Master's Thesis of Martina Gintarė de Vries

The Environmental and Country Specific Determinants of Solar and Wind Electricity Production

- A panel approach on the case of Africa -

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Abstract

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An increasing global concern on energy security and the future of the planet, considering global warming, have heightened interest in renewable energy. Although several studies have been conducted on the drivers and detriments of renewable energy, this study dives deeper and contributes to the existing literature by putting a sole focus on factors that are related to the production of solar and wind powered electricity in Africa. By using a panel data approach over a 10-year period, from 2010 to 2019.

The study results indicate that starting a business score, FTA’s, FDI outflows, access to clean cooking fuels and electricity, carbon emissions, received aid towards sector 232, the Paris agreement and the by the UN, in 2012, declared year of electricity for all, positively impact the production of solar and wind powered electricity in Africa. While the death rate from indoor pollution, the proportion of individuals living in rural areas, being landlocked, fuel imports, and forest coverage diminish the production of electricity through solar and wind sources. Regional differences and contradictions to the existing literature were discovered, and implications are examined in consideration of regional statistics, in this study.

Herewith the study reinforces the importance of development, politically, economically, and socially, global environmental concerns, assistance, and the pressure to uphold established global commitments to produce electricity powered by solar and wind energy. Furthermore, the study indicates that natural disadvantages of being landlocked or having a substantial proportion of the population live in rural areas can be beneficial. These regional specific results should be taken into consideration by national entities and aid donors, to effectively enhance and improve the up scaling of solar and wind energy for electricity.

Keyword: Renewable, Solar & Wind Energy, African continent
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List of Abbreviations

CBAM	Carbon Border Adjustment Mechanism
CRS	Creditor Reporting System
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
IFC	International Finance Corporation
LCOE	Levelized Cost of Energy
LPG	Liquefied Petroleum Gas
NGO	Non-Governmental Organization
ODA	Official Development Assistance
REDD+	Reducing Emissions from Deforestation and forest Degradation

Chapter Ⅰ. Introduction

1. Definition and Purpose of Research

The issue of global warming has been on the world's political agenda for years. With a continuously growing global consciousness on carbon dioxide emissions and the well-being of the planet earth, more nations around the world seek for ways to make life more sustainable.

Renewable energy sources are increasingly being acknowledged as an environmentally friendly alternative to fossil fuels for electricity generation. Understanding the factors that drive or obstruct an increase in the production of renewable energy, provide policy makers and aid providers with the needed knowledge to enhance and improve designs for the further up scaling of the renewable energy sector and upcoming sustainability policies.

Comparisons of various energy generating technologies indicates that, on a LCOE basis, solar and wind energy have the lowest cost for electricity generation (Lazard, 2021). Through this decline in solar and wind electricity generation costs and technical advancements, the generation of electricity through solar and wind sources has increased throughout the years. According to EMBER's (2022) yearly global electricity review, solar and wind sourced electricity generated more than 10% of the total global electricity output for the first time in history, in 2021. Nonetheless, energy demands, both the use of fossil fuels for electricity and carbon dioxide emissions have risen. Therefore, in order to limit global warming to the, during the 2016 Paris Agreement ratified, 1.5 degrees

Celsius, the global growth of the production of solar and wind powered electricity has to increase.

Africa is one of the most vulnerable continents to global climate changes. With the highest extreme poverty rates, the highest share of undernourished people, high conflict rates, low resilience and sensitive economies, an increase in natural events quickly undermines made development efforts. Even if severe actions are undertaken to reduce global warming, the effects of climate change will be felt for years to come. To avoid being trapped in a poverty trap, exacerbated by climate change, Africa's only path out is to strengthen its resilience.

Energy has long been recognized as a crucial factor to development. According to the environmental Kuznets curve theory, economic growth increases polluting emissions, which declines the quality of the environment. This indicates that the usage of fossil fuels is unavoidable for development. However, such a historical trajectory of relying entirely on fossil fuels to fully support development is not a necessity. With access to current technologies and the significant energy potential, Africa can enhance its use of solar and wind energy. Whereby nations can expand their electricity accessibility, improve energy security and public health, while simultaneously positively impacting the global environment and derive from the notion that development, emissions, and environmental deterioration go hand in hand.

Solar and wind energy form a lucrative solution in Africa. Because of its advantageous geographical location between the Northern Latitude of 37.3° and the Southern Latitude of 34.8°, the African continent's vast land receives annually a large amount of solar radiation. As a result, Africa has a large solar energy potential that is evenly distributed over the continent (Hafner et al. ,2018).

The potential of wind on the other hand, is determined by a variety of elements, including the terrain and its physical features, that determine wind speed. As a result, contrary to the solar energy potential, this potential is not evenly distributed across the continent. Nonetheless, research by Elsner (2019) on the potential of offshore wind energy and Mentis et al. (2015) on onshore wind energy, do confirm the high potential of wind energy in certain nations. This is supported by the IFC's report on Africa's wind potential in 2020, that declared a total potential sufficient to cover over 250 times the continent's demand (Whittaker, 2020). While barely 1% of its potential was harvested in 2018 (Alemzero et al., 2021).

Currently, only a small fraction of both solar and wind electricity is used in the electricity mix. With the fast current and predicted future increase in potential of these renewable sources of energy, due to global warming (Sawadogo et al., 2021), it is desirable to enhance the among of electricity generated by solar and wind sources in Africa's energy mix.

Because of Africa's availability and abundance of wind and solar resources, it has the opportunity to take a different development trajectory than any other continent has taken before. That would contribute to its own resilience and the wellbeing of the planet. For these reasons and the existing gap in the literature, this study aims to determine the factors that influence the production of solar and wind powered electricity, for nations within Africa. With a focus on factors that can be put into 6 sectors: political, social, economic, nation specific, environmental, and international.

It is of great importance to establish the factors that influence the production of electricity through solar and wind energy, for both national agencies and non-governmental agencies that provide development assistance with a target of development in sustainable ways. With enough awareness on the factors, a higher efficiency can be gained in the switch to use more solar and wind energy. This would not only contribute to the sustainable development of Africa, but it also influences the worlds energy trajectory. Therefore, this study delves into the various sectors and corresponding factors and their influence on the generation of electricity through solar and wind energy.

The study first investigates the existing literature, to find commonly found results as well as inconsistencies or gaps. Based on the literature, hypotheses were formulated. This is followed by a discussion on the study's used methodology to ensure control for biases in addition to the examination of trends in the data. The results of the study are then outlined and analyzed before the study concludes with among other policy recommendations.

Chapter Ⅱ. Literature Review

1 Overall Review

For the last decade, there has been a growth in interest to construct and overall recognition of renewable energy, as an essential contributor to slow climate change. The number of published papers on the determinants of renewable energy reflect this, as it has steady increased. Yet, research on developing nations is underrepresented (Bourcet,2020). Nonetheless, the literature shows that research has been conducted on multiple scales but with various issues, mostly concerning sample sizes and availability of data.

Research conducted on a global scope by M. Aguirre and G. Ibikunle (2013), on 38 nations from 1990 to 2010, considered socioeconomic, political, and country specific variables. Their findings primarily demonstrate how governmental energy regulations obstruct investments in renewable energy. Similarly, N. Bamati and A. Raoofi (2019), investigated the influence of economic and environmental factors on the generation of renewable energy, on 29 countries between 2000 and 2015. In comparison to their worldwide scope, both studies featured a small country sample size. On the contrary, B. Pfeiffer and P. Mulder (2013) used a large sample size, combining data from 108 developing countries between the period of 1980 and 2010, covering economic and regulatory variables. Although their findings demonstrate that economic variables and stable regimes have a positive effect on renewable energy (hydro sources excluded), there is some uncertainty to their study due to a lack of data. They noted that their dependent variable consisted for 71% out of zero values.

Research done at a regional scale, was either done by geographical classifications or based on membership to a certain group. A.A. Romano and G. Scandurra (2014), conducted research on 12 OPEC members from 1980 till 2009. That took socioeconomic, political, and environmental factors into account and concluded there to be a lack of incentives. While T. Lee (2019) conducted research on 18, G-20 countries from 2009 to 2013, with a focus on the effect of financial investments. On a geographical base, frequent cited research by Marques et al. (2010) focused on economic, social, and environmental variables (8 in total) and their effect on renewable energy development within 24 EU and EU membership requesting countries.

For the African region, L. Nyiwul (2017) conducted research on the Sub-Saharan region (1980-2011) and found that environmental factors did contribute to an increase in the consumption of renewable energy. Meanwhile economic variables were discovered to have an insignificant effect on the use of renewable energy. This is consistent with the findings of M.S. Ben Aissa et al. (2014), who concluded that trade has no substantial impact on renewable energy consumption in 11 African nations between 1980 and 2008.

On a larger scale, S.J. Ergun et al. (2019) conducted research on 21 countries from 1990 to 2013. Both social and economic factors were taken into consideration (6 variables in total), whereby only FDI was found to have a positive influence on renewable energy consumption. Contrary to these findings, O.J. Akintande et al. (2020) found that socioeconomic, macroeconomic, and institutional factors do have a positive influence on the consumption of renewable energy. Their research was conducted on 5 nations with the highest population in Africa, using 34 variables from 1996 to 2016. Factors such as population growth, electricity demand, GDP, and institutional factors such as stability, effectiveness and control of corruption, were found to have a positive influence on the consumption of renewable energy.

While their findings, when relevant, will be examined further in the next section. The existing literature, for any scale, portrays a gap in the number of either variables or nations considered and little consensus in findings. There seems to be no research that encompasses all African states, nor is there any research that takes all variable categories, such as social, economic, institutional, national specific, environmental and international, into account. This study bridges the existing literature gap, by expanding the scope of previous research on Africa, by implementing a different time period, and merging the various available variables from the six areas.

2 Factor Review

This study focuses exclusively on the production of electricity through solar and wind energy. These renewable sources of energy are yet to be fully harnessed and have a high generation potential that is expected to grow in the upcoming years, within Africa. Nonetheless, it is anticipated that these sources of electricity will not become the sole source of electricity. With variability in the reliability of solar and wind energy, it is expected that other technologies will complement and support the usage of these clean energy sources. Although hydropower, bioenergy, geothermal energy, and marine energy are also considered as renewable energy, they are not included in this study for the following reasons.

Hydropower, often included in the existing literature, has been excluded by some researchers such as Pfeiffer and Mulder (2013). The argument behind the exclusion stems from the negative implications' that hydropower can have on the environment and communities located near water sources connected to the power plants. For this reason, in addition to the decline in potential, as a reduction of water resources is predicted due to climate change caused droughts and changes in precipitation (Obahoundje & Diedhiou, 2022), hydropower was excluded from this study.

For bioenergy, a divergence of opinions exists among researchers on the negative and positive impacts of the use of bioenergy on the environment (Creutzig, 2014). This research takes a stance that solar and wind energy is a better alternative as the use of bioenergy in traditional ways, for example, burning of wood inside to cook has additional to environmental impacts, negative consequences on human health. Due to this existing discussion on negative environmental and health consequences, bioenergy was chosen not to be included within the dependent variable.

A recent study by Elbarbary et al. (2022) that pinpoints areas that should have high potential for geothermal energy, present the limit of this source. With 4 regions categorized within 6 countries in Africa to be of high potential, it is excluded from this study because of its limited suitability for all 54 nations.

Lastly, marine energy represents a promising set of new and emerging technologies that are not yet in use. For this reason alone, it could not be included in this study because there is no data available.

2.1 Political factors

Effective good governance, accountability, rule of law and control of corruption are all known to contribute to a stable government that leads to development of a nation, and in particular economic growth. Through effective governess, the right policies can be implemented that enhance besides economic growth the production of renewable energy (Akinyemi, 2019), but for this there needs to be control of corruption and compliance to laws and enforcement. It is therefore, of no surprise that research done on the influence of corruption on renewable energy, such as by Amoah et al. (2022) on Africa, shows a negative impact. Thus, meaning control of corruption would have a positive impact. A nation with a high level of corruption would face the issue of either firms with unsustainable practices easily obtaining licenses for their businesses through corrupt officials, or an increase in costs from paying bribes for each step that must be undertaken for the construction of renewable sources and import of materials.

However, the existing literature suggests that these factors of good governance can have negative impacts. Amoah et al. (2020) discovered a negative impact for the rule of law. Which indicates that existing inequalities in property rights within Africa, would enlarge once the index for rule of law rises, herewith negatively influencing consumption.

On a smaller regional scale, it is expected that some regions where politicians are at power that support unsustainable practices and policies, will show a negative relation of control of corruption and other good governance factors with renewable energy. Such a negative relation has been found by Asongu and Adhiambo (2021) for the factors: rule of law, control of corruption, political stability and voice and accountability. Despite these findings, they defend their theory of good governance having a positive influence, based on the estimated values being standardized on a sample of the world. They argue that as the study only considers Africa, it is skewed and needs to be read differently. However, such argumentation does not seem to uphold. Even though skewed, the results are based on differences within the model, thus the relation that coefficients indicate are valid and do not change upon standardization. Therefore, this study does accept the possibility of regional inconsistencies to the overall positive relation, between the political factors and the production of electricity through solar and wind sources.

2.2 Economic factors

Businesses are besides governments and non-governmental organizations, entities that can develop and implement renewable energy solutions (MacLean & Brass, 2015). Therefore, a nation that has an environment that is suitable for businesses to settle and evolve, will contribute to the construction of and access to renewable energy sources.

An evolvement of a new industry is often portrayed to reduce unemployment, but research shows otherwise. A study conducted on employment in Spain, has reported that while it is usually expected that the renewable energy industry will create new "green" jobs, due to national funding being redirected to the renewable energy sector, more jobs are destroyed than created (Alvarez et al.,2010). Thus, unemployment can be regarded as a factor that possibly obstructs the generation of renewable energy, as nations already struggle with large numbers of unemployment.

Furthermore, with long term unemployment a lack of financial funds becomes a large concern, that obstructs households from investing in renewable energy. For those connected to the electricity grid, research conducted in Kenya concluded that monthly fees are preferred compared to paying once for the installation of solar panels due to the initial large sum needed (Abdullah & Jeanty, 2011). For the same reasons, in rural areas most households are not able to install remote solar panels and/or wind turbines (Mohammed et al., 2013). Therefore, a large amount of unemployment obstructs construction of solar or wind energy because of the large investments needed.

This is in line with the theory that a nation with a higher GDP typically consumes more energy and faces fewer financial obstructions to for example, develop technologies and gather the needed materials to construct solar panels or wind turbines. As a result, a nation with a high GDP has a lower barrier to consider increasing its production of renewable energy. This is one of many reasons that research has established a positive significant effect of GDP and income on the production of renewable energy (Aquirre, 2014). Nonetheless, there appears to be a certain threshold as numerous studies conducted on Europe found a negative effect (Bourcet, 2020), due to an increase in the energy demand that comes with the growth in GDP, that cannot yet be fulfilled through renewable sources alone (Cadoret & Padovano, 2016).

For the African region, Nyiwul (2017) concluded that income has a positive impact on the growth in renewable energy consumption, albeit not proven significant. This suggests that economic growth was not accompanied by an increase in the consumption of renewable energy. Contrary to their findings in Africa between 1980 and 2011, as this study focuses on more recent years, a positive and significant relation of GDP on the production of solar and wind powered electricity is expected. Based on technological advancements throughout the years that have drastically reduced the financial barrier to construct solar panels and wind turbines. Therefore, an increase in GDP makes an increase in the generation of solar and wind electricity more accessible than before.

Other economic avenues exist to incorporate environmental concerns and enhance the uptake of solar and wind energy for the use of electricity. Over time, Free Trade Agreements (FTA's) have become a lucrative pathway to incorporate environmental concerns into made agreements by placing environmental provisions. Herewith creating a global trade market that promotes the development of renewable energy (Cima, 2018) (Dent, 2021). The EU forms an example, as it plans through its Green Deal and Carbon Border Adjustment Mechanism (CBAM), to push other nations outside its own borders to consider clean energy sources. Additionally, FTA's impact production opportunities and costs, as agreements contribute to the transfer of materials that weren't available or too costly. Therefore, this study takes the number of FTA's a nation has into account and expects this to have a positive impact on the generation of solar and wind produced electricity.

With FTA's contributing to the transfer of materials, foreign direct investments contribute to the transfer of knowledge and technologies. Foreign direct investments are often accounted for within the existing literature, for example Pfeiffer and Mulder (2013) found that an increase in FDI has a significant negative effect on the adoption of renewable energy. Meanwhile Ergun et al. (2019) concluded that FDI has a positive significant bi-directional causality on the share of renewable energy in the consumption. Nonetheless a significant relation is yet to be proven according to Bourcet (2020).

2.3 Social factors

The use of solid and fossil fuels for cooking contribute to indoor pollution and deforestation in mainly developing nations. This is an issue that not only dramatically undermines health, but it also often enlarges environmental issues and inequalities. Women are often in charge of cooking and will by this suffer most from its negative consequences such as, inhalation of polluting fuels when cooking. The introduction of clean cooking fuels can mitigate these fundamental issues and improve quality of life (Rosenthal et al., 2018).

Various sources can be categorized as clean cooking fuels, LPG and electricity included. The former has become a very common source that indeed does reduce deforestation and lowers the amount of polluting emissions that are released from burning charcoal or firewood. Nonetheless, even though it is often considered as a cleaner fuel, it is a fossil fuel. Consequently, an increase in demand for LPG raises issues of fulfilling the demand for it and environmental uncertainties. Another option is electricity, which is not necessarily produced through renewable sources. However, when it is produced through renewables, it becomes a cleaner alternative.

Bhandari and Pandit (2018) found that in the case of Nepal, it was more cost beneficial to make a transition from LPG to renewable electricity, due to the need to import LPG to suffice the demand. However, obstacles remain for the use of electricity for cooking instead of solid fuels and LPG. Gould et al. (2020) in Ecuador and Banerjee et al. (2016) in India determined that household's uptake of induction was limited due to either a lack of access to electricity or due to a fear for higher usage costs.

With the use of mostly solid fuels or LPG for cooking in Africa, this continent as well deals with the various health, environmental and equality concerns that could be mitigated by using cleaner cooking fuels. However, for clean cooking fuels other than LPG to be used, when provided, access to renewable electricity is required. Off grid renewable systems such as solar panels or mini wind turbines bring a cost-efficient solution, in comparison to connecting to the existing grid or suppliance of LPG, due to the large land mass and proportion of people living in rural areas. With the adaptation of LPG standing for the willingness to switch to cleaner fuels, this desire to use cleaner cooking fuels, will increase the production of solar and wind energy produced electricity, to suffice the demand for cleaner fuels and as it can majorly improve quality of life for various reasons.

2.4 National factors

Sanctions have been used by various nations as retaliation throughout history and recently due to the Russian invasion into Ukraine (2022). Consequently, with a large fuel exporter as Russia involved, the export of fossil fuels has been halted to several nations, hitting those who are most dependent on the import of fossil fuels. This demonstrates an energy vulnerability, as nations that mainly import energy are vulnerable to supply crises, price fluctuations, foreign volatile supply chains and sudden cut offs (Gnansounou, 2008). To decrease risk, a nation could turn towards renewable energy as an alternative way to produce its own electricity. This would decrease the dependency on import and lessen their vulnerability to sudden exogenous shocks.

Various literature supports the expectation that energy vulnerability encourages a nation to become self-sustainable through renewable energy development. Yet research conducted by Aquirre and Ibikunle (2013) found that energy import was not a significant variable that contributes globally to renewable energy deployment. Narrowing down to one region, in case of Marques et al. (2010) conducted research on Europe, the relationship of renewable energy deployment and energy import dependency was bimodal. They concluded that there is less incentive for a nation that already generates renewable energy beyond a certain threshold, to reduce import and produce more nationally. Yet a nation with a low domestic renewable energy generation and a high dependency on energy import, has a strong incentive to generate renewable energy.

Even though accordingly to a comprehensive literature review conducted by Bourcet (2020) the impact of the import of energy/fossil fuels on the production of renewable energy has not been taken into consideration for research done on developing nations. In line with previous conducted research done by Marques et al. (2010), the status of renewable energy development in Africa and the economic vulnerability to sudden crises of most African nations that are still in their early stages of development, it is expected that energy import has a positive significant relation to the production of electricity through solar and wind energy.

Yet many nations already rely on their own production of electricity sources. Nations with access to fossil fuels within their own territories can find themselves in a natural resource trap that is found to stagnate its economy (Collier, 2007). Through easy access to fossil fuel sources, a nation finds itself dependent on these resources and will be unlikely to transform to the use of renewable energy sources (Nyiwul, 2017). This is also the case for nations with direct access to hydro power or nuclear power plants (Bourcet, 2020). When a high proportion of a nation's energy comes from one of these sources it will be reluctant to construct (other) renewable energy sources. With many nations in Africa having direct or through neighbors' resources access to fossil fuels or hydropower, a dependency on these fuels to generate electricity will remove incentives to switch to renewable sources. Especially as the tapping of local fossil fuels and hydropower could theoretically be expanded, based on the untapped potential within Africa, and has already received a great deal of funding. Additionally, hydropower forms a special case as it is a renewable energy source and herewith removes incentives for other renewable sources.

Nonetheless, while this is a clean source of energy, global opposition has increased as awareness of the negative consequences grow. Besides implications on the ecosystem and agriculture, by disrupting natural water flows that cause for low water levels downstream, which impact agricultural areas that depend on these downstream flows. Reasons such as the space needed for construction, possible floods and displacement of communities that habited close to the connected rivers cause for enough concerns. Yet the main reason for hydropower to support other renewable energy productions lays with the sustainability of hydropower due to climate changes. Currently, with the increase in global warming, droughts are occurring more frequently and rainfall patterns are changing. This disrupts the production of hydropower and causes for energy shortages (Hafner et al. ,2018). Likewise fossil fuel resources are non-renewable sources, which indicates that the availability of these resources is limited. With reduction of these resources yearly, a nation will eventually have to look for ways to eventually replace its usage of fossil fuels (Romano & Scandurra, 2014). While import is an option, it is costly. As such patterns of scarcity are not expected to diminish, to meet the electricity demand, other sources are needed to suffice. These future expected developments could reverse the negative impact of hydropower or fossil fuels on the use of other renewable sources, and cause for an incentive to produce more electricity through solar and wind energy.

Those mostly impacted by local resource traps are those landlocked, without direct access to the ocean, that according to Collier (2007) have a natural disadvantage. Depended on their neighbors for overspill of economic growth and for access to ports, infrastructure is crucial. Such an infrastructure of roads and electrical grids is yet to be fully developed. While plans were made for a continental electricity grid, these are yet to be constructed. Till then, nations that are landlocked will have to either produce their own energy or transport it from abroad through any existing infrastructure. This can create incentives to invest into the national production of renewable energy.

Subsequently, Collier (2007) gave the recommendation to landlocked nations to place a priority on rural development. As rapid industrialization did not seem to be an option, landlocked nations are expected to have a much larger rural population. Therefore, instead of building an extensive national grid, local solar panels are an effective off grid solution to bring development to rural areas. (Table A - 2. contains a list of landlocked nations, within the geographical scope of research)

2.5 Environmental factors

A nations extreme vulnerability to climate change, indicates that climate change impacts have an enormous negative effect on a nation's well-being. To increase its resilience and decrease climate change impacts, nations can increase the production of renewable energy to support development and readiness.

A recent study of Hao and Shao (2021), states that a nation that can be categorized as highly vulnerable to climate change impacts, put greater effort in increasing the amount of renewable energy in their energy mix. This is supported by COP22, where 47 vulnerable states communicated their objective to target a usage of 100% renewable energy, to be realized as fast as possible (United Nations Climate Change Conference, 2016). Thus, out of their national interest, those most vulnerable are more concerned with the implementation of sustainable clean production of electricity.

With most nations within Africa being currently classified as vulnerable, it is assumed that this level of vulnerability gives incentive to increase the renewable energy generation. However, there are many other ways to increase resilience and herewith lower vulnerability. When a nation does not undertake any of such measures to increase resilience, they will neither invest in the production of renewable energy for electricity.

Carbon dioxide emissions are often portrayed as the main cause of global warming and thus the indirect cause of increased vulnerabilities. With global increases in emissions, concerns for the wellbeing of our earth grow that instigates action. Various nations and regions have reacted by putting standards and policies in place to create worldwide incentives for reduction of carbon emissions and uptake of renewable energy. Carbon tax forms an example, where nations try to create a renewable industry friendly economic environment by putting higher prices on the import of products that released carbon emissions during their production. This stimulates other nations that desire to export to reconsider their ways of production. Nonetheless, it's not the economic benefits that are pointed out throughout literature. Research done by Aguirre and Ibikunle (2014) globally, and by Nyiwul (2017) and Akintande et al. (2020) on Africa, held a believe that the environmental concerns created by a growth in the release of CO2, increases the production of renewable energy. However, different results were found within literature depending on the measurement of CO2 (Bourcet, 2020). The amount of emissions released within Africa is compared to other continents very low. This is expected to impact the strength of the relation between both variables, as nations abroad are mostly accountable for emissions, that enlarge global warming.

Another way to partially tackle the issue of carbon emissions besides renewable energy is reforestation. As forests play a large role in the reduction of emissions, reforestation is often advocated for. For example, under the United Nations Framework Convention on Climate Change, REDD+ was established to combat degradation and deforestation. Currently, 18 countries within Africa are part, Zambia is one of them. In line with Zambia's vision for 2030 to build a resilient and sustainable economy, through REDD+, the Ministry of Lands, Natural Resources and Environmental Protection (2015) has built a strategy to improve forest management. While reforestation and good management of forests reduces carbon emissions, it could possibly remove the incentive for the usage of renewable energy. Especially within nations such as Zambia that rank high in deforestation rates, the national urgency to improve forest management and the positive impact this has on carbon emissions, could remove the urgency to turn to renewable energy. Research conducted on Malaysia (Raihan and Tuspekova, 2022) and Pakistan (Waheed et al., 2018) has proved a negative relation of reforestation and renewable energy on CO_2 emissions. However, to the best of our knowledge, no relation has yet been established between renewable energy and forest coverage.

