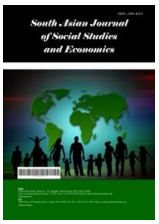

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Do Environmental Policy Stringency Promote Human Development in Developing Countries?

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

This article analyses the effect of multilaterals environmental agreements (MEAs), the Ministry of Environment and Environmental Democracy on human development in developing countries. The sample comprises 72 countries and the data cover the period from 1995 to 2017. The analysis is carried out in cross-section and the estimation technique is that of double least squares. The results show that MEAs, the ministry of environment and environmental democracy increase the human development index. The results also show that MEAs reduce child mortality, income inequality, and improve secondary school completion rates. Finally, our results indicate that climate change, level of development and geographical location impact on human development in developing countries. We therefore recommend that these countries promote environmental policy stringency while improving their level of governance.

Keywords: Environmental policy stringency; MEA; ministry of environment; environmental democracy; HDI.

JEL classification: O13, O15, Q56.

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1. INTRODUCTION

Human development is a concept of development that originated in the work of Sen [1]. It is a form of critique of the concept of economic development based on gross domestic product growths and emphasizes the notions of "functionning" and “capability”. *Functioning,* as Sen [1] indicates, refers to the different modes of functioning, such as individual achievements. *Capability, on* the other hand, refers to the freedom these individuals have to choose their own lifestyles. According to Boidin [2], human development is a priority of sustainable development in developing countries. However, more than 15 years after the adoption of the Millennium Development Goals (MDGs) and about five years after the adoption of the Sustainable Development Goals (SDOs), human development remains a major concern in these countries [3]. Indeed, the average inequality-adjusted human development index for developing countries is about 0.55 in 2018. It is much lower than that of developed countries, whose value is around 0.90. However, in order to promote their sustainable development, governments around the world are increasingly tending to implement stringent environmental measures. In the case of developing countries, these include measures such as participation in MEAs, the creation of the Ministry of Environment and the promotion of environmental democracy.

The economic literature teaches that environmental policy stringency increases human development. It reduces the effects of pollution and climate change on health, education and income [4,5]. Indeed, an increase in population and/or climate change degrades the health of individuals [6,7,8]. It also increases school absenteeism [9,10,11], classroom behavioural disorders [12,13,14] and brain development disorders [15,16,17]. However, the representation on a point cloud of average levels of human development and participation in MEAs in developing countries shows that the relationship between these variables is counter-intuitive. Indeed, MEAs seem to promote human development in countries such as Uruguay, Estonia, Turkey, Lativia, Argentina, Indonesia, Georgia, Bosnia, Albania, Jamaica, Kazakhstan and Iran. In African countries, on the other hand, they seem to negatively affect human development.

This article questions the effect of environmental policy stringency measures on human development in developing countries. The objective is to analyze and explain the effect of MEAs, the ministry of environment, and environmental democracy on human development. *We hypothesize that environmental policy stringency promotes human development in developing countries*. The sample comprises 72 countries and the study period is from 1995 to 2017. The estimation technique is that of double least squares. The results indicate that. The results show that MEAs, the Ministry of Environment increase human development and its components. However, this effect depends on the level of development of the country and its geographical location. The rest of the article is organized as follows, 2- literature review, 3- stylized facts, 4- the model and variables, 5- results, 6-conclusion.

2. REVIEW OF LITERATURE

The effect of environmental policy stringency on education, health and income is widely debated in the literature. Regarding education, Ransom and Pope [9], Butz et al. [12], Bussing et al. [13], Gilliland et al. [10], Halterman [14], Suglia [15], Currie et al. [18], Wang et al. [16] teach that environmental policy stringency affects education through its capacity to reduce the level of pollution and the extent of climate change. Indeed, these authors teach that pollution in general and air pollution in particular generates diseases that affect the cognitive abilities of learners and impair their academic performance. They indicate four channels through which pollution affects education. The first is that of school absenteeism. It is defended in the literature by Ransom and Pope [9], Gilliland et al. [10], Pastor et al. [11], Currie et al. [18]. The second is that of behavioural disorders in the classroom. It is defended in the literature by; Butz et al. [12], Bussing et al. [13], Halterman [14]. The third channel is revision fatigue. The authors of this channel are Legot et al. [19]; Gaffron and Niemeier [20]. The fourth channel is that of cerebral development disorders. It is defended by Suglia et al. [15], Wang et al. [16], Mohai et al. [17]. These authors then indicate that environmental policy stringency increases human development since it allows reducing pollution and climate change.

