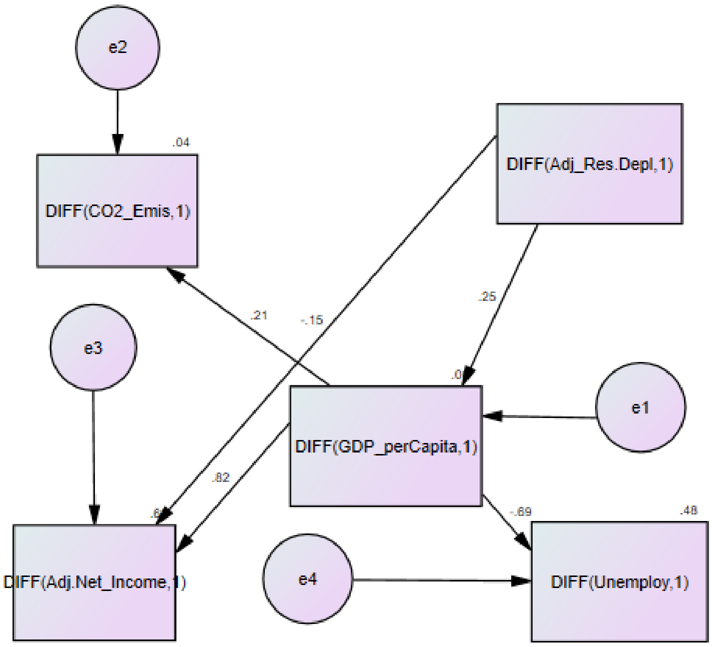
SEM is undertaken to appreciate path dependencies between each of Green Growth's concepts. However without technical jargon, the goal is to see if Economic Growth can simultaneously exist: 1) without causing increased Climate Change risks and Resource Constraints, and 2) lower overall financial Poverty. If this form of Economic Growth exists, it is termed: Green Growth. The investigation's attempt will utilize 24 years' worth of historical data and the predefined variables to observe whether Green Growth can possibly exist. If it does, this can be revolutionary, not only for Thailand, but for the United Nations in their role of furthering ethical, inclusive, and ecological Sustainable Development.

Also, it is important to note that SEM is an exploratory science which requires manual fine-tuning, therefore evaluation will only be made on the final round. The fine-tuning of an SEM model involves the inclusion/exclusion of non-significant variables, adjusting indirect pathway to explain more variance in the dependent variable(s), etc., with the intention of building a good model fit, as characterized by model fit indices and significance (McDonald & Ho, 2002). Further, time series can be modeled in SEM if each year (case) is taken as independent from each other, thereby removing linear trends (Kurogi et al., 2007). This is performed by taking first-order differences (difference between years 1 & 2, years 2 & 3) to disengage the intrinsic relationship.

Thus, the SEM model is based on the first-order differences of each Green Growth variable (n=23).

4.11.1 Interpretation of Green Growth SEM Model

FIGURE 39: GREEN GROWTH SEM MODEL



As one can quickly deduce, the expected pathways depicted in *Fig. 38*, was not found to hold true during SEM. Certain relationships provided such heavy insignificance (p-values=>0.35) that they penalized the model fit of the data. This is not to disregard the important implications of insignificance, but if there are too many, it jeopardizes the model's ability to explain variance for specific dependent variables (e.g. Adj. Net National Income.) Therefore, the first important is the exclusion of insignificant relationships, namely:

1) CO_2 Emissions and Adj. Net National Income are not related.

   Literature claims that over time, CO_2 Emissions may indirectly negatively influence affluence, and vice versa, the model does not reveal this to be true in Thailand. Possible reasons could be the presence of social security offsetting the financial impact of climate change on affluence, or likely, that due to an engrained culture of "Sufficiency", Thai citizens do not utilize higher wealth to consume more products but rather invest in service goods (e.g. education).

2) Natural Resource Depletion and CO2 Emissions are not related.

In abiding by Green Growth's original operationalization, concepts within the same family (i.e. Climate Change and Resource Constraints) will not be related because of multi-collinearity concerns. However, the lack of relationship here may likely due to the specificity of the variables chosen to represent the larger concepts. For example, depletion of natural resource may not cause CO_2 emissions, because the largest contributor of atmospheric waste is still fossil fuel combustion, a minor part of natural resources.

3) Unemployment and Adj. Net National Income are not related.

In traditional neoclassical economic, the lack of employment restricts conventional income which increases poverty. However, this direct relationship does not hold true in Thailand, whereby unemployment is a temporary set-back, resolved through employment social security and unemployment benefits. This can reduce the negative impact of Unemployment on Adj. Net National Income.

Fig. 39 depicts the final (28th) round of SEM analysis, with error values present for all dependent variables, and construction based on UNESCAP's Green Growth definition. 63.5% of variance in the Adj. Net National Income is being explained by all independent variables (see *Table 8*), while this seems low, the model's Goodness-of-Fit (GOF) significance=0.699 (see *Table 7*), which indicates that overall Model Fit is significant and explains valuable variance (and lack thereof).

TABLE 8: ROUND 28: MULTIPLE SQ. CORRELATIONS

	Estimate
GDP_pe_1	.060
Unempl_1	.479
Adj.Ne_1	**.635**
CO2_Em_1	.042

TABLE 7: ROUND 28: GOODNESS-OF-FIT SIGNIFICANCE

Minimum was achieved
Chi-square = 3.009
Degrees of freedom = 5
Probability level = .699

While GOF is not the ultimate deciding factor most other values also reinforce the conclusion of good model fit. For a good model, Comparative Fit Index (CFI) >0.95, Root Mean Square Error of Approximation (RMSEA) <0.05, Normalized Fit Index (NFI >0.95), and Tucker-Lewis Index (TLI) >0.95, our values are: CFI=01.00, RMSEA=0.00, NFI=0.955, and TLI=1.119 (see *Table 9*).

TABLE 9: ROUND 28: CFI, RMSEA, NFI, TLI MODEL FIT INDICES

Model	**RMSEA**	LO 90	HI 90	PCLOSE
Default model	**.000**	.000	.220	.724
Independence model	.382	.270	.502	.000

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	**.931**	.862	1.052	**1.119**	**1.000**
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Given that all indicators of Model Fit are positive, Regression Weights are examined to see whether there is presence of non-significant values.

TABLE 10: ROUND 28: REGRESSION WEIGHTS

			Estimate	S.E.	C.R.	P	Label
GDP_pe_1	<---	Adj_Re_1	129.055	106.198	1.215	.224	
Unempl_1	**<---**	**GDP_pe_1**	**-.001**	**.000**	**-4.596**	*******	
Adj.Ne_1	<---	Adj_Re_1	-53.317	46.275	-1.152	.249	
Adj.Ne_1	**<---**	**GDP_pe_1**	**.556**	**.088**	**6.311**	*******	
CO2_Em_1	<---	GDP_pe_1	.000	.000	1.010	.312	

Table 10 reveals that only GDP per capita is a significant predictor of Unemployment and Adj. Net National Income. In this case, it is the insignificant predictors which are important. With the inclusion of the aforementioned insignificant relationships (arrows delineate directionality):

1) CO_2 Emissions ←→Adj. Net National Income
2) CO_2 Emissions ←→Natural Resource Depletion
3) Adj. Net National Income ←→Unemployment
4) Natural Resource Depletion → GDP Per Capita
5) Natural Resource Depletion → Adj. Net National Income
6) GDP Per Capita → CO_2 Emissions

According to the SEM model, the above relationships are insignificant (p=0.05). This implies that, despite conventional economic growth ideology, certain variables like GDP per Capita may not increase CO_2 Emissions. This may signify the presence of Green Growth policies. Further detail will be provided in *4.12 Discussions with Historical Context* in order to explain why there may be a relationship absence between certain variables, and whether this points towards the possible existence of Green Growth policies and impacts in Thailand.

TABLE 11: ROUND 28: STANDARDIZED REGRESSION WEIGHTS

			Estimate
GDP_pe_1	<---	Adj_Re_1	.246
Unempl_1	**<---**	**GDP_pe_1**	**-.692**
Adj.Ne_1	<---	Adj_Re_1	-.150
Adj.Ne_1	**<---**	**GDP_pe_1**	**.820**
CO2_Em_1	<---	GDP_pe_1	.206

Table 11 reveals the standardized impacts of direct effects for significant relationships. When GDP Per Capita increases by 1 standard deviation (SD), Unemployment decreases by 0.692, which according to the original coding indicates a fall of 0.69% of total labor force.

When GDP per capita increases by 1 SD, Adjusted Net National Income increases by 0.820, which according to the original coding indicates a rise of $0.82 in income per capita.

This reinforces the popular economic policy that a robust economic system in Thailand (i.e. rising GDP per capita levels) significantly increases national income and lowers unemployment. It is an important finding as it confirms part of the Green Growth definition, which is, "*a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises*" (MCED-5, 2005a; UN ESCAP, 2012). According to UNESCAP's operationalization, economic growth is required to indirectly increase employment, and directly reduce the incidence of poverty. This is not a novel concept, as literature has shown that economic growth is seen as a panaces which "lifts all boats" (see *1.4.4.3 Economic Growth → Poverty*). Rather, it is more interesting to understand why economic growth is not shown to necessarily lead to resource constraints and climate change. In any case, it is a positive sign to confirm for Thailand that its economy does service its citizens.

TABLE 12: REPEAT – ROUND 28: SQ. MULTIPLE CORRELATIONS

	Estimate
GDP_pe_1	.060
Unempl_1	.479
Adj.Ne_1	**.635**
CO2_Em_1	.042

It is also relevant to interject that in this model, 63.5% of Adj. Net National Income is explained by its independent variables (see *Table 12*), thereby opening up this finding to further development research to understand what drives marginal increases in affluence and whether, there are indirect pathways to Natural Resource Depletion and GDP per Capita.