Forest degradation is a pressing transboundary issue within Africa. Through overexploitation, fires, changes in the climate and ecosystems, creation of land to be used for labor activities and as usage for biofuels, the continent has seen an overall rapid decline in forest coverage. While no recent data is available on the decline, research conducted by Aleman, Jarzyna and Staver (2017) has determined an approximate 22% average decrease in forests within the 20^{th} century. However, deforestation of the African forests, is not a homogenous phenomenon. The western and eastern regions of Africa saw a decline of 83% to 93%. Therefore, once a nation has experienced a major amount of deforestation as in Zambia, it could put a focus on reforestation that simultaneously forms a substitute of renewable energy to reduce carbon emissions. Thus Africa, especially regions with a lot of deforestation, could more likely turn to reforestation and will be less motivated to generate more renewable energy which requires large financial investments.

2.6 International factors

Globally, Aquirre and Ibikunle (2013) found that, climate concerns do largely contribute to investments made into renewable energy. Such concerns were reflected by the creation of the historical steppingstone of the Kyoto Protocol (1992) that bound developed nations to a commitment to reduce emissions. The creation of specific policies and buildup of renewable energy could be detected, post Kyoto agreement. Consequently, Popp et al. (2011) concluded in their research that those that ratified the agreement, invested more in renewable energy. This indicates, that while a nation might have been concerned about the climate before such protocols, through ratification of an international agreement, an extra push is created through international pressure to uphold to the agreed upon standards.

However, as the Kyoto Protocol was ratified in 1997, outside of our time frame of research, the research turns towards the Paris Agreement. The Paris Agreement, similar to the Kyoto Protocol, is established due to environmental concerns and is therefore expected to have a similar positive impact on the generation of renewable electricity.

International climate concerns reach further than international agreements and obligations to uphold them. It also influences the way aid is distributed to developing nations. While a lack of funds, form a large obstacle to the development of the renewable energy sector in many developing nations (Painuly & Wohlgemuth, 2006). Throughout various aid projects, donors have brought renewable energy to local communities across Africa. For example, through the installation of solar panels at locations where communities are not connected to the main electricity grid. Additionally, aid forms an incentive to further put local resources into renewable energy solutions, that would otherwise not have received the attention from local governments (MacLean & Brass, 2015).

Yet aid does not always effectively contribute to the development of renewable energy. P. Collier (2007) stated in his book *The Bottom Billion*, that aid loses its effectiveness, when it exceeds 16% of a nations GDP. Furthermore, it often partially leaks into different sectors therewith undermining its effectiveness. Wang et al. 's (2021) conducted research on ODA assistance to Sub-Saharan Africa and its impact on renewable energy development, further contributes to the potential ineffectiveness of aid. They concluded that aid has only a positive effect on the development of renewable energy when a nation is still in its early stages of development. When, urbanization, technical progress and carbon dioxide emissions are below a certain degree. After the threshold has been surpassed, aid has a reverse effect and hinders the development of renewable energy (Wang et al., 2021). Additionally, Pfeiffer and Mulder (2013) discovered a negative relation between aid and renewable energy. Arguing that with aid targeting the most undeveloped and often fragile nations, the amount given is partially dispersed to unintended purposes. However, while their argumentation generally upholds to a certain extent, their study was based on total aid received, not aid specifically given to the area of renewable energy. Based on the above-described literature, this study considers aid specifically received for the renewable energy sector.

With the amount of aid given below global set targets, of 0.7% of GNI and 100 billion US dollars for climate change adaptation and mitigation. In addition to, many African nations yet to surpass the early stages of development, that can be partially argued by the large proportion of the African population that have no access to electricity in comparison to the rest of the world (IEA, n.d.). Aid is expected for these reasons to have a positive relation with the production of wind and solar powered electricity in Africa. With a difference between regions, especially the Northern region, to be expected due to differences in development in accordance with Wang et al.'s (2021) conducted research.

3 Literature extension

While Africa has a large growing potential in solar and wind energy it is often considered together with other sources such as hydropower or bioenergy. These sources such as hydropower are however growing a negative reputation due to the environmental and social impacts. Therefore, it becomes important to differ between the various renewable sources and to consider them separately to avoid the creation of a bias. This helps to better understand what influences the generation of electricity through solar and wind and to target an increase. With a large scarcity of research conducted solely on the influential factors of electricity produced through solar and wind energy, this study is bound to create evidence and fill the literature gap.

For the political sector, this study agrees with the overall existing theory that better political circumstances encourage an increase in the generation of electricity through wind and solar. However, the assumption of interpreting the results differently due to skewedness seems dubious. Inconsistencies can be further found within economic factors. For example, the often referred to FDI is calculated by The World Bank by deducting the FDI net inflows from net outflows. Yet the literature often mentions the transfer of knowledge and technologies when using FDI data, while referring to FDI net inflows of foreign investments made within a country. This study chose to instead consider the FDI net outflows. Herewith looking at investments made abroad by the local population. This is expected to demonstrate that when investments decline, insinuating a lack of funds in the local economy, the production of solar and wind energy produced electricity will be negatively impacted.

Additionally, literature on Africa and developing nations is limited. While significance was proven for developed nations, the relation of factors such as the import of fossil fuels to the production of electricity through solar and wind energy has not yet been determined for developing nations (Bourcet, 2020). Similarly, there are many factors that were not considered within the literature such as FTA's, being landlocked, forest coverage or access to clean cooking. This study believes these to be of importance due to the above discussed literature and therefore researched their influence.

Furthermore, while international climate concerns have been proven to contribute to the development of renewable energy, the indicators were never refined to the extent that this study does. To give an example, official development assistance has been included in the existing literature, yet its usage is very broad. By researching the influence of the total disbursed ODA on renewable energy, a completely different conclusion can be formed in comparison to a more refined definition of aid to one sector. Therefore, this study took ODA into account that is solely allocated to the sector of renewable energy. While the Kyoto protocol has been proven to have had an impact on renewable energy, other international agreements or objectives were added to this study to measure the extend of the effect of international pressure to uphold commitments.

Chapter Ⅲ. Theoretical Framework

1 Research Questions

This research aims to determine the factors that either have a positive or negative effect on the production of electricity from solar and wind sources within Africa. Renewable energy is often comprehensively examined by other researchers, including hydro energy and biofuels, this study excludes these sources and solely focuses on electricity produced through solar and wind energy sources, for reasons discussed in chapter Ⅱ.

To find the answers to the main research question, multiple research questions are posed, such as: (1) Which sectors influence the production of electricity through solar and wind energy? (2) If so, is the relation negative or positive? (3) Does the relation of these sectors differ per geographical region, and how? (4) Does the natural disadvantage of being landlocked have an influence on the impact of studied factors and on the production of electricity from solar and wind sources.

Through regression analyses, these questions are examined by using 27 explanatory variables that can be categorized under multiple sectors. Yet these were divided under respective categories for this study. The full list of considered variables is discussed in detail in chapter Ⅱ, further details and the data sources can be found in Table 1. in chapter Ⅳ.

2 Hypothesis

Based on the existing literature and the above specified research questions, this research covers the subsequent hypotheses.

Hypothesis 1. Political stability, governmental effectiveness, voice and accountability, control of corruption and rule of law that fall under political factors and indicate good governance, all have a positive association with the production of electricity through solar and wind sources.

Hypothesis 2. Economic factors such as: FTA, FDI outflow and business score that indicate an open and growing economy have a positive effect on the production of electricity through solar and wind sources.

Hypothesis 3. A higher proportion of individuals living in rural areas, and access to electricity and clean cooking fuels have a positive effect, while the death rate due to indoor pollution negative influence the production of electricity through solar and wind sources.

Hypothesis 4. The reliance on hydropower or fossil fuels for electricity generation has a negative effect on the usage of solar and wind energy, contrary to the beneficial effect of fossil fuel imports and the characteristic of a nation being landlocked.

Hypothesis 5. The ND-Gain score and depletion of natural resources that represent environmental concerns, have a positive association to electricity produced from solar and wind sources. While other environmental factors: vulnerability and forest coverage have a negative association.

Hypothesis 6. International factors, such as: aid, the Paris Agreement, and the year 2012, that represent international concerns and pressure of commitments have a positive effect on the production of electricity through solar and wind sources.

Hypothesis 7. Those landlocked, are represented to be in a disadvantageous geological position, that positively influence the production of electricity through solar and wind sources.

Chapter IV. Methodology

1 Data

A panel data regression method is used with data collected from 54 countries situated within the continent of Africa (See Table A - 1. for a full list of countries) and for 51 countries (Comoros, Equatorial Guinea and Libya excluded). For a 10-year period, from 2010 to 2019. This time frame was selected based on the availability of data, the uptake of solar and wind powered electricity generation within Africa and to control for the impacts of the COVID-19 pandemic. For South Sudan alone, the year 2010 has been removed from the data set in line with the declaration of independence in 2011.

For this study a total of 27 variables were used and categorized under 6 areas: political, economic, social, national, environmental, and international. Table 1. Below includes a full list of variables, their definition and source. Variables that represent carbon emissions, unemployment and GDP Growth are considered as control variables within this study.

Table 1. Variable definition and data source

Code	Indicator	Value	Source
WSProd	Solar and Wind electricity production combined in million kwh	Gwh	United Nations Statistics `Division – Energy statistics database
WS-Per	Solar and Wind electricity production combined of total electricity production in Gwh	%	United Nations Statistics `Division – Energy statistics database
CO2	Annual CO2 emissions	kt	World Bank

Code	Indicator	Value	Source
CO2Cap	Annual CO2 emissions, metric tons per capita	mt	World Bank
GDP Growth	Annual growth of GDP in percentage.	%	World Bank
FTA	Yearly count of Free Trade Agreements	Number	WTO Regional Trade Agreements Database
FDIout	Foreign Direct Investment net outflow	US Dollars	World Bank
BUS	Starting a business score. Generated by the total average of indicators: procedures, time and cost to formally operate and minimal required capital	Score	World Bank
UNEMP	Total Unemployment of labor force.	%	ILOSTAT
Corrupt	Control of corruption, captures to which extend public power is used for personal gains	Number (-2.5 to 2.5)	World Bank
RuleLaw	Rule of Law, measures the compliance with rules, quality of law enforcement agencies and likelihood of violence	Number (-2.5 to 2.5)	World Bank
GovEffec	Government effectiveness, as quality of implementation and formulation of policies, and credibility of a government.	Number (-2.5 to 2.5)	World Bank
Account	Voice and Accountability captures freedom of association, expression and media, and the ability of a citizen to select their nation's government	Number (-2.5 to 2.5)	World Bank
COOK	Access to clean technologies and fuels (alcohol, electricity, gas) for cooking	%	World Bank
AIRPOL	Annual number of deaths per 100,000 people, due to indoor air pollution	Value	IHME – Global Burden of Disease
ACCESS	The percentage of the population that has access to electricity	%	World Bank

Code	Indicator	Value	Source
RURAL%	Rural population as a percentage of the total population	%	World Bank
LOCK	Dummy variable for landlocked nations	Number 0 or 1	Geographical location
Fuel-IM	Percentage of imported fuels belonging to SITC section 3 (Coal, Electric current, Gas, Petroleum), out of total merchandise imports	%	World Bank
Fossil	Total electricity generation using fossil fuels (Coal, Oil, Natural Gas)	Gwh	IEA
Hydro	Gross electricity production through hydropower, in million kwh	Gwh	United Nations Statistics `Division – Energy statistics database
Forest%	Forest area percentage of land area. (Agricultural trees and urban areas excluded)	%	The Food and Agricultural Organization
DEPLET	Determined monetary value of energy, forest, and mineral resource depletion	% of GNI	World Bank
VULNE	Vulnerability index, indication to a country's vulnerability to global challenges such as climate change. (High value = larger vulnerability)	Value (0.000 to 1.000)	ND-GAIN – Notre Dame Global Adaptation Initiative
ND-GAIN	ND-GAIN country index, indication to a country's vulnerability to global challenges such as climate change. Calculated by using Readiness and Vulnerability indexes. (Low value = larger vulnerability)	Value (0 to 100)	ND-GAIN – Notre Dame Global Adaptation Initiative
AID232	Total Official Development Assistance, received in disbursements to sector 232 (Energy generation, renewable sources, Total)	Million US Dollars (2020)	OECD - CRS Statistics

Code	Indicator	Value	Source
Paris	Paris agreement ratification dummy, a value of 1 is given from the year of ratification	Number 0 or 1	United Nations Treaty Collection – Paris Agreement
2012	UN international year of sustainable energy for ALL, a value of 1 is given from 2012 onwards	Number 0 or 1	-

2 Summary Statistics and Trends in Data

2.1 African continent

The summary statistics of all variables for the 54 nations within the African continent can be found in Table 2. below. Variables for all nations were included from 2010 to 2019, apart from South Sudan which has a range in line with its independence since 2011. Therefore, the maximum variable count stands at 539.

The overall statistics indicate a good difference (standard deviation) in values for the variables, supporting the suitability for regressions. Except for the import of fuels and FDI outflow explanatory variable, all variables have an adequate number of data available. The column N-0 indicates the number of values available in the data set, zero values excluded. A zero value does not necessarily indicate unavailability of data, depending on the circumstances and the explanatory variable.

The statistics indicate an on average unfavorable political and social situation as political factors show negative values and around half of the population does not have access to electricity and lives in rural areas. In addition to, on average only 27% having access to clean cooking fuels and more than 100 people out of 100,000 annually dying due to indoor air pollution. Furthermore, it ascertains the high production of electricity through fossil fuels, followed by hydropower and lastly wind and solar energy.

Table 2. Continent statistic summary (2010-2019)

	Mean	Std	Min	Max	N	N-0
WSProd	211.82	1011	0	11433	539	419
WS-Per	1.455	3.23	0	20.8	536	411
CO2	23636.2	67755.5	100	447980	538	538
CO2Cap	1.211	1.97	0	10.088	485	484
GDP Growth	3.973	7.940	-62.076	123.14	519	519
FTA	2.35	1.9	0	9	539	488
FDIout	2.35e+08	8.3e+08	-2.4e+09	7.692e+09	421	406
BUS	68.65	17.7	4.3	94.5	514	514
UNEMP	8.55	6.5	0.32	28.47	529	529
Corrupt	-0.66	0.64	-1.82	1.03	539	539
RuleLaw	-0.712	0.636	-2.42	0.97	539	539
GovEffec	-0.799	0.655	-2.48	1.06	539	539
Account	-0.64	0.755	-2.22	0.98	539	539
COOK	27.1	33.6	0	100	529	520
AIRPOL	119.5	73.4	0.13	297	539	539
ACCESS	47.5	28.5	2.7	100	538	538
RURAL%	55.6	18.4	10.2	89.5	531	531
LOCK	0.295	0.456	0	1	539	159
Fuel-IM	16.15	8.5	0.1	50.6	410	410
Fossil	11275	38058	0	243637	539	518
Hydro	2304.8	3812	0	17092	537	405
Forest%	28.2	24.66	0.045	91.78	539	539
DEPLET	7.8	9.2	0	57.9	518	508
VULNE	0.53	0.074	0.379	0.688	539	539
ND-gain	39.12	6.31	26.989	56.66	530	530
AID232	21.77	51.48	0.002	637.17	467	467
Paris	0.33	0.47	0	1	540	176
2012	0.8	0.4	0	1	540	54

2.2 Regional

The averages in production of electricity through solar and wind energy indicate a higher uptake in the Northern and Western regions followed by the Eastern region and Landlocked nations in Table 3. Median averages show a different stance for the Northern region.

Regional statistics for all variables can be found in Table A - 3. within the appendix.

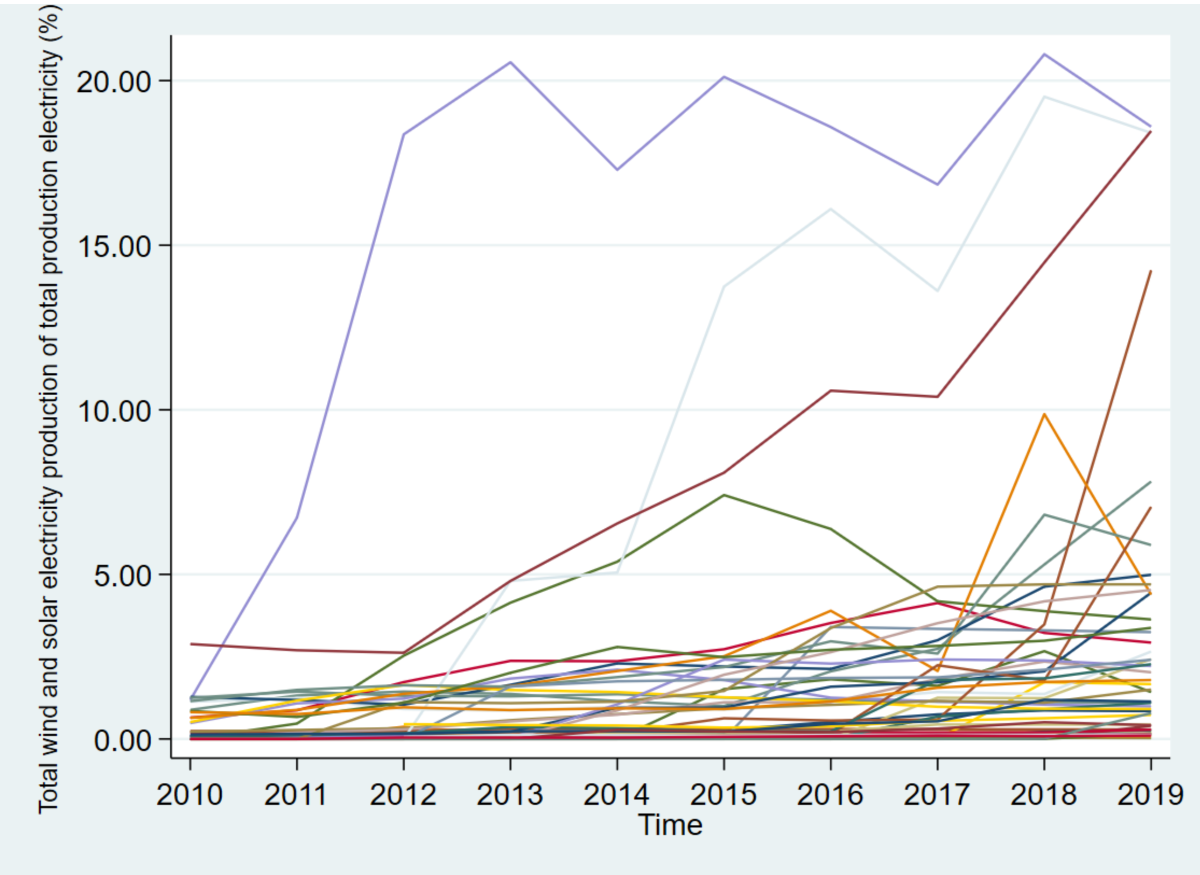
Table 3. Regional statistic summary of the production of electricity through solar and wind energy (2010-2019)

WSPer	North	East	South	West	Central	Landlocked
Mean	2.08	1.19	0.98	2.38	0.25	1.17
Median	0.88	1.00	0.37	1.16	0.16	0.93
Std	3.63	1.725	1.84	4.88	0.68	1.58
Min	0	0	0	0	0	0
Max	18.47	14.24	9.87	20.8	3.4	7.8
N	58	178	50	160	90	158
N-0	54	140	35	128	62	126

2.2.1 Solar and Wind Electricity production trends

The following figures indicate the trends of electricity produced through wind and solar sources as a proportion of the total electricity production, for the researched period from 2010 till 2019.

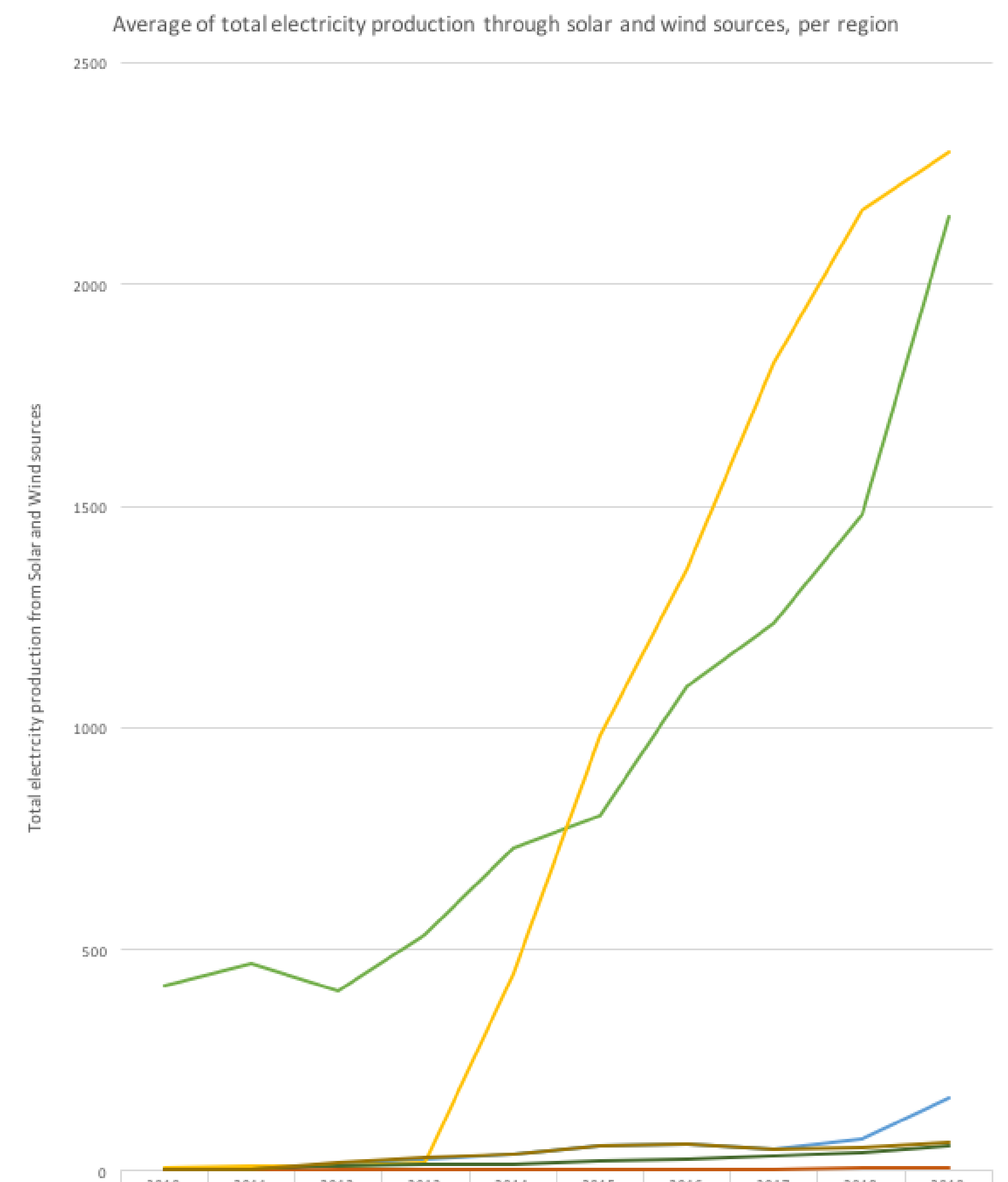
Figure 1. Trends in production of electricity through solar and wind sources



Source: Created by the author using data from the United Nations Statistics Division

Figure 1. reveals large differences between countries in terms of the proportion of electricity produced through wind and solar energy out of the total electricity produced nationally. Overall, while the graph is volatile, an increasing trend can be distinguished. Nonetheless there is no consistency, except for an observable dip for some nations in 2017. It should be noted that a dip does not necessarily imply a decrease in electricity produced through solar and wind energy. To accommodate an increase in the demand for electricity, the use of other sources to generate electricity could increase. If electricity generated through solar and wind remains stable or increases less than the increase in other fuels, result would show a decline in percentage.

Figure 2. Trends in average production of electricity through solar and wind sources in Gwh, per region.

