Estimating and modelling the relation between climate change, governance, and GDP

Abstract.

Climate change has been impacting the development of various countries around the globe, including GDP, the Gini index and private investment, among others. Therefore, policy makers and governments have a crucial role to play in mitigating these impacts through the creation and implementation of plans, policies, and strategies to improve people's well-being, income, and livelihoods. Regarding to the ND-GAIN index, this article aims to analyse in 182 countries the relationship between governance readiness, climate change vulnerability, and GDP, outlining how these variables influence each other. The structure has been suggested to simplify reading. It is divided into context and background, methodology and discussion, which also includes the results.

Keywords: GDP (Gross Domestic Product), climate change vulnerability, governance readiness.

Introduction.

Climate change effects on worldwide economy continues to be the main focus of various political and academic debates. Actual evidence shows that anthropic-induced climate change has a serious global threat to growth and development in the long and medium term (Abidoye and Odusola, 2015; Du et al., 2017).
Climate change is a long-term and global event that demand coordination and a constructive and progressive policy approach. During the last decades, the cumulative impacts of climate change have increased and affected various global ecosystems (Claudet et al., 2020; Cogan, 2003), which play a fundamental role in human well-being and development. Regarding climate change, various countries face different adaptation challenges (Chen et al., 2015), such as sea-level rise and extreme weather events (Kompas et al., 2018; United Nations, 2018). In addition, global warming consequences regarding GHG emission growth are considered a serious threat to the Earth's future. Consequently, governments and stakeholders around the globe are increasing their efforts to mitigate these impacts generating and strengthen policies, strategies, and programs at local, regional, and global scale. Moreover, the impacts of climate change have been shown to impact global economy in a considerable manner (Tol, 2002; Hilmi et al., 2021). These impacts are different in each country, some of them are more vulnerable than others, especially those whose livelihoods, economies and well-being depend on nature and its ecosystem services.

The hypothesis of this article has been defined as:
H_1 A country GDP will be affected detrimentally by the country climate change vulnerability and governance readiness level.
H_0 A country GDP will not be affected detrimentally by the country climate change vulnerability and governance readiness level.

Context and background.

The Earth's surface since 1850 has turn warmer and specifically during the last three decades. Among 2000 and 2010, emissions grew more quickly, also, since 1990 carbon dioxide (CO2) levels have heightened around 50%. Beneath the impact of climate change, the ice and snow amount has been decreased, sea levels have increased, and oceans have warmed (Kompas et al., 2018). From 1901 to 2010, worldwide average sea level rises close to 19 cm and has been predicted to raise up to 24 – 30 cm by 2065, and by 2100 could be between 40 to 63 cm (United Nations, 2018).

Every year, climatic extreme events cause massive economic damages, furthermore, is expected that risks will increase with climate change and unceasing socioeconomic development. Commonly, risk is characterized as the probability of a hazardous events occurs or the odds that impact multiplied by tendency if these tendency or events happen (Chen et al., 2020). The interaction between vulnerability, hazard and exposure generate risk. Frequently, exposure refers to the population, resources, infrastructure, livelihoods, cultural and socioeconomic assets in settings and places that could be adversely impacted (IPCC, 2014).

The value of mitigation and the impacts on human wellbeing will determine the distribution of climate change impacts (Dennig et al., 2015). However, the global distribution of climate change effects is heterogeneous, not only within countries throughout the globe, also over income classes and occupations (Hallegate et al., 2018).

Furthermore, considering and using only the global GDP as a variable to measure the impacts of climate change could probably increase the skew of the study (Mendelsohn et al., 2000; Tol, 2002; Hope, 2006; Mendelsohn et al., 2006; Stern, 2006; Tol, 2009; Nordhaus, 2014; Hsiang et al., 2017; Hallegate et al., 2018). Study climate change impacts on GDP requires a different approach, focused also on governance and vulnerability, considering diverse factors such as food access, infrastructure, ecosystems, water access, among others. Moreover, a study published by the World Bank in 2016 about "Poverty and climate change" drove to develop different depth studies in this field (Hallegate et al., 2018).
Managing and assessing the vulnerability against climate change requires specific data, studies, and metrics (Hallegate et al., 2018). Certainly, there have been some attempts to use large-scale economic modelling to investigate the full global, intertemporal, and disaggregated effects of climate change on GDP. These mainly involve modelling the economic interdependence between countries in the global economic system, trade patterns and spillover effects over the years (Kompas et al., 2018).
Since 2006, the climate research community started a new lateral approach to dynamic scenarios, where model development growth synchronously rather than successively (Moss et al., 2010; van Vuuren et al., 2014). Several future scenarios are extensively used in climate change research, aiming to collaborate with the explanation of future long-term environmental and socioeconomic consequences of climate change, and the analysis of possible adaptation and mitigation and measures (van Vuuren & Carter, 2014).