TABLE 13: ROUND 28: STANDARDIZED INDIRECT EFFECTS

	Adj_Re_1	GDP_pe_1
GDP_pe_1	.000	.000
Unempl_1	-.170	.000
Adj.Ne_1	.201	.000
CO2_Em_1	.051	.000

Under the assumption of significance, Natural Resource Depletion would have an indirect effect on CO_2 Emissions, Unemployment, and Adjusted Net National Income. As Depletion rates increase by 1 SD, CO_2 Emissions rise by 0.051 metric tons, Unemployment drops by 0.170% of total labour force, and Adj. Net National income increases by $0.20 per capita. This suggests that although the there is no significant direct effect, Natural Depletion rates do contribute, to a minor degree, to the increase of CO_2 Emissions, which certainly has governance implications for the environment.

Furthermore, with the mediating variable of GDP per Capita (representing economic activity) being excluded, it seems that Natural Depletion can improve job creation and poverty incidence. This is not necessarily a bad sign as it is over depletion of natural resources that can become problematic. It is expected that in order to thrive within the economic system's artificial bounds, the energy must come from the biophysical environment. This indirect effect confirms a widely-accepted worldview that human life is sustained through the use of natural resources, both non-renewable and renewable.

However, it is arguably that SEM's total effects provides the most insight into whether Green Growth exists in the history of Thailand.

TABLE 14: ROUND 28: STANDARDIZED TOTAL EFFECTS

	Adj_Re_1	GDP_pe_1
GDP_pe_1	.246	.000
Unempl_1	-.170	**-.692**
Adj.Ne_1	.052	**.820**
CO2_Em_1	.051	.206

The total effects is the culmination of all indirect and direct effects and shows path dependence. It is important to analyze only the significant relationships and effects, as the insignificant effects will be scrutinized in the later sections, with the inclusion of historical contexts.

As GDP Per Capita increases by 1 SD:

- Unemployment decreases by 0.692% of total labor force,
- Adj. Net National Income increases by $0.82 per capita,

The total effects further solidify the idea that economic activity assists in the improvement of unemployment and poverty incidence, which confirms one part of UNESCAP's Green Growth model. In addition to the nonsignificant results which include GDP Per Capita not being linked to CO_2 Emissions and Natural Resource Depletion, we can tentatively make the happy statement that Green Growth might very well exist in Thailand, benefitting the poor through economic development (known as growth without quantitative consumption of natural resources). This may point towards the beginnings of relative decoupling of resources from economic processes.

4.11.2 Summation of Important Empirical Findings

Strictly through the use of cross-correlations and SEM, the important empirical findings are summarized below, based on the Green Growth definition:, "*a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises*" (MCED-5, 2005a; UN ESCAP, 2012)

GDP Per Capita (Economic Activity) significantly coincides with Unemployment (Job Creation) and Adj. Net National Income (Poverty). However –

- Adj. Net National Income is unrelated to CO_2 Emissions & Natural Resource Depletion
- Adj. Net National Income is not directly related to Unemployment
- Resource Constraints does not predict variance in GDP Per Capita and Adj. Net National Income
- GDP Per Capita does not predict variance in CO_2 Emissions

Empirical results imply that 1) economic growth assists poverty and unemployment, and 2) economic growth does not worsen resource constraints and climate change. At this stage of analysis, there is a strong possibility that in Thailand, between the years of 1990-2014, policies reflecting Green Growth ideology is **active and present.**

4.11.3 Green Growth Noise Residuals 1990-2014

FIGURE 40: GREEN GROWTH TRENDS 1990-2014

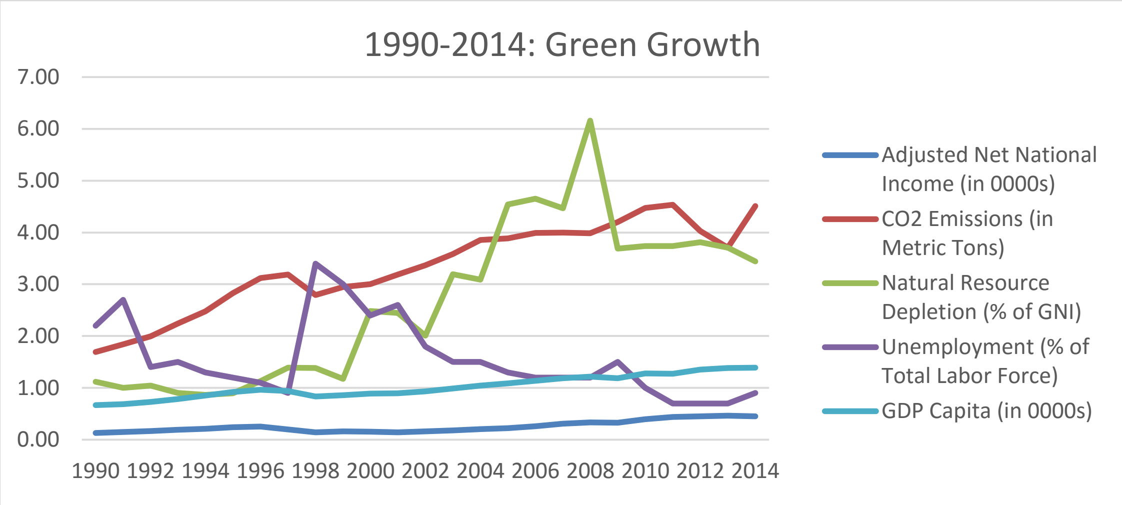
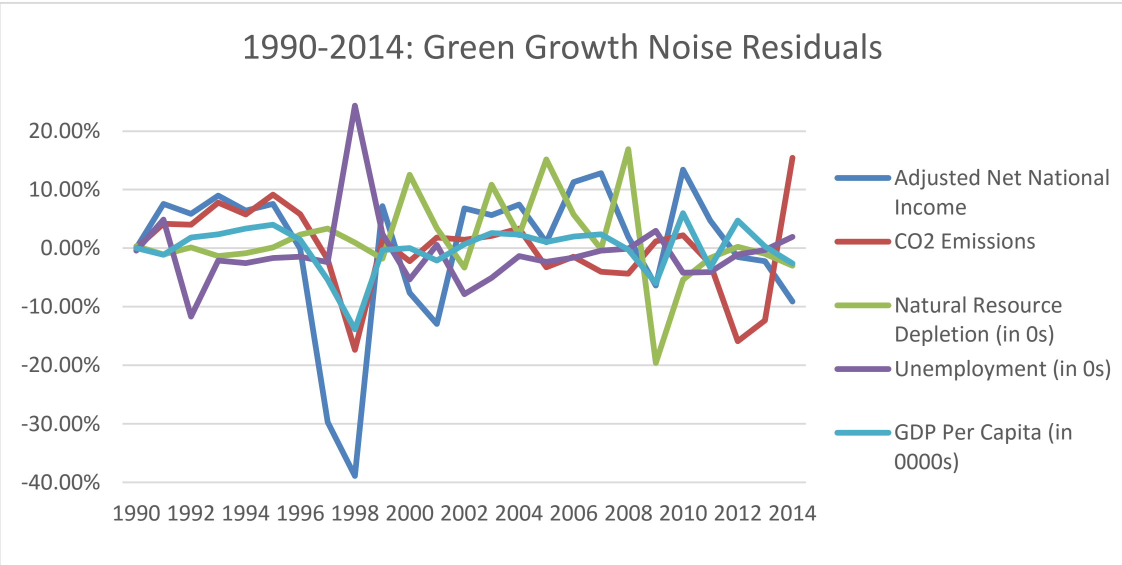


Fig. 40 plots the five Green Growth variables in order to identify by performance stratified by year which is important to know when including explanatory historical context. Unemployment and GDP Per Capita seems to follow a very similar trajectory, whereas inferences can't be made with certainty for the remaining three variables as the fluctuations are too large.

FIGURE 41: GREEN GROWTH NOISE RESIDUALS 1990-2014



Therefore noise residuals are plotted on *Fig. 41*, which results in the finding that if there are co-variance brought on by tertiary variables, they are not affecting variables consistently, further there is no cyclical effect. The noise residuals were created using forecasting expert modeler in SPSS. A brief correlation and SEM analysis is carried out using the noise residuals to examine if our findings in *4.11.2 Summation of Important Empirical Findings* still hold true, please see Appendix A to view the complete SPSS and AMOS outputs.

4.11.3.1 Correlations between Noise Residuals

TABLE 15: CORRELATION BETWEEN NOISE RESIDUALS

Correlations

		Noise residual from Adj_Res. Depl-Model_1	Noise residual from CO2_Emis-Model_1	Noise residual from Adj. Net_Income-Model_1	Noise residual from GDP_perCapita-Model_1	Noise residual from Unemploy-Model_1
Noise residual from Adj_Res.Depl-Model_1	Pearson Correlation	1	-.178	-.034	.163	-.135
	Sig. (2-tailed)		.404	.876	.445	.519
	N	25	24	24	24	25
Noise residual from CO2_Emis-Model_1	Pearson Correlation	-.178	1	.392	.317	-.402
	Sig. (2-tailed)	.404		.058	.131	.052
	N	24	24	24	24	24
Noise residual from Adj. Net_Income-Model_1	Pearson Correlation	-.034	.392	1	.827**	-.607**
	Sig. (2-tailed)	.876	.058		.000	.002
	N	24	24	24	24	24
Noise residual from GDP_perCapita-Model_1	Pearson Correlation	.163	.317	.827**	1	-.723**
	Sig. (2-tailed)	.445	.131	.000		.000
	N	24	24	24	24	24
Noise residual from Unemploy-Model_1	Pearson Correlation	-.135	-.402	-.607**	-.723**	1
	Sig. (2-tailed)	.519	.052	.002	.000	
	N	25	24	24	24	25

**. Correlation is significant at the 0.01 level (2-tailed).

Noise residuals are defined as the statistical discrepancy between the actual values and those predicted by forecasting models (IBM, 2015). For the purposes of this investigation, noise residuals should be correlated, because that would indicate that there is information left in the residuals (e.g. from tertiary variables, co-variance, etc.) which would relate the variables better with each other. *Table 15* shows that in alignment with our empirical results:

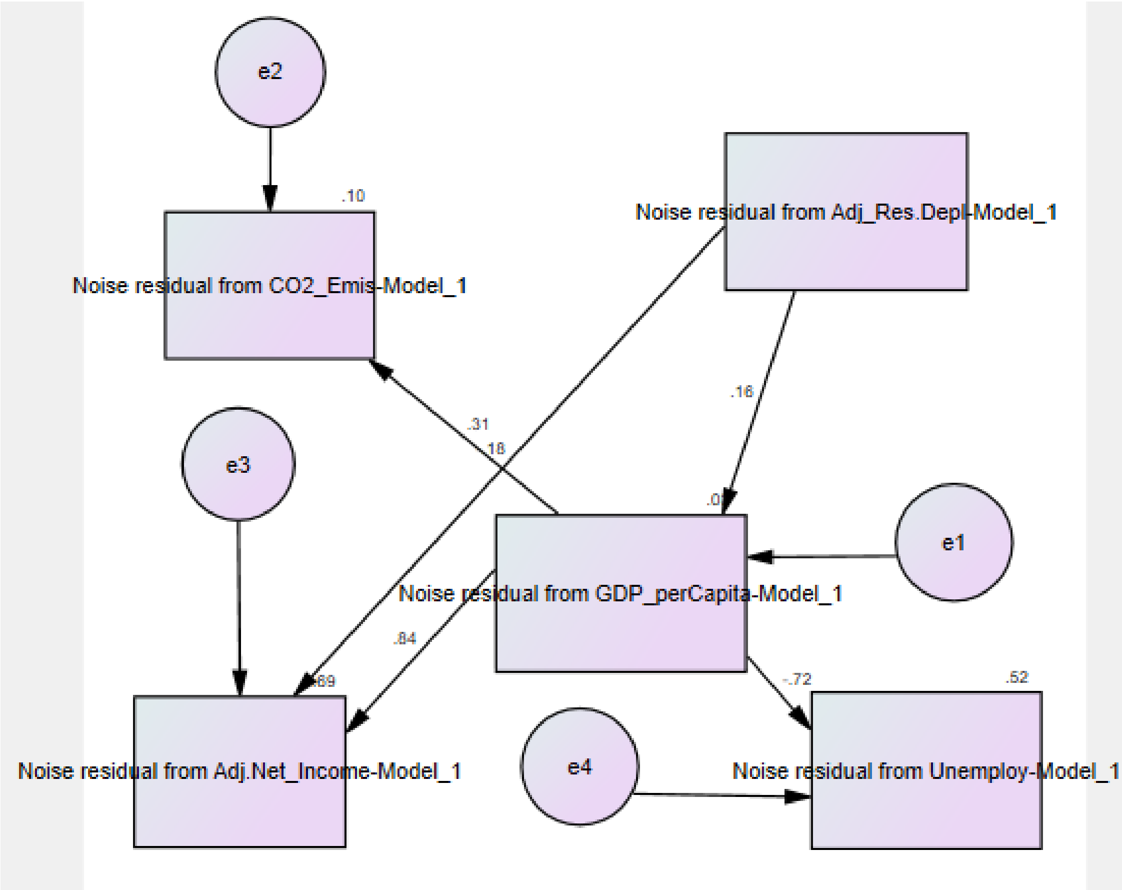
- Natural Resource Depletion is not related to CO2 Emissions, Adj. Net National Income, GDP Per Capita and Unemployment,
- CO2 Emissions is not related to Adj. Net National Income, GDP Per Capita and Unemployment,
- Adj. Net National Income is related to GDP Per Capita and Unemployment,
- and GDP Per Capita is related to Unemployment.

Essentially, correlations between the noise residuals confirms our findings in *4.11.2 Summation of Important Empirical Findings,* however SEM analysis is still undertaken to confirm the empirical possibility of Green Growth. Ideally, there would be no difference in SEM results between the noise residuals and the actual values.

4.11.3.2 SEM Analysis on Noise Residuals

The individual outputs from the SEM analysis conducted on noise residuals are found in Appendix A. As expected, model fit was relatively strong (P=0.466, NFI=0.914, RFI=0.828, TLI=1.018, and RMSEA= 0.000), though not as perfect as the SEM conducted on the original observed values. This is to be expected because noise residuals have been detrended, which implies that cross-over effects from each other have been taken out, as well any time-series relationship.

FIGURE 42:NOISE RESIDUALS SEM MODEL



However, in general the empirical results echo and confirm what is in *4.11.2 Summation of Important Empirical Findings.* This reinforces our objectives going forward that our empirical data is robust in indicating a strong possibility of Green Growth activity in Thailand. Historical context will be included to potentially explain the factors which allowed Green Growth to flourish.

4.12 Discussions with Historical Context

The principal objective of this investigation is to empirically observe whether Green Growth is possible, by examining the significance of its concepts' interrelationship during 1990-2014. It is impossible to critically state, with certainty, any causalities there may be, because all mediating variables haven't been controlled for. Because the focus is on "empirical possibility," historical context is necessary to contextualize and reinforce the truthfulness of the above statistical statements. At the same time, it is important to note that historical context is based on secondary and tertiary sources, which may not always provide the level of detail hoped for. As a result, we will examine years and short time-periods which represent Thailand's overall trend.

Additionally, extra efforts are dedicated to the deconstruction of the one significant relationship (Economic Growth alleviating Unemployment and Poverty), because as Astronomer Carl Sagan once said, "The absence of evidence is not the evidence of absence." In other words, it is difficult to prove a negative; therefore literature explained in the following sections can only suggest reasons for why the lack of relationships may exist between certain variables.

4.12.1 Green Growth Trends between 1990-2014[3]

4.12.1.1 Significant: GDP Per Capita improves Unemployment & Adj. Net National Income

Thailand is one of the four "Tiger Cub Economies (TCE)", along with Indonesia, Malaysia and Philippines. These four countries in Southeast Asia serve as a foil to the "Four Asian Tiger Economies", and are appropriately named for being newly industrialized and possessing an economic development model driven by export-led growth (Clifford & Pau, 2011). The label of TCE was granted in 2001, with the advent of Thailand's 23rd Prime Minister Thaksin Shinawatra's set of unorthodox (at the time) policies, known as "Thaksinomics" (Looney, 2004). Thaksinomics intended to alleviate Thailand's reliance on foreign trade and investment by increasing inclusive domestic activity with open market reform as well as foreign investment (ibid). To discuss the effects of Thaksinomics, we must first revisit the events of 1980-1998.

During his term (1980-1988), 16th Prime Minister Prem Tinsulanonda made the critical decision allow Thailand to receive and participate in international trade. Prem was concerned with rectifying government budget deficit and rising public debt, which triggered a civil uprising in 1973 (Hicken, 2004). The deficit was made worse by two sharp oil price shocks in the early 1980s,

[3] Unless otherwise mentioned, all statistics are calculated based on World Bank data used in this investigation (World Bank, 2015a).

which created an overall unfavorable world economy. However, Prem's free market reform produced economic prosperity between 1985-1997 when lowered oil prices and the depreciated Thai Baht (tied to the US Dollar) jump-started the Thailand's manufacturing industry (Bosworth, 2005). Strong economic growth was facilitated by Thailand's political stability between 1992-1997, brought on by removing corrupt government and military officials from office (ibid).

However in late 1997, a currency crisis in Asia occurred, led by unhedged borrowing, defaulted loans, and leveraged corporate sectors, forcing millions of Thai citizens out of employment (Krishnamurty, 2009). The crisis raised unemployment rates by 2.5% according to World Bank.

The peak between 1997-1998 is reflected in *Fig. 40* and was the primary cause behind Thaksinomics and its ideology of strengthening domestic economies through inclusive growth (Krongkaew, 2002). The inclusivity aspect emphasized the skillful training and improvement of Thai employees, in order to compete head-to-head with transnational corporations, especially in manufacturing (Bosworth, 2005).

Additionally, Thailand began to boost domestic aggregate demand through the "One Tambon One Product" scheme which provided credit to local small and medium businesses, as well as increase consumer spending through instituting social policies aimed to reduce household expenditure on health and debt (Phongpaichit, 2003). The outcome was positive. Between 2001 and 2006, GDP growth increased by an average of 5-6% per year (ibid), and GDP per capita by an average of $485 per year, with the upward trend visible on *Fig. 40*. The investment in building up human capital facilitated a decrease of overall unemployment, by an average of 0.23% per year during the same time period.

Similar economic recovery policies were undertaken to counteract 2009's banking crisis (Jitsuchon & Sussangkarn, 2009). It is, therefore, necessary to amend the statement to reflect that GDP Per Capita led by qualitative development of human capital and social policies, stimulated a reduction in Unemployment, and improvement of Adj. Net National Income.

4.12.1.2 Adj. Net National Income is unrelated to CO_2 Emissions & Natural Resource Depletion

Thailand's development intentions are largely detailed in their NESDPs, which are published every four years, since 1961 (NESDB, 2012). They have been vital in transitioning Thailand from an agrarian society to a middle-income industrialized economy, and as of 2011, an upper-middle country (World Bank, 2016b). The NESDPs retained an exclusively growth orientation until 1992 in which the 7th NESDP stated that Thailand's final objective would be for its citizens' social and community development, by way of economic growth and other variables (United Nations, 2002c). In fact, between the 7th and 10th NESDP (1992-2011), each plan focused on rectifying a predictor of poverty, congruent with the political and economic climate at the time, respectively: improved governance of agricultural industry, allow free access to privatization, successful co-operative and entrepreneurial community education, and finally, building up the financial welfare of communities including mobilization of skilled youth (Yothasmutr, 2008).