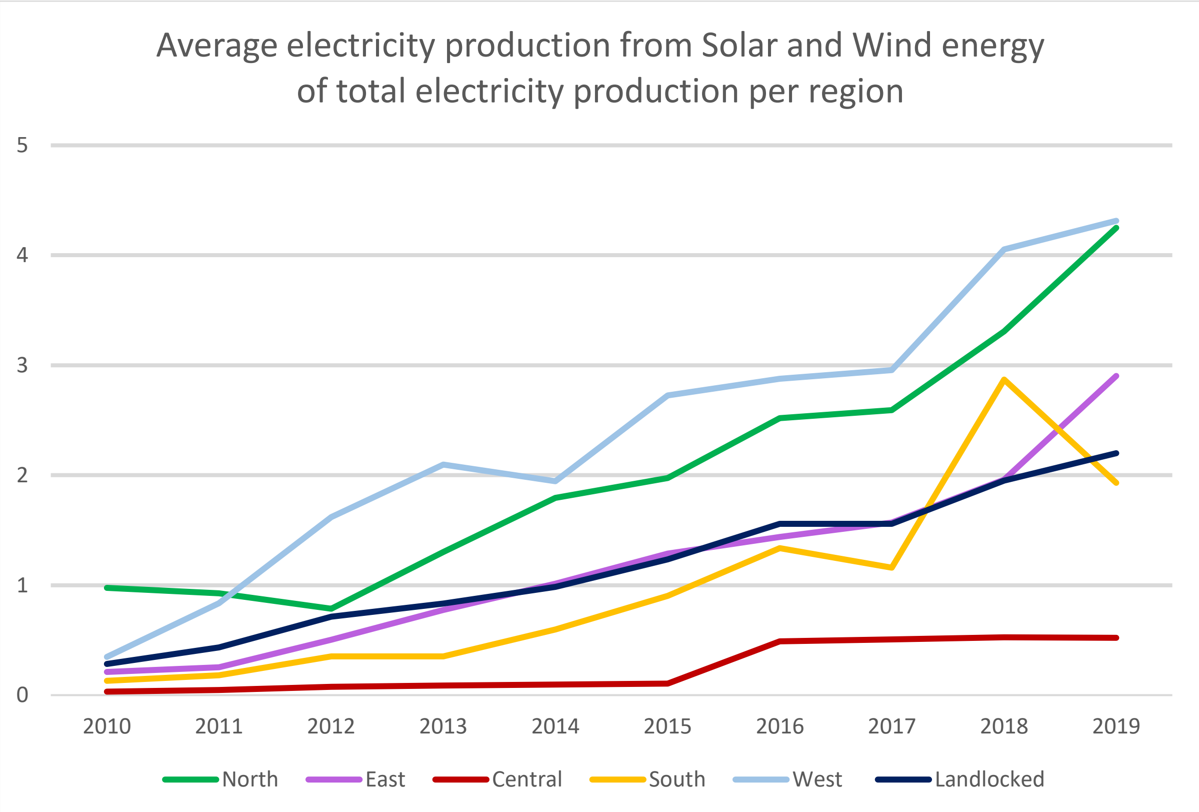


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
North	418.03	468.75	406.23	532.10	727.79	802.37	1093.02	1234.67	1480.45	2150.84
East	3.09	5.10	15.42	26.34	37.27	55.65	60.34	50.47	73.63	166.46
South	8.48	10.25	11.89	17.00	443.78	982.78	1357.80	1821.14	2168.54	2297.32
West	2.04	4.39	9.50	13.76	13.79	21.20	25.79	32.76	41.64	58.79
Central	1.24	1.59	2.49	2.61	3.17	3.62	4.96	5.36	8.66	8.92
Landlocked	2.548125	5.4825	17.751875	28.944375	39.244375	56.990625	60.8	48.6046875	52.599125	64.1766

Source: Created by the author using data from the United Nations Statistics Division

Data on the total electricity produced in Gwh through solar and wind sources and Figure 2. on regional averages, do reconfirm that there was no dip during the year 2017. Instead Figure 2. shows the large growth in the production of electricity through solar and wind energy in the Northern and Southern regions from the years 2012 and 2013 onwards, in comparison to any other region of Africa. Nevertheless, this is expected due to regional differences in electricity demand and total production, as these regions are known to be more developed.

Figure 3. Trends in average production of electricity through solar and wind sources of total electricity production, per region.



Source: Created by the author using data from the United Nations Statistics Division

Figure 3. shows more heterogenity than Figure 2. by controling for regional differences in total electricity production, by taking the regional averages of the portion

of electricity produced from solar and wind source out of the total production. With all regions showing an overall increasing trend in percentage of solar and wind energy in the electricity mix, it affirms that these renewable sources gradually replace other sources of electricity. Regardless of this increase, these averages form a small percentage, of under 5 percent, of the total electricity production. With the Western region taking the lead in mean (Figure 3.) and max values (Table 3.) followed by the Northern region. Additionally, the Southern region has seen a decrease in 2018 and the Central region's average percentage has seen no further growth since 2016.

Those landlocked have a steady increase throughout the years in the average use of solar and wind energy for the production of electricity out of the total production. The similar trajoctary to the Eastern region could be partially due to 8 landlocked nations being part of this region. The other 8 landlocked nations are situated within the Central, Western and Southern regions. Only the Northern region has no influence on this trend as no countries are categorized as landlocked.

3 Model

The study used mainly panel data regressions with the following equations that belong to fixed and random effect models:

$$1)\quad Y_{ij} = \beta_1 x_{ij} + \beta_2 x_{ij} + \ldots + \alpha + u_{ij} + \varepsilon_{ij}$$

$$2)\quad Y_{ij} = \beta_1 x_{ij} + \beta_2 x_{ij} + \ldots + \alpha_i + u_{ij}$$

A panel data regression was chosen, to conduct both a cross-sectional analysis and to observe the variables over time. Both fixed effect and random effect regressions are used to look at within as well as across country differences. An OLS regression was deemed not appropriate through the Breusch-Pagan Lagrange multiplier test[1].

Through fixed effect regressions, it is established that there are unobserved variables that are correlated to the explanatory variables used in the regressions. This could indicate that a random effects regression is not a proper fit due to bias.

Accordingly, the Hausman test was performed. Nonetheless, Schmidheiny (2021) states that a Hausman test is valid only under homoscedasticity. To test if this is the case for the performed regressions, the Modified Wald test for groupwise heteroskedasticity[2] was used on fixed effect regressions. Results indicated the presence of heteroscedasticity, which was expected based on Figure 1. And Figure 2.. Therefore, clustered standard errors were used within the regressions. However, this precludes the use of a Hausman test. Instead, a robust Hausman test was used to assess the validity to use a random effect regression.

[1] For the Breusch-Pagan Lagrange multiplier test, the STATA command "xttest0" was used.
[2] For the Modified Wald test for groupwise heteroskedasticity, the STATA command "xttest3" was used.

For all regressions in this study, both fixed and random effect regressions are conducted, compared, and analyzed. The random effect regression results are included within the appendix.

To control for biases, the panel data regressions for the whole of Africa are conducted for both a data set that includes all 54 nations and one that included 51 nations. The nations Comoros, Equatorial Guinea and Libya were excluded from the latter due to them having mostly zero values for the dependent variable WS-Per during all researched years. Additionally explanatory variables were tested through Pearson correlations.

Besides an overall panel data regression, a regression on landlocked nations (a full list of landlocked nations can be found in Table A - 2. in the Appendix) and in-depth regional regressions were conducted for each region. (In accordance with Table A - 1. in the Appendix)

Lastly, logarithms were taken for variables with large values, such as total carbon emissions. An interaction indicator for the years and being landlocked was created to include this dummy variable in fixed effect regressions that were determined to be more reliable through the robust Hausman test. In addition to variables being lagged to exclude for possible effects that the regressand might have on the explanatory variables.

Chapter Ⅴ. Results

1 Regression results

1.1 General regression results

Results of regressions that contain explanatory variables from all 6 different sectors (Table 4.), portray strong significances for aid, forest coverage, the proportion with access to electricity and living rurally when all other variables are controlled for. Random effect regressions (Table B - 1.) add international variables to the list of those having a significant influence on the generation of electricity through solar and wind energy.

Nonetheless, the number of observations is small due to the large combination of variables that often lack data (Table 2.) for different countries. Additionally, the measurement of multicollinearity indicates that except for aid, multicollinearity is present for all other variables.[3] With a conservative threshold of 2.5 taken, in accordance with Johnston et al. (2017), merely 5 variables fall below this threshold.

Therefore, it cannot be stated that the other variables do not influence the dependent variable. Instead, the study took a step closer to the base regression models by running three regressions individually each of which included two research sectors to provide a clear perspective for analysis. Both fixed effect and random effect regressions were performed to account for unobserved effects. These regressions can be found within the appendix, while results are discussed within this chapter in following sections.

[3] The Variance Inflation Factor (uncentered) was used to determine multicollinearity.

Table 4. Fixed effect regressions all sectors

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per
GDP Growth	0.00823	0.00726	0.0436	0.0184
	(0.0161)	(0.0157)	(0.0469)	(0.0385)
FTA	-0.306	-0.372		
	(0.375)	(0.408)		
BUS	0.0195	0.0164		
	(0.0268)	(0.0279)		
Account	-0.412		-0.207	-0.0492
	(0.708)		(0.645)	(0.660)
AID232	0.00500*	0.00520*	0.00599**	0.00647**
	(0.00279)	(0.00264)	(0.00241)	(0.00283)
Paris	0.198	0.185	0.242	0.970***
	(0.370)	(0.377)	(0.412)	(0.300)
Forest%	0.915*	0.989**	1.190*	0.861*
	(0.495)	(0.489)	(0.619)	(0.444)
Deplet	-0.0110	-0.00687	-0.0534	-0.0907
	(0.0352)	(0.0346)	(0.0514)	(0.0772)
logCO2kt	-0.152	-0.0529	-1.058	1.277
	(1.858)	(1.806)	(2.103)	(2.636)
TimeLock	-0.121	-0.124	-0.0687	-0.183
	(0.158)	(0.160)	(0.188)	(0.205)
Hydro	2.61e-05	1.55e-06	-0.000131	-6.82e-05
	(0.000179)	(0.000167)	(0.000198)	(0.000145)
Fuel-IM	-0.00185	-0.00347	0.0190	0.0134
	(0.0131)	(0.0116)	(0.0182)	(0.0188)
RURAL%	-0.797**	-0.766**	-0.816**	
	(0.364)	(0.344)	(0.352)	
Fossil	-5.08e-05	-4.73e-05	-6.67e-05	-8.54e-05**
	(3.44e-05)	(3.44e-05)	(4.02e-05)	(4.15e-05)
AIRPOL	0.0198		0.0127	
	(0.0318)		(0.0364)	
ACCESS	-0.0571**	-0.0628**		
	(0.0276)	(0.0261)		

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per
2012	0.705	0.608	0.702	1.351
	(0.741)	(0.726)	(0.788)	(0.803)
ND-Gain	0.443*	0.403	0.348**	0.300
	(0.252)	(0.293)	(0.170)	(0.183)
Corrupt		0.0603		
		(1.595)		
FDIout			-2.66e-10	-2.70e-10
			(1.78e-10)	(2.18e-10)
COOK				0.132
				(0.137)
Constant	96.30	99.25	54.39	66.73
	(114.1)	(113.9)	(105.0)	(99.25)
Observations	313	313	287	287
R-squared	0.357	0.355	0.344	0.271
Number	41	41	38	38

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

1.1.1 Political and Economic regression results

For the regressions conducted for political and economic explanatory variables, there are not many differences between the regressions for 54 and 51 countries. The starting a business score and FTA are significant and have a positive effect on the electricity production through solar and wind sources. FTA's are highly significant when the starting a business score is not included in the model. When unemployment is added to the model, FTA's become slightly less significant. Yet unemployment itself is insignificant and has no major effects on other explanatory variables. This insignificance could be explained by tiny changes within a country over time. However, while a slight positive significant coefficient for across-country differences can be discovered for 51 nations, the overall insignificance remains. As a result, this research concludes that unemployment has little effect on the production of solar and wind energy generated electricity in Africa.

Growth in GDP fluctuates between positive and negative and is mostly insignificant. Similarly, foreign direct outflows are positively significant but lose significance when control of corruption is added to the model without the starting a business score. Control of corruption itself is barely significant for the 6th regression in Table B - 5. when the national sample is set at 51 with an exact two-tail p-value of 0.100. This factor was further tested, to contradict Asongu and Adhiambo's (2021) premise that the negative results do need a positive interpretation due to skewedness as the original variable was standardized based on a global sample, through standardization. The findings of the standardization of political sector variables did not demonstrate a gain in efficiency, since standardization did not translate into better p-values, due to a reduction in both coefficient and standard values that are utilized for p-value calculations. Because standardization has no effect on the direction of the relationship, the interpretation of governmental unsustainable preferences is consistent with the negative valued data findings. Thus skewedness of the factors does not impact the findings.

Random effect regressions (Table B - 3. and Table B - 6.) did not show large differences in either significance, relation nor coefficients compared to fixed effect regressions. Except for the FTA variable that loses its significance for most random effect regressions.

1.1.2 Social and National regression results

Similarly, to the political and economic factor regressions, the social and national factor regressions have apart from slight difference in coefficients no large differences between the regressions conducted on 54 and 51 countries. Yet there are some large differences between fixed and random effect regressions. The random effect regressions that can be found in Table B - 10. have a higher significance for the variable fuel import but indicate that the logarithm of CO2 is insignificant. Contrarily, the logarithm of CO2 within fixed effect regressions has a highly significant positive effect for the first couple regressions but gradually loses its significance when other variables are added to the model.

From the fixed effect regression results in the table below, besides CO2, access to electricity and access to clean fuels for cooking are positive and significant. The import of fuels, death by air pollution and the rural population have a significant and negative effect. Meanwhile, production of electricity through both hydro power and fossil fuels is negative but insignificant.

To control for the effect the production of electricity through solar and wind can have on the explanatory variables, variables were lagged. The lagged variables that indicate death by air pollution, access to clean cooking fuels, access to electricity and the import of fuels returned significant in the models.

The landlocked dummy variable was not directly included in the fixed effect regressions. Random effect regressions did include this variable and are not excluded from this study. Nevertheless, there is an uncertainty about the random effect regression appropriateness for this study. Therefore, to measure the time invariant landlocked dummy variable through a fixed effect regression, an interaction indicator was added to the model.[4]

Table B - 11 displays the results of a fixed effect regressions that includes an interaction indicator for time and the landlocked dummy variable. These results were based on the year 2011, which is therefore omitted, and look at average differences between time and being landlocked or not. The interaction indicator is highly significant for this regression. Another supportive result that can be retrieved from the regression is a clear difference within the coefficients. For each year, the landlocked (indicated by a 1 behind a year) coefficient is around half the value of the coefficient that indicates those that are not landlocked. Table 5. further confirms that being landlocked negatively influences the generation of electricity through solar and wind sources, compared to non-landlocked nations.

Table 5. Regression for all 54 nations, on differenced variable of interaction indicator for time and landlocked variable

WS-Per	Coef.	Robust St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
D. Time*LOCK	-.458	.25	-1.83	.068	-.95	.033	*
Constant	1.724	.21	8.22	0	1.312	2.136	***

Mean dependent var	1.588	SD dependent var	3.372
R-squared	0.004	Number of obs	484
F-test	3.356	Prob > F	0.068
Akaike crit. (AIC)	2551.287	Bayesian crit. (BIC)	2559.651

**** p<.01, ** p<.05, * p<.1*

4 To create an interaction indicator, within STATA the command "i.Time#LOCK" was used.

1.1.3 Environmental and International regression results

The regressions done for environmental and international factors, present interesting results. This time CO2 per capita was taken but is insignificant for all regressions. Additionally, depletion of natural resources is insignificant, yet in contrast to CO2 per capita, negative. The ratification of the Paris agreement, the UN declared year 2012, and the disbursements of aid to sector 232 are highly significant and have a positive impact, even when lagged, on the production of electricity through wind and solar sources.

Vulnerability and forest coverage show intriguing differences between regressions. The vulnerability factor loses its significance almost immediately for random effect regressions (Table B - 15. and Table B - 16.) when other variables are added to the model. Slightly, for fixed effect regressions and is completely insignificant when lagged (Table B - 13. and Table B - 14.). On the other hand, ND-gain shows significance even when lagged, this implies an influence of readiness. Another intriguing result is the significant positive relation that forest coverage has for fixed effect regressions, which turns to be negative for random effect regressions.

With the Northern region excluded, as its classified as an arid region, the squared forest coverage shows a positive significance when added to the model. This implies that while forest coverage has a negative impact on the production of electricity through solar and wind energy sources, it eventually reaches a tipping point. Once this tipping point is surpassed, forest coverage has a positive effect on the regressand. Conducted calculations[5]

[5] Calculation used based on indicated relation by coefficient to determine tipping points: 0 = $-x\beta_1 + x\beta_2$^2

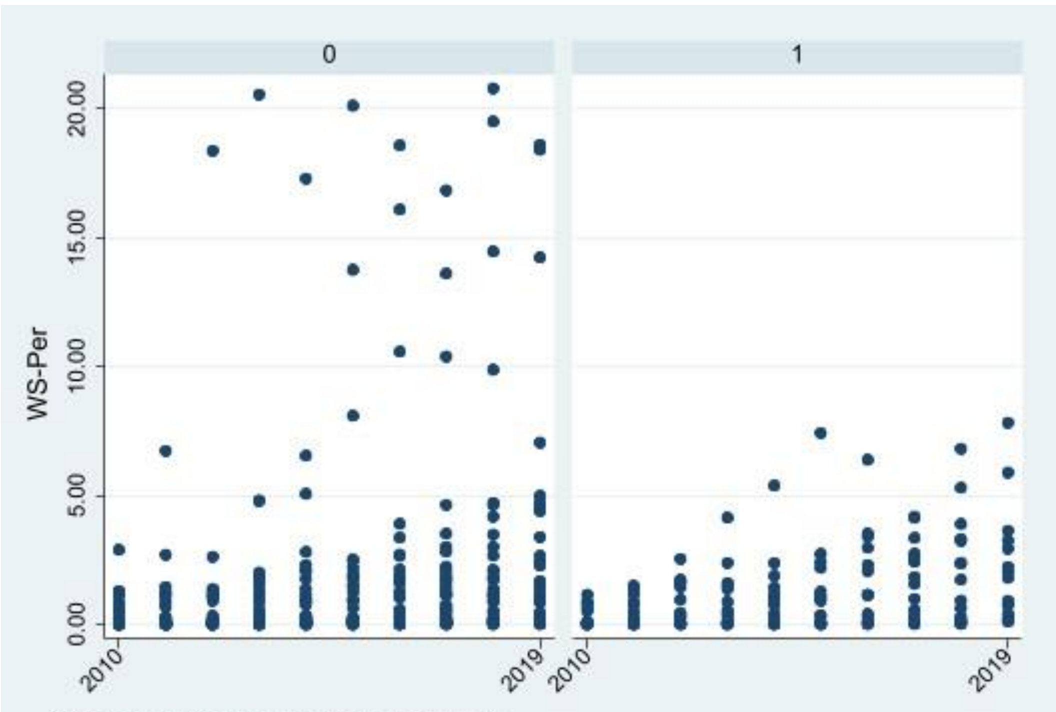
with the available coefficients in Table B - 17., Table B - 18. and Table B - 19. suggest a tipping point of 53.4%, 64,6% and 65,6% respectively. While controlling for more variables would further lower this percentage, the percentage is not expected to be drastically lowered. Therefore, the study suggests that nations within the Africa region (The Northern countries excluded) that surpass the tipping point range, could see a positive effect on the regressand from further forest growth.

1.2 Landlocked regression results

The regressions done on the whole continent of Africa established that there is a possible difference in the production of electricity through solar and wind, between those landlocked and those with direct access to the ocean. This is confirmed through Figure 4. that indicates that some nations with direct access to the ocean are more likely to have larger proportions of electricity produced through solar and wind energy. Meanwhile landlocked nations, follow the lower bounds of such production development.

To further investigate the influence of having no direct access to the ocean, the study conducted regressions on all 16 landlocked nations besides taking the landlocked dummy into account for regional regressions.

Figure 4. Distribution of proportion of total electricity produced through solar and wind energy between landlocked nations and nations with direct access to the ocean.



Source: Compiled by author using data from the United Nations Statistics Division

1.2.1 Sector results, landlocked

For political and economic effects, it is visible from the regressions that unlike the overall regressions, FTA's do not have a significant effect on landlocked nations. Additionally, foreign direct investment outflows lose their significance once political variables are introduced to the model. On the other hand, the political factor, governmental effectiveness does become significant, and rule of law would be significant with a slightly higher p-value setting. All other variable results remain similar to the overall regressions.

Comparable to the overall regressions for the social and national sectors, the logarithm of carbon dioxide emissions is positive and significant within all regressions. The production of electricity through hydropower, contrary to the overall regressions, gains significance when the population living in rural areas is added or when carbon emissions are excluded from the model. Additionally, for the overall regressions the import of fuels and access to clean cooking fuels was significant, yet for landlocked nations these factors do not seem to influence the production of electricity through solar and wind sources.

The 12th regression in Table C - 3. confirms the significance of the lagged variables, death by air pollution and the percentage of the population living rurally. It is notable that the latter has a positive influence for landlocked nations, while the overall regressions showed the percentage of the population living rural to have a negative effect. While not included in the regressions below, the study conducted tests and found that carbon emissions were also significant when lagged. Yet access to electricity, and the generation of electricity through hydropower or fossil fuels were not.

In line with the last regressions on social and nation specific variables, the regressions on environmental and international variables present a continued high significance for carbon emissions. This is the case for both lagged and non-lagged variables that are expressed as the emissions per capita.

Compared to the overall regressions discussed earlier, for landlocked nations, aid is less significant, yet remains to have a significant positive effect. Meanwhile the forest coverage, the UN declared year 2012, and the Paris agreement have lost their significance. Despite this, resource depletion has gained significance, but loses this once it is lagged. The same goes for the vulnerability variable that is insignificant once lagged. Instead, a similar variable, ND-gain that represents both vulnerability and readiness within one score, was added to the model. This variable is strongly significant and similarly to the overall regressions, keeps its significance once lagged.

1.3 Regional regression results

The next five sections discuss the regional regression results.

1.3.1 Northern region

The Northern region exists out of six countries, resulting in a limited number of up to 60 observations. This causes for certain difficulties to measure significance and effects of factors on the production of electricity through solar and wind sources. Nonetheless, negative significant effects were found for fuel imports and, lagged and normal values of, death rate due to air pollution (Table D - 4.). The variable for the generation of electricity through hydropower fluctuates from significant to insignificant and positive to negative. Positive significant effects were found for the variables: FTA's, access to clean fuels for cooking, voice and accountability, and aid.

1.3.2 Western region

For the Western region, all political and most of the economic variables are insignificant. The starting a business score forms the only exception with its positive effect on the production of through solar and wind energy produced electricity. FTA's seem to be significant but immediately lose its significance once other variables are added to the fixed effect model and do not explain the model well considering the zero valued R-square. Additionally, the political variable, control of corruption is significant for random effect regressions (Table D - 8.).

Social and national variable regressions, indicate a significant negative effect of fuel imports on the regressand, for random effect regressions (Table D - 10.) while insignificant for the fixed effect regression models (Table D - 9.). For both random and fixed effect regressions, the population percentage living rurally and, both normal and lagged variables of, death due to indoor air pollution are negative and significant. Meanwhile access to electricity is positive and significant. But loses this significance in the fixed effect regressions once carbon emissions are added to the models.

Contrary to the overall regressions, within the Western region, fixed effect regressions (Table D - 11.), vulnerability, aid and the forest coverage are insignificant, while depletion of natural resources, carbon emissions per capita and the ND- gain index are significant. The Paris agreement is significant yet loses its significance once readiness is added to the model, by excluding the vulnerability variable and including the ND-gain variable.

1.3.3 Southern region

Similar to the Northern region, the Southern region encompasses a small number of nations and therefore could come with difficulties to measure significant correlations. Nonetheless, for the 10-year timeframe, economic variables, both lagged and not, such as FTA's and FDI outflows are positive and significant. For political variables, the p-values suggests that corruption nears significance.

Social and national factors seem to be less influential for the Southern region. Within nation models, the regression results indicate that the proportion of the population living in rural areas and the production of electricity through fossil fuels have a strong negative relation with the regressand. This is not the case for across country regressions, these show there to be a strong negative effect of the landlocked dummy on the regressand.

For environmental and international factors, within nations, the Paris agreement seems to significantly impact the regressand when vulnerability is taken out of the model. The negative impact of carbon emissions per capita keeps its significance throughout the fixed model. Across nation models, reconfirm the positive impact of the Paris agreement.

1.3.4 Eastern region

Political variables have shown to have no significance but the economic variable, starting a business index does. Once this variable is excluded for the within nation models, FTA's become significant.

The social and national factors have a larger influence on the regressand. The fixed regressions demonstrated that, carbon emissions and production of electricity through hydropower have a positive effect while electricity generated from fossil fuels and the rate of death caused by air pollution have a negative effect (Table D - 21.). Except for the factor that takes into account the effect of hydropower, for random effect regressions (Table D - 22.) the results for these variables are the same. Additionally, within these across country models, fuel imports have a negative effect and, both lagged and normal valued, access to electricity has a positive effect on the regressand.

Environmental and international variables have the largest impact on the regressand. Vulnerability and the depletion of resources have negative and a significant impact for within nation models (Table D - 23). Additionally, the Paris agreement, the UN year of sustainability and aid have a significant positive effect, yet for aid this becomes insignificant when either depletion of resources or carbon emission are accounted for within the model. For random effect regressions (Table D - 24.), vulnerability and the depletion of resources are insignificant however the Paris agreement, the UN year of sustainability and aid remain to have the same effect. Furthermore, forest coverage is determined to have a negative significant impact and carbon emissions per capita have a positive significant impact.

1.3.5 Central region

Surprisingly for the Central region, contrary to other regions, vulnerability is positive and significant until forest coverage is added to the model (Table D - 29.). Additionally, within the random effect regression (Table D - 30.), forest coverage and aid have a negative and significant impact on the regressand. The fixed effect regressions, give no significant results. Low variance between variables within a nation can account for this.

Similarly, the political and economic variables do not show much significance. Only for certain circumstances are some factors significant, such as the starting a business index, FTA's, control of corruption and FDI outflows.

This region is most impacted by social and national variables. Within fixed effect regressions (Table D - 27.), a strong negative significance has been identified for the proportion of the population living in rural areas. The random effect regressions (Table D - 28.) further prove the positive significance of being landlocked and access to electricity.

2 Analysis

The greatest influences on the production of electricity through solar and wind energy within Africa, has been determined by this study to be aid given to sector 232, the forest coverage, the Paris agreement and the proportion of people living rurally. This does not exclude the possibility of other factor influences due to proven multicollinearity and the reduction in observations when all sectors were combined. Yet it does imply that these four factors have a very strong existing and clear influence on the production of electricity through solar and wind energy. Thus, to increase the usage of solar and wind energy, a closer look has to be given to these factors.