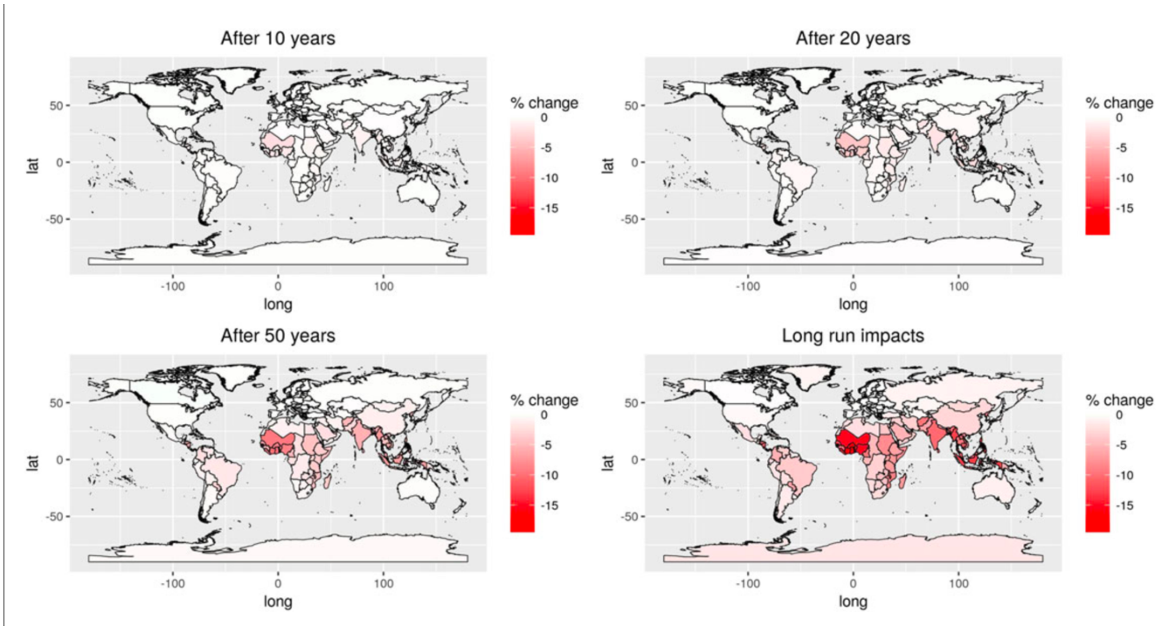

Figure n°. Dynamic effects of global warming (3∘C) on global GDP (% change/year). Source: Kompas et al., 2018.

Some researchers argue that better and appropriate methods rely on the net factor income and the value of the market trade (Ngazy et al., 2004; Ahmed et al., 2004; Cesar and Chong, 2004), which estimate the link among nature and economic activity.
It has always been attracting for policymakers to estimates and understand the economic impacts of climate change. Nevertheless, most of the time, these estimates have been studied in terms of global GDP or the impact on country-level (Arent et al., 2014), not considering how climate change affects human well-being, specially to most developing countries. However, researchers have found that policies that encourage demand for low–carbon energies are relevant for public policymakers (Anadon and Holdren, 2009).
Currently, business leaders and bankers must admit that Earth's climate is a dynamic boundary quality for guiding their affairs. There is a direct link between the investment decisions they make, the nature situation that underpins economic success, and climate issues. New governance basis must consider this important point (Afrifa et al., 2020).

It has been mentioned that the impact of climate change on poor populations represents a minor part of national wealth, being classified many times as invisible (measuring them on GDP) (Hallegate et al., 2018). Socioeconomic vulnerability would increment significantly due to climate change, being Asia and Africa the most affected continents. Thus, it has been demonstrated that South America and Africa will increase their population exposure. (Chen et al., 2020). The impacts on "new" economies are drastic due to their economic strength depends heavily on sectors such as forestry and tourism, agriculture, which are profoundly sensitive to climatic conditions (Wade and Jennings, 2015). However, despite recent improvement in assessing the climatic extremes threats, it has been demonstrated that global socioeconomic exposure related to climate change has received less support and attention (Burke et al., 2015; Carleton and Hsiang, 2016; Hirabayashi et al., 2013; Cook et al., 2014; King et al., 2017; Huang et al., 2017; Nath et al., 2017; Chen et al., 2020).