In the 10th NESDP, His Majesty King Bhumbibol Adulyadej's "Philosophy of Sufficiency Economy" began to be implemented, with full integration at government and societal levels by the end of the 11th NESDP. To name a few impacts: at the government level, the Philosophy manifested as conservative fiscal actions to control budget; financial and business sectors experienced significant restructuring; and education fields were required to establish a database system chronicling best-practice and past experience (NESDB, 2012). The goal was to establish "balanced development" by encouraging the principles: reasonableness, moderation and resilience (ibid). By observing the objectives and impact trend across all NESDPs, it is fair to state that economic strategies to resolve poverty revolve around building up of knowledge transfers, education and training of human capital, and development of community resources, especially at a rural level.

Furthermore, longitudinal study between 1996-2009 found that poverty reduction was achieved not only through economic growth but also NESDP's populist policies carried out with strong and good quality governance, chiefly in improving participatory civil voice, government accountability, political stability, absence of violence and a dependable rule of law (Vora-Sittha, 2012). Therefore, there is no relationship between CO_2 Emissions and Natural Resource Depletion influencing Ad. Net National Income levels, as tertiary variables are performing this task already.

However, the variance in CO_2 Emissions and Natural Resource Depletion should still be addressed separate from poverty incidence. An analysis of biodiversity conservation poverty alleviation initiatives revealed that forest products contribute up to 70% of household income, through monetary and subsistence means (Silori, 2010). This finding suggests that variation in natural resource depletion may be related to simple rate of consumption. A brief correlation was carried out between Thailand's Total Population (World Bank, 2015a) and Natural Resource Depletion between 1990-2014 to examine the strength and significance (see *Table 15*).

TABLE 16: CORRELATION BETWEEN TOTAL POP & NATURAL RESOURCE DEPLETION

Correlations

		TotalPopulation	NaturalResourceDepletion
TotalPopulation	Pearson Correlation	1	.877**
	Sig. (2-tailed)		.000
	N	25	25
NaturalResourceDepletion	Pearson Correlation	.877**	1
	Sig. (2-tailed)	.000	
	N	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Statistical results indicate that there is a strong, positive, and significant relationship (r=0.877) between Total Population and Natural Resource Depletion. In other words, when Thailand's total population increases, so does the rate of natural resource consumption or vice versa (Bugna & Rambaldi, 2002). Between 1960 to 1990, agricultural productivity soared thanks in part to open market reforms and the export of cash crops, however the result was heavy environmental degradation (i.e. deforestation, infertility of arable land) (ICEM, 2003). Environmental pressures were compounded by rising populations in the 1980s. As a result, Thailand established a National Land Reform Program which provided non-transferable farmland certificates to poor families (ibid). Pressure was alleviated when industrial development led nearly 50% of the population to work in urban areas, in the 1990s (Buch-Hansen et al., 2006).

At the same time, Natural Resource Depletion rates may vary with the sustainable governance of new protected regions and technological improvements. In other words, the total number of natural resource-rich regions may increase. In the 21st century, the Thai Ministry of Agriculture and Co-Operatives (TMAC) have seen a record number of technological advances geared towards sustainably utilizing natural resources (Buch-Hansen et al., 2006). For example, investment in irrigation infrastructure facilitates the sustainable production of 2-3 cash crops per year (ICEM, 2003). This allowed Thailand, in 1999, to set aside larger amounts of land and regions of rich biodiversity as part of their "Protected Area System" (ibid). In 2007, the PA system covered 18% of the country's total land areas, establishing more than 400 national parks, non-hunting areas, botanical gardens and wildlife sanctuaries (UNDP, 2007). Therefore the statement of Adj. Net National Income being insignificantly related to Natural Resource Depletion is reinforced; Resource Constraints are influenced by tertiary variables (e.g. technological innovation, governance, and population).

Regarding CO^2 emissions in Thailand, poverty is not a significant predictor of its variance because emission levels are directly influenced by the industrial sector (Muangthai et al., 2014). Specifically, electricity generation represents the largest source of CO_2 Emissions (32% of total emissions) (IIP, 2013). However, it contributes to only 30% of Thailand's national income (Selvakkumaran et al., 2014), implying that national income may be unrelated to CO_2 Emissions.

Furthermore, a decomposition analysis between 1990-2008 found that Thailand's total amount of CO_2 Emissions are contributed: 1) 66.6% by carbon intensity of industrial energy sources, 2) 18.4% by population growth, 3) 13% by technological improvements in energy consumption efficiency, and 4) 2% by conventional economic growth (Peytral & Simon, 2011). In the same report, Peytral & Simon (2011) specifically stated that residential consumption, such as automobile use (Srisurapanon & Wanichapun, 2003) , is a *relatively* weak CO_2 emitter. This reinforces that there is a weak, and indirect relationship between CO_2 Emissions and Adj. Net National Income because tertiary variables contribute the bulk of emissions (i.e. industrial energy).

4.12.1.3 Adj. Net National Income is not directly related to Unemployment

In 4.12.1.1 Significant: GDP Per Capita improves Unemployment & Adj. Net National Income, there is evidence that an economic expansion brings with it, increased employment opportunities and reduced incidence of poverty. Yet the two latter variables are not significantly related to each other because Thai poverty is addressed in a multitude of ways, not only job creation.

For example, Thailand has a rich social policy to alleviate household expenditure on health care services. In 1975 with the 2nd NESDP, Thailand began to establish free medical care for the poor (quantified as citizens living below the 1,386Baht national poverty line), which proceeded to decrease poverty rates by 2% per year until 1982 (Sakunphanit & Suwanrada, 2011a), when the 5th NESDP came into effect. It sought to maximize social impact by implementing the Universal Coverage Scheme, under which Thai citizens pay 13.7% of total health expenditure, with the government insuring each for approximately $93 per year (ADB, 2014b). By 2002, free Thai healthcare was achieved through systems corresponding to employment sectors: 1) the Civil Servant Medical Benefit Scheme, 2) Social Security Scheme (for private employees), and 3) Universal Coverage Scheme (for all others) (Tangcharoensathien, et al., 2010).

Other examples include: 1) 500 Baht Universal Pension Scheme for the Thai elderly citizens (ages 60+) and 2) Contractual One-Baht Expenses Reduction Group, specifically targeted at community development (Sakunphanit & Suwanrada, 2011b). The 500 Baht Scheme allowed elderly citizens, who were otherwise excluded from government pension schemes, to receive 500 Baht supplemental income to assist living expenses. While the One-Baht Expenses Reduction Group asked poor communities to contribute 1 Baht per day for charity for 180 days, in order to receive a myriad of benefits such as maternity pay (500 Baht per birth), 30% reduction of educational expenses, debt clearing, etc. If they contributed regularly over 15 years, they were also eligible for pension schemes between 300Baht to 1,200Baht per month (ADB, 2013c).

In addition to the aforementioned, most of Thailand's social policies are universally inclusive and aim to reduce poverty regardless of employment status (Paitoonpong et al., 2010), thereby reinforcing the finding that a steady income may not significantly influence Adj. Net National Income, nor the aim of resolving Adj. Net National Income causing citizens to seek employment.

4.12.1.4 Natural Resource Depletion does not predict variance in GDP Per Capita & Adj. Net National Income

In alignment with ecological economics, the expansion of the artificial economic system is fed by the natural biophysical environment, which, in theory, implies that there should be negative relationships between Natural Resource Depletion and GDP per Capita. Comparing GDP sectoral growth in 1990-2000 and 2000-2010, Thailand experienced: 1) -2% in Agriculture (14-12%), 2) +7% in Manufacturing (28-35%), 3) +2% in Transportation and Communication (8-10%), and the rest, a function of Wholesale and Retail Trade, and Services (Manprasert, 2004). In fact, industries using the most natural resources, would be manufacturing and transportation, largely to provide raw input materials and industrial energy sources (Peytral & Simon, 2011). There are two likely reasons why these industries would grow, yet we might not see the corresponding increases in natural resource depletion, and at the end-stage of production, atmospheric waste.

Between 2000-2015, Thailand has imported: 20% petroleum and mineral products, 12% of metals, and 7% chemicals of all imported products (UN ESCAP, 2015b). This indicates that 39% of all Thai imports are raw materials, which puts the strain of natural resource depletion on neighboring countries, chiefly China (20.7%) and Japan (18.8%) (ibid). In fact, it has a considerably lower time and resource cost to import raw materials than extract them in Thailand; for example, the import of raw materials for electronic devices from China takes five days, door-to-door (Keretho & Naklada, 2011). Therefore this would be the first reason why there might not be a corresponding natural resource depletion strain for the growing industries.

Though more recent, the second reason is more probable: the presence of green industrial practices. Between 1985 to 2005, resource intensive industries has declined from 49.2% to 34.6% of value added, which when coupled with implemented green practices, suggests, at the very least, a relative decoupling of domestic resource consumption and economic growth (Anuchitworawong et al., 2012). With the 2012 11th NESDP, Thailand created three National Plans on Environment & Climate Change: National Environmental Quality Management Plan

(2012-2016), Green Growth Strategy (2014-2018), and National Master Plan on Climate Change (2019-2050). Strategies from the first two plans were implemented in the four Thai Ministries (Energy, Transport, Industry, and Agriculture & Cooperative) and their governance policies (Mungcharoen, 2015). The goal was to achieve sustainable consumption & production, eco-efficiency indicators, green businesses and markets, among others (ibid).

Prior to 2012, there was no consolidation of programs to address sustainable consumption. Undesirable environmental effects were targeted using fiscal tools such as taxes, bans, and regulations (UNIDO, 2011). For the sake of brevity, an example will be used to illustrate green innovative behavior on a voluntary, government-regulated, and industrial best-practices level.

The Thai Green Label was launched in 1994 by the Ministry of Industry (Green Label, 2013) to voluntarily certify products based on their ecologically-conscious supply chain. There are presently, 144 products and services certified (ibid). Of notable mentions are the Carbon Label (certifying products which reduce emissions across its lifecycle), Crown Standard (certifying products which reduce emissions at production) and Energy Efficiency Label (UNEP, 2013). Voluntary eco-standards are considered the highest standard of sustainable production in Thailand and greatly impact manufacturing decisions (UN ESCAP, 2014c).