The results do suggest that international factors have a large influence on the uptake of solar and wind energy for the use of electricity in Africa. Thus, that foreign roles and perceptions on the importance of renewable energy will play a role in the shaping of the renewable sector in Africa. The power of commitment to uphold international agreements, such as was measured in the literature for the Kyoto protocol, continue to positively influence the solar and wind energy sector. This indicates the importance of the Paris agreement as well as any other future climate agreement. The Kyoto protocol was already established to have a positive influence. Yet this study established that those that ratified the Paris agreement, especially in the Eastern, Western and Southern regions, see an increase in solar and wind energy usage for electricity. This implies that new refined international climate agreements would further strengthen the uptake of renewable energy sources upon ratification. Accordingly global climate concerns play a large role as this influences the possibility of future refined and strong new international agreements.

Such global climate concerns further reflect into the given official development assistance. If national interests or perspectives of developed nations to enlarge this sector decreases, aid given to sector 232 decreases, thus the development of solar and wind energy could as a result slow down. Likewise, a rise in global concerns could increase disbursements to this sector, which this study has proven to be beneficial to the production of electricity through solar and wind energy.

Yet the impact of aid to this sector is not dependent on foreign influences alone. Results have shown that disbursed aid seems to be least influential for the Central region. This region, opposite to other regions, seems to have a negative relation between aid and the regressand. With regional statistics (Table A - 3.) showing that on average the Central region has the worst control of corruption and accountability indexes. Pfeiffer and Mulder (2013)'s theory could uphold for this region alone, as the negative influence of aid could be due to the fragile state of the region. Leading to aid possibly being used for different purposes that undermine the intended increase in production of electricity through solar and wind energy. Regional circumstances thus play a crucial role in the effectiveness of aid to this sector and must be taken into account.

Nonetheless, the theory of Wang et al.'s (2021) that aid will also have a negative effect once a certain threshold is surpassed for development, indicated by urbanization and carbon emissions, seems to be invalid in the case of Africa. As results show that regions with similar statistically high values for these factors show different relationships between aid and the regressand. Thus, difference in the influence of aid cannot be declared to these factors of urbanization or carbon emissions. Yet it can be stated that overall, the effect of aid is aligned with its purpose. Aid mostly contributes to an increase in the production of electricity generated through solar and wind energy once development takes place and this effect is only removed for the Central region that forms an exception most likely due to its fragile state.

However, it is not only the foreign international perspectives on renewable energy or regional stability that influence uptake of solar and wind energy in Africa. The strong influence of the proportion of people living rurally and forest coverage, shows the importance of national perspectives on renewable energy. Whereby forest coverage indicates a countries interest in sustainability and environmental safekeeping. While a large population living rurally indicates an obstruction to produce more solar and wind energy for the generation of electricity. With multicollinearity present between the two factors, it cannot be stated that an increase in the proportion of the population living in rural areas has a negative influence exclusively due to economic reasons. While a larger population living rurally does suggest less economic development and financial abilities as come with urbanization. It also contributes to deforestation and other environmental degradation. Especially with changes in the climate making it harder to produce crops, land is overexploited. This could attribute to national attention being placed on sustainable agricultural practices and agroforestry instead of expansion of renewable energy. Although a rural population could attribute to an increase in the use of solar and wind energy. When a nation has a low enough number of people living in rural areas, it can easily bring access to electricity through renewable sources to these areas. As the number of electricity sources needed would be financially feasible to cover.

This study has proven that regional differences, perspectives, and development influence the factors that impact either positively or negatively the production of electricity through solar and wind energy. Nonetheless there are other significant factors that are less apparent during overall models have been proven to be relevant through sectoral and regional model approaches. The results of those other factors and those mentioned above are further analyzed in detail below.

2.1 Political sector

Statistically (Table 2.), on average Africa's current governance situation is unfavorable. Regional statistics are no different, with negative averages. Yet available data on maximums shows that there are nations with a more favorable political environment. Nonetheless, most regional data indicates that growth in terms of the improvement of a nation's political situation, positively relates to the production of electricity through solar and wind sources. This is mostly confirmed, by measured significant positive effects of rule of law, governmental effectiveness, and control of corruption in the Western region, control of corruption and voice and accountability in the Southern region, voice and accountability and governmental effectiveness in the Northern region, and the rule of law in the Central region.

It is notable, that while generally these governmental factors have a positive effect, regions that statistically have less favorable conditions, such as the Central, East, and partially the North, showcase for certain factors negative relations. While control of corruption seems to positively influence all regions, rule of law has a significant negative impact in the Northern region, and governmental effectiveness and voice and accountability have significant negative impacts in the Eastern region. Other factors, that show negative relations in these regions are insignificant. This suggests that, while improvements to the governmental system have an overall positive effect on the production of electricity through solar or wind energy, it is entirely dependent on the stance of the ruling national parties. Results imply that regions that do statistically better than others in Africa, appear to have better control of corruption and a political position that contributes to a favorable climate to produce electricity through solar or wind energy. Controlling for corruption within regions that score statistically lower in governmental indexes, nevertheless, could add to the renewable electricity production, although ruling parties may more often have preferences that impede electricity production through solar and wind energy. As a result, less governmental strength has a favorable influence on the production of electricity through solar or wind energy, in the Eastern region.

2.2 Economic sector

Besides better governance and political circumstances, economic growth is often interlinked in the existing literature with growth of renewable sources. Through the creation of opportunities for companies and the availability of funds, investments can be made in favor to sustainable energy sources. It is therefore of no large revelation that economic factors that indicate a better national economic environment, were proven to generally have a beneficial influence on the production of electricity through solar and wind energy. The business score, FTA and FDI outflows are discovered to have positive significant effects on the regressand. With lagged variables demonstrating significance (regression 8 in Table B - 5.), it can be stated that an extensive economy that is outwardly oriented with a good trading and business environment positively influences the production of, through solar and wind powered, electricity.

Yet, while the study anticipated a favorable effect of GDP as average growth in GDP could lower the financial barrier to invest in the production of renewable electricity through solar and wind energy. This study, like the previously described literature review, did not discover any significance. However, in contrast to Nyiwul (2017) findings of a positive effect, the results of this study point towards the possibility of a negative effect in the Central region, as well as partially in the Northern and Southern regions. This suggests that while Africa's overall GDP is growing (Table 2.), the growth is insufficient to lower the financial barrier. Instead, the increasing need for energy that comes with growth, is often not sufficed through renewable sources. Therefore, in the case of the mentioned regions, nations will more likely lean to other sources of energy to suffice the required energy to sustain economic growth. This tradeoff between economic growth lowering the financial barrier yet renewable energy not being able to suffice the need of energy that comes with the economic growth, gives GDP the found overall neutral effect.

2.3 Social sector

The death rate from indoor air pollution is declining in Africa (Figure 7.), indicating that nations are attempting to improve public health, which is shown, through the results, to positively influence the production of solar and wind powered electricity. An approach taken to decline the death rate is to introduce clean cooking fuels in households, however this requires either a supply of LPG or an electrical connection. The findings reveal that an intention to enhance the use of clean fuels correlates positively to the production of solar and wind powered electricity. Meaning that for more households to use cleaner cooking fuels, electrical connections powered by solar and wind energy are established. This is further confirmed by the findings for the influence of access to electricity on the production of electricity through solar and wind energy, particularly for the Western and Eastern regions. These regions have on average the least access to electricity. Which implies that especially in regions that could still experience improvement in access to electricity, increased access to electricity has a beneficial effect on the production of electricity through solar and wind energy.

While a significant share of people living in rural areas was predicted to bolster the influence of above-mentioned factors, due to large costs to connect homes to the existing grid making renewable energy a financial lucrative option. To the contrary, the results established it to have a negative influence on the production of electricity through solar and wind energy. Only the Eastern region that has on average the highest share of individuals living in rural areas, shows there to be a positive relation, although insignificant. While a high proportion of those living in rural areas does potentially contribute to the lack of access to electricity (Table B - 7.), that positively effects the regressand. The rural proportion has overall negative influences. Due to its overall slow decline (Figure 5.) urbanization can be said to be occurring, implying that a higher proportion of people living in urban settings makes it more favorable to produce electricity through solar and wind energy. This has to do with the development of the economy that comes with urbanization (Wang et al, 2021), that lowers the financial and other barriers, as observed from the previously described economic variables that positively influence the production.

2.4 National sector

With growing environmental as well as dependency concerns it was expected that a nation would gradually move away from using its own unsustainable energy reserves or its reliance on others. It is therefore of no surprise, with the various argumentations within the literature supporting the hypothesis of a positive effect of carbon emissions on renewable electricity production, that this study indeed found a positive significant effect for both normal and lagged values in fixed effect regressions. Believably due to environmental concerns.

However, these environmental concerns do not seem to translate onto national energy choices. Results on electricity produced through fossil fuels imply that in Africa a dependency on fossil fuels is not accompanied with an increase in solar and wind energy produced electricity. Instead, nations find themselves too dependent on fossil fuels and are reluctant to replace this with renewable sources. Significant regional results for the Eastern and Southern regions confirm this. As although a positive relation was expected for the Southern and Northern region, as they have the largest usage of fossil fuels for electricity production indicating a high dependency of fossil fuels, a negative relation was found. Similarly, results for the Eastern region indicate that even for regions with a low usage of fossils, the choice of fossil fuels to produce electricity negatively impact the regressand. Yet, results found for the Central region, that has similar averages to the Eastern region but over the 10-year time span an overall lower usage (Table A - 3.), indicate a positive relation between the usage of fossil fuels and solar or wind energy to produce electricity. This implies that fossil fuels could have a positive impact to a certain extent. Plausibly because fossil fuels are needed to develop, as seen through history. Therefore, through the usage of fossil fuels, to a certain limit, capabilities are created to produce and invest in the harvesting of solar and wind energy.

Nonetheless, the results show that in most cases nations get stuck in their dependency on fossil fuels and do not replace this source with renewable options. Consequently, the dependency on fossil fuel imports does not positively influence the production of solar and wind energy powered electricity. Contrary to the hypothesis based on the found results in Europe (Marques et al., 2010) that a nation with a low domestic renewable energy generation and a high dependency on energy import will increase its production in renewable energy. This study shows that while the national production of solar and wind energy in Africa is low, the amount of fossil fuels imported might not be sufficiently high for it to have a positive effect on national production of renewable energy as expected from Marques et al. (2010). Instead, with an overall average of 16% of imported merchandise (Table A - 3.), fossil fuel imports contribute to suffice the energy demand instead of national produced renewable energy. Therefore, a reliance on these imports has a negative impact on the production of electricity through solar and wind energy, and environmental concerns that could surround the use of fossil fuels are not apparent in Africa.

Similarly, the study results imply that currently another source of energy that is surrounded by environmental concerns, hydropower, does not significantly impact the production of electricity through solar and wind energy. Nonetheless the influence of hydropower is overshadowed by regional difference.

Regionally, hydropower has exclusively a significant positive effect in the Eastern region on the regressand. Characterized by a larger production of hydropower, than any other African region, it seems that a dependency on hydropower does positively impact solar and wind energy production for electricity in East Africa. Possibly because of an expected increase in climate change induced droughts and the desire to diversify the electricity mix while sticking to renewable sources to suffice increasing demands. The results further suggest that this region is oriented towards using its own national available renewable resources as can be seen from its usage of hydropower. Resulting into the expectation that, as hydropower is a source that has its own limits, this region will lean towards increasing its dependency on solar and wind energy. As a combination of hydro, solar and wind energy can strengthen electricity access reliability by compromising for fluctuations in the production of energy. Meanwhile, regions that produce the least amount of hydropower such as the South and West, have insignificant yet negative coefficients. This implies that if in the future these regions choose to increase their hydropower to suffice electricity demands, the production of solar and wind energy would be negatively affected as hydropower becomes a replacement.

2.5 Environmental sector

While earlier found results within the national sector for the influence of carbon emissions implied that environmental concerns do affect the uptake of solar and wind energy. No significance was found for carbon emissions per capita nor the depletion of natural resources. It is anticipated that the low emissions per capita in comparison to other continents led to the overall insignificance. With Africa not being one of the main contributors to climate change, due to enlarged amounts of carbon emissions within the atmosphere, the incentive that large polluters have to diminish emissions could be less of a concern to Africa.

Meanwhile the study did not find support for the theory that depletion of resources stimulates a nation to increase their usage of solar and wind energy to lessen the occurring depletion. Yet with regions showing a positive yet insignificant relations, the suggested theory of resource depletion having a positive impact cannot be fully excluded. There are still some years left till complete depletion (Shafiee & Topal, 2009), thus while not imminent yet future data could show significance.

Environmental concerns can be addressed through other means than changes in energy patterns or availability of resources. The study's results show that forest coverage, from all other environmental factors, impacts the production of electricity through solar and wind energy sources the most. Remarkably, the relationship that forest coverage has with the regressand changes depending on the models used. Within country models a significant positive relation is established while a negative significant relation is discovered for models considering differences across countries. This implies that nations with a larger forest coverage, compared to other nations, have a larger negative effect on the regressand. However, the within country models suggest that growth of forests positively impacts the regressand.

Even though a national increases in forest coverage indicates a national favorable stance towards a sustainable way of living. Since forest coverage does not majorly change over a period of 10 years, it could be said that the negative relation that the study expected as found for across country models is upheld. This could be due to the actions of reforestation taking away the incentive to produce more renewable energy to combat carbon emissions, as the forests already contribute to such a reduction. Nonetheless, the positive coefficients found were not disregarded, with regional results partially clarifying the circumstances for the differences in results. The Northern region for example has the lowest average of forest coverage at 4% and shows, for both within and across country models, a positive significant impact on the production of electricity through solar and wind energy. This region could be considered as an outlier due to the presence of the Sahara (arid climate). Yet results indicate that if a nation in this arid region enlarges its forest, it is more likely to increase its production of electricity through solar and wind sources. Meanwhile, it has been established for other regions that as the limit to further extensions of their forests near, an increase in forest coverage begins to positively influence the production of electricity through solar and wind sources. This reverse in effect could be possibly attributed to the need to find other measures to lower emissions and increase sustainability once the forest coverage comes to an extend that would be hard to largely further increase. Herewith the large forest coverage begins to indicate a nations interest in sustainability.

All these factors play into the perception of a nation being resilient against climate change and other external forces. The study expected that a nation that can be categorized as vulnerable would put more effort into becoming resilient through sustainable approaches towards energy. Nevertheless, the study found, that once lagged, the vulnerability index factor completely losses its significance. Therefore, proving the relation to be reversed, whereby an increase in the production of electricity through solar and wind energy sources decreases a nations vulnerability index. Nonetheless, the ND-gain index was found to be significant, even when lagged, as can be seen from Table B - 15., regressions 8 to 12. Which indicates that as a nation aims to increase its readiness score, therewith resilience, it will look at various opportunities to make economic, governmental, or social improvements. This will create a better national environment, as was found in sections above, suitable to increase the production of solar or wind powered electricity.

2.6 Landlocked

Against expectations, it seems that landlocked nations are more disadvantaged in terms of production of electricity through solar and wind energy, compared to those that border to an ocean (Table B - 11.). However overall, the less reliable across country models do suggest there to be fluctuations between a negative and positive relation. This is caused by regional differences, as the results for the Southern and Western region indicate there to be a negative relationship while results for the Central and Eastern region indicate there to be a positive relationship between being landlocked and the regressand. To investigate what influences the production of electricity through solar and wind sources in landlocked nations, an overall analysis was conducted, as a division between the landlocked regions would give a too small of a sample size.

From the study results it becomes clear that political factors and most economic factors have no significant effect except for the business score. This implies that a favorable economic environment does positively relate to the production of solar and wind powered electricity, but connections to abroad through FTA's of FDI outflows do not contribute. With a high dependency on the infrastructure of their neighbors to have access to abroad, that in most cases is not as advanced as desirable, it is of no surprise that factors that represent connectiveness to abroad do not contribute to the production of electricity through solar and wind energy. Instead, Collier's (2007) recommendation has become reality.

With the natural disadvantage of being depended on their neighbors for overspill of economic growth and access to ports, Collier (2007) recommended landlocked nations to place a priority on rural development. This could be achieved through off grid solutions through local solar panels. Based on the study's results this study supports this recommendation, as the proportion of the population residing in rural areas has found to have a significant positive effect on the regressand. This is consistent with the studies theory, that was not supported by the overall and regional models. However, the eastern region did give indications of a possible positive relation.

Statistically, the landlocked nations have on average a higher share of individuals living rurally (72%) than any geographical region. Additionally, over the years there hasn't been much of a decline in percentages (Figure 6.). This creates enough incentives to provide rural areas with off grid solutions as it is financially inefficient to construct an extensive electrical grid and rural development should be supported.

2.7 Overall

The study results imply that with political stability, economic growth and the improvement of basic social needs and living circumstances, that together form development, the usage of solar and wind energy to produce electricity would expand within Africa. While it also emphasizes the importance of global perspectives and effort to address global concerns and assist through aid with the expansion of renewable sources for electricity. In addition to environmental concerns possibly obstructing renewable energy when addressed through other outlets, or instead these form an indication of national sustainable goals.

Furthermore, this study provides a more in-depth assessment of existing regional differences. When looking at Africa as a whole, these are typically disregarded, even though the disparities between regions are significant. By taking this into account, various relations could be better defined. For example, it has become evident that aid is not always beneficial and that hydropower can positively influence the usage of solar and wind energy for electricity if a region is already depended on hydropower. It further highlighted that some regions could turn the disadvantage of being landlocked into an advantage for the production of renewable energy, as landlocked nations could focus more on rural development.

Chapter VI. Conclusion

1 Implications

Several questions were investigated in this study, to determine associations between factors from different sectors on the production of solar and wind powered electricity in Africa. Primarily, the study focused on determining the overall positive or diminishing influences. Further research was undertaken to investigate regional variances and the effects of being landlocked on the production of solar and wind powered electricity.

Several previously unknown correlations were discovered during the study. Firstly, political influences seem to differ regionally and negative effects, that were often disputed in literature, were detected and proven to be valid for the Eastern region. Secondly, results on economic effects imply there to be a positive relation between the economic variables FTA, starting a business score and FDI outflows, and the production of solar and wind powered electricity. Which suggests that an outward oriented economy could be more beneficial for the reliance on solar and wind energy for electricity. While GDP and unemployment have no significant effect.

Social effects of access to clean cooking fuels and electricity are proven to have a positive significant effect. The latter mostly gains influence in the Western and Eastern regions that experience the least access to electricity. Meanwhile the death rate due to indoor pollution and the proportion of individuals living rurally, have negative influences. With the Central, Eastern and Western region being mostly impacted by the death rate. One of the most important findings is that the proportion of individuals living in rural areas has a positive influence for landlocked nations. Meanwhile being landlocked has overall a positive influence in the Eastern and Central regions while the Southern and

Western regions are disadvantaged for being landlocked. Further results on other national factors, show a significant negative influence for fuel imports. While the production of electricity through either hydro or fossil fuels has overall insignificant negative influences. Nonetheless, the Eastern region experiences a positive influence of hydropower and the Central region for the use of fossil fuels.

Lastly, environmental and international sectors indicate that while international commitments, assistance and pressure positively affect the production of electricity through solar and wind sources, environmental factors mostly do not. The study concludes that depletion of resources has an insignificant effect and forest coverage negatively influences the regressand up to a certain tipping point.

2 Policy suggestions

The findings of this study have resulted in a few considerations to be taken by policymakers and aid providers. With rising environmental concerns, it is of critical importance to increase the share of renewable energy and reduce reliance on fossil fuels. It is therefore, recommended that policymakers and aid providers assess the many established relations, to design the most effective national-specific policies, target challenges and strengthen efforts to expand the production of electricity generated through solar and wind energy.

First and foremost, it has been established that international commitments and pressure that come with them, contribute to a growth in solar and wind powered electricity. Although not as effective for every region, probably due to Africa's minor contribution to global warming, the East, West and South appear to be most prone to it. Secondly, aid has been proven to positively contribute to the production of solar and wind powered electricity, particularly in landlocked nations and nations in the Northern and Eastern regions. With renewable energy aid initiatives frequently targeting rural areas and the proven positive effect, landlocked nations form suitable recipients. The positive established relation of a large proportion of people living in rural areas as well as the low amount of aid being received, endorse this recommendation.

While good governance and stronger policies do not seem to favorably impact the Eastern and Northern region, it is recommended to assist and encourage nations within Africa to establish good governance. Similarly, economic policies that encourage growth with an emphasis on international interactions should be promoted. In addition to, creating accessibility to clean cooking fuels to address health and environmental concerns in Western and Central regions.

Finally, while the use of hydropower in the Eastern region seems to positively contribute to diversification of their electricity mix, through an increase in the production of electricity through solar and wind energy. Other nations should be discouraged to expand their use of hydropower or fossil fuels due to various environmental consequences and instead turn towards solar and wind energy.

3 Limitations

There are certain limitations to this study, that are recommended to be addressed for future expansions to this study. Primarily, as the forest coverage explanatory variable demonstrated, not all variables have linear relations to the production of electricity through solar and wind energy. Therefore, this research should be extended by conducting quantile regressions to better understand the possible correlations between the explanatory variables and regressand. Additionally, the time frame must be extended. This was previously unattainable due to the relatively recent utilization of solar and wind energy as a source of electricity. The study's relevance is likely to remain, thus new data could be added in the future to increase the sample size. This is of importance since, for example, data on forest coverage is typically collected with 5-to-10-year intervals. Furthermore, a longer time frame would enhance the sample size and so strengthen regional findings, particularly for the Northern and Southern regions, which have only 6 and 5 nations, respectively. Moreover, as global warming worsens and resources are further depleted, previously undiscovered relations may begin to emerge.

Additionally, once more data becomes available, future research can built upon this study to investigate the different influence of being landlocked on renewable energy in the different regions in Africa. As this study could find no commonality in differences between the two regions for which a positive relation was found, and neither for those that a negative relation was found for.

Lastly, this study could be extended by including the distribution of NGO's, as these determine the distribution of aid, the number of environmental policies, democracy, and a factor that encompasses only the use of electricity as a clean cooking fuel, to exclude the use of LPG. In addition to future data updates, that could make data available for factors such as fuel imports and FDI outflows that do not have data available for all points in time.

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Abstract in Korean

기후변화와 관련된 에너지안보 및 지구의 미래에 대한 세계적 우려가 증대되면서, 재생에너지에 대한 관심 역시 커지고 있다. 재생에너지 발전에 영향을 미치는 요인에 대한 연구는 학계에서 진행되어왔으며, 본 연구는 아프리카의 태양광 및 풍력 발전량과 관련된 요인에 대한 심도있는 규명에 초점을 맞추어 2010 년부터 2019 년까지 10 년 간의 패널 데이터를 통한 분석을 진행하였다.

연구 결과에 따르면, 창업지표(starting a business score, 세계은행), FTA, 해외직접투자 유출(FDI outflows), 조리용 청정 연료 및 전기에 대한 접근성, 탄소 배출량, 섹터 232 에 따른 지원, 파리 협정 및 유엔의 2012 년 전기의 해 선언 등이 아프리카의 태양광 및 풍력 발전에 긍정적인 영향을 미치는 것으로 드러났다. 실내 오염으로 인한 사망률, 농촌지역 주민비율, 내륙에 위치하였는지의 여부, 연료 수입량, 산림 비율은 태양광 및 풍력 발전량에 부정적 효과를 미치는 것으로 드러났다. 본 연구에서 발견한 지역적 차이 및 기존 연구와의 차이에 대하여는 지역별 통계를 고려하여 시사점을 검토하였다.