Governance quality - measured in terms of monitoring the state of institutions, and the State capacity to formulate appropriate policies (Kaufmann, Kraay and Mastruzzi, 2003; and 2007) – is expected to impact countries' contemporary policies towards sustainable environments. Hence, countries with favorable quality governance may be able to seek, design and invest in vanguard innovative technologies directed at curbing environmental harm (Gani, 2012). Also, companies and governments around the world, in respond to several stakeholder pressures, have been focus their investments into climate resilient and low-carbon infrastructure in their innovation strategies, generating policies showing their compromise about environmental problematics (Cimato and Mullan, 2010; Darnall and Carmin, 2005; Moratis, 2018; Afrifa et al., 2020). However, exist very little information about the current link between emerging countries' governance, climate change goals and innovation activities (Afrifa et al., 2020).

There is a value in contributing to actual climate enhancement endeavor by emerging economies over research conversations relating to climate change, governance, and innovation. Yet, not enough progress has been accomplished in interlacing knowledge gaps. Indeed, researchers seem to pay more attention to stimulus (Tauringana and Chithambo, 2015) and effects (Chithambo et al., 2020; Boakye et al., 2020) of GHG emissions and climate change, instead of questioning how new investments in innovative technologies impact on the environment (Afrifa et al., 2020). Still, emerging economies are more susceptible than developed countries to attempt with correct and proper levels of high-quality governance (Oman and Arndt, 2010).

The climate change mitigation agenda is unquestionably a main global goal of the 21st century (Cadez et al., 2019). The Paris Agreement target to support the country's ability to carry out the effects of climate change (United Nations Framework Convention on Climate Change [UNFCCC], 2018a), and is seen as a fundamental path for the human response to decrease emissions and generate climate resilience (Kompas et al., 2018). This vital initiative is leaded by regional, national, and international stakeholders that promote action to tackle the impacts of climate change (Freeman et al., 2010). It has been identified in the literature diverse external stakeholders that are either regulatory authorities or market actors (Okereke and Russel, 2010). These encompass local authorities, national governments, suppliers, competitors, non-governmental organisations (NGOs), customers, competitors, investors, employees, regional bodies, among others (Cadez et al., 2019). According to theory perspective of climate change efforts, international governing bodies, such as ECOWAS in sub-Saharan Africa or the EU in Europe, and governments are considered between the most crucial stakeholders with the capacity to support climate change goals (Sprengel and Busch, 2011).

The unique importance of governments relies in the fact that they are more inclined to implement a long-term view of the impacts of environmental behaviours, hence, are expected to take immediate action to guard and guide behaviours that limit the achievement of positive results. This is fundamental, regarding that the non-immediate impacts of deficient environmental practices on climate achievements do not motivate individual companies and consumers to treat environmental concerns with the proper urgency (Simaens and Koster, 2013; Afrifa et al., 2020).

Developed countries governments have been enthusiastic to contribute to efforts that decrease carbon emissions (Afrifa et al., 2020), playing a fundamental role in reducing climate change impacts by setting up tax regimes that can contribute to decrease the use of fossil fuels (Zheng et al., 2019). In addition, governance regulations on innovations impact climate change achievements depend on contextual factors. The success of a policy in relation to innovations is linked to the anticipated reductions in emissions that can be accomplished using the innovation (Newell, 2010; Afrira et al., 2020).

Regarding climate change objectives, if organisations recognize positive benefits in the sustainability report application, they may initiate severe innovations, which are a strategic advantage in dealing with several stakeholder audiences (Simaens and Koster, 2013). Research suggests that possible progress and achievement between mitigation of climate change impacts, governmental action, and eco-innovations, may influence these relationships (Afrira et al., 2020), especially, to government pressures, if they examine that innovations start to decrease the information gaps between themselves and stakeholders regarding their commitment to environmental concerns, they could respond positively (Afrira et al., 2020).

Methodology.

With the aim to address the relation between climate change vulnerability, the readiness governance and how these variables impact in the GDP (Gross Domestic Product) of the countries, it has been used and analyzed the Notre Dame Global Adaptation Initiative Index, which includes 182 countries between the years 1995 and 2020 (due to data availability). It must be considered that this data has been developed regarding the expert's advice and consultancy (Cheng et al., 2015).