In 2011, the Ministry of Industry implemented the Green Industry Initiative (Ministry of Industry, 2013), which asked small and medium-sized enterprises to develop sustainable practices by following the five-step development plan (green commitment, green activity, green system, green culture, and green network). At the end, there would be a government-certified Green Industry Mark (Anuchitworawong et al., 2012). This Mark allowed corporations numerous benefits including: 1) for five years: annual corporate fee exemption, 50% reduction of corporate income tax, and 2) for three years: exemption of import duties. As of 2012, 609 corporates achieved the Mark, with 1,581 corporations in progress (ibid). The Mark allowed for the government-regulated development of eco-industries which focuses on using renewable energy, recycling resources, and reducing greenhouse gas emissions (TBI, 2014).

While the aggregate development of sustainable green industries is supported by the Thai government, the manufacturing and energy sectors have contributed many innovations which lower the consumption of virgin natural resources (Anuchitworawong et al., 2012). Of notable mention is the “Closed-Type Anaerobic Reactor”, which biologically treats industrial wastewater to be suitable for reuse in irrigating farmlands, while also producing biogas as an alternative source of energy (Chotwattanasak & Puetpaiboon, 2011). To ensure wide dissemination of green best-practices, United Nations Environment Program (UNEP) established in 2006, the 3R Knowledge Hub to collect knowledge transfers relating to the 3Rs: reduce, reuse and recycle (3RKH, 2014). The Hub also creates guidelines and government recommendations for countries to develop policy frameworks to promote resource efficiency (UNIDO, 2011). Therefore, Natural Resource Depletion may not significantly predict variance in GDP Per Capita because the presence of comprehensive and wide-ranging Green Growth policies facilitate a relative decoupling of resources from economic growth.

Regarding the relationship between Natural Resource Depletion and Adj. Net National Income, *4.12.1.3 Adj. Net National Income is not directly related to Unemployment* has established that Adj. Net National Income is influenced by a variety of factors, but not directly by the level of Natural Resource Depletion.

4.12.1.5 GDP Per Capita does not predict variance in CO_2 Emissions

Perhaps the most fascinating finding, GDP Per Capita is not significantly related to CO_2 Emissions. This is in direct contrast to the literature which states as natural resources are transformed into financial value, its exit into the biophysical environment is usually in the form of waste, atmospheric (i.e., CO_2 Emissions) included. There are 2 main reasons to explain the divergence.

Firstly, a country's level of CO_2 Emissions is measured within its national borders, which means if manufacturing is outsourced to cheaper countries, the CO_2 Emissions associated with that decision registers as the cheaper country's problem (Vate, 1996). This is known as "production-based accounting", whereas "consumption-based accounting" labels manufacturing as a service consumed by corporations, and is more valid and reliable when observing Thailand's emission pressures (Boitier, 2012). Unfortunately as of 2016, there is no such standardized metric existing yet for Thailand. This suggests that there is a likelihood that Thailand's CO_2 Emission levels are decreasing because they are exporting more of their manufacturing needs, especially towards China as they have a very strong trade-relationship going back to 1976 (Hongfang, 2013). Although this is simply a theory as there is no literature supporting Thailand exporting CO^2 Emissions. In fact, given that the Thai manufacturing sector has been robustly growing (Manprasert, 2004), it is likely that the second reason is more probable: presence of Green Growth.

Between 1990 and 2008, Thailand's CO_2 Emissions have been increasing, but at a decreasing pace (relative to the 1980s) (Peytral & Simon, 2011). With this trend, there is hope for Thailand stabilizing and finally reducing their level of atmospheric waste by 34% before 2050

(Selvakkumaran et al., 2014). As aforementioned, the 2012 11th NESDP triggered national plans within each of the four Ministries. As a result, the Ministry of Energy and Ministry of Industry jointly created the Energy Efficiency Development Plan, which aimed primarily to reduce overall emissions by 49 million tons and save 11 million tons of oil through cuts to industrial energy consumption (IIP, 2013). Thailand's CO_2 Emissions are primarily driven by industrial electricity generation, largely through fossil fuel combustion. Essentially, energy drives emissions. Therefore, Thailand has implemented a multitude of policies to develop renewable energy sources and economy. For the sake of brevity, an example will be used to illustrate policies characterized by the IPP as "effort-defining", "supportive", and "implementary" (ibid).

Effort-defining policies are regulatory standards which encourage energy efficiency and saving, and emissions reduction. A prime example would be Thailand's 2007 Energy Conservation Promotion Act, which requires all actors of energy and manufacturing industry to adopt following rules: 1) install industrial plans with no less than 1 megawatt and an annual consumption of more than 20 million mega joules, 2) appoint energy managers to moderate energy consumption levels, and 3) third-party objective audits to ensure minimal CO_2 Emissions (Bhumibol, 2007). By 2012, there was a 20% reduction in CO_2 emission (depicted on *Fig. 40*) and a corresponding 9% increase in renewable energy production (IIP, 2013).

Supportive policies are operant conditioning ("carrot-and-stick") actions which encourage corporations to make environmentally-conscious changes. The Energy Conservation Promotion Program was established in 1992 to provide financial support for three programs: Energy Efficiency Revolving Fund in 2003, the ESCO Fund in 2008 and a tax incentives scheme. The Energy Efficiency Revolving Fund stimulated industrial investments in renewable energy by allowing national banks to provide loans at no interest (UNDP, 2012). It was greatly beneficial as by 2010, it funded 335 energy efficiency projects and 112 renewable energy projects, which saved 4 billion Baht (~112 million USD) worth of CO_2 Emissions (CCAP, 2012a). The ESCO Fund provided equity capital for small and medium enterprises to lead energy efficiency projects (ibid). Within two years of its inception, it had financed 1 billion Baht (~27.9 million USD) into 15 billion Baht (~419.5 million USD) worth of green investments (CCAP, 2012b). Finally, tax incentives varied from waiving import duties for energy efficiency/renewable energy equipment to awarding nationally-recognized "Energy Awards" to encourage corporate leadership on green energy (UNDP, 2012). Impacts are difficult to gauge with the tax incentives.

Implementary policies are capacity-building guidelines which support all government initiatives to reduce CO_2 emissions via energy efficiency and renewable energy investments. These included the distribution of manuals and guidelines for following all governmental regulation, and how to monitor and report difficulties and results to the government (IIP, 2013).

The aforementioned emission-reduction policies, though not comprehensive, suggest that GDP per Capita does not significantly predict variance in CO_2 Emissions because the presence of strong energy efficiency and renewable energy Green Growth policies allow for a manufacturing-driven economic growth to be relative decoupled from atmospheric waste.

5 PART V: CONCLUSION

*"Crisis can bring about the courage to change. There will come new opportunities and strength for us to take steps that we can't do in normal circumstances, such as striving towards **development of a green economy through Green Growth**." (Former Prime Minister of Thailand Abhisit Vejjajiva in "Change, Challenge & Collaboration for Asia' Prosperity")*

5.1 Introduction

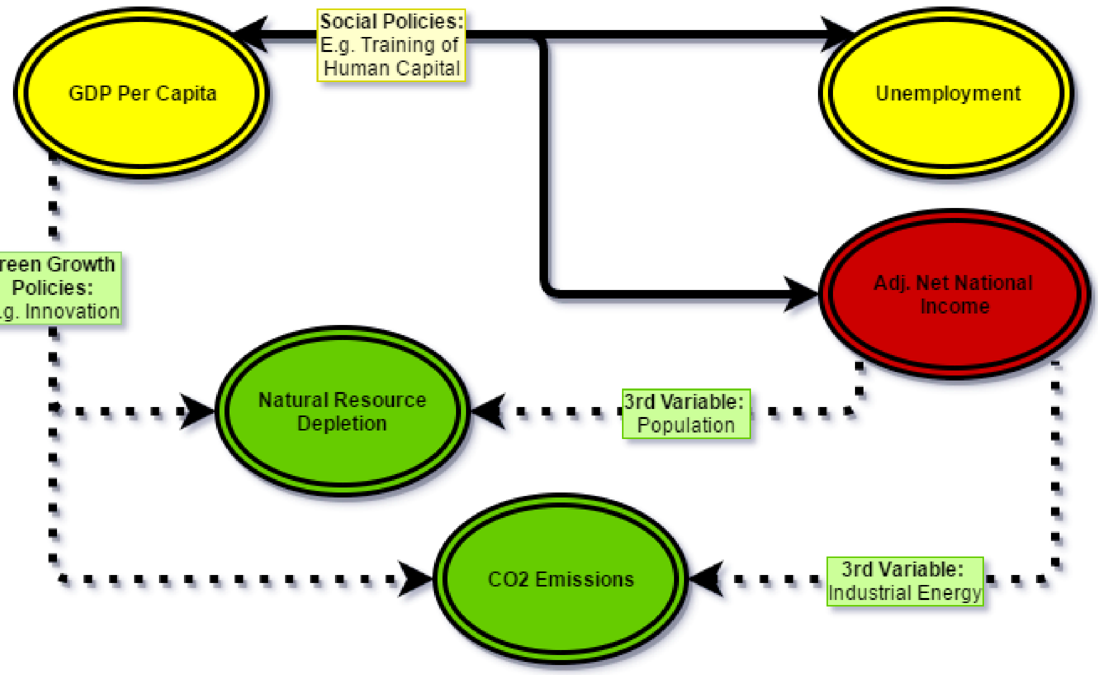
This investigation sought to explore the RQ: *"Is there evidence of significant relationships between: Economic Growth & Job Creation, Poverty Reduction, and Resource Constraints & Climate Change during 1990-2014 in Thailand?"* The variables selected make up UNESCAP's definition of Green Growth which, to reiterate, is: "a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises" (MCED-5, 2005a). In essence, the aim is to understand whether impacts of Green Growth are empirically possible, in Thailand's recent history (1990-2014).