In terms of health, Kempe [4] and Morton [5] teach that climate change is causing phenomena such as extreme drought and flooding. These phenomena are the cause of population displacement. They expose people to problems

such as undernourishment, malnutrition and adverse weather conditions. Furthermore, Berger et al. [21], Harrignton and Portney [22], Alberini et al [7], Arceo et al [23] and Yang [24] show that pollution leads to disutility among consumers. According to Berger et al. [21], pollution increases the frequency of respiratory diseases such as asthma in the population. These diseases, as Alberini et al. [7] indicate, affect the well-being of these individuals. This author shows that an individual's usefulness depends not only on the amount of leisure time they have, but also on the time they spend being ill and the nature and severity of the illness. However, they show that the ability of environmental measures to promote health depends on the cultural and socio-economic characteristics of populations.

Regarding income, Azzarri and Signorelli [25] show that unstable rainfall and temperature instability leads to reduced production in sectors such as agriculture, livestock and tourism. Furthermore, Hirazawa et al. [26] show that MEAs affect international income inequalities. They indicate that MEAs help to share the environmental burden between countries and that the effect of MEAs on income inequalities depends on the way the burden is distributed. When pollution abatement costs are distributed among countries in proportion to their average income, Hirazawa et al. [26] show that pollution abatement policies affect income inequalities in a non-linear way. In the short term, they lead to an increase in income inequality between rich and poor economies. In the long term, on the other hand, they show that income inequalities gradually decrease and may even disappear. Hirazawa et al. [26] teach that the magnitude of the short- and long-term effects of the pollution burden on income inequalities depends on the sensitivity between an individual's human capital and that of his or her parents. The greater this sensitivity, the greater the short-term divergence effect. The main limitation of the study by Hirazawa et al. [26] is that it does not provide any information on the effect of these policies on internal inequalities.

This article is a contribution to the previous literature as it focuses on the effect of environmental policy stringency measures on human development as a whole. Indeed, almost all previous studies analyze the effect of environmental policy stringency on the components of human development in isolation. It is also a contribution to the literature insofar as it highlights the role of implicit indicators of environmental policy stringency, namely MEAs, the Ministry of the Environment and environmental democracy. Finally, it is a contribution to the literature since most of the studies referred to in the literature are conducted at the microeconomic level. This study therefore makes it possible to verify whether the results obtained at the microeconomic level are valid at the macroeconomic level.

3. STYLIZED FACTS

The economic literature teaches that measures of environmental policy stringency such as MEAs, MEAs, and environmental democracy can enhance human development [7,8,9,11,14, 16,17]. However, Fig. 1 shows that the relationship between MEAs and human development is counter-intuitive in developing countries. This graph represents the average human development index as a function of the average index of participation in MEAs in developing countries.

Looking at this graph we see that countries such as Uruguay, Estonia, Turkey, Lativia, Argentina, Indonesia, Georgia, Bosnia, Albania, Jamaica, Kazakhstan and Iran, which have relatively high participation indices in multilateral environmental agreements, have relatively high human development indices. On the other hand, most African countries (Senegal, Malawi, Niger, Burkina Faso, Mozambique, Ethiopia, Tanzania, etc.), whose participation indices in MEAs are also high, have very low human development indices. There are therefore many atypical cases in the relationship between MEAs and the HDI in developing countries. There is therefore a need to understand why participation in MEAs appears to promote human development in some developing countries and not in others.