In first place, the data was collected from different data bases ("raw" data), subsequently, has been converted into different indexes, normalizing the range of values to a common standard deviation and mean, scaling and transforming the data into a prescribed range that will oscillate between 0 and 1. Additionally, with the goal to represent the real sensitivity of the data, the errors were corrected through the linear interpolation and the labelling for the missing data, and it has been identified the minimum and maximum baseline ("reference points") for "raw" data, achieving to ease the comparison between the reference points and countries. For example, the reference points can be non-potable water for human consumption is 0 percent (0), on the other hand, potable water for human consumption is 100 percent (1).

The scale has been developed using the equation below:

$$S = \left| D - \frac{r\ data - Rp}{BM - Bm} \right|$$

In which, Scale “raw” has been represented with “r”, data to “score” with “S”, reference point as “Rp”, baseline maximum as “BM”, and baseline minimum as “Bm”. Furthermore, the parameter “D” which means direction, can also take two values, 0 and 1, representing the opposite in some case, for example, when the vulnerability score is close to 0 means that the country has a high vulnerability against climate change. Parallelly, when the score of governance is close to 1 means that the country has a high governance (“better governance”). To compute these scores has been used the arithmetic mean from the different variables. Finally, to get the ND-GAIN score and provide a value between 0 and 100, for each country has been subtracted from the readiness score the vulnerability score, using the next equation:

$$NDGAINscore = (Readinessscore - Vulnerabilityscore + 1) * 50$$

Indicators - variables (Cheng et al., 2015):

Governance: refers to the effective investment use regarding the adaptation against climate change impacts, developing an efficient and safe business environment, also, considering the stability of the institutions and the civil society arrangements that will manage to decrease the investment risks. Therefore, a democracy with high governance capacity and stable economy should be able to reassures investors that their capital could grow without interruption as long as they have the support of public services.

Climate change vulnerability: This indicator consider how climate change negative effects are impacting the countries. However, it must be considered that this indicator includes six life-supporting sectors: health, water, food, human habitat, ecosystem services, infrastructure, and human habitat.

GDP: Gross Domestic Product.

To measure the relation between GDP, climate change vulnerability and governance, it has been used a multiple regression multivariate model, implementing the equation below:

$$Y = \beta_{0\,+}\, \beta_1 \chi_{1\,+}\, \beta_2 \chi_{2\,+\,\mu}$$

In which Y represents the GDP (dependent variable), β_1 represent climate change vulnerability, and β_2 the governance readiness. For instance, the formula applied in this study is:

$$GDP = \beta_{0\,+}\, Climate\ change\ vulnerability\chi_{1\,+}\, Governance\ readiness\chi_{2\,+}\ \mu$$

The implement this formula implies that χ_n is a lineal function, besides the constant term of β_0 (intercept), and the unobservable μ variable. Also, the next assumptions have to be considered: μ and the lineal function of χ_n must be 0 (Urdinez and Cruz, 2020), following the formula:

$$\mathrm{E}(\mu|\chi) = 0$$

For each value of the independent variable of interest χ, the average of the unobserved factors will be 0. If these assumptions are accomplished it will be possible to observe the impact of χ in Y, maintaining constant the other values (Urdinez and Cruz, 2020).

In addition, it has been applied a PCA (Principal Component Analysis) aiming to simplify the sample complexity, conserving their information, allowing to find values of underlying factors predicting possible results. Even so, it is still necessary to have the original value of the variables to calculate the components.
Each principal component (Z_1) is obtained by linear combination of the original variables. They can be understood as new variables obtained by combining the original variables in a certain way. The first principal component of a group of variables ($\chi_1, \chi_{2,\ldots,}\chi_\rho$) is the normalised linear combination of said variables that has the greatest variance (Rodrigo, 2017), applying the formula:

$$\mathrm{Z}_1 = \emptyset_{11}\chi_1 + \emptyset_2\,\chi_2 + \ldots + \emptyset_{p1}\chi_p$$

That the linear combination is normalized implies that:

$$\sum_{j=1}^{\rho} \emptyset_{j1}^2 = 1$$

Terms $\emptyset_{11,}\ldots,\emptyset_{1p}$ receive the name of loadings and are the ones that define the component. $\emptyset_{11}$ is the loading of the variable $\chi_1$of the first principal component. The loadings can be interpreted as the weight/importance that each variable has in each component and, therefore, they help to know what type of information each of the components collects (Rodrigo, 2017).