There were two objectives: 1) Whether there is a lead-lag relationship between concepts which constitute Green Growth, and 2) whether historical context reinforces the empirical likelihood of Green Growth's existence in Thailand between 1990-2014. From our results, we have answered our objectives and research question.

Firstly, while there was some presence of lead-lag relationships as evidenced by the cross-correlations, the variables ultimately chosen for their strongest, significant relationships did not possess lead-lag relationships with each other (i.e. zero time lags). This suggested variables within Green Growth influence each other simultaneously, or indirectly with the inclusion of tertiary mediators. Fortunately, due to zero time lags and strong, significant cross-correlations, a valid and reliable SEM model was visualized. Results from the SEM model produced five statements, with which historical context was used to reinforce its likelihood of accuracy. This brings us to the second objective.

With the inclusion of profound research in Thailand's history, *Fig. 43* shows us the final products of this investigation, which answers that there is an empirical likelihood of Green Growth's existence in Thailand between 1990-2014. Arrows indicate directionality of influence and dashed lines indicate that there was no significant relationship by reason of the green boxes. Yellow boxes indicate the reason explaining why there is a significant relationship.

FIGURE 43: RESULTING GREEN GROWTH MODEL (THAILAND, 1990-2014)



Althoug there are, of course, opportunities to deepen this investigation, with the time and resources at hand, we are able to answer the RQ, which is: Yes, there is empirical evidence of the likelihood of Green Growth activity between 1990-2014 in Thailand. Based on our fascinating findings, we address: its applicability to other ASEAN countries, significance to the field of Sustainable Development, methodological limitations, as well as implications and recommendations for various stakeholder groups. Finally, we conclude with implications for further research into the topic of Green Growth activity, primarily for Asian countries.

5.2 Applicability to Other ASEAN Countries

Association of Southeast Asian Nations (ASEAN) was established in 1967 with the objective of forming an economic trading bloc which allowed for unrestricted free trade, capital and labor through the Free Trade Area (Nielson, 2014). It is partially facilitated by the removal of tariff barriers. In 2007, ASEAN comprises Singapore, Malaysia, Indonesia, Thailand, Philippines, Brunei, Vietnam, Cambodia, Laos and Myanmar, all working towards economic growth, social progress, cultural development, regional peace and stability, and active collaboration and mutual assistance (ADB, 2014b). It has been instrumental in East Asian trade integration, thereby characterizing its members by similar economic development pattern, industry clusters, growth rates, and cultural features (Kurlantzick, 2012). It implies that the existence of Green Growth in

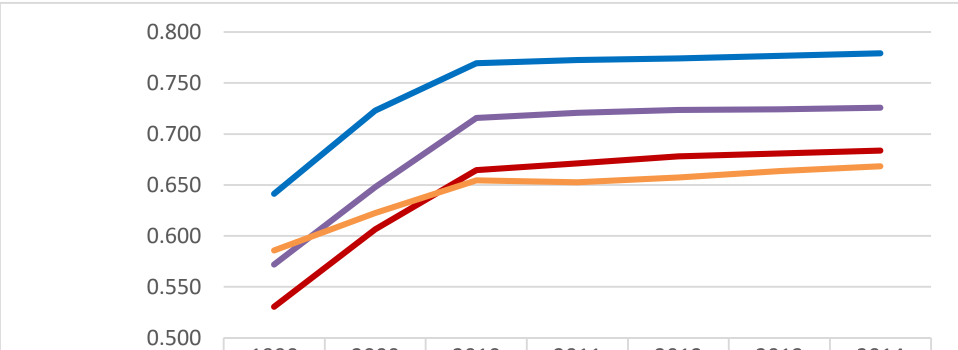
Thailand may be observable in other ASEAN countries, given favorable historical context. This is especially true of other Tiger Cub Economies such as Indonesia, Malaysia and Philippines.

Membership in ASEAN doesn't exclude advantageous trade with other regional countries. Outside of the original 10 nations, there are 6 (known as the ASEAN+6) who benefit from trade efficiency including Australia, China, India, Japan, New Zealand, and South Korea (Urata, 2008). However, this is not to say the ASEAN-6 have similar development priorities as the original 10 ASEAN countries, whose official membership hinges on acceding to the treaties, declarations and agreements outlined in the 1967 Bangkok Declaration, which includes peaceful coexistence and mutual collaboration on economic and social issues (ASEAN, 2016).

Revising the concept of Tiger Cub Economies, these are newly-industrialized countries whose economic activity is driven by exports (Clifford & Pau, 2011). At present, all TCE are ASEAN member countries. This implies that, economically-speaking, Indonesia, Malaysia and Philippines are similar to Thailand (PERC, 2011). However, there are social dimensions to be considered. It is important to note that environmental dimensions are excluded because proximity, climate, and biodiversity typically produce similar baseline level natural resources and its regenerative rates, if located in the same geographical region (i.e. Southeast Asia) (Sodhi et al., 2010).

UNDP regards HDI as a relatively strong measure of social progress, as it includes health, education and living standards (UNDP, 2015). Using data retrieved from the UN Statistics Division (UN DATA, 2015), we can compare HDI trends in 1990-2014 between all four countries and calculate their correlations with Thailand. Unfortunately, due to varying data collection times, there are only seven aggregate time points.

FIGURE 44: HUMAN DEVELOPMENT INDICES (1990-2014) FOR THAILAND, INDONESIA, MALAYSIA, AND PHILIPPINES



	1990	2000	2010	2011	2012	2013	2014
Thailand	0.572	0.648	0.716	0.721	0.723	0.724	0.726
Indonesia	0.531	0.606	0.665	0.671	0.678	0.681	0.684
Malaysia	0.641	0.723	0.769	0.772	0.774	0.777	0.779
Philippines	0.586	0.623	0.654	0.653	0.657	0.664	0.668

TABLE 17: HDI CORRELATIONS BETWEEN THAILAND, INDONESIA, MALAYSIA, AND PHILIPPINES

Correlations

		Thailand	Indonesia	Malaysia	Philippines
Thailand	Pearson Correlation	1	**.998****	.995**	.990**
	Sig. (2-tailed)		.000	.000	.000
	N	7	7	7	7
Indonesia	Pearson Correlation	.998**	1	.995**	.995**
	Sig. (2-tailed)	.000		.000	.000
	N	7	7	7	7
Malaysia	Pearson Correlation	.995**	.995**	1	.986**
	Sig. (2-tailed)	.000	.000		.000
	N	7	7	7	7
Philippines	Pearson Correlation	.990**	.995**	.986**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	7	7	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 42 and *Table 16* shows that all three countries have significantly near-identical HDI trends compared to Thailand, and therefore it would be fair to say that their social impacts, governance priorities, and national policies can be qualified as comparable. This implies that the likely presence of Green Growth activity in Thailand, would be generalizable and applicable for Indonesia, Malaysia and Philippines if similar research is undertaken. Furthermore, any recommendations made for Thailand could be relevant for the other three Tiger Cub Economies.

5.3 Contributions to Sustainable Development Knowledge

UNESCAP's definition of Green Growth is: "a strategy of sustaining economic growth and job creation necessary to reduce poverty in the face of worsening resource constraints and climate crises." (MCED-5, 2005a). Within this framework, there are multiple relationships which are reflected in the new SDGs' call-to-action. For example, Goal 1, Indicator 7 (1.7) represents the need to implement inclusive policies to eradicate poverty (United Nations, 2015c), and Goal 8, Indicator 5 (8.5) encourages inclusive employment for all persons (United Nations, 2015a). Both 1.7 and 8.5 continue the economic and development rhetoric that poverty can be reduced through gains in economic growth and employment. In this manner, our significant finding that GDP Per Capita positively influences (the lack of) Unemployment, ad Adj. Net National Income, is not a new development, though it is always soothing to see policy confirmed through data.

Arguably, the most important SDG is Goal 8, Indicator 4 (8.4):

> *Improve progressively, through 2030, global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programs on Sustainable Consumption and Production, with developed countries taking the lead.* (General Assembly, 2015, p. 19)

Never before has there been such a loud international call to develop the economy qualitatively (and if needed: quantitatively) without corresponding natural resource depletion and atmospheric waste. Therefore, our findings contribute significantly to the field of sustainable development research by suggesting that relative decoupling has been occurring in Thailand between 1990-2014. Naturally, the empirical results must be viewed in light of its potential limitations, but as it stands, they hold merit in claiming that GDP Per Capita does not relate significantly to an increased level of Natural Resource Depletion and CO_2 Emission.

This finding should spur academics to seek confirmation of this finding by tracking the longitudinal environmental impact of Thailand's Green Growth policies. This can be pursued with the Thai government requesting that environmental management accounting be undertaken by manufacturing corporations, who are affected by national policies to preserve ecological integrity (UN DESA, 2001). Environmental management accounting is defined as the identification and collection of environmental costs and physical flows in order to inform regulatory bodies and strategic management decisions (ibid). Specifically, the strength of such an approach is enhance collective accountability, and disperse resource costs associated with data collection. Such an endeavor would provide corporations with knowledge regarding environmental guidelines such as ISO 26000:2010 and/or the Global Reporting Initiative's G3 (NBS, 2011). On the part of environmental policy scientists, it is worthwhile to seek the development of metrics which would allow all of Thailand's solid or atmospheric waste from natural resources to be recorded. This would provide a more accurate understanding of the environmental impact of economic expansion, which would assist sustainable development policy.

5.3.1 Limitations

Ideally, if there was more time and resources, there would have been the inclusion of *all* variables corresponding to each of Green Growth's concepts, and to observe their inter-dependencies. Furthermore, trend analysis would be pursued to remove the confounding effects of tertiary variables. This would present a cleaner, statistically more valid and reliable image of which variables influence each other, at a causal level. While there are several limitations, the prime would be the restriction of only 2-6 variables per concept. Though every effort has been taken to ensure representativeness (e.g. methodology adjustments, research into competing datasets and sources, etc.), one can never be 100% sure whether the interaction from another data point may have explained more variance in the dependent variable. This is precisely why caution of validity is recommended to any readers looking to make generalizations based on each variable being able to represent the entirety of each concept.