Appendix 1. Regional characteristics

Table A - 1. List of countries per region in Africa

REGION	COUNTRY	
NORTH	Algeria	Morocco
	Egypt	Sudan
	Libya	Tunisia
WEST	Benin	Liberia
	Burkina Faso	Mali
	Cabo Verde	Mauritania
	Cote d'Ivoire	Niger
	Gambia	Nigeria
	Ghana	Senegal
	Guinea	Sierra leone
	Guinea-Bissau	Togo
SOUTH	Botswana	Namibia
	Eswatini	South Africa
	Lesotho	
EAST	Burundi	Mozambique
	Comoros	Rwanda
	Dijibouti	Seychelles
	Eritrea	Somalia
	Ethiopia	South Sudan
	Kenya	Tanzania
	Madagascar	Uganda
	Malawi	Zambia
	Mauritius	Zimbabwe
CENTRAL	Angola	Equatorial Guinea
	Cameroon	Gabon
	Central African Republic	Republic of the Congo

REGION	COUNTRY	
	Chad	Sao Tome and Principe
	Democratic Republic of Congo	

Table A - 2. List of landlocked nations in Africa

Landlocked	Botswana
	Burkina Faso
	Burundi
	Central African Republic
	Chad
	Eswatini
	Ethiopia
	Lesotho
	Malawi
	Mali
	Niger
	Rwanda
	South Sudan
	Uganda
	Zambia
	Zimbabwe

Table A - 3. Regional statistic summary (2010-2019)

Variable	Region	Mean	Std	Min	Max	N-0	N	SUM
FTA	Locked	2.29375	1.50302	0	6	150	160	
	North	5.05	2.79482	2	9	60	60	
	West	1.675	0.756939	0	3	150	160	
	South	4.7	1.19949	3	7	50	50	
	East	1.96111	1.407736	0	5	148	180	
	Central	1.23333	0.73515	0	3	80	90	
BUS	Locked	65.8611	18.5392	17.7	94.5	157	157	
	North	79.2667	6.06163	70.9	93	57	57	
	West	70.57179	18.79158	4.3	93.7	156	156	
	South	75.456	5.62147	64.6	83.1	50	50	
	East	67.983	17.0859	26.1	94.5	171	171	
	Central	54.56	18.9072	17.7	90.2	80	80	
FDIout	Locked	21567433	1.76E+08	-9.8E+08	1.1E+09	80	115	
	North	3.57E+08	5.57E+08	-2.9E+08	2.72E+09	43	52	
	West	1.2E+08	3.34E+08	-7.7E+08	1.61E+09	122	151	
	South	9.4E+08	2.15E+09	-1.6E+08	7.69E+09	28	45	
	East	4.6E+07	1.91E+08	-9.8E+08	1.1E+09	81	113	
	Central	2.5E+08	5.95E+08	-2.3E+09	2.09E+09	51	60	
GovEffec	Locked	-0.8	0.62	-2.48	0.53	159	159	
	North	-0.74	0.63	-1.92	0.22	60	60	
	West	-0.8	0.44	-1.76	0.32	180	180	
	South	-0.05	0.47	-0.86	0.53	50	50	
	East	-0.82	0.79	-2.47	1.06	179	179	
	Central	-1.20	0.36	-1.85	-0.63	90	90	
RuleLaw	Locked	-0.67	0.63	-1.97	0.67	159	159	
	North	-0.7	0.55	-1.85	0.06	60	60	
	West	-0.65	0.47	-1.59	0.63	180	180	
	South	0.05	0.36	-0.53	0.67	50	50	
	East	-0.75	0.74	-2.42	0.97	179	179	
	Central	-1.18	0.36	-1.82	-.046	90	90	
Account	Locked	-0.73242	0.645094	-1.99008	0.53297	159	159	
	North	-0.99818	0.599833	-1.94042	0.304584	60	60	
	West	-0.3024	0.568067	-1.46007	0.979163	160	160	

Variable	Region	Mean	Std	Min	Max	N-0	N	SUM
	South	0.044296	0.73507	-1.44883	0.651226	50	50	
	East	-0.77078	0.783729	-2.22605	0.940896	179	179	
	Central	-1.09592	0.55817	-2.00025	0.364222	90	90	
Corrupt	Locked	-0.61238	0.680023	-1.77347	1.027206	160	160	
	North	-0.74625	0.544268	-1.6265	-0.0368	60	60	
	West	-0.59913	0.514391	-1.55852	0.950537	160	160	
	South	0.182008	0.427017	-0.49025	1.027206	50	50	
	East	-0.68542	0.652973	-1.788	0.970011	180	180	
	Central	-1.1215	0.459397	-1.81581	0.196552	90	90	
Fuel-IM	Locked	15.9272	7.94165	0.29768	31.2801	136	136	
	North	13.8861	6.44962	1.05533	27.5878	44	44	
	West	18.2109	9.230957	0.098967	38.28578	126	126	
	South	14.63274	5.144993	2.471387	25.63109	50	50	
	East	17.9673	7.72145	0.47025	50.6255	136	136	
	Central	9.83342	9.19359	0.29768	30.3544	53	53	
Hydro	Locked	2137.906	3724.617	0	14563.6	120	160	342064
	North	3897.83	5170.424	0	13822	48	58	226074
	West	1130.046	2207.47	0	8387	110	160	180807
	South	1364.252	1780.25	0	5791	40	50	68212
	East	3012.692	4666.106	0	17092.6	127	180	542284
	Central	2448.17	3253.16	0	11064	80	90	220335
RURAL%	Locked	72.3875	13.5339	29.828	89.358	160	160	
	North	40.8652	16.0513	19.607	66.911	60	60	
	West	55.92353	11.38066	33.805	83.792	160	160	
	South	54.5024	18.5066	29.828	77.52	50	50	
	East	67.6004	15.8583	22.085	89.358	172	172	
	Central	42.7588	18.6455	10.259	78.015	90	90	
LOCK	North	0	0	0	0	0	60	
	West	0.1875	0.391538	0	1	30	160	
	South	0.6	0.494872	0	1	30	50	
	East	0.44444	0.49829	0	1	80	180	
	Central	0.22222	0.41809	0	1	20	90	
CO2	Locked	3515.49	3680.86	0	16280	142	144	506230
	North	85900	72095.4	14500	246260	54	54	4638600
	West	10360.07	25954.22	240	130670	144	144	1491850

Variable	Region	Mean	Std	Min	Max	N-0	N	SUM
	South	88569.1	172392	960	447980	45	45	3985610
	East	4238.15	4825.37	0	18890	160	162	686580
	Central	6790	9356.06	100	35410	81	81	549990
AIRPOL	Locked	161.114	47.4887	50.06	284.44	160	160	
	North	17.0125	33.458	0.13	118.37	60	60	
	West	146.356	53.07787	23.6	246.01	160	160	
	South	84.0594	48.5547	11.6	176.28	50	50	
	East	137.12	68.274	0.37	297.03	180	180	
	Central	124.992	80.4097	7.21	284.44	90	90	
COOK	Locked	12.8125	17.9885	0	56.1	150	160	
	North	88.02	22.4208	33	99.9	50	50	
	West	13.79625	19.88233	0.2	78	160	160	
	South	52.788	16.5539	31.2	86.3	50	50	
	East	16.4761	30.4736	0	100	170	180	
	Central	23.4544	26.2736	0.4	87.9	90	90	
ACCESS	Locked	26.3219	18.3558	1.5	77.1696	160	160	
	North	85.8705	20.3617	38.0963	100	60	60	
	West	41.55954	22.09423	4.1	95.53354	160	160	
	South	57.6534	19.1869	17	86	50	50	
	East	38.6917	28.0555	1.5	100	180	180	
	Central	44.1939	26.703	6.4	90.6853	89	89	
CO2Cap	Locked	0.46229	0.74576	0	3.64231	142	144	
	North	3.175338	2.552929	0.391125	9.383784	54	54	
	West	0.390313	0.259601	0.082385	1.14261	144	144	
	South	2.927731	2.620352	0.876695	8.300179	45	45	
	East	0.666764	1.331085	0	6.407474	160	162	
	Central	1.482803	2.360871	0.026146	10.08859	81	81	
ND-gain	Locked	36.03992	5.315891	26.98901	49.28104	140	140	
	North	45.40737	6.969469	31.12733	54.5015	60	60	
	West	36.85026	3.834139	29.02126	46.97769	150	150	
	South	45.80412	2.481439	40.8621	49.28104	40	40	
	East	38.6944	5.92331	30.41946	56.65821	170	170	
	Central	35.71953	5.513723	26.98901	43.91761	90	90	
DEPLET	Locked	8.265217	5.59367	0.1	24.9	138	138	
	North	6.188462	5.606182	0.3	20.9	60	60	

Variable	Region	Mean	Std	Min	Max	N-0	N	SUM
	West	9.437324	5.994496	0.2	23.6	142	142	
	South	2.551111	1.388037	0.4	5.8	45	45	
	East	5.811111	5.873529	0	24.9	125	144	
	Central	16.80123	15.69924	0	57.9	72	81	
Fossil	Locked	680.575	1089.363	0	4587	138	160	108892
	North	49637.4	50300.6	1297	175998	60	60	2978244
	West	2915.959	6042.3	17	28331	160	160	466553
	South	46976.3	93939.17	0	243637	30	50	2348814
	East	1037.7	1356.7	0	5227	178	180	186778
	Central	1081.1	1238.1	1	4583	90	90	97296
VULNE	Locked	0.571969	0.054251	0.466	0.688	160	160	
	North	0.44	0.084488	0.379	0.623	60	60	
	West	0.557625	0.061563	0.422	0.688	160	160	
	South	0.47474	0.035837	0.409	0.527	50	50	
	East	0.551494	0.056805	0.42	0.682	180	180	
	Central	0.528633	0.069762	0.424	0.662	90	90	
Forest%	Locked	20.51654	16.37174	0.862177	62.81494	159	159	
	North	4.729892	5.09232	0.045186	12.84358	60	60	
	West	28.48321	21.75995	0.308819	82.22633	160	160	
	South	16.10016	10.90777	1.137022	29.00446	50	50	
	East	25.4563	20.96758	0.241588	73.26087	179	179	
	Central	55.60884	25.29696	3.511753	91.78178	90	90	
AID232	Locked	11.26181	17.35758	0.002512	102.568	143	143	
	North	72.21515	117.4349	0.006836	637.1763	50	50	
	West	10.60168	16.59663	0	111.0818	147	148	
	South	15.74262	43.04741	0.002512	200.1962	40	40	
	East	21.29449	38.57999	0.021941	304.7683	164	164	
	Central	13.31841	28.54632	0	147.4698	64	65	
Paris	Locked	0.33125	0.472141	0	1	53	160	
	North	0.28333	0.45442	0	1	17	60	
	West	0.35	0.478467	0	1	56	160	
	South	0.38	0.49031	0	1	19	50	
	East	0.31667	0.46647	0	1	57	180	
	Central	0.3	0.46082	0	1	27	90	
2012	Locked	0.8	0.401256	0	1	128	160	

Variable	Region	Mean	Std	Min	Max	N-0	N	SUM
	North	0.8	0.40338	0	1	48	60	
	West	0.8	0.401256	0	1	128	160	
	South	0.8	0.404061	0	1	40	50	
	East	0.8	0.40112	0	1	144	180	
	Central	0.8	0.40224	0	1	72	90	

Appendix 2. Overall regressions

Table B - 1. Random effect regression on all sectors

WS-Per	Coef.	Robust St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
GDP Growth	.006	.019	0.30	.762	-.032	.044	
FTA	-.385	.341	-1.13	.259	-1.053	.283	
BUS	.017	.03	0.57	.568	-.041	.075	
Corrupt	-.694	1.427	-0.49	.627	-3.491	2.102	
AID232	.007	.003	2.24	.025	.001	.014	**
Paris	.7	.264	2.65	.008	.183	1.218	***
Forest%	-.069	.026	-2.69	.007	-.119	-.019	***
Deplet	-.051	.053	-0.96	.339	-.156	.054	
logCO2kt	-.509	.553	-0.92	.357	-1.592	.575	
TimeLock	0	.001	0.23	.818	-.001	.001	
Hydro	0	0	0.69	.488	0	0	
Fuel-IM	-.004	.011	-0.34	.737	-.025	.018	
Rural%	-.075	.052	-1.45	.147	-.177	.027	
Fossil	0	0	-1.49	.135	0	0	
Airpol	-.003	.011	-0.29	.773	-.024	.018	
Access	-.049	.019	-2.61	.009	-.086	-.012	***
COOK	.02	.023	0.85	.397	-.026	.065	
2012	1.138	.632	1.80	.072	-.1	2.376	*
ND-Gain	.248	.158	1.58	.115	-.06	.557	
Constant	2.68	9.281	0.29	.773	-15.511	20.871	

Mean dependent var	1.656	SD dependent var	3.428
Overall r-squared	0.395	Number of obs	313
Chi-square	53.438	Prob > chi2	0.000
R-squared within	0.231	R-squared between	0.395

**** p<.01, ** p<.05, * p<.1*

Table B - 2 Fixed Effect regressions for all 54 nations, Political and Economic variables[6]

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
GDP Growth	-0.00143	0.00354	0.00621	0.0127	-0.00291		0.0126
	(0.0128)	(0.0118)	(0.0122)	(0.0180)	(0.00370)		(0.0189)
BUS	0.0569**	0.0544**	0.0563**	0.0537*		0.518*	0.0535*
	(0.0226)	(0.0230)	(0.0238)	(0.0267)		(0.0277)	(0.0292)
FTA		0.421	0.427*	0.514*	0.748***	0.533*	0.516*
		(0.253)	(0.219)	(0.265)	(0.198)	(0.281)	(0.293)
UNEMP			0.178				
			(0.152)				
FDIout				2.25e-10*	1.45e-10	2.35e-10*	2.26e-10*
				(1.19e-10)	(1.27e-10)	(1.28e-10)	(1.31e-10)
Corrupt					1.554	0.771	
					(0.932)	(1.299)	
Std. Corrupt							0.0267
							(0.925)
Constant	-2.429	-3.325**	-4.952*	-3.730*	0.450	-3.166	-3.730*

[6] Regression 8, 9 and 10 can be found in the appendix under Table B-3.

	(1.599)	(1.569)	(2.516)	(1.889)	(0.608)	(2.147)	(1.892)
Observations	496	496	486	402	419	404	402
R-squared	0.102	0.111	0.115	0.104	0.034	0.106	0.104
Number	53	53	52	45	46	45	45

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 3. RE Regressions for all 54 nations, Political and Economic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per
GDP Growth	-0.000931	0.000811	0.00178	0.00642	-0.00497	-0.00168	0.000573	-0.00240
	(0.0124)	(0.0108)	(0.0112)	(0.0162)	(0.00450)	(0.0138)	(0.0153)	(0.0148)
BUS	0.0544***	0.0530**	0.0532**	0.0546**		0.0536**	0.0547**	0.0518**
	(0.0208)	(0.0219)	(0.0222)	(0.0258)		(0.0218)	(0.0233)	(0.0218)
FTA		0.154	0.134	0.228	0.323*	0.103	0.131	0.0913
		(0.218)	(0.233)	(0.237)	(0.188)	(0.267)	(0.246)	(0.256)
UNEMP			0.0201			0.0214	0.0277	0.0200
			(0.0578)			(0.0550)	(0.0602)	(0.0580)
FDIout				1.88e-10*	1.12e-10			
				(1.11e-10)	(1.18e-10)			
Corrupt					1.323			
					(0.822)			
Account							0.00384	
							(0.602)	
GovEffec						0.417		
						(0.893)		
RuleLaw								0.661
								(0.811)
Constant	-2.237*	-2.515**	-2.648**	-3.068**	1.429	-2.223	-2.750*	-4.636**
	(1.306)	(1.188)	(1.315)	(1.472)	(1.085)	(1.436)	(1.648)	(2.018)
Observations	496	496	486	402	419	459	459	459
Number	53	53	52	45	46	49	49	49

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 4. Fixed effect regressions for all 54 nations, Political and Economic

	(8)	(9)	(10)
VARIABLES	WS-Per	WS-Per	WS-Per
GDP Growth	0.00433	0.00835	0.00477
	(0.0167)	(0.0159)	(0.0143)
BUS	0.0544**	0.0589**	0.0573**
	(0.0224)	(0.0247)	(0.0235)
FTA	0.484**	0.471**	0.486**
	(0.198)	(0.214)	(0.203)
UNEMP	0.242	0.191	0.206
	(0.179)	(0.156)	(0.169)

Account		-0.222	
		(0.504)	
GovEffec			1.007
			(1.555)
RuleLaw	1.643		
	(1.234)		
Constant	-4.398*	-5.444**	-4.636**
	(2.265)	(2.688)	(2.018)
Observations	459	459	459
R-squared	0.128	0.120	0.123
Number	49	49	49

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 5. Fixed Effect regressions for 51 nations, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per
BUS		0.0584**	0.0535**	0.0554**	0.0533**		0.0518*	
		(0.0233)	(0.0215)	(0.0223)	(0.0264)		((0.0277)	
GDP Growth	-0.0219*	-0.003						0.0015
	(0.0121)	(0.0168)						(0.0236)
FTA			0.454*	0.463**	0.505*	0.750***	0.5374*	
			(0.252)	(0.213)	(0.266)	(0.199)	(0.282)	
UNEMP				0.183				
				(0.152)				
FDIout					2.28e-10*	1.65e-10	2.37e-10*	
					(1.21e-10)	(1.34e-10)	(1.30e-10)	
Corrupt						1.627*	0.777	1.91e-10
						(0.968)	(1.306)	(1.61e-10)
L.BUS								0.050**
								(0.024)
L.FTA								0.555**
								(0.258)
Constant	1.648***	-2.488	-3.247**	-4.896**	-3.608*	0.442	-3.174	-3.302*
	(0.050)	(1.684)	(1.452)	(2.624)	(1.797)	(0.593)	(2.137	(1.700)
Observations	486	469	485	475	394	408	394	352
R-squared	0.002	0.105	0.113	0.120	0.104	0.035	0.106	0.104
Number	51	50	50	49	43	44	43	42

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 6. RE Regressions for all 51 nations, Political and Economic

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per

GDP Growth	-0.0203*	-0.00326	-0.0160	0.00684	-0.0266
	(0.0122)	(0.0165)	(0.01000)	(0.0256)	(0.0178)
BUS		0.0557***		0.0547**	
		(0.0216)		(0.0260)	
FTA			0.315*	0.231	0.311*
			(0.177)	(0.238)	(0.187)
UNEMP				1.89e-10*	1.27e-10
				(1.14e-10)	(1.25e-10)
FDIout					1.366
					(0.851)
Corrupt	1.624***	-2.266	0.844	-3.061**	1.576
	(0.394)	(1.382)	(0.644)	(1.519)	(1.113)
Constant	1.624***	-2.266	0.844	-3.061**	1.576
	(0.394)	(1.382)	(0.644)	(1.519)	(1.113)
Observations	486	469	486	392	406
Number	51	50	51	43	44

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 7. Pearson Correlation Coefficient Social variables

Variables	(1)	(2)	(3)	(4)
(1) COOK	1.000			
(2) ACCESS	0.852	1.000		
(3) AIRPOL	-0.843	-0.859	1.000	
(4) RURAL	-0.519	-0.667	0.600	1.000

Table B - 8. Fixed Effect regressions for all 54 nations, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
lnCO2	2.913***	2.887***	3.418**	3.340**	3.108**	2.148*	2.142*	2.335*	0.664
	(1.056)	(1.078)	(1.388)	(1.354)	(1.345)	(1.130)	(1.152)	(1.312)	(1.161)
Hydro		4.00e-05	-6.21e-07	6.10e-06	-6.63e-05	-1.14e-06	-0.0001	-0.0001	-7.04e-05
		(0.00011)	(0.00012)	(0.00012)	(0.00013)	(0.00012)	(0.00016)	(0.00012)	(0.00019)
Fossil			-2.14e-05						
			(3.12e-05)						
Fuel-Im			-0.0301*	-0.0307*	-0.0317*		-0.0315*	-0.0261	-0.0238
			(0.0161)	(0.0158)	(0.0165)		(0.0158)	(0.0184)	(0.0151)
COOK					0.199*				
					(0.115)				
ACCESS						0.0503**			
						(0.0251)			
AIRPOL							-0.0387**		
							(0.0178)		
L. AIRPOL								-0.0367**	
								(0.0153)	
RURAL%									-0.508**
									(0.223)

Constant	-22.69**	-22.57**	-26.53**	-26.17**	-29.95**	-18.74**	-11.30	-13.04	25.48
	(8.695)	(8.782)	(11.32)	(11.16)	(11.59)	(8.981)	(9.536)	(10.46)	(18.95)
Observations	482	482	370	370	366	481	370	329	370
R-squared	0.084	0.084	0.104	0.103	0.135	0.100	0.130	0.138	0.192
Number	54	54	44	44	43	54	44	44	44

VARIABLES	(10) WS-Per	(11) WS-Per	(12) WS-Per	(13) WS-Per
logCO2	3.22**	2.835**	0.913	
	(1.535)	(1.187)	(1.118)	
Hydro	-0.00006	-.00005	-0.0001	-0.0001
	(0.00009)	(0.00009)	(0.00014)	(0.00011)
Fuel-Im	-0.27		-0.015	-0.026
	(0.18)		(0.018)	(0.024)
L.COOK		0.159**		
		(0.077)		
L.ACCESS	0.1934**			
	(0.904)			
L. RURAL%			-0.504**	
			(0.22)	
L. logCO2				3.656**
				(1.456)
Constant	-30.66**	-25.95**	23.30	-28.467**
	(13.566)	(10.145)	(16.6)	(12.273)
Observations	326	422	329	355
R-squared	0.141	0.114	0.199	0.114
Number	43	53	44	42

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 9. Fixed Effect regressions for all 51 nations, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
lnCO2	3.136***	3.119**	3.541**	3.456**	3.249**	2.342*	2.256*	2.505*	0.721
	(1.132)	(1.165)	(1.440)	(1.403)	(1.389)	(1.236)	(1.198)	(1.393)	(1.221)
LOCK		-	-	-	-	-	-	-	-
Hydro		2.36e-05	-6.46e-06	7.63e-07	-7.53e-05	-1.27e-05	-0.000105	-0.000106	-7.20e-05
		(0.00011)	(0.00012)	(0.00012)	(0.00013)	(0.00012)	(0.00016)	(0.00012)	(0.00019)
Fossil			-2.26e-05						
			(3.13e-05)						
Fuel-IM			-0.0297*	-0.0303*	-0.0305*		-0.0312*	-0.0247	-0.0229
			(0.0164)	(0.0160)	(0.0165)		(0.0161)	(0.0189)	(0.0154)
COOK					0.206*				
					(0.117)				
ACCESS						0.0497*			
						(0.0263)			

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
AIRPOL							-0.0387**		
							(0.0178)		
L. AIRPOL								-0.0364**	
								(0.0152)	
RURAL									-0.507**
									(0.224)
Constant	-24.43**	-24.35**	-27.67**	-27.26**	-31.68**	-20.13**	-12.26	-14.56	24.95
	(9.319)	(9.470)	(11.82)	(11.65)	(12.18)	(9.769)	(9.944)	(11.21)	(19.52)
Observations	455	455	357	357	357	455	357	318	357
R-squared	0.090	0.090	0.107	0.106	0.140	0.105	0.133	0.142	0.193
Number	51	51	42	42	42	51	42	42	42

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 10. Random Effect regressions for all 51 nations, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	0.371	0.444	0.630	0.420		0.00955
	(0.272)	(0.322)	(0.520)	(0.396)		(0.412)
LOCK		-0.103	-0.306	-0.253	-0.00865	1.041*
		(0.703)	(0.951)	(0.945)	(0.628)	(0.552)
Hydro		-7.23e-05	-7.56e-05	-7.47e-05	-4.72e-05	-3.66e-05
		(0.000116)	(0.000116)	(0.000120)	(0.000104)	(0.000106)
Fossil			-1.49e-05			
			(1.11e-05)			
Fuel-Im			-0.0330**	-0.0333**	-0.0301	
			(0.0156)	(0.0157)	(0.0195)	
COOK					0.0352**	
					(0.0178)	
ACCESS						0.0515**
						(0.0230)
AIRPOL						
L. AIRPOL						
RURAL						
Constant	-1.691	-2.080	-2.761	-1.191	1.291**	-1.289
	(2.292)	(2.742)	(4.442)	(3.562)	(0.530)	(2.741)
Observations	455	455	357	357	394	455
Number	51	51	42	42	42	51

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
lnCO2	-0.169	-0.160	0.208	0.654
	(0.478)	(0.511)	(0.433)	(0.581)

LOCK	0.879	0.873	2.251	-0.308
	(0.804)	(0.885)	(1.461)	(1.046)
Hydro	-3.68e-05	-5.55e-05	-2.32e-05	-0.0001
	(0.000114)	(9.65e-05)	(0.000121)	(0.000102)
Fossil				-0.00002
				(0.00001)
Fuel-Im	-0.0310**	-0.0363**	-0.0264*	
	(0.0155)	(0.0171)	(0.0141)	
L. Fuel-Im				-0.0428*
				(0.0236)
AIRPOL	-0.0286**			
	(0.0127)			
L. AIRPOL		-0.0294**		
		(0.0127)		
RURAL			-0.126*	
			(0.0695)	
Constant	6.685	7.052	6.731	-2.623
	(5.474)	(5.831)	(6.341)	(4.841)
Observations	357	318	357	318
Number	42	42	42	43

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 11. Fixed Effect regressions for all 54 nations, interaction indicator for time and landlocked variable

WS-Per	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
2010	0	.	.	.	.	.	
2010 -1	-.151	.057	-2.66	.01	-.265	-.037	**
2011 -0	.173	.152	1.14	.261	-.133	.479	
2011 (omitted)	0	.	.	.	.	.	
2012 -0	.566	.471	1.20	.234	-.378	1.511	
2012 -1	.337	.151	2.23	.03	.034	.639	**
2013 -0	.931	.541	1.72	.091	-.154	2.016	*
2013 -1	.456	.252	1.81	.075	-.048	.961	*
2014 -0	1.028	.464	2.22	.031	.097	1.959	**
2014 -1	.607	.323	1.88	.066	-.041	1.255	*
2015 -0	1.45	.631	2.30	.025	.185	2.714	**
2015 -1	.86	.458	1.88	.066	-.059	1.778	*
2016 -0	1.685	.654	2.57	.013	.372	2.997	**
2016 -1	1.183	.427	2.77	.008	.327	2.038	***

WS-Per	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
2017 -0	1.773	.578	3.07	.003	.613	2.932	***
2017 -1	1.182	.346	3.41	.001	.487	1.877	***
2018 -0	2.596	.792	3.28	.002	1.007	4.185	***
2018 -1	1.575	.444	3.54	.001	.684	2.466	***
2019 -0	3.053	.826	3.70	.001	1.397	4.709	***
2019 -1	1.693	.475	3.56	.001	.739	2.646	***
Constant	.291	.342	0.85	.398	-.395	.978	

Mean dependent var	1.462	SD dependent var	3.231
R-squared	0.211	Number of obs	536
F-test	3.137	Prob > F	0.001
Akaike crit. (AIC)	2092.546	Bayesian crit. (BIC)	2169.661

*** *p<.01, ** p<.05, * p<.1*

Table B - 12. Fixed Effect regressions for all 51 nations, interaction indicator for time and landlocked variable

WS-Per	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnCO2	.894	1.401	0.64	.526	-1.92	3.708	
2010b	0	.	.	.	.	.	
2010b	0	.	.	.	.	.	
2011	.207	.195	1.06	.294	-.185	.599	
2011	.127	.132	0.96	.342	-.139	.393	
2012	.612	.569	1.08	.288	-.532	1.756	
2012	.477	.257	1.86	.069	-.039	.993	*
2013	1.042	.641	1.63	.11	-.245	2.328	
2013	.565	.368	1.54	.13	-.173	1.304	
2014	1.148	.596	1.93	.06	-.049	2.344	*
2014	.75	.395	1.90	.063	-.043	1.543	*
2015	1.628	.719	2.26	.028	.183	3.072	**
2015	.982	.522	1.88	.065	-.065	2.03	*
2016	1.949	.733	2.66	.011	.477	3.421	**
2016	1.368	.619	2.21	.032	.125	2.612	**
2017	2.066	.681	3.04	.004	.699	3.434	***
2017	1.411	.638	2.21	.032	.128	2.693	**
2018	3.018	.897	3.36	.001	1.216	4.82	***