Once the PCA has been applied, factorial analysis will corroborate the results.

Various tests were conducted to compare the different variables and their relationship to each other. Shapiro test was used to observe the sample distribution. Kruskal-Wallis rank sum test was applied to determine if there are significant differences between variables. In addition, correlation test was used to measure the degree of association between variables and to assess the significance of the relationship between the different variables.

Results and Discussion.

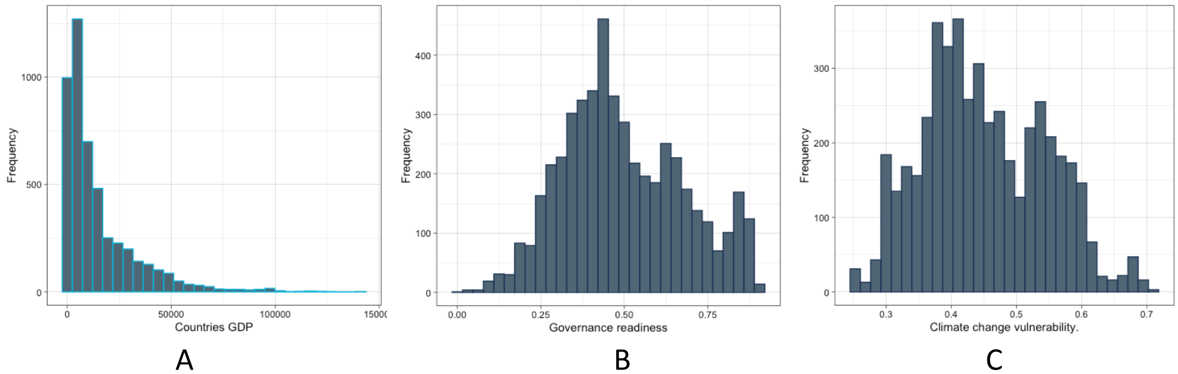

Fig. n°. Histogram A) GDP. B) governance readiness. C) climate change vulnerability.

Figure No. shows that GDP (A) fluctuates between the lower levels in most countries. Moreover, readiness for governance is not uniform. It is more pronounced at the middle levels, but there is also a wide range at the higher levels. Vulnerability to climate change also varies at the middle levels, without following an even distribution.

Table n°. Correlation between vulnerability, GDP and governance

	Vulnerability	GDP	Governance
Vulnerability	1.00	-0.61	-0.68
GDP	-0.61	1.00	0.64
Governance	-0.68	0.64	1.00

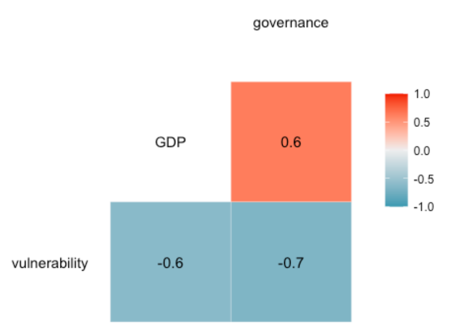

Figure n°. Correlation matrix between vulnerability, GDP, and governance

It is noted that there is a positive correlation of 60% between GDP and governance. This can be interpreted to mean that the better the governance, the higher the country's GDP. On the other hand, there is a negative correlation between vulnerability and governance, also with GDP. However, recent studies have shown that there are some countries where climate change vulnerability affects GDP, such as the Maldives, where coral reef tourism contributes almost 43.17% to GDP, with an approximate value of US$205,505/km2 /year, equivalent to almost US$1 billion/year in income (Spalding et al., 2017). Thus, if climate change affects coral reefs (which it does), it will affect the income of local people.

The model 3 screenreg (see section Appendices) shows that the model explains 47% (R^2 = 0.47), which is considered an acceptable result in this case. It also shows that there are significant differences between the variables ($p < 0.001$), which can be interpreted to mean that there is an influence between the variables.

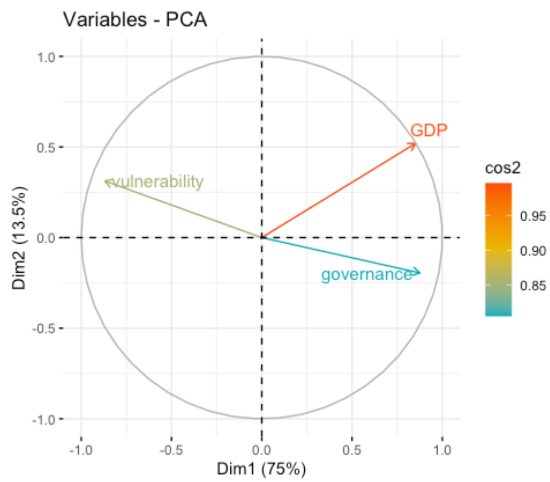

Fig. n°. PCA cos2.