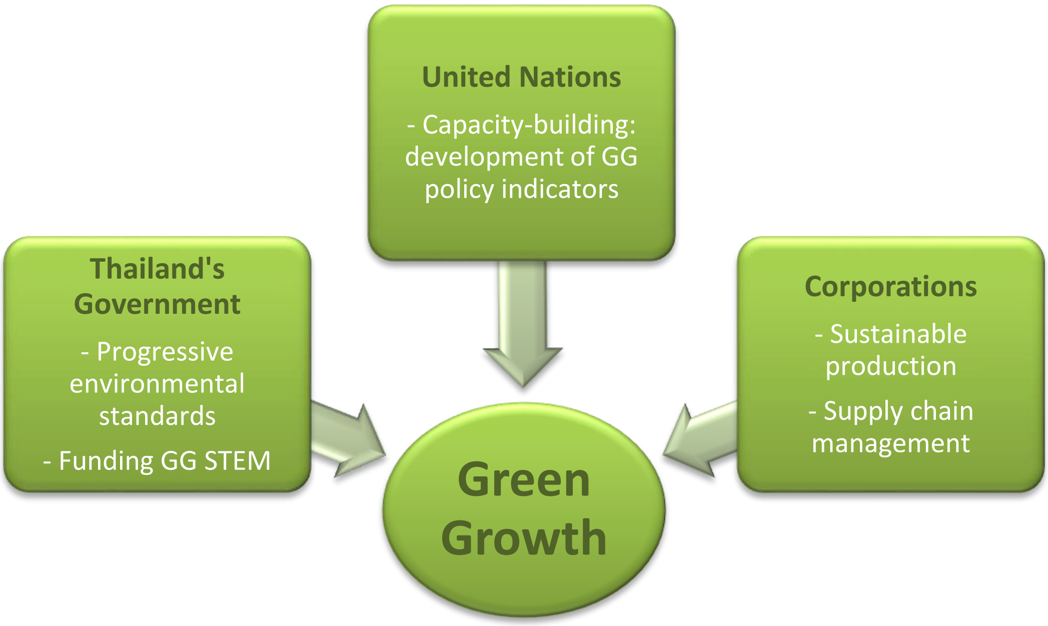
Secondly, a standard limitation in analyzing historical data is the presence of varying data collection times. In other words, multiple imputation is a powerful tool to “fill in” any missing data points, but it does not replace the need for actual data. With the parameters of this investigation (i.e. 1990-2014, Thailand, etc.), using multiple imputation, though unavoidable, might have created standardized error estimates, influencing the cross-correlation strength and goodness-of-fit indices in SEM. Methodological limitations were minimized as much as possible by delineating in SPSS, what are the maximum and minimum possible ranges for each data given neighboring data values. This provided statistical constraints which minimized the chance of outliers.

Finally, SEM is an exploratory procedure, after all, which requires multiple trial-and-errors in order establish a good model-fit. The selection of each variable was based on their strongest, significant cross-correlations with each other, however correlation is limited by directionality inferences, which means this tool cannot to determine which variable, if any, is the predictor. As a result, significant effort was taken to explore all possibilities of variables and their direction of effect. Results are based on the 29th complete round of SEM analysis which provided the best goodness-of-fit indices and significance. The limitation here is the possibility for human error.

5.4 Implications for Relevant Stakeholder Groups

If we consider the fact that Green Growth is present and active in Thailand, there are heavy implications for three influential stakeholder groups: the Thai government, United Nations, and corporations as depicted on *Table 45.* The following section features three components: 1) brief discussion of stakeholder characteristics and power of influence, 2) their interest in Green Growth, and 3) policy and/or behavioral recommendations to partake in expanding Green Growth as a national development approach for Thailand. Recommendations are sourced from frequently-used available policy options (Perrels, 2001; Cairney, 2011; John, 2011). It is important to note that recommendations listed below are by no means exhaustive.

FIGURE 45: GREEN GROWTH STAKEHOLDER GROUPS & RECOMMENDATIONS



5.4.1 Thailand's Government

Thailand' government implemented a national Green Growth Strategy, active between 2014-2018 (Anuchitworawong et al., 2012), with the primary goal of affecting change in the corporate sector (i.e. manufacturing). In addition to a proactive policy, the government has also drafted a Climate Change Master Plan (2014-2050) which reacts from the back-end to indictors of climate change, namely temperature, precipitation and CO_2 emissions (Duronkaveroj, 2015).

While there are many national plans (e.g. National Industrial Development Master Plan 2012-2031, 11th NESDP 2012-2016, etc.) (Ministry of Industry, 2013), the two aforementioned strategies are critical in centralizing the Thai government as the most effective agent to bring about Green Growth (ibid). Their power of influence stems largely from common but differentiated responsibilities within the Council of Ministers (COM) in the Thai governmental structure. The COM comprises of 35 senior members (nominated by the Prime Minister) leading governmental policy within 13 Ministries (Chardchawarn, 2010). Of notable mention are the Ministries: of Natural Resource and Environment, of Energy, and of Industry; however, when the mandate is drafted to pursue Green Growth, all Ministries must develop their own national plans, tailored to their area of influence. This implies that accountability for Thailand's wellbeing is collectively held, which reinforces the strength of any and all regulatory frameworks (MFA, 2014).

Thailand's government has been effective in penalizing and incentivizing new manufacturing corporations to produce according to pre-defined ecological limits (Anuchitworawong et al., 2012). This policy has developed a rather sizable “green industry” in Thailand (TBI, 2014). However, there is weak regulation for existing high-polluting firms, which means that there is a net economic growth of CO_2 emissions without the corresponding shrinkage of conventional manufacturing industries. It is understandable that there is general anxiety that by applying more stringent policies, the manufacturing industry would shrink too quickly, resulting in economic system contraction, affecting poverty incidence. In 1992, Thailand implemented the Enhancement and Conservation of National Environmental Quality Acts which asserts guidelines which district administration and corporations can follow, but there is no follow-up systems (MoE, 1999). One recommendation is to create a regulatory framework which progressively levies increasingly rigorous environmental standards over the long term (~10-15 years). In 2009, China passed the Circular Economy Promotion Law which imposed progressive standards (i.e. dilution [of environmental impact], treatment, and recycling, waste prevention) on its manufacturing industries. (PRC, 2008) For the leather industry 30% producers were pushed out, mostly foreign-invested firms looking to manufacture cheaply in China (Zhou, 2006). As a result, the remaining firms are reasonably environmentally-friendly, that is, until the next stage of standards. Thailand can succeed as well and completely restructure their industry to be green from the inside-out.

At the moment, the Thai government does not specifically fund improvements to “Green Growth science”, conceived to be the interaction between environmental concerns with economic priorities to benefit social good. Green Growth knowledge is placed within the Ministry of Science and Technology (Durongkaveroj, 2015), and unfortunately, the majority of efforts seem to be the education of high-level politicians and policy makers (WWF, 2014). In order for the Thai society to adopt a Green Growth orientation, and the sustainable development tenants within, there should be governmental funding of education surrounding Green Growth science, technology, mathematics, and engineering (STEM), primarily at a university level to target young people with the highest potential. They are vital, because they establish the tolerance level for ethical behavior and informing them about the existence and urgency for sustainable Green Growth, is incredibly beneficial (UNESCO, 2015). In 2014, the Thai government implemented the 5-Year STEM Master Plan which proposed the education of 3.25 million citizens, with participation from 30,000 schools, 400 vocational colleges, 150 universities, and numerous others (ATPAC, 2015). While this effort is venerable, there should be a critical distinction made between encouraging traditional STEM foci which might contribute to harmful economic growth, and sustainable development involving green STEM fields. This is known as the development of technical and intellectual capacity in Thailand.

5.4.2 United Nations

The UN presence in Thailand, is as the United Nations Economic and Social Commission for the Asia-Pacific providing “results oriented projects, technical assistance and capacity building to member States” (UN ESCAP, 2015a). In other words, UNESCAP can be qualified as Asia’s largest think-tank organization, protecting the peace, knowledge integration and qualitative development (e.g. improve poverty) (ibid). In terms of supporting Asia-Pacific’s governments, UNESCAP waits for official requests-of-assistance before mobilizing their resources, allowing it to retain neutrality (UN ESCAP, 2015b).

In fact, UNESCAP is often called upon to analyze imbalanced patterns of sustainable development in each Member State, and suggests strong rectifications based on best-practices observed elsewhere in the region (UN ESCAP, 2012b). This implies that UNESCAP has a tremendous wealth of knowledge on how to mobilize Green Growth, and influence to disseminate this information to all of Asia-Pacific.

To enact UNESCAP’s strengths, they should work towards establishing a set of Green Growth policy indicators tailored for low, medium, and high-polluting countries. Policy indicators are separate from standard performance indicators as they 1) assess the program effectiveness, 2) understand societal challenges which arise (e.g. social conditions), and 3) gauge macro-level trends (UNIDO, 2011), whereas performance indicators are typically industry-specific (i.e. micro-level) and therefore not comparable at an aggregate level. In 2009, UNESCAP developed the Eco-Efficiency Indicators (UN ESCAP, 2009) which are effective in measuring sustainable production in manufacturing industries. It was applied by countries in Northeast Asia (Russian Federation, and Democratic People’s Republic of Korea) and Vietnam, but was not formally adopted because it ignored other facets of development intrinsically tied to economic development, namely poverty (European Commission, 2013). Policy indicators would observe all impact dimension of Green Growth. Moreover, an analysis of Green Growth strategies in Asia revealed that although specific incentives may vary depending on development models, resources and technological capacity, there are commonalities (Jacob et al., 2013) which can inform UNESCAP’s foundation for constructing broad Green Growth policy indicators. A prime example of good Green Growth policy indicators derives from OECD for their member countries (OECD, 2011c). In theory, UNESCAP can follow their methodology to develop indicators for Asia-Pacific.