2018	1.88	.787	2.39	.021	.299	3.462	**
Hydro	0	0	-0.27	.789	0	0	
ACCESS	-.04	.02	-1.99	.052	-.081	0	*
Constant	-5.2	11.046	-0.47	.64	-27.385	16.986	

Mean dependent var	1.374	SD dependent var	3.076
R-squared	0.211	Number of obs	455
F-test	4.339	Prob > F	0.000
Akaike crit. (AIC)	1704.307	Bayesian crit. (BIC)	1782.593

**** p<.01, ** p<.05, * p<.1*

Table B - 13. Fixed Effect regressions for all 54 nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per
VULNE	-28.79**	-29.52**	-13.94*	-15.76**	-8.403	-7.661	-7.126	-6.970
	(12.99)	(13.94)	(7.752)	(7.855)	(7.699)	(8.797)	(6.390)	(6.370)
AiD232		0.00836***	0.00656***	0.00656***	0.00558***	0.00536**	0.00715**	0.00715**
		(0.0028)	(0.0024)	(0.0023)	(0.0015)	(0.0023)	(0.0034)	(0.0034)
Paris			1.379***	1.561***	1.346***	1.382***	1.180***	1.169***
			(0.315)	(0.380)	(0.354)	(0.348)	(0.276)	(0.269)
Forest%				0.289*		0.517**	0.241*	0.244*
				(0.145)		(0.214)	(0.136)	(0.138)
L. Forest%					0.388**			
					(0.182)			
2012					1.085**	1.307**		
					(0.410)	(0.537)		
DEPLET							-0.0797	-0.0798
							(0.0667)	(0.0667)
CO2Cap								0.235
								(0.788)
Constant	16.70**	17.08**	8.354**	1.409	-6.048	-10.087	-1.494	-1.889
	(6.874)	(7.398)	(4.126)	(6.136)	(7.662)	(9.488)	(5.894)	(6.097)
Observations	536	464	464	464	425	464	403	403
R-squared	0.016	0.039	0.140	0.147	0.179	0.196	0.136	0.136
Number	54	53	53	53	53	53	53	53

VARIABLES	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per	(13) WS-Per	(14) WS-Per
VULNE	-13.19**		-12.86**	-4.267			
	(7.606)		(7.125)	(8.469)			
ND-gain					0.26*		
					(0.151)		
AiD232	0.008***	0.006606***		0.0048***	0.0086***	0.0081***	0.008***
	(0.0018)	(0.0023)		(0.0016)	(0.0028)	(0.0026)	(0.002)
Paris		1.607***	1.413***	1.241***			
		(0.380)	(0.360)	(0.329)			
Forest%	0.188	0.270***	0.265*	0.456**			
	(0.149)	(0.148)	(0.155)	(0.215)			
DEPLET					-0.0887	-0.0929	
					(0.0677)	(0.0695)	
CO2Cap					0.566	0.603	
					(0.812)	(0.835)	
L. Paris	1.553***						
	(0.404)						
L. 2012				1.006***			
				(0.378)			
L. Aid			0.007***				
			(0.003)				
L. ND-gain						0.245*	
						(0.138)	
L. VULNE							-18.965
							(11.71)
Constant	0.188	-6.475	0.597	-9.812	-9.059	-8.359	11.608*
	(0.149)	(4.137)	(6.131)	(9.096)	(5.82)	(5.303)	(6.236)
Observations	425	464	418	425	389	352	425
R-squared	0.158	0.143	0.155	0.187	0.1585	0.146	0.032
Number	53	53	53	53	50	50	53

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 14. Fixed Effect regressions for all 51 nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
VULNE	-45.15***	-45.05***	-18.08	-20.99*	-9.18	-12.80	-9.068	-17.95		-16.388
	(15.57)	(15.91)	(11.58)	(11.50)	(13.88)	(11.53)	(9.880)	(11.29)		(11.219)
AID232		0.00822***	0.00653***	0.0065***	0.0054**	0.0065***	0.00705**	0.0080***	0.0066***	
		(0.0028)	(0.0024)	(0.0023)	(0.0024)	(0.0023)	(0.0034)	(0.0018)	(0.0023)	
Paris			1.383***	1.559***	1.393***	1.453***	1.170***		1.633***	1.414***
			(0.329)	(0.389)	(0.358)	(0.354)	(0.277)		(0.385)	(0.370)
Forest%				0.291**	0.514**	0.316**	0.261*	0.186	0.266*	0.265*
				(0.143)	(0.213)	(0.155)	(0.139)	(0.148)	(0.147)	(0.154)

2012					1.293**					
					(0.550)					
DEPLET						-0.0781	-0.0800			
						(0.0604)	(0.0610)			
CO2Cap							0.206			
							(0.768)			
L. Paris								1.561 ***		
								(0.412)		
l. Aid										0.007 ***
										(0.002)
Constant	25.62 ***	25.38 ***	10.59 *	4.169	-9.169	-0.503	-1.208	5.623	-6.342	2.494
	(8.299)	(8.447)	(6.187)	(7.753)	(11.882)	(7.935)	(7.707)	(7.213)	(4.121)	(7.928)
Observations	506	455	455	455	455	443	400	416	455	410
R-squared	0.025	0.048	0.142	0.150	0.197	0.156	0.137	0.161	0.145	0.157
Number	51	51	51	51	51	50	50	51	51	51

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 15. Random effect regressions for all 54 nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	-9.590*	-7.788	-5.712	-5.658	-4.856	-3.469	-4.314
	(5.214)	(5.318)	(5.054)	(4.954)	(4.702)	(4.510)	(6.800)
AID232		0.00930 ***	0.00751 ***	0.00733 ***	0.0065 **	0.00743 *	0.00742 *
		(0.00300)	(0.00262)	(0.00268)	(0.00281)	(0.00381)	(0.00381)
Paris			1.381***	1.354***	1.081***	1.032***	1.034***
			(0.308)	(0.306)	(0.293)	(0.235)	(0.234)
Forest%				-0.032***	-0.031***	-0.025***	-0.025***
				(0.0112)	(0.0110)	(0.00928)	(0.00884)
2012					1.021**		
					(0.429)		
DEPLET						-0.0529	-0.0531
						(0.0412)	(0.0416)
CO2Cap							-0.0714
							(0.244)
Constant	6.536**	5.469*	3.920	4.812	3.626	3.858	4.365
	(3.003)	(3.056)	(2.911)	(3.057)	(2.701)	(2.722)	(4.058)
Observations	536	464	464	464	464	403	403
Number	54	53	53	53	53	53	53

Robust standard errors in parentheses

VARIABLES	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per
ND-GAIN	0.0523*	0.0687*	0.103**		0.0523*
	(0.0293)	(0.0392)	(0.0464)		(0.0293)
AID232	0.00888***	0.00914***	0.0105***	0.00854***	0.00888***
	(0.00317)	(0.00198)	(0.00221)	(0.00296)	(0.00317)
Paris	1.022***	1.275***		0.968***	1.022***
	(0.233)	(0.284)		(0.225)	(0.233)
Forest%	-0.0200***	-0.0242***	-0.0263***	-0.0223***	-0.0200***
	(0.00662)	(0.00811)	(0.00858)	(0.00755)	(0.00662)
DEPLET	-0.0198			-0.0210	-0.0198
	(0.0226)			(0.0243)	(0.0226)
L. ND-GAIN				0.0488*	
				(0.0290)	
Constant	-0.674	-1.328	-2.179	-0.391	-0.674
	(1.081)	(1.408)	(1.642)	(1.162)	(1.081)
Observations	389	443	443	352	389
Number	50	50	50	50	50

*** p<0.01, ** p<0.05, * p<0.1

Table B - 16. Random effect regressions for all 51 nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
VULNE	-11.72**	-8.801	-6.020	-5.618	-4.879	-3.825	-4.753	-6.245	-6.994	-7.574
	(5.883)	(5.698)	(5.471)	(5.286)	(5.065)	(5.360)	(7.531)	(5.632)	(5.552)	(5.702)
AID232		0.00917***	0.00741***	0.00724***	0.00637**	0.00732***	0.00730*	0.00839***	0.0062***	
		(0.00301)	(0.00263)	(0.00268)	(0.00282)	(0.00264)	(0.00382)	(0.00198)	(0.0022)	
Paris			1.407***	1.384***	1.106***	1.257***	1.034***			
			(0.314)	(0.312)	(0.3001)	(0.284)	(0.232)			
Forest%				-0.0335***	-0.0320***	-0.0266***	-0.0242***	-0.0366***	-0.0394***	-0.0402***
				(0.0116)	(0.0109)	(0.00979)	(0.00935)	(0.0130)	(0.0127)	(0.0131)
2012					1.014**					1.378***
					(0.431)					(0.420)
DEPLET						-0.0576	-0.0593			
						(0.0444)	(0.0456)			
CO2Cap							-0.132			
							(0.275)			
L. Paris								1.455***		
								(0.355)		
L. 2012									1.266***	
									(0.332)	
L. AID232										0.0092

										*** (0.0034)
Constant	7.796** (3.385)	6.066* (3.269)	4.127 (3.150)	4.851 (3.232)	4.857 (3.224)	4.110 (3.118)	4.682 (4.508)	5.447 (3.447)	5.368 (3.338)	5.427 (3.301)
Observations	506	455	455	455	455	443	400	416	416	410
Number	51	51	51	51	51	50	50	51	51	51

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B - 17. Random effect regression on environmental and international variables, the North region excluded

WS-Per	Coef.	Robust St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
VULNE	-3.553	7.657	-0.46	.643	-18.561	11.455	
AID232	.007	.006	1.15	.25	-.005	.018	
Paris	1.161	.282	4.11	0	.608	1.715	***
Forest%	-.115	.057	-2.03	.042	-.226	-.004	**
Forest % Squared	.001	.001	1.67	.095	0	.002	*
DEPLET	-.066	.053	-1.24	.214	-.169	.038	
Constant	5.225	4.826	1.08	.279	-4.233	14.683	

Mean dependent var	1.422	SD dependent var	3.168
Overall r-squared	0.143	Number of obs	395
Chi-square	37.105	Prob > chi2	0.000
R-squared within	0.125	R-squared between	0.149

**** p<.01, ** p<.05, * p<.1*

Table B - 18. Linear regression on forest coverage, the Northern region excluded

WS-Per	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Forest%	-.11	.02	-5.43	0	-.15	-.07	***
Forest % Squared	.001	0	3.58	0	0	.001	***
Constant	3.486	.323	10.81	0	2.852	4.121	***

Mean dependent var	1.448	SD dependent var	3.231
R-squared	0.114	Number of obs	458
F-test	29.203	Prob > F	0.000
Akaike crit. (AIC)	2323.705	Bayesian crit. (BIC)	2336.086

**** p<.01, ** p<.05, * p<.1*

Table B - 19. Random effect regression on forest coverage, the Northern region excluded

WS-Per	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Forest%	-.109	.047	-2.32	.02	-.201	-.017	**
Forest % Squared	.001	0	1.81	.07	0	.002	*
Constant	3.515	1.082	3.25	.001	1.394	5.637	***

Mean dependent var	1.448	SD dependent var	3.231
Overall r-squared	0.113	Number of obs	458
Chi-square	10.764	Prob > chi2	0.005
R-squared within	0.006	R-squared between	0.166

*** $p<.01$, ** $p<.05$, * $p<.1$

Appendix 3. Landlocked nations regressions

Table C - 1. Random Effect regressions for all 16 landlocked nations, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
GDP Growth	-0.00156	-0.00482	-0.00444	0.0205	-0.00540	0.0114
	(0.0162)	(0.0156)	(0.0154)	(0.0207)	(0.0121)	(0.0208)
FTA		-0.317***	-0.151*	-0.139	-0.117	-0.0433
		(0.116)	(0.0818)	(0.0925)	(0.128)	(0.144)
FDIout				1.80e-10**	1.59e-10	0
				(7.00e-11)	(1.42e-10)	(1.72e-10)
RuleLaw						1.807*
						(1.012)
GovEffec						-2.493**
						(1.098)
BUS	0.0559***	0.0564***	0.0571***	0.0647***		
	(0.0121)	(0.0121)	(0.0118)	(0.0180)		
UNEMP			-0.112***			
			(0.0316)			
Corrupt					-0.0262	
					(0.491)	
Constant	-2.501***	-1.779**	-1.333**	-3.324***	1.389**	0.458
	(0.755)	(0.751)	(0.680)	(1.153)	(0.655)	(0.626)
Observations	153	153	153	113	113	113
Number	16	16	16	13	13	13

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C - 2. Fixed Effect regressions for all 16 landlocked nations, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
GDP Growth	-0.000872	-0.00170	-0.00169	0.0270	-0.00261	-0.00959
	(0.0146)	(0.0143)	(0.0143)	(0.0225)	(0.0149)	(0.0197)
BUS	0.0720***	0.0723***	0.0717***	0.0707***		
	(0.0121)	(0.0122)	(0.0121)	(0.0195)		
FTA		-0.0628	-0.102	-0.0235	0.275	0.0641
		(0.0735)	(0.110)	(0.101)	(0.199)	(0.130)
UNEMP			-0.0628			
			(0.123)			
FDIout				1.91e-10***	3.94e-10	-1.70e-10
				(6.24e-11)	(2.72e-10)	(2.95e-10)
Corrupt					2.110	
					(1.964)	
RuleLaw						2.122
						(1.222)
GovEffec						-4.358*
						(2.031)
Constant	-3.559***	-3.428***	-2.806*	-4.082**	1.302	-0.610
	(0.813)	(0.789)	(1.345)	(1.410)	(0.919)	(1.052)
Observations	153	153	153	113	113	113
R-squared	0.368	0.369	0.370	0.366	0.050	0.108
Number	16	16	16	13	13	13

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table C - 3. Fixed Effect regressions for all 16 landlocked nations, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	2.585**	2.248**	3.793***	2.268**	2.234**	2.531**
	(0.947)	(0.889)	(0.866)	(0.900)	(0.872)	(1.026)
Hydro		0.000179	-2.36e-05	0.000169	0.000153	0.000181
		(0.000104)	(8.51e-05)	(0.000109)	(0.000105)	(0.000104)
Fossil			-0.000924 ***			
			(0.000259)			
Fuel-Im			-0.0179	-0.00726	-0.00757	
			(0.0145)	(0.0138)	(0.0135)	
COOK					0.0608	
					(0.0575)	
ACCESS						-0.0163
						(0.0215)
Constant	-18.74**	-16.54**	-27.25***	-16.73**	-17.32**	-18.30**

	(7.258)	(6.726)	(6.500)	(6.855)	(6.590)	(7.538)
Observations	142	142	123	123	123	142
R-squared	0.263	0.280	0.423	0.324	0.333	0.286
Number	16	16	14	14	14	16

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per
lnCO2	1.887*	3.731***	3.319***			3.678***
	(0.956)	(1.139)	(1.006)			(1.163)
Hydro	0.000160	0.000141*	0.00012*	0.000257**	0.000159**	9.12e-06
	(0.000106)	(7.48e-05)	(0.00006)	(8.87e-05)	(6.41e-05)	(0.00006)
Fuel-Im	-0.0104	-0.0134	-0.021*			-0.029
	(0.0138)	(0.00987)	(0.0099)			(0.01934)
COOK						
ACCESS				0.0310*		
				(0.0175)		
AIRPOL	-0.0115		-0.022*		-0.0433***	
	(0.0091)		(0.11)		(0.0143)	
L. AIRPOL						-0.0236*
						(0.0128)
RURAL%		0.303*	0.367**			
		(0.144)	(0.154)			
L. RURAL %						0.44**
						(0.187)
Constant	-11.89	-49.62**	-47.44**	-0.209	7.804***	8.604***
	(7.875)	(17.97)	(15.61)	(0.355)	(2.399)	(2.740)
Observations	123	123	123	158	158	158
R-squared	0.331	0.369	0.391	0.097	0.236	0.244
Number	14	14	14	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C - 4. Random Effect regressions for all 16 landlocked nations, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	0.928*	0.787**	1.645***	1.017**	1.026**	0.787*
	(0.484)	(0.385)	(0.570)	(0.469)	(0.408)	(0.421)
Hydro		9.51e-05	1.37e-05	9.54e-05	4.04e-05	9.10e-05
		(0.000174)	(0.000162)	(0.000174)	(0.000167)	(0.000174)
Fossil			-0.000552***			
			(0.000171)			
Fuel-Im			-0.0213	-0.0165	-0.0211	
			(0.0210)	(0.0217)	(0.0222)	

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
COOK					-0.0406**	
					(0.0160)	
ACCESS						-0.00359
						(0.0144)
AIRPOL						
L. AIRPOL						
RURAL%						
Constant	-6.044*	-5.167*	-10.95***	-6.747**	-6.028**	-5.065*
	(3.545)	(2.725)	(3.989)	(3.178)	(2.719)	(2.905)
Observations	142	142	123	123	123	142
Number	16	16	14	14	14	16

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per
lnCO2	0.862	0.881	1.171**		
	(0.559)	(0.566)	(0.493)		
Hydro	9.49e-05	2.56e-05	6.34e-05	0.000113	0.000136
	(0.000177)	(0.000140)	(0.000148)	(0.000140)	(0.000143)
Fossil				-0.000158	2.33e-06
				(0.000151)	(0.000127)
Fuel-Im	-0.0177	-0.0298	-0.0205		
	(0.0222)	(0.0203)	(0.0205)		
COOK					-0.0225***
					(0.00639)
ACCESS					
AIRPOL	-0.00427			-0.0148**	
	(0.00870)			(0.00737)	
L. AIRPOL		-0.00279			
		(0.00878)			
RURAL%			0.0582**		
			(0.0260)		
Constant	-4.840	-4.785	-11.96**	3.416**	1.161***
	(4.780)	(5.076)	(5.099)	(1.505)	(0.289)
Observations	123	109	123	158	158
Number	14	14	14	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C - 5. Fixed Effect regressions for all 16 landlocked nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per
VULNE	-63.22**	-63.37**	-49.75*	-49.91*	-38.81	-35.13	-36.24				
	(26.68)	(24.92)	(24.06)	(24.50)	(24.80)	(21.52)	(21.68)				
AID232		0.0181*	0.0120*	0.0122*	0.0134*	0.0132	0.0121	0.0266*	0.0148	0.0219*	0.0139
		(0.00876)	(0.00672)	(0.00683)	(0.0065)	(0.00932)	(0.00857)	(0.0132)	(0.00940)	(0.0112)	(0.00949)
Paris			0.609*	0.590	0.476	0.401	0.427				
			(0.319)	(0.368)	(0.366)	(0.424)	(0.424)				
Forest%				-0.0353	0.0199	-0.0959	-0.152				
				(0.224)	(0.189)	(0.288)	(0.295)				
2012					0.630						
					(0.388)						
DEPLET						-0.126*	-0.137*	-0.133**	-0.0602	-0.0801	
						(0.069)	(0.069)	(0.052)	(0.047)	(0.052)	
CO2Cap							-0.563**	-0.167	-0.672***	-0.585**	
							(0.225)	(0.111)	(0.216)	(0.208)	
L. VULNE								-20.19			
								(19.95)			
ND-gain									0.469***		0.579***
									(0.111)		(0.140)
L. ND-gain										0.324***	
										(0.105)	
L.DEPLET											0.0479
											(0.050)
L.CO2Cap											-0.761***
											(0.233)
Constant	37.30**	37.32**	29.37*	30.21	22.19	24.08	26.25	13.73	-15.07***	-9.542**	-19.74***
	(15.25)	(14.28)	(13.83)	(17.51)	(17.32)	(17.53)	(17.95)	(11.30)	(3.899)	(3.841)	(5.121)
Observations	158	142	142	142	142	123	123	112	117	106	119
R-squared	0.131	0.208	0.258	0.259	0.294	0.272	0.281	0.216	0.335	0.282	0.313
Number	16	16	16	16	16	16	16	16	14	14	14

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C - 6. Random Effect regressions for all 16 landlocked nations, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per

VULNE	3.026	4.268	5.770	2.242	3.246	2.816	3.111	3.021	-2.897
	(5.821)	(4.921)	(4.374)	(5.678)	(5.347)	(5.161)	(5.287)	(5.178)	(7.406)
AID232		0.0257**	0.0167**	0.0169**	0.224***	0.0182***	0.0255**	0.0209	0.0182
		(0.0107)	(0.00714)	(0.00713)	(0.0067)	(0.006)	(0.0105)	(0.0130)	(0.0119)
Paris			0.823**	0.798**		0.547		0.663**	0.705**
			(0.326)	(0.320)		(0.362)		(0.297)	(0.294)
L. Paris					0.651*				
					(0.349)				
Forest%				-0.0299**	-0.0296**	-0.0279**	-0.0289**	-0.0283**	-0.0342*
				(0.0139)	(0.1389)	(0.0143)	(0.013)	(0.0142)	(0.0175)
2012						0.837**			
						(0.381)			
L. 2012							0.760***		
							(0.267)		
DEPLET								-0.0209	-0.0407
								(0.0355)	(0.0382)
CO2Cap									-0.636*
									(0.329)
Constant	-0.565	-1.529	-2.589	0.0503	-0.030	-0.993	-0.789	-0.284	3.685
	(3.422)	(2.873)	(2.576)	(3.607)	(3.417)	(3.221)	(3.301)	(3.202)	(4.729)
Observations	158	142	142	142	131	142	131	123	123
Number	16	16	16	16	16	16	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 4. Regional regressions

Table D - 1. Fixed Effect regressions for the Northern region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
Corrupt	5.786					
	(6.029)					
Account	0.656	0.700	0.800**	1.099*	0.941*	1.118
	(0.353)	(0.490)	(0.309)	(0.431)	(0.385)	(0.633)
GovEffec		-0.868				
		(1.738)				
GDP Growth			0.0420	-0.00398	0.0717*	0.0671
			(0.0235)	(0.00261)	(0.0317)	(0.0338)
BUS			0.811		0.824	0.834
			(0.546)		(0.501)	(0.506)
FTA				1.061***		
				(0.107)		
FDIout					2.46e-09	2.28e-09
					(1.57e-09)	(1.71e-09)
UNEMP						-61.75
						(41.58)
Constant	6.948	2.136	-61.57	-2.280***	-63.64	-0.193
	(4.281)	(1.430)	(43.58)	(0.126)	(40.61)	(0.310)
Observations	58	58	55	58	49	49
R-squared	0.23	0.09	0.64	0.29	0.68	0.67
Number	6	6	6	6	6	6

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 2. Random Effect regressions for the Northern region, Political variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
Corrupt	3.667					
	(3.280)					
Account	0.449	1.227***	0.135			
	(0.510)	(0.419)	(0.602)			
GovEffec		0.897*	-1.925***	-1.791***		-1.205**
		(0.541)	(0.680)	(0.681)		(0.616)
RuleLaw					-1.837***	
					(0.603)	
GDP Growth			0.00759	0.00754	0.000499	0.05089***
			(0.0312)	(0.0306)	(0.0311)	(0.00524)
BUS			0.857***	0.861***	0.842***	0.830***
			(0.247)	(0.233)	(0.232)	(0.174)

FTA			-0.644*	-0.651**	-0.553*	-0.715***
			(0.330)	(0.303)	(0.302)	(0.255)
UNEMP			-0.103	-0.0903**	-0.0331	
			(0.0874)	(0.0411)	(0.0724)	
FDIout						2.24e-09***
						(8.49e-10)
Constant	5.232*	3.911**	-62.39***	-62.87***	-62.58***	-61.66***
	(2.967)	(1.685)	(19.42)	(17.81)	(18.04)	(13.075)
Observations	58	58	55	55	55	49
Number	6	6	6	6	6	6