In an attempt to explain the wide dispersion of the effect of MEAs on human development in developing countries, we highlight the role of governance. Indeed, MEAs provide developing countries with investments in climate change mitigation and adaptation. Cohen and Tubb [27] teach that governance is a fundamental determinant of investment. As a result, countries with the best levels of governance are the best candidates to receive climate change mitigation and adaptation investments. Graphs 1. A and 1.B highlight the role of governance on the relationship between MEAs and the Human Development Index. These graphs show that governance improves the effect of MEAs on human development. We can see from these

graphs that countries with high human development are necessarily those in which governance is also high. Examples are Uruguay, Estonia, Argentina, Turkey, Georgia, Latvia, Kazakstan, Iran, Indonesia, Albania, Chile, and Uruguay.

On the other hand, African countries that are characterized by relatively low human development are also countries with weak governance. This may help explain why African countries despite their high participation in MEAs have relatively low human development compared to the countries mentioned above. Corruption control and the quality of regulation in African countries are very weak. This makes them less attractive for adaptation investments that are made within the framework of MEAs. However, since the above observations are only presumptions, it is necessary that we proceed with a regression in order to capture and explain in a concrete manner the effect of environmental policy stringency indicators on human development in developing countries.

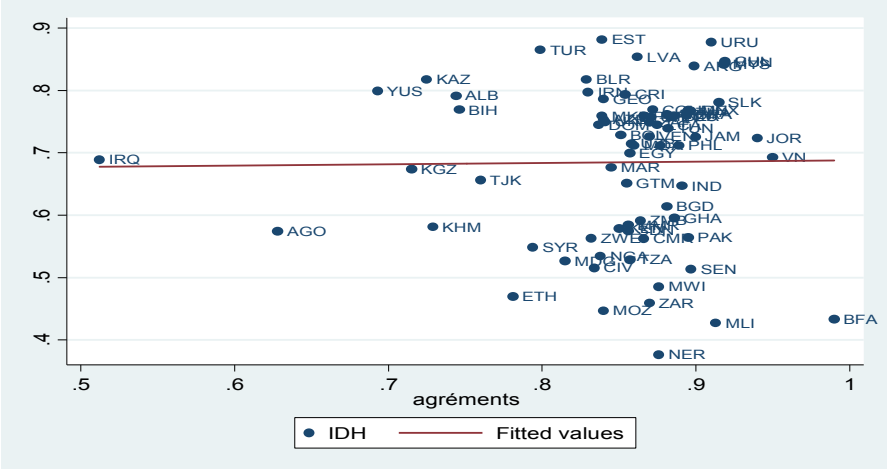
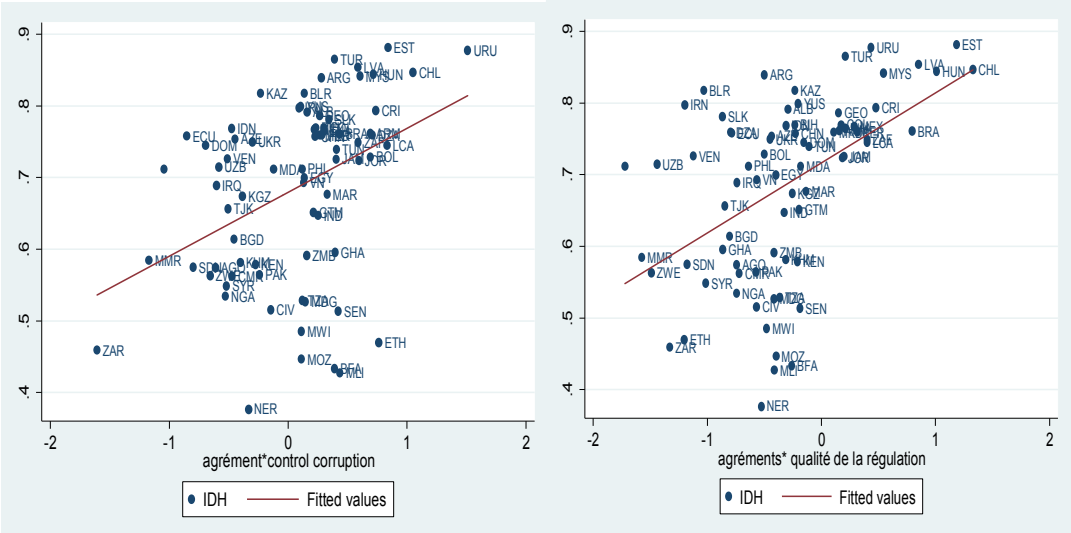