5.4.3 Thai Corporations

While corporations can be conceived as being beneficiaries of Thai governmental policies, they, in fact, wield substantial influence in encouraging Green Growth activity. As of 2016, there is no aggregate metric of how many businesses are currently active in Thailand, however World Bank ranks Thailand as #96 out of 189, based on how easy it is to perform business (World Bank, 2016c). This suggests that when compared to other Southeast Asian countries, Thailand is particularly attractive for businesses, which means density should be high.

Industrial energy sources which is both green and renewable, is an especially rich opportunity for corporations. Historically, Thailand has depended heavily on natural gas (37.9%) and imported oil (47.15%) to drive manufacturing (Haema, 2012). In fact, after the oil price spikes in 2000s, the government established a price ceiling for diesel prices in 2008, and substantial subsidies in 2010 to maintain easy access to fossil fuels (ADB, 2015b). The problem is, oil is nonrenewable and will eventually run out. This implies that Thai corporation, especially in the manufacturing sector, have an opportunity to adopt green production practices, for two reasons: 1) it will assist in the development of green energy industries, and 2) over the long-term, production costs are lower due to economies of scale.

As of 2012, Thailand has established the 10-Year Alternative Energy Development Plan (2012-2021), which sought 25% market share for alternative energy in total energy consumption by 2021 (Haema, 2012), including: hydropower, wind, solar, geothermal, and biomass energies. The Plan was pursued with a combination of financial and fiscal incentives, including exemption on income tax and dividends for up to 13 years for renewable energy manufacturing (Beerepoot et al., 2013). With increasing government support and investment for renewable energy, it is recommended that corporations take advantage by transitioning. Relative to conventional firms, corporations adopting green practices are not required to submit to, on average, as many environmental regulations and fines, auditing, data reporting schedules, etc. many of which would save time and resources (DLA, 2013). Other societal benefits include energy security, which problematically manifested in 2013, as 12% of Thailand's GDP to import fossil fuels (ibid). Green energy industries also provide net employment growth (Bowen & Kuralbayeva, 2015) and reduction to resource constraints and climate risk (UN ESCAP, 2012b), and CO_2 emissions by 76 million tons per year by 2021 (Haema, 2012).

There is presently a lack of literature indicating what the precise per-unit cost of non-renewable vs. renewable energy use is in Thailand. However, it widely accepted that green energy is as competitive, if not more, than non-renewable energy (Beerepoot et al., 2013; IRENA, 2015). Multiple comparative studies on corporations operating on green production principles found that those adopting reduced energy consumption, waste generation, and hazardous materials usage, were considered as having “Lean Manufacturing Systems” which significantly improved economies of scale and per-unit costs between 5-10 years (Bergmiller & McCright, 2009; Dues et al., 2011). Successful case studies (Leelakulthanit, 2014; Elks, 2014; ISA, 2015;) have shown that it is both a profitable and environmentally-friendly decision to adopt renewable energy as part of the production process, both for the corporation itself and larger society.

For some secondary and most tertiary sectors who may not be involved chiefly with manufacturing, they still retain significant stakeholder power, by requesting their products to be made in an ecologically-friendly way. This is known as sustainable supply chain management. Critics might claim that it is often more expensive to purchase green products and services, but providing Thailand continues its comprehensive investment campaign in green production, marginal costs should decrease yearly. There are multiple successful case studies which indicate the financial benefits of adopting a sustainable supply chain management, notably including cement industry (Muangpan et al., 2014), eco-tourism (Vongsaroj, 2013), electronics manufacturing (Tippayawong et al., 2015), and retail (Sapsanguanboon & Sukhotu, 2015). Effective marketing of a sustainable supply chain to consumers can be especially profitable for corporations.

5.5 The Future

Green Growth is not a replacement for Sustainable Development. Rather, it is a temporary solution to appease the demands of our artificial economic system, until we are all ready for a paradigm shift – one that calls for a balance between human population and the Earth. The United Nations asked for developed countries to take the lead in reducing production and consumption demands to a sustainable level; therefore, by analyzing Thailand, one of the largest economies in Asia-Pacific, this investigation yielded hopeful results that there are already signs of Green Growth as Thailand begins to internalize and implement the principles of Sustainable Development. Green Growth is understood as economic growth and job creation which desires to rectify social ills while simultaneously easing pressures on the environment, in the form of reducing climate change risk and resource constraints. Implicit in this definition is the confession that poverty is largely rectified by economic growth, but this is a logical fallacy. In the new era of Sustainable Development, poverty will be qualified as a damaged quality-of-life with numerous indicators, and therefore, in the future, we should all hope that Green Growth becomes obsolete. For now, it’s a good first step towards something great.

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APPENDICES

Appendix A: Noise Residuals

TABLE 18: CORRELATION BETWEEN NOISE RESIDUALS OF GG VARIABLES

Correlations

		Noise residual from Adj_Res. Depl-Model_1	Noise residual from CO2_Emis-Model_1	Noise residual from Adj. Net_Income-Model_1	Noise residual from GDP_perCapita-Model_1	Noise residual from Unemploy-Model_1
Noise residual from Adj_Res.Depl-Model_1	Pearson Correlation	1	-.178	-.034	.163	-.135
	Sig. (2-tailed)		.404	.876	.445	.519
	N	25	24	24	24	25
Noise residual from CO2_Emis-Model_1	Pearson Correlation	-.178	1	.392	.317	-.402
	Sig. (2-tailed)	.404		.058	.131	.052
	N	24	24	24	24	24
Noise residual from Adj. Net_Income-Model_1	Pearson Correlation	-.034	.392	1	.827**	-.607**
	Sig. (2-tailed)	.876	.058		.000	.002
	N	24	24	24	24	24
Noise residual from GDP_perCapita-Model_1	Pearson Correlation	.163	.317	.827**	1	-.723**
	Sig. (2-tailed)	.445	.131	.000		.000
	N	24	24	24	24	24
Noise residual from Unemploy-Model_1	Pearson Correlation	-.135	-.402	-.607**	-.723**	1
	Sig. (2-tailed)	.519	.052	.002	.000	
	N	25	24	24	24	25

**. Correlation is significant at the 0.01 level (2-tailed).

TABLE 19: NOISE RESIDUALS - GOODNESS-OF-FIT SIGNIFICANCE

Result (Default model)

Minimum was achieved
Chi-square = 4.602
Degrees of freedom = 5
Probability level = .466

TABLE 20: NOISE RESIDUALS - CFI, RMSEA, NFI, TLI MODEL FIT INDICES

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.914	.828	1.008	1.018	1.000
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.000	.000	.272	.502
Independence model	.425	.317	.541	.000

TABLE 21: NOISE RESIDUALS - REGRESSION WEIGHTS

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
NResidual_GDP_perCapita_Model_1	<---	NResidual_Adj_Res.Depl_Model_1	93.346	114.045	.818	.413	
NResidual_Unemploy_Model_1	<---	NResidual_GDP_perCapita_Model_1	-.001	.000	-5.124	***	
NResidual_CO2_Emis_Model_1	<---	NResidual_GDP_perCapita_Model_1	.000	.000	1.589	.112	
NResidual_Adj.Net_Income_Model_1	<---	NResidual_GDP_perCapita_Model_1	.000	.000	7.278	***	
NResidual_Adj.Net_Income_Model_1	<---	NResidual_Adj_Res.Depl_Model_1	-.031	.020	-1.522	.128	

TABLE 22: NOISE RESIDUALS - STANDARDIZED REGRESSION WEIGHTS

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
NResidual_GDP_perCapita_Model_1	<---	NResidual_Adj_Res.Depl_Model_1	.165
NResidual_Unemploy_Model_1	<---	NResidual_GDP_perCapita_Model_1	-.723
NResidual_CO2_Emis_Model_1	<---	NResidual_GDP_perCapita_Model_1	.309
NResidual_Adj.Net_Income_Model_1	<---	NResidual_GDP_perCapita_Model_1	.840
NResidual_Adj.Net_Income_Model_1	<---	NResidual_Adj_Res.Depl_Model_1	-.176

TABLE 23: NOISE RESIDUALS - MULTIPLE SQ. CORRELATIONS

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
NResidual_GDP_perCapita_Model_1	.027
NResidual_Unemploy_Model_1	.522
NResidual_Adj.Net_Income_Model_1	.689
NResidual_CO2_Emis_Model_1	.095

TABLE 24: NOISE RESIDUALS - STANDARDIZED TOTAL EFFECTS

Standardized Total Effects (Group number 1 - Default model)

	NResidual_Adj_Res.Depl_Model_1	NResidual_GDP_perCapita_Model_1
NResidual_GDP_perCapita_Model_1	.165	.000
NResidual_Unemploy_Model_1	-.119	-.723
NResidual_Adj.Net_Income_Model_1	-.037	.840
NResidual_CO2_Emis_Model_1	.051	.309

TABLE 25: NOISE RESIDUALS - STANDARDIZED DIRECT EFFECTS

Standardized Direct Effects (Group number 1 - Default model)

	NResidual_Adj_Res.Depl_Model_1	NResidual_GDP_perCapita_Model_1
NResidual_GDP_perCapita_Model_1	.165	.000
NResidual_Unemploy_Model_1	.000	-.723
NResidual_Adj.Net_Income_Model_1	-.176	.840
NResidual_CO2_Emis_Model_1	.000	.309

TABLE 26: NOISE RESIDUALS - STANDARDIZED INDIRECT EFFECTS

Standardized Indirect Effects (Group number 1 - Default model)

	NResidual_Adj_Res.Depl_Model_1	NResidual_GDP_perCapita_Model_1
NResidual_GDP_perCapita_Model_1	.000	.000
NResidual_Unemploy_Model_1	-.119	.000
NResidual_Adj.Net_Income_Model_1	.139	.000
NResidual_CO2_Emis_Model_1	.051	.000