It can be observed that in the cos2 method, vulnerability has a higher influence in dimension 2. On the other hand, governance and GDP have a higher value in dimension 1, especially GDP.

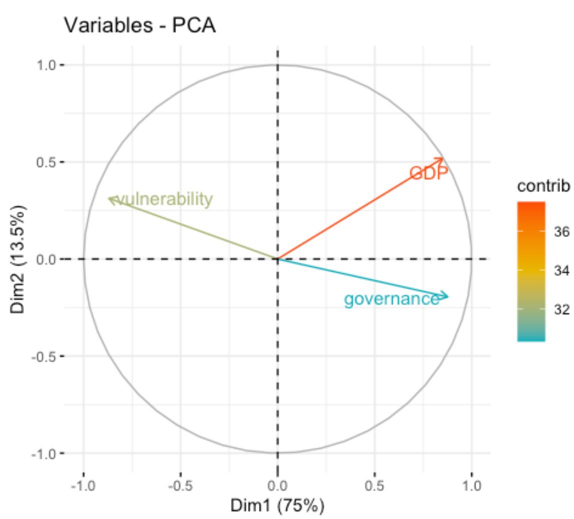

Fig. n°. PCA contribution.

It is possible to interpret that the contribution of vulnerability is greatest in dimension 2. In contrast, GDP (highest) and governance are dominant in dimension 1.

Analysing both methods, it is possible to observe that governance and GDP are close in both dimensions, in other words, they influence one another.

Consider that about 75 per cent of the world's income flows to Europe, North America, and East Asia, while other regions such as sub-Saharan Africa contribute only 3 per cent. In all cases and for all temperature increment, the greatest losses occur in sub-Saharan Africa, Southeast Asia, and India (Kompas et al., 2018).

The ecosystem degradation and their related services is destroying many of the global poorest communities and people, becoming a fundamental driving factor of poverty in vulnerable countries (TEEB Foundations, 2010).
The outcomes have shown that the impacts of climate change vary according to region, economic sector, and time. However, they tend to increase over time and worsen in the relatively poor countries of Asia and Africa, where the fall in GDP is most strict here and in all countries near the equator, affecting several of the poorest countries (Kompas et al., 2018). If effects regularly impact low-income people, consequences especially in population well-being will be much bigger than in developed countries due to their capacity to mitigate those impacts. Poor countries have less resources, thus, they have a lower readiness, adaptive capacity, and a high sensitivity to climate change impacts (Chen et al., 2015). Additionally, as was mentioned above, poor countries represent a small part of global economy, consequently, there are almost invisible in aggregate economic statistics (Hallegate et al., 2018).

Due to the relationship between GPD and tax revenues, plus GPD decrease in the long term, governments will suffer fiscal stress. Also, if climate change impacts are increasing the frequency of natural disasters, likewise emergency expenses and management, the pressure on government budget will be extremely serious (Kompas et al., 2018). Despite the pressure on their budget, governments should firmly supervise the investments to establish quotas related to climate-friendly technologies.

An important limitation of these models is the lack of constructive behavior, based on static price-level expectations, and consecutive single period calculations. In other words, economic agents, only react to shocks in the present year (or past years), ignoring future changes. Therefore, responses in economic behavior happen once the impacts are finished (Kompas et al., 2018). Some researchers propose to consider de GPI in future studies (Genuine Progress Indicator), which include both environmental and social costs of ES management (Kubiszewski et al., 2013; Reyes et al., 2013; Long & Ji, 2019).

“Values derived from different valuation methods may not be measuring the same economic construct, hence, values from different methods may not be directly comparable” (De Groot et al., 2012).

Conclusion.

The aim of this paper is to explore the implications for GPD in 182 countries affected by climate change vulnerability and governance readiness, with reference to the findings of the available literature

Studies on the impact of climate change on macroeconomics still have much room for improvement. Little has been done to date to adequately assess the linkages between climate change vulnerability, governance, and economic fields. This is a peculiar challenge as the trend in impact studies tends to focus more on small areas and details.
Assessing global economic impacts due to climate change vulnerability and governance readiness is not an easy task, but is still complex. In order to build more accurate models, the implementation of dynamic and large-scale modelling is needed to enable better approaches and holistic interpretation. It must be kept in mind that there is no "one model fits all". However, a number of important caveats should be considered for future research. Furthermore, it is not possible to include the impacts of natural hazards in the models, as there are no aleatory components.