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 3. Fixed Effect regressions for the Northern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
lnCO2	5.441	5.564	18.99	9.729	-1.401	4.325	2.323	2.596	-1.366
	(4.837)	(4.111)	(10.20)	(6.428)	(2.114)	(2.736)	(2.298)	(2.884)	(5.125)
Hydro		-0.00112	-0.000882	-0.00107*	-0.000214	-0.00136*	0.000913	1.84e-05	-0.000476
		(0.000743)	(0.000654)	(0.000462)	(0.00122)	(0.000627)	(0.000776)	(0.000361)	(0.000545)
Fossil			-8.77e-05						
			(4.71e-05)						
Fuel-Im			-0.218	-0.245	-0.243*		-0.0583	-0.0553*	-0.210*
			(0.154)	(0.173)	(0.0928)		(0.0399)	(0.0253)	(0.0890)
COOK					4.198**				
					(1.106)				
ACCESS						0.225			
						(0.179)			
AIRPOL							-0.962***		
							(0.0558)		
L. AIRPOL								-0.960***	
								(0.0454)	
RURAL%									-1.149
									(0.687)
Constant	-58.31	-55.33	-200.4	-100.1	-392.6*	-60.39	-23.15	-22.60	66.26
	(53.46)	(43.21)	(112.7)	(71.99)	(137.9)	(39.19)	(27.24)	(33.41)	(68.96)
Observations	52	52	39	39	35	52	39	34	39
R-squared	0.096	0.187	0.547	0.497	0.769	0.294	0.896	0.922	0.666
Number	6	6	5	5	4	6	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 4. Random Effect regressions for the Northern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
lnCO2	2.766*	-0.233	-1.783	1.343	-1.281**	-3.221**	0.245	-3.598	0.025
	(1.592)	(1.810)	(1.330)	(1.606)	(0.517)	(1.582)	(1.394)	(2.719)	(1.601)
Hydro	0.000638	-3.40e-05	0.000184	-0.000371	0.000126*	0.000423*	-0.000824**	0.0005	-0.0009**
	(0.000590)	(0.000266)	(0.000177)	(0.000351)	(6.54e-05)	(0.000220)	(0.000403)	(0.004)	(0.0004)
Fossil	-0.000115								
	(8.14e-05)								
Fuel-Im	0.0639	-0.128	-0.0701		-0.0553	-0.327	0.118	-2.909	0.099
	(0.163)	(0.124)	(0.186)		(0.0711)	(0.247)	(0.0921)	(0.369)	(0.137)
COOK			-1.950***						
			(0.602)						
ACCESS				0.0880					
				(0.0891)					
AIRPOL					0.337***				
					(0.0163)				
L. AIRPOL						0.552***			
						(0.127)			
RURAL%							0.336*		
							(0.173)		
L. RURAL%									0.394**
									(0.192)
L. COOK								-2.999**	
								(1.411)	
Constant	-25.14**	6.631	216.1***	-19.10	16.06***	40.28**	-11.85	342.80*	-10.965
	(12.65)	(18.77)	(74.86)	(21.98)	(6.224)	(20.39)	(15.91)	(173.84)	(17.45)
Observations	39	39	35	52	39	34	39	31	34
Number	5	5	4	6	5	5	5	4	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 5. Fixed Effect regressions for the Northern region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	-12.59	-52.15	-222.4	-385.5	-375.3	-223.5	-214.5
	(49.13)	(250.9)	(306.7)	(294.9)	(295.9)	(262.8)	(252.1)
AID232		0.00874**	0.00426*	0.00215**	0.000224*	0.00655***	0.00658***
		(0.00195)	(0.00180)	(0.000552)	(0.00085)	(0.000662)	(0.000649)
Paris			2.680	3.575	3.356	2.184	2.030

			(2.089)	(1.814)	(1.841)	(1.401)	(1.373)
Forest%				12.62	12.03	8.829	8.517
				(7.380)	(7.489)	(6.531)	(6.256)
2012					0.674		
					(0.701)		
DEPLET						-0.0385	0.0170
						(0.0572)	(0.0565)
CO2Cap							3.374
							(2.310)
Constant	7.544	24.53	97.95	99.39	97.6	49.27	39.45
	(21.31)	(109.0)	(132.7)	(97.14)	(96.63)	(89.65)	(85.68)
Observations	58	48	48	48	48	42	42
R-squared	0.001	0.112	0.339	0.526	0.535	0.550	0.567
Number	6	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 6. Random Effect regressions for the Northern region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	-14.17	-11.58	-14.38	-19.38***	-20.34***	-14.95***	-19.77***
	(12.06)	(7.830)	(10.60)	(3.072)	(3.832)	(0.957)	(7.495)
AID232		0.0111***	0.00684***	0.00929***	0.00935***	0.0104***	0.0100***
		(0.00218)	(0.00197)	(0.00281)	(0.00321)	(0.00103)	(0.000929)
Paris			2.163	1.995	1.680	1.307	1.437
			(1.631)	(1.654)	(1.551)	(1.232)	(1.290)
Forest%				0.412***	0.409***	0.301***	0.252***
				(0.0732)	(0.0774)	(0.0271)	(0.0764)
DEPLET						-0.0324	-0.0139
						(0.0227)	(0.0452)
CO2Cap							-0.626
							(0.946)
2012					1.223		
					(0.762)		
Constant	8.251	6.728	7.508	7.274***	6.792***	6.097***	9.716*
	(6.380)	(4.266)	(5.146)	(0.973)	(0.975)	(0.410)	(5.465)
Observations	58	48	48	48	48	42	42
Number	6	5	5	5	5	5	5

VARIABLES	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per
ND-GAIN	0.192***	0.236***	0.254***	
	(0.0360)	(0.0656)	(0.0687)	
AID232	0.0107***	0.00907***	0.00953***	0.0105***
	(0.000961)	(0.00295)	(0.000548)	(0.00168)
Paris	1.293	1.857		1.170
	(1.202)	(1.597)		(1.175)

Forest%	0.298***	0.357***	0.365***	0.319***
	(0.0520)	(0.0739)	(0.0570)	(0.0529)
DEPLET	0.0311			0.0300
	(0.0316)			(0.0281)
L. ND-GAIN				0.208***
				(0.0368)
Constant	-9.588***	-11.61***	-11.83***	-10.25***
	(2.123)	(3.302)	(3.045)	(2.072)
Observations	42	48	48	38
Number	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 7. Fixed Effect regressions for the Western region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(6) WS-Per
GDP Growth	0.00565	0.00521	0.0153	0.0105	0.0347	0.00865	0.00265
	(0.0192)	(0.0194)	(0.0284)	(0.0413)	(0.0625)	(0.0151)	(0.0193)
BUS	0.0622*	0.0639*	0.0648*	0.0622*			0.0529*
	(0.0337)	(0.0345)	(0.0357)	(0.0333)			(0.0306)
FTA		-0.839	-0.378	-0.714	0.290	0.135**	-1.645**
		(0.924)	(1.006)	(0.828)	(0.371)	(0.0610)	(0.809)
UNEMP			0.246				0.331
			(0.459)				(0.334)
FDIout				-5.46e-10	-1.11e-09		
				(8.71e-10)	(1.22e-09)		
Corrupt					0.490		
					(1.708)		
RuleLaw							2.393
							(3.260)
Constant	-1.979	-0.699	-2.933	-0.579	2.228	2.109***	-1.066
	(2.420)	(2.149)	(5.171)	(2.232)	(1.735)	(0.128)	(3.754)
Observations	156	156	156	147	151	160	156
R-squared	0.127	0.129	0.134	0.129	0.010	0.000	0.142
Number	16	16	16	16	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 8. Random Effect regressions for the Western region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
GDP Growth	0.000852	0.00225	0.0206	0.00383	-0.0198	-0.00839	0.00265
	(0.0194)	(0.0202)	(0.0272)	(0.0438)	(0.0587)	(0.0199)	(0.0193)
BUS	0.0622*	0.0653*	0.0661*	0.0646*		0.0551*	0.0529*

	(0.0330)	(0.0340)	(0.0345)	(0.0332)		(0.0302)	(0.0306)
FTA		-1.655*	-0.993	-1.726*	-1.939**	-2.106**	-1.645**
		(0.951)	(0.792)	(0.931)	(0.779)	(0.887)	(0.809)
UNEMP			0.419			0.246	0.331
			(0.443)			(0.289)	(0.334)
FDIout				-6.43e-10	-9.00e-10		
				(8.40e-10)	(1.16e-09)		
Corrupt					3.850**		
					(1.762)		
GovEffec						4.477**	
						(2.102)	
RuleLaw							3.364**
							(1.520)
Constant	-2.023	0.520	-3.041	0.829	8.190***	4.289	1.736
	(2.036)	(2.058)	(3.862)	(2.096)	(2.544)	(2.972)	(2.858)
Observations	156	156	156	147	151	156	156
Number	16	16	16	16	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 9. Fixed Effect regressions for the Western region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
lnCO2	4.722	4.747	6.397	5.952	5.238	3.669	3.306
	(3.014)	(3.030)	(4.072)	(3.810)	(4.095)	(3.255)	(3.116)
Hydro		-0.000134	-0.000106	-0.000102	-0.000224	-7.25e-05	-6.24e-05
		(0.000138)	(0.000147)	(0.000159)	(0.000367)	(0.000226)	(0.000434)
Fossil			-0.000208				
			(0.000205)				
Fuel-Im			-0.00618	-0.0116	-0.0171		-0.0146
			(0.0196)	(0.0194)	(0.0269)		(0.0262)
COOK					0.230		
					(0.312)		
ACCESS						0.0666	
						(0.0711)	
AIRPOL							-0.0789
							(0.0606)
Constant	-35.31	-35.36	-49.08	-46.06	-43.85	-29.58	-13.44
	(23.91)	(23.99)	(32.94)	(31.27)	(32.63)	(25.00)	(26.74)
Observations	144	144	114	114	114	144	114
R-squared	0.096	0.096	0.125	0.119	0.139	0.108	0.160
Number	16	16	14	14	14	16	14

VARIABLES	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per	(13) WS-Per	(14) WS-Per
lnCO2	4.384	0.124					
	(3.349)	(3.572)					
Hydro	-9.63e-05	-0.000103	-0.000310				
	(0.000412)	(0.000580)	(0.000616)				
Fossil						-0.000180	-0.00032
						(0.000153)	(0.000253)
Fuel-Im	0.00425	-0.0308	-0.0175				
	(0.0300)	(0.0300)	(0.0284)				
ACCESS						0.158*	
						(0.0835)	
AIRPOL							-0.092*
							(0.0488)
L. AIRPOL	-0.0639			-0.0793*			
	(0.0506)			(0.0434)			
RURAL%		-0.829	-0.829*				
		(0.553)	(0.442)				
L. ACCESS					0.119*		
					(0.0686)		
Constant	-24.34	48.55	49.59*	14.35**	-2.236	-3.678	-16.79
	(26.34)	(52.70)	(24.75)	(6.432)	(2.794)	(3.093)	(7.808)
Observations	102	114	126	144	144	160	160
R-squared	0.182	0.217	0.235	0.349	0.136	0.195	0.435
Number	14	14	14	16	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 10. Random Effect regressions for the Western region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per
Ln CO2	0.409	1.017	1.242	0.681	-0.184
	(1.041)	(1.378)	(2.467)	(1.740)	(0.758)
LOCK		-0.766	-1.406	-1.122	1.823***
		(1.518)	(1.858)	(1.742)	(0.673)
Hydro		-0.000524	-0.000442	-0.000507	-0.000263
		(0.000388)	(0.000344)	(0.000450)	(0.000337)
Fossil			-0.000166		
			(0.000248)		
Fuel-Im			-0.0247	-0.0286*	-0.0440**
			(0.0199)	(0.0172)	(0.0214)
COOK					0.188***
					(0.0338)
Constant	-1.083	-5.181	-5.806	-1.669	1.782
	(8.475)	(10.67)	(19.38)	(14.14)	(5.721)
Observations	144	144	114	114	114
Number	16	16	14	14	14

VARIABLES	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
Ln CO2	-0.273	-0.608	-0.720	0.356
	(1.195)	(0.755)	(0.889)	(1.303)
LOCK	2.196	3.449**	3.441*	9.376
	(1.452)	(1.711)	(1.799)	(6.011)
Hydro	-0.000493	-0.000594*	-0.000537	-0.000629*
	(0.000413)	(0.000331)	(0.000356)	(0.00026)
Fuel-Im		-0.0298	-0.0136	-0.0219*
		(0.0217)	(0.0201)	(0.020)
ACCESS	0.129*			
	(0.0699)			
AIRPOL		-0.0840***		
		(0.0230)		
L.AIRPOL			-0.0887***	
			(0.0253)	
RURAL				-0.518**
				(0.262)
Constant	-0.787	19.91***	21.57***	30.93*
	(8.014)	(5.517)	(6.699)	(14.50)
Observations	144	114	102	126
Number	16	14	14	14

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 11. Fixed Effect regressions for the Western region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
VULNE	-43.42	-38.54	42.61	36.79	60.14	46.39
	(35.12)	(31.34)	(51.47)	(49.25)	(54.84)	(50.81)
AID232		0.0266	0.0178	0.0194	0.0158	0.00813
		(0.0450)	(0.0391)	(0.0383)	(0.0335)	(0.0442)
Paris			2.015**	2.306**	2.216**	1.260**
			(0.802)	(1.062)	(0.960)	(0.553)
Forest%				0.370	1.007	0.0405
				(0.403)	(0.704)	(0.286)
2012					2.676	
					(1.686)	
DEPLET						-0.423
						(0.364)
Constant	26.59	23.59	-22.31	-29.81	-63.20	-21.32
	(19.58)	(17.37)	(28.91)	(34.20)	(47.10)	(29.32)
Observations	160	148	148	148	148	130
R-squared	0.009	0.026	0.116	0.122	0.140	0.174
Number	16	16	16	16	16	16

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
VULNE	50.07			
	(50.21)			
AID232	-0.00397	0.0261**	0.0260**	0.0458
	(0.0278)	(0.0107)	(0.0103)	(0.0294)
Paris	0.895	-0.237		1.150**
	(0.902)	(0.708)		(0.412)
Forest%	0.124	0.280	0.349	
	(0.304)	(0.227)	(0.255)	
2012				
DEPLET	-0.391	-0.432*	-0.421*	
	(0.286)	(0.235)	(0.215)	
CO2Cap	10.89	19.63**	19.13***	
	(15.70)	(6.789)	(5.829)	
ND-GAIN		0.256*	0.246**	0.257
		(0.126)	(0.108)	(0.198)
Constant	-30.19	-19.21**	-20.99*	-8.834
	(28.04)	(7.845)	(9.859)	(7.502)
Observations	130	122	122	139
R-squared	0.200	0.532	0.531	0.244
Number	16	15	15	15

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 12. Random Effect regressions for the Western region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	-28.29	-25.85	-16.78	-14.59	-13.79	-4.545	20.08
	(19.38)	(19.74)	(20.62)	(20.65)	(20.69)	(18.84)	(24.49)
AID232		0.0298	0.0212	0.0252	0.0210	0.0135	-0.00431
		(0.0461)	(0.0393)	(0.0390)	(0.0389)	(0.0416)	(0.0347)
Paris			1.597***	1.481***	0.964*	0.973***	0.797**
			(0.586)	(0.556)	(0.585)	(0.356)	(0.329)
Forest%				-0.0637**	-0.0624**	-0.0551	-0.0445*
				(0.0314)	(0.0302)	(0.0369)	(0.0248)
2012					1.761		
					(1.283)		
DEPLET						-0.302	-0.202
						(0.230)	(0.180)
CO2Cap							10.77**
							(5.244)
Constant	18.15	16.47	10.92	11.52	9.85	8.693	-10.27
	(11.45)	(11.87)	(12.45)	(12.60)	(11.87)	(10.46)	(14.61)
Observations	160	148	148	148	148	130	130
Number	16	16	16	16	16	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 13. Fixed Effect regressions for the Southern region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per
GDP Growth	-0.133	-0.0221	-0.00275	-0.0410	-0.0474	-0.0365	-0.00253	0.00550
	(0.120)	(0.0373)	(0.0302)	(0.0392)	(0.0311)	(0.0290)	(0.0307)	(0.0379)
BUS	0.0513	-0.0537	0.0894**	-0.0400			0.0863	0.0734**
	(0.113)	(0.105)	(0.0309)	(0.122)			(0.0445)	(0.0160)
FTA		0.741	0.597	0.822*	0.815*	0.730*	0.602*	0.619*
		(0.353)	(0.286)	(0.350)	(0.321)	(0.318)	(0.271)	(0.264)
UNEMP			0.355				0.356	0.302
			(0.269)				(0.271)	(0.264)
FDIout				1.28e-10 **	2.03e-10 ***			
				(0)	(0)			
Corrupt					4.704*	3.999		
					(1.964)	(2.104)		
L. FDIout						2.29e-10 ***		
						(0)		
Account								2.780***
								(0.519)
RuleLaw							0.208	
							(2.774)	

Constant	-2.512	1.610	-16.55*	0.293	-3.678	-3.132	-16.36	-14.40*
	(8.480)	(7.878)	(6.669)	(9.336)	(1.862)	(1.770)	(8.312)	(6.079)
Observations	50	50	50	45	45	41	50	50
R-squared	0.091	0.314	0.378	0.378	0.424	0.418	0.378	0.393
Number	5	5	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 14. Random Effect regressions for the Southern region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
GDP Growth	-0.146	-0.0212	-0.00665	0.00124	-0.0219	-0.0342	-0.0181
	(0.128)	(0.0341)	(0.0370)	(0.0555)	(0.0597)	(0.0555)	(0.0662)
BUS	0.0129	-0.0549	-0.0502	-0.0501			
	(0.0564)	(0.0597)	(0.0644)	(0.0361)			
FTA		0.750**	0.875**	0.973**	1.083***		1.054***
		(0.352)	(0.398)	(0.427)	(0.394)		(0.406)
UNEMP			-0.0229				
			(0.114)				
FDIout				2.08e-10***	1.81e-10***	1.81e-10***	
				(7.70e-11)	(6.15e-11)	(6.95e-11)	
Corrupt					1.157	1.283	1.141
					(0.707)	(0.794)	(0.771)
L. FTA						1.137***	
						(0.381)	
L. FDIout							2.23e-10***
							(8.09e-11)
Constant	0.425	1.661	1.184	0.142	-4.243**	-4.235***	-4.147**
	(4.140)	(4.425)	(5.631)	(2.542)	(1.661)	(1.447)	(1.702)
Observations	50	50	50	45	45	40	41
Number	5	5	5	5	5	5	5

VARIABLES	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per
GDP Growth	-0.0268	-0.0337	-0.0163	-0.0329
	(0.0330)	(0.0288)	(0.0435)	(0.0265)
BUS	-0.0760***	-0.132***	-0.108***	-0.146***
	(0.0236)	(0.0199)	(0.0128)	(0.0358)
FTA	0.968***	0.879***	0.967***	0.837***
	(0.296)	(0.253)	(0.217)	(0.249)
UNEMP	0.0993	0.117	0.294**	0.105
	(0.0848)	(0.0712)	(0.143)	(0.0731)
Account		1.128***		1.489***
		(0.183)		(0.229)
GovEffec	2.016***	0.714*		

	(0.361)	(0.370)		
RuleLaw			3.689***	
			(0.765)	
Constant	0.110	4.273***	-2.112	5.765**
	(1.716)	(1.047)	(2.502)	(2.509)
Observations	50	50	50	50
Number	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 15. Fixed Effect regressions for the Southern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	1.518	1.529	1.991	1.697	1.473	1.791
	(1.842)	(1.851)	(1.707)	(2.027)	(1.330)	(1.305)
Hydro		0.000289	0.000350	0.000281	0.000370	
		(0.000944)	(0.000966)	(0.000947)	(0.000870)	
Fossil			-0.000211***			-0.000166**
			(1.21e-05)			(4.88e-05)
Fuel-Im			-0.00745	-0.0367	-0.0341	-0.0127
			(0.00538)	(0.0535)	(0.0382)	(0.00922)
COOK					0.189	0.105
					(0.157)	(0.129)
Constant	-12.68	-13.17	-7.303	-14.13	-22.21	-12.62
	(16.46)	(15.96)	(14.45)	(17.21)	(16.48)	(18.83)
Observations	45	45	45	45	45	45
R-squared	0.030	0.034	0.252	0.046	0.186	0.280
Number	5	5	5	5	5	5

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per
lnCO2	1.063	0.924	0.259	-0.0359	-5.001	-5.104
	(1.555)	(1.016)	(1.516)	(1.714)	(2.495)	(3.218)
Hydro	0.000329		0.000330	0.000443	0.000160	0.000160
	(0.000914)		(0.000880)	(0.00104)	(0.000734)	(0.000717)
Fossil		-0.000191***				
		(1.98e-05)				
Fuel-Im		-0.00377	-0.0270	-0.0121	0.0148	0.0579
		(0.0109)	(0.0487)	(0.0733)	(0.0272)	(0.0477)
COOK						
ACCESS	0.0253					
	(0.0270)					
AIRPOL		-0.0307	-0.0430			

		(0.0353)	(0.0418)			
L. AIRPOL				-0.0503		
				(0.0503)		
RURAL%					-0.811**	
					(0.233)	
L. RURAL%						-0.890**
						(0.253)
Constant	-10.49	4.315	2.208	5.293	89.52*	94.62*
	(14.15)	(9.624)	(14.79)	(17.18)	(34.45)	(42.32)
Observations	45	45	45	40	45	40
R-squared	0.044	0.287	0.132	0.132	0.534	0.519
Number	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 16. Random Effect regressions for the Southern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per
lnCO2	0.235***	-0.0897	0.465	-0.00860	-0.222	-0.118	-0.233	-0.562
	(0.0851)	(0.292)	(0.421)	(0.232)	(0.445)	(0.286)	(0.395)	(0.576)
LOCK		-2.964***	-1.854	-2.861***	-2.951***	-2.968***	-2.325**	-2.159*
		(0.614)	(1.167)	(0.731)	(0.739)	(0.637)	(1.128)	(1.113)
Hydro		-0.000232	0.000471	-0.000278	-0.000266	-0.000226	-5.85e-05	0.000337
		(0.000495)	(0.000813)	(0.000469)	(0.000490)	(0.000497)	(0.000578)	(0.000800)
Fossil			-2.05e-05					
			(1.59e-05)					
Fuel-Im			-0.0275	-0.0286	-0.0340		-0.0364	-0.0350
			(0.0399)	(0.0400)	(0.0452)		(0.0504)	(0.0502)
COOK					0.0274			
					(0.0367)			
ACCESS						0.00357		
						(0.00825)		
AIRPOL							-0.00850	
							(0.0102)	
RURAL%								-0.0338
								(0.0307)
Constant	-1.223	3.770**	-1.433	3.464***	4.048**	3.816**	5.695*	9.099
	(0.977)	(1.559)	(3.804)	(1.313)	(1.939)	(1.569)	(3.367)	(5.557)
Observations	45	45	45	45	45	45	45	45
Number	5	5	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 17. Fixed Effect regressions for the Southern region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
VULNE	-133.6	-156.7	-76.23	-78.86	-66.25	-83.85	-71.23		
	(73.08)	(75.93)	(76.87)	(80.22)	(110.98)	(62.36)	(42.14)		
AID232		-0.00620	-0.00190	-0.00188	-0.00194	0.00117	-0.00112		0.00127
		(0.00300)	(0.00512)	(0.00527)	(0.00502)	(0.00225)	(0.00298)		(0.00316)
Paris			1.502	1.564	1.576	1.695	0.696*	0.946**	0.928***
			(0.914)	(0.988)	(1.002)	(0.907)	(0.265)	(0.318)	(0.198)
Forest%				0.201	0.314	0.275	-3.886	-3.599	-4.329
				(1.486)	(1.721)	(1.395)	(2.275)	(2.116)	(2.677)
2012					0.260				
					(0.816)				
DEPLET						0.181	0.202	0.239	0.300
						(0.398)	(0.309)	(0.379)	(0.340)
CO2Cap							-3.212*	-2.667*	-3.307*
							(1.305)	(1.097)	(1.417)
Constant	64.42	74.60	36.24	34.44	26.64	34.97	103.0*	65.81	76.36
	(34.70)	(35.59)	(36.07)	(40.30)	(63.51)	(33.47)	(44.88)	(36.48)	(44.57)
Observations	50	40	40	40	40	36	36	45	36
R-squared	0.156	0.190	0.339	0.340	0.342	0.337	0.501	0.427	0.474
Number	5	5	5	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 18. Random Effect regressions for the Southern region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	-28.90*	-31.87*	-27.21	-14.52**	-14.1**	-14.56***	-58.80
	(14.82)	(16.96)	(18.14)	(6.823)	(6.809)	(5.148)	(38.83)
AID232		-0.00418	-0.000726	0.000501	0.000235	0.000243	0.00192
		(0.00396)	(0.00460)	(0.00324)	(0.00306)	(0.00319)	(0.00280)
Paris			1.713*	1.774**	1.618**	1.583	1.737*
			(0.944)	(0.880)	(0.813)	(0.991)	(0.893)
Forest%				-0.0516	-0.0514	-0.0706	-0.0393
				(0.0549)	(0.0558)	(0.0492)	(0.0330)
2012					0.447		
					(0.295)		
DEPLET						-0.306	-0.188
						(0.197)	(0.172)
CO2Cap							-0.605
							(0.511)
Constant	14.70*	16.14*	13.15	7.971***	7.819***	9.127***	30.95
	(7.530)	(8.576)	(9.162)	(2.592)	(2.596)	(2.406)	(20.13)
Observations	50	40	40	40	40	36	36
Number	5	5	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 19. Fixed Effect regressions for the Eastern region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per
GDP Growth	0.0179	0.0210	0.0237	0.0497	0.0346
	(0.0273)	(0.0276)	(0.0262)	(0.0519)	(0.0259)
BUS	0.0821***	0.0786**	0.0781**	0.117	
	(0.0275)	(0.0293)	(0.0295)	(0.0897)	
FTA		0.194	0.0806	0.201	1.105***
		(0.281)	(0.280)	(0.452)	(0.318)
UNEMP			-0.151		
			(0.166)		
FDIout				7.44e-11	4.53e-10
				(1.91e-10)	(4.27e-10)
Corrupt					3.042
					(2.002)
Constant	-4.703**	-4.900**	-3.865*	-8.466	-0.290
	(2.018)	(2.049)	(2.193)	(6.248)	(0.401)
Observations	155	155	145	111	111
R-squared	0.165	0.168	0.170	0.156	0.101
Number	18	18	17	13	13

VARIABLES	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
GDP Growth	0.0288	0.0267	0.0267	0.0234
	(0.0348)	(0.0209)	(0.0209)	(0.0223)
BUS	0.0739**	0.0761**	0.0761**	0.0770**
	(0.0278)	(0.0284)	(0.0284)	(0.0304)
FTA	0.151	0.189	0.189	0.0590
	(0.279)	(0.263)	(0.263)	(0.284)
UNEMP	-0.138	-0.152	-0.152	-0.159
	(0.176)	(0.153)	(0.153)	(0.155)
Account		-1.210*	-1.210*	
		(0.688)	(0.688)	
GovEffec				-0.838
				(0.908)
RuleLaw	1.045			
	(1.239)			
Constant	-3.138	-4.755*	-4.755*	-4.321**
	(2.242)	(2.589)	(2.589)	(1.963)
Observations	145	145	145	145
R-squared	0.180	0.184	0.184	0.174
Number	17	17	17	17