Conflict of interest.

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability statement.

The datasets presented in this study are open source and can be found in online repositories at https://gain.nd.edu/our-work/country-index/rankings/.

Appendices.

Table n°. Shapiro-Wilk normality test – Climate change vulnerability
data: df_general_real$vulnerability
W = 0.98148, p-value < 2.2e-16
(not normal distribution/non-parametric)

Table n° Shapiro-Wilk normality test – GDP
data: df_general_real$GDP
W = 0.73436, p-value < 2.2e-16

(not normal distribution/non-parametric)

Table n° Shapiro-Wilk normality test – Governance
data: df_general_real$governance
W = 0.97895, p-value < 2.2e-16
(not normal distribution/non-parametric)

Table n° Variance test GDP – Climate change vulnerability
data: df_general_real$GDP and df_general_real$vulnerability
F = 3.8922e+10, num df = 4835, denom df = 4731, p-value < 2.2e-16
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 36776898624 41192228185
sample estimates:
ratio of variances
      38922348704

Table n°. Variance test GDP – Governance readiness
data: df_general_real$GDP and df_general_real$governance
F = 1.0454e+10, num df = 4835, denom df = 4887, p-value < 2.2e-16
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
  9882329783 11058611183
sample estimates:
ratio of variances
      10453894292

Table n°. Kruskal-Wallis rank sum test GDP - Governance

data: df_general_real$GDP and df_general_real$governance
Kruskal-Wallis chi-squared = 4756.3, df = 4570, p-value = 0.0268

Table n°. Kruskal-Wallis rank sum test GDP – Climate change vulnerability

data: df_general_real$GDP and df_general_real$vulnerability
Kruskal-Wallis chi-squared = 4653, df = 4653, p-value = 0.4972

Figure n°. Countries GDP histogram

Figure n°. Governance readiness histogram

Figure n°. Climate change vulnerability histogram

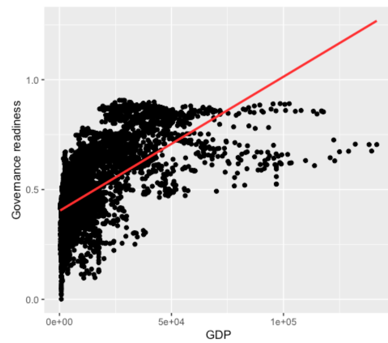

Figure n°. Scaterrplot Model 1 (GDP-Governance)

Table n°. Model 1 Screenreg (GDP-Governance)

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========================
             Model 1
------------------------
(Intercept)     0.40 ***
               (0.00)
GDP             0.00 ***
               (0.00)
------------------------
R^2             0.40
Adj. R^2        0.40
Num. obs.    4758
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*** p < 0.001; ** p < 0.01; * p < 0.05
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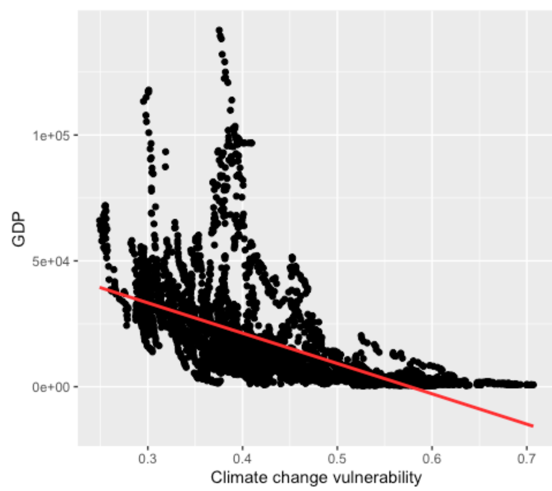

Figure n°. Scatterplot Model 2 (Climate change vulnerability – GDP).

Table n°. Model 2 Screenreg

	Model 2
(Intercept)	69475.42 ***
	(1038.81)
vulnerability	-120496.27 ***
	(2260.13)
R^2	0.38
Adj. R^2	0.38
Num. obs.	4654

*** p < 0.001; ** p < 0.01; * p < 0.05

Table n°. Models screenreg (includes model 3 GDP-governance-Climate change vulnerability)

	Model 1	Model 2	Model 3
(Intercept)	-17264.64 ***	69475.42 ***	23818.66 ***
	(613.97)	(1038.81)	(1885.90)
governance	65720.93 ***		42453.27 ***
	(1163.42)		(1500.50)
vulnerability		-120496.27 ***	-65372.97 ***
		(2260.13)	(2880.05)

R^2	0.40	0.38	0.47
Adj. R^2	0.40	0.38	0.47
Num. obs.	4758	4654	4576

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*** p < 0.001; ** p < 0.01; * p < 0.05

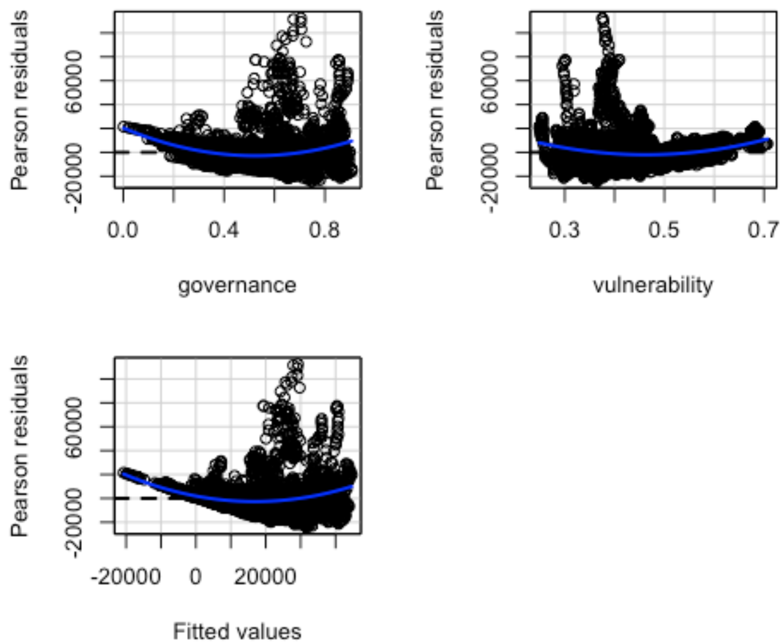

Figure n° Residuals vs fitted values plot (homocedasticity) in model 3 (GDP, governance and vulnerability).

Table n°. model 3 lm(GDP~1+governance+ vulnerability)

	Test stat	Pr(>|Test stat|)	
governance	16.512	< 2.2e-16	***
vulnerability	11.777	< 2.2e-16	***
Tukey test	16.800	< 2.2e-16	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

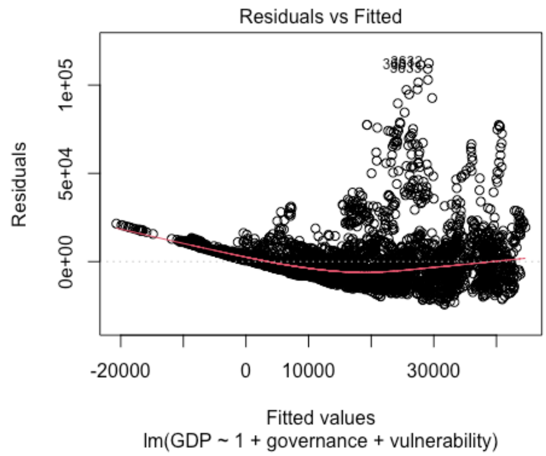

Figure n°. Residual vs fitted values plot for lm(GDP~1+governance+ vulnerability)

Table n°. Eigenvalue (variance).

	eigenvalue	variance %	cumulative variance %
Dim.1	2.2501172	75.00391	75.00391
Dim.2	0.4058812	13.52937	88.53328
Dim.3	0.3440016	11.46672	100.00000

Table n°. Variance values PCA

	Dim.1	Dim.2	Dim.3
Vulnerability	-0.8699453	0.3125710	0.38143752
GDP	0.8519214	0.5197522	-0.06393421
governance	0.8760949	-0.1950340	0.44093018

Table n°. Factorial analysis (CC vulnerability, GDP, and governance).

Uniquenesses:

vulnerability	GDP	governance
0.350	0.421	0.293

Loadings:

	Factor1
Vulnerability.	-0.806
GDP	0.761
governance	0.841

	Factor1
SS loadings	1.936
Proportion Var	0.645

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