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 20. Random Effect regressions for the Eastern region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per
GDP Growth	0.0148	0.0134	0.0168	-0.00543	-0.0238
	(0.0215)	(0.0209)	(0.0195)	(0.0306)	(0.0169)
BUS	0.0418**	0.0431**	0.0445**	0.0528**	
	(0.0200)	(0.0202)	(0.0205)	(0.0220)	
FTA		-0.122	-0.192	0.0376	0.227
		(0.181)	(0.190)	(0.0845)	(0.158)
UNEMP			-0.0386		
			(0.109)		
FDIout				0	9.94e-11
				(3.78e-10)	(3.53e-10)
Corrupt					0.230
					(0.372)
Constant	-1.713	-1.556	-1.287	-2.985**	0.701
	(1.478)	(1.470)	(1.483)	(1.360)	(0.441)
Observations	155	155	145	111	111
Number	18	18	17	13	13

VARIABLES	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
GDP Growth	0.0285	0.0264*	0.0198	0.0237
	(0.0175)	(0.0160)	(0.0168)	(0.0180)
BUS	0.0537**	0.0596***	0.0528**	0.0574***
	(0.0209)	(0.0216)	(0.0209)	(0.0219)
FTA	-0.101	0.0305	-0.160	0.0194
	(0.212)	(0.212)	(0.209)	(0.206)
UNEMP	-0.0777	-0.0492	-0.0622	-0.0369
	(0.0978)	(0.0917)	(0.0895)	(0.0999)
Account		-1.215**		-1.343***
		(0.521)		(0.442)
GovEffec	-0.966**	-0.295		
	(0.413)	(0.433)		
RuleLaw			-0.638	
			(0.561)	
Constant	-2.752	-3.933**	-2.285	-3.666**
	(1.765)	(1.703)	(1.843)	(1.712)
Observations	145	145	145	145
Number	17	17	17	17

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 21. Fixed Effect regressions for the Eastern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
lnCO2	2.445**	1.642**	2.139**	1.171	0.713	1.143	0.973	0.829	1.397
	(0.882)	(0.701)	(0.776)	(0.667)	(0.840)	(1.022)	(0.940)	(0.947)	(1.196)
Hydro		0.000179***	4.44e-05	0.000142**	0.000110*	0.000178**	0.000147*	6.80e-05	0.000138**
		(5.86e-05)	(6.75e-05)	(6.52e-05)	(6.19e-05)	(6.43e-05)	(6.94e-05)	(5.15e-05)	(6.09e-05)
Fossil			-0.000450**						
			(0.000184)						
Fuel- Im			-0.0255*	-0.0245*	-0.0236		-0.0243	-0.0260*	-0.0269*
			(0.0128)	(0.0132)	(0.0143)		(0.0139)	(0.0146)	(0.0143)
COOK					0.184				
					(0.107)				
ACCESS						0.0285			
						(0.0326)			
AIRPOL							-		

							0.00777		
							(0.0200)		
L.AIRPOL								-0.0139	
								(0.0207)	
RURAL%									0.0514
									(0.174)
Time*Lock		0.0985	0.121*	0.155**	0.182**	0.0851	0.137	0.122	0.153**
		(0.0607)	(0.0597)	(0.0611)	(0.0636)	(0.0640)	(0.0827)	(0.0961)	(0.0616)
Constant	-17.59**	-98.82*	-139.9**	-167.8**	-196.2***	-84.27	-146.6	-130.0	-171.9**
	(6.708)	(52.17)	(59.32)	(61.50)	(63.03)	(56.59)	(89.56)	(103.5)	(57.90)
Observations	160	160	123	123	123	160	123	109	123
R-squared	0.247	0.296	0.438	0.397	0.418	0.312	0.398	0.341	0.398
Number	18	18	14	14	14	18	14	14	14

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 22. Random Effect regressions for the Eastern region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	0.487	0.440**	0.911***	0.667***	0.704***	0.343**
	(0.314)	(0.174)	(0.265)	(0.226)	(0.242)	(0.172)
LOCK		0.150	0.377	0.591	0.873	1.156
		(0.604)	(0.672)	(0.780)	(0.907)	(0.706)
Hydro		4.53e-05	-1.60e-05	5.52e-05	7.10e-05	6.09e-05
		(0.000128)	(0.000103)	(0.000121)	(0.000122)	(0.000108)
Fossil			-0.000356***			
			(0.000117)			
Fuel-Im			-0.0281*	-0.0260*	-0.0254*	
			(0.0156)	(0.0147)	(0.0148)	
COOK					0.0124	
					(0.0117)	
ACCESS						0.0335***
						(0.00899)
Constant	-2.694	-2.543*	-5.402***	-4.322**	-5.077**	-3.562**
	(2.245)	(1.352)	(2.085)	(2.030)	(2.346)	(1.484)
Observations	160	160	123	123	123	160
Number	18	18	14	14	14	18

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(11) WS-Per	(12) WS-Per
lnCO2	0.436*	0.473*	0.664***	0.395**	0.726**	0.777**
	(0.238)	(0.253)	(0.249)	(0.199)	(0.349)	(0.382)
LOCK	1.322	1.416	0.716	1.144	0.854	0.125
	(0.981)	(0.927)	(1.107)	(0.698)	(0.661)	(0.735)
Hydro	0.000111	5.68e-05	5.46e-05	1.78e-05		
	(0.000111)	(8.02e-05)	(0.000123)	(8.18e-05)		
Fossil					-0.000410**	-0.000423**
					(0.000179)	(0.000199)
Fuel-Im	-0.0231	-0.0285**	-0.0256*			
	(0.0156)	(0.0140)	(0.0144)			
ACCESS					0.0318***	
					(0.00807)	
AIRPOL	-0.0191***					-0.00988**
	(0.00742)					(0.00476)
L. AIRPOL		-0.0176***				
		(0.00657)				
RURAL%			-0.00957			
			(0.0529)			
L. ACCESS				0.0299***		
				(0.0102)		
Constant	-0.609	-0.725	-3.696	-3.580**	-5.678**	-3.157
	(1.917)	(2.009)	(4.829)	(1.600)	(2.484)	(2.427)
Observations	123	109	123	143	160	160
Number	14	14	14	18	18	18

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 23. Fixed Effect regressions for the Eastern region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per
VULNE	-27.20*	-25.42*	-21.03**	-21.19**	-12.83**	-12.48**	-11.99**	-11.24*	-11.52**
	(15.13)	(14.31)	(9.736)	(9.755)	(5.810)	(5.705)	(5.405)	(5.686)	(5.400)
AID232		0.0101***	0.00804***	0.00830***	0.000834	0.000839	0.00210	0.000982	-0.000148
		(0.00241)	(0.00257)	(0.00257)	(0.00143)	(0.00144)	(0.00256)	(0.00222)	(0.00260)
Paris			1.007***	1.148***	0.715**	0.675**	0.738**		0.695***
			(0.282)	(0.321)	(0.264)	(0.293)	(0.264)		(0.235)
Forest%				0.249	0.0649	0.0602	0.142	-0.0318	0.261*
				(0.167)	(0.201)	(0.205)	(0.227)	(0.193)	(0.141)
DEPLET					-0.112*	-0.114*		-0.131**	
					(0.0593)	(0.0605)		(0.0459)	
CO2Cap						0.408	0.372	0.548	0.0753
						(0.411)	(0.359)	(0.326)	(0.291)
L. DEPLET							-0.0255		

							(0.0700)		
L. Paris								0.609*	
								(0.301)	
2012									0.866**
									(0.361)
Constant	16.17*	14.96*	12.26**	5.959	6.723	6.415	3.307	8.320	-0.311
	(8.330)	(7.849)	(5.304)	(6.561)	(7.072)	(7.035)	(7.376)	(6.495)	(5.114)
Observations	178	163	163	163	136	136	123	125	146
R-squared	0.058	0.085	0.191	0.203	0.266	0.270	0.216	0.255	0.318
Number	18	18	18	18	18	18	18	18	18

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 24. Random Effect regressions for the Eastern region, Environmental and International variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per
VULNE	0.741	2.732	3.109	1.007	0.687	3.489		0.374	2.344
	(3.276)	(4.145)	(3.550)	(3.573)	(3.663)	(3.492)		(3.602)	(3.238)
AID232		0.0103***	0.00850***	0.00789***	0.000941	0.00117	0.000904	0.00138	-0.000934
		(0.00192)	(0.00179)	(0.00172)	(0.00210)	(0.00235)	(0.00225)	(0.00342)	(0.00254)
Paris			1.050***	1.032***	0.783***	0.784***	0.771***		0.568**
			(0.331)	(0.333)	(0.230)	(0.230)	(0.252)		(0.251)
Forest%				-0.0195*	-0.0155	-0.0182**	-0.0201*		-0.0191**
				(0.0106)	(0.0102)	(0.00781)	(0.0108)		(0.00790)
DEPLET					-0.0183	0.00438	-0.000333		
					(0.0281)	(0.0251)	(0.0268)		
CO2Cap						0.224***	0.132	0.188**	0.156**
						(0.0743)	(0.289)	(0.0935)	(0.0696)
ND-GAIN							0.00321		
							(0.0823)		
L.Paris								0.769***	
								(0.253)	
L. Forest%								-0.0238**	
								(0.0101)	
2012									0.856**
									(0.381)
Constant	0.773	-0.471	-0.987	0.684	0.900	-0.855	1.112	1.264	-0.679
	(1.799)	(2.211)	(1.880)	(1.997)	(1.981)	(1.903)	(3.172)	(2.118)	(1.817)
Observations	178	163	163	163	136	136	134	134	146
Number	18	18	18	18	18	18	17	18	18

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 25. Fixed Effect regressions for the Central region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per	(8) WS-Per
GDP Growth	-0.0138	-0.0140	-0.0159	0.00309	-0.00401	-0.0180	-0.0130	-0.0171
	(0.0153)	(0.0155)	(0.0174)	(0.00303)	(0.00345)	(0.0188)	(0.0160)	(0.0188)
BUS	0.0134	0.0152	0.0166	0.00252***		0.0172	0.0166	0.0163
	(0.0128)	(0.0150)	(0.0164)	(0.000473)		(0.0158)	(0.0164)	(0.0155)
FTA		-0.265	-0.204	0.0267	0.0420	-0.281	-0.168	-0.116
		(0.330)	(0.288)	(0.0525)	(0.0618)	(0.335)	(0.252)	(0.260)
UNEMP			0.157			0.163	0.162	0.158
			(0.157)			(0.151)	(0.162)	(0.156)
FDIout				0*	0			
				(0)	(0)			
Corrupt					0.283			
					(0.368)			
Account							-0.594	
							(0.536)	
GovEffec								-0.937
								(0.869)
RuleLaw						0.634		
						(0.602)		
Constant	-0.446	-0.178	-1.518	-0.135	0.338	-0.703	-2.360	-2.810
	(0.678)	(0.462)	(1.728)	(0.112)	(0.395)	(1.228)	(2.343)	(2.722)
Observations	80	80	80	50	60	80	80	80
R-squared	0.126	0.137	0.156	0.336	0.164	0.168	0.163	0.180
Number	8	8	8	5	6	8	8	8

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 26. Random Effect regressions for the Central region, Political and Economic variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
GDP Growth	-0.0168	-0.0152	-0.0117	0.00102	-0.00407	-0.0127
	(0.0182)	(0.0166)	(0.0141)	(0.00208)	(0.00390)	(0.0137)
BUS	0.00585	0.00926	0.0145	0.00258***		0.0108
	(0.00526)	(0.00902)	(0.0142)	(0.000703)		(0.0106)
FTA		-0.220	-0.453	0.0295*	0.0581*	-0.230
		(0.258)	(0.405)	(0.0166)	(0.0337)	(0.260)
UNEMP			-0.0639			
			(0.0497)			
FDIout				0***	0	
				(0)	(0)	
Corrupt					0.174**	-0.592
					(0.0885)	(0.664)
Constant	-0.0291	0.0871	0.600	-0.139*	0.208***	-0.733

	(0.143)	(0.206)	(0.396)	(0.0803)	(0.0469)	(0.824)
Observations	80	80	80	50	60	80
Number	8	8	8	5	6	8

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
GDP Growth	-0.00554	-0.00405	-0.0118	-0.00675
	(0.0109)	(0.00963)	(0.0139)	(0.0123)
BUS	0.0160	0.0161	0.0144	0.0152
	(0.0154)	(0.0160)	(0.0144)	(0.0128)
FTA	-0.619	-0.677	-0.400	-0.740*
	(0.449)	(0.483)	(0.373)	(0.443)
UNEMP	-0.0801	-0.0863	-0.0566	-0.121*
	(0.0522)	(0.0554)	(0.0440)	(0.0625)
Account		0.105	-0.105	
		(0.303)	(0.331)	
GovEffec	0.0917	0.133		
	(0.214)	(0.216)		
RuleLaw				0.874**
				(0.419)
Constant	0.969*	1.274*	0.344	2.462**
	(0.581)	(0.663)	(0.539)	(1.004)
Observations	80	80	80	80
Number	8	8	8	8

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 27. Fixed Effect regressions for the Central region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per
lnCO2	0.509	0.528	0.240	0.245	0.452
	(0.535)	(0.546)	(0.274)	(0.282)	(0.333)
Hydro		2.45e-05	6.41e-06	9.92e-06	-3.72e-06
		(2.76e-05)	(1.69e-05)	(1.97e-05)	(1.96e-05)
Fossil			1.72e-05		
			(3.06e-05)		
Fuel-Im			-0.00101	-0.00129**	-0.000845
			(0.000665)	(0.000441)	(0.000767)
COOK					0.0196
					(0.0130)
Constant	-3.765	-3.968	-1.718	-1.748	-3.634
	(4.181)	(4.296)	(2.106)	(2.166)	(2.761)
Observations	81	81	49	49	49

R-squared	0.020	0.021	0.119	0.104	0.257
Number	9	9	6	6	6

VARIABLES	(6) WS-Per	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per
lnCO2	0.520	0.204	0.205	0.103	0.0911
	(0.517)	(0.154)	(0.169)	(0.0989)	(0.110)
Hydro	-7.59e-05	-4.13e-05	-3.69e-05	-4.03e-05*	-3.74e-05
	(5.79e-05)	(2.25e-05)	(2.35e-05)	(1.72e-05)	(1.99e-05)
Fuel-Im		-7.15e-05	-0.000585	0.000537	0.000131
		(0.000716)	(0.000860)	(0.000900)	(0.00126)
ACCESS	0.0521				
	(0.0374)				
AIRPOL		-0.00461*			
		(0.00201)			
L. AIRPOL			-0.00456		
			(0.00229)		
RURAL%				-0.0477***	
				(0.00800)	
L. RURAL%					-0.0497***
					(0.0114)
Constant	-5.938	-0.650	-0.645	1.516	1.724
	(5.358)	(0.893)	(0.955)	(0.833)	(0.956)
Observations	80	49	44	49	44
R-squared	0.074	0.427	0.393	0.648	0.640
Number	9	6	6	6	6

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 28. Random Effect regressions for the Central region, Social and National variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per
lnCO2	-0.0447	0.0329	-0.0324	0.00655	-0.0544***	0.0344
	(0.0363)	(0.0481)	(0.0234)	(0.0152)	(0.0129)	(0.0516)
LOCK		0.657*	0.167***	0.155***	0.203***	0.876*
		(0.347)	(0.0474)	(0.0588)	(0.0449)	(0.456)
Hydro		-3.10e-06	5.93e-06	4.49e-07	1.15e-05*	1.36e-05
		(8.74e-06)	(6.69e-06)	(8.16e-06)	(6.44e-06)	(1.35e-05)
Fossil			4.56e-05***			
			(1.63e-05)			
Fuel-im			0.00126	-0.000812	0.00255	
			(0.00197)	(0.000527)	(0.00168)	

COOK					0.00601***	
					(0.000785)	
ACCESS						0.00387
						(0.00310)
Constant	0.568	-0.178	0.271*	0.0648	0.356***	-0.448
	(0.362)	(0.412)	(0.149)	(0.103)	(0.0823)	(0.474)
Observations	81	81	49	49	49	80
Number	9	9	6	6	6	9

VARIABLES	(7) WS-Per	(8) WS-Per	(9) WS-Per	(10) WS-Per	(12) WS-Per
lnCO2	-0.0166	-0.0175	-0.00659	-0.00986	-0.0591***
	(0.0315)	(0.0339)	(0.0111)	(0.0132)	(0.0176)
LOCK	0.449*	0.417	0.481***	0.460***	0.210***
	(0.265)	(0.271)	(0.169)	(0.163)	(0.0485)
Hydro	1.29e-05	1.14e-05	2.62e-05	2.40e-05	1.08e-05
	(1.57e-05)	(1.66e-05)	(1.89e-05)	(1.88e-05)	(7.18e-06)
Fuel-im	0.00254	0.00273	0.00315*	0.00332	0.00277
	(0.00257)	(0.00271)	(0.00182)	(0.00208)	(0.00180)
AIRPOL	-0.00176				
	(0.00182)				
L. AIRPOL		-0.00152			
		(0.00190)			
RURAL%			-0.0114*		
			(0.00597)		
L. RURAL%				-0.0105*	
				(0.00586)	
L. COOK					0.00629***
					(0.00122)
Constant	0.372	0.368	0.488*	0.496*	0.397***
	(0.404)	(0.439)	(0.252)	(0.269)	(0.105)
Observations	49	44	49	44	44
Number	6	6	6	6	6

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 29. Fixed Effect regressions for the Central region, Environmental and International variables

VARIABLES	(1) WS-Per	(2) WS-Per	(3) WS-Per	(4) WS-Per	(5) WS-Per	(6) WS-Per	(7) WS-Per
VULNE	17.19	20.21	35.10	36.97	41.37	28.36	26.89
	(24.46)	(28.65)	(33.82)	(34.12)	(38.90)	(27.77)	(27.02)
AID232		-0.00124	5.79e-05	-0.000257	-0.00159	0.000201	0.000459
		(0.00140)	(0.000913)	(0.000938)	(0.00107)	(0.00132)	(0.00135)
Paris			0.521	0.494	0.479	0.405	0.442

			(0.398)	(0.405)	(0.394)	(0.357)	(0.382)
Forest%				-0.0326	0.0108	-0.0157	-0.00915
				(0.0361)	(0.0539)	(0.0507)	(0.0511)
2012					0.228		
					(0.192)		
DEPLET						-0.00527	-0.00674
						(0.00781)	(0.00825)
CO2Cap							0.345
							(0.250)
Constant	-8.837	-10.63	-18.82	-18.12	-22.90	-14.24	-14.06
	(12.93)	(15.39)	(18.31)	(18.62)	(22.99)	(16.26)	(16.25)
Observations	90	65	65	65	65	59	59
R-squared	0.023	0.030	0.247	0.250	0.269	0.204	0.214
Number	9	9	9	9	9	9	9

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D - 30. Random Effect regressions for the Central region, Environmental and International variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per	WS-Per
VULNE	4.138*	3.220*	3.407*	1.117	1.389	1.428	0.613	1.185
	(2.295)	(1.686)	(1.746)	(1.523)	(1.653)	(1.573)	(0.788)	(0.765)
AID232		-0.00395**	-0.00284**	-0.00191*	-0.00189**	-0.002**	-0.00185**	-0.000683
		(0.00180)	(0.00114)	(0.00107)	(0.0008)	(0.00109)	(0.000813)	(0.000737)
Paris			0.399	0.385	0.371	0.362	0.303	0.329
			(0.328)	(0.328)	(0.340)	(0.338)	(0.255)	(0.263)
Forest%				-0.00796**	-0.00743**		-0.00549**	-0.00814***
				(0.00378)	(0.00353)		(0.00225)	(0.00168)
L. Forest %						-0.008**		
						(0.0035)		
2012					0.087***	0.167*		
					(0.029)	(0.0903)		
DEPLET							0.00220	0.000785
							(0.00444)	(0.00349)
CO2Cap								0.116*
								(0.0668)
Constant	-1.939*	-1.462*	-1.698*	-0.0622	-0.296	-0.367	0.0466	-0.214
	(1.143)	(0.847)	(0.980)	(0.927)	(1.009)	(1.000)	(0.496)	(0.466)
Observations	90	65	65	65	65	59	59	59
Number	9	9	9	9	9	9	9	9

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 5. Additional figures

Figure 5. Proportion of population living in rural areas, for all nations

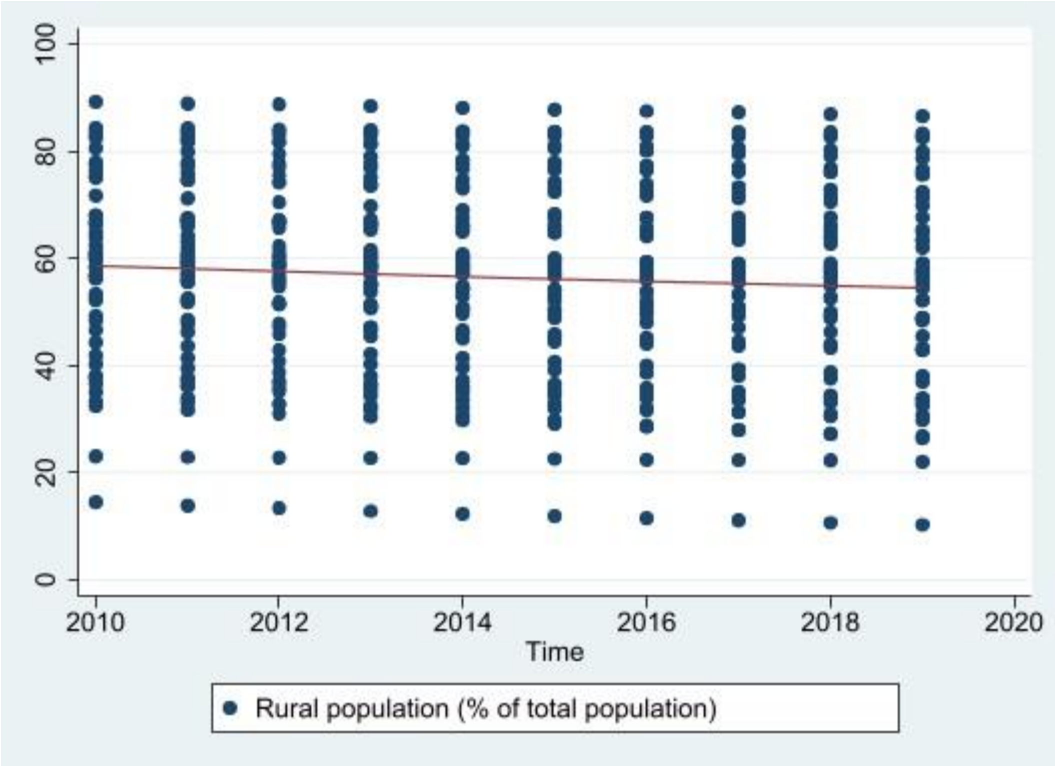

Figure 6. Proportion of population living in rural areas, landlocked nations

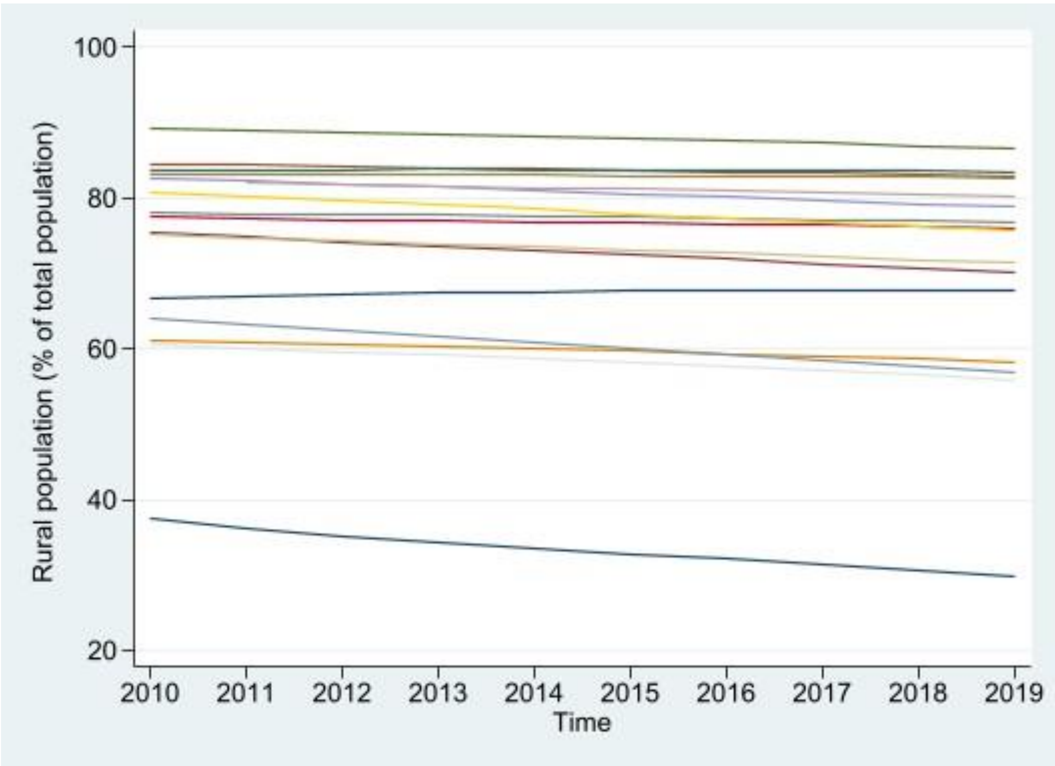

Figure 7. Death rate from indoor air pollution for all nations