Fig. 1. Relationship between MEAs and the human development Index of developing countries between 1995 and 2017

Source; Author based on United Nations data and International Environmental Agreements



A: Control of corruption **B: Regulatory quality**

Graph 1. Relationship between MEAs and the HDI in DCs: the role of governance

Source: Author based on United Nations and World Bank data.

4. THE ECONOMETRIC MODEL AND THE VARIABLES

First we present the variables, and then we present the econometric model.

4.1 Variables and Data

This study is conducted on a sample of 72 developing countries. The data cover the period 1995- 2017. The variables we present here are the variables of interest in our study. They are the indicators of environmental policy stringency, namely, MEAs, Ministry of Environment and Environmental Democracy.

4.1.1 Multilateral Environmental Agreements (MEAs)

This variable captures a country's level of environmental policy stringency by referring to its participation in MEAs. It has already been used in the literature by Javorcik et Wei [28] and Greenstone, [29]. However, the MEA indicator constructed by these authors is a cross-sectional indicator since it provides for each country the overall score obtained by considering a certain number of agreements. However, it omits an essential element that deserves to be taken into account when calculating the level of environmental policy stringency of a country with reference to MEAs. This is the speed with which countries adhere to these agreements. In other words, it is necessary to take into account the time that elapses between the moment the agreement is adopted and the moment the country signs, ratifies and implements it. To compensate for this shortcoming, our MEA participation index is constructed as a panel. There are four stages in its construction. In the first stage, we list the main agreements signed by developing countries between 1995 and 2017. We give priority to multilateral agreements on Ozone and climate because of the interest in climate change in these countries. Eight agreements have been selected: the Convention on the Protection of the Ozone Layer 1986 and its associated protocol 1988, the Convention on Climate Change 1992 and its main amendments 1999 and 2006 respectively, the Kyoto Protocol (1997) and its amendments 2011 and finally, the Paris Agreement 2015. The information on these agreements comes from the *International Environmental Agreement 2018*. At the second stage, we give a score of 0 for each year of our study period to any country that has not signed any agreement. Once a country has signed an agreement, we give it a score of 0.5 for the agreement in question for all subsequent years until the agreement is ratified. When ratified, we assign a score of 1 until the accreditation is put into effect by that country. Finally, when the accreditation comes into force we score 2 for all remaining years. In the third step we calculate for each year the total score for each country by adding up the scores obtained by that country on the different accreditations.

$$score_{i,t} = \sum_{k=1}^{8} score_{ki,t} \quad (1)$$

$scoreki_{,t}$ represents the score obtained by country i for agreement k in year t.

Finally, in the fourth step, we deduce the values of our environmental policy stringency index calculated on the basis of participation in MEAs by reporting each year the score obtained by a country at the maximum score. The maximum score represents the score that would have been obtained by a country that in year t has signed, ratified and implemented all the agreements available at that date. It is therefore the highest score that can be obtained for each year.

$$agrément_{i,t} = \frac{score_{i,t}}{score_{\max,t}} x100 \quad (2)$$

This indicator varies between 0 and 100, with a country being more stringent the closer its index is to 100.

4.1.2 The ministry of environment

This is the main state body responsible for environmental issues. It is responsible for implementing in a country the resolutions taken in the MEAs. The longer a country delays the establishment of this ministry, the less environmentally stringency it is. We constructed this variable by assigning a score of 0 to a country for all the years in which it does not have a ministry of the environment and 1 for the years in which it does have such a ministry. This is a binary variable with a negative expected sign on TFP growth.

4.1.3 Environmental democracy

This is a composite indicator constructed in 2011 on 70 countries by the *World Resources Institute* (WRI) and *The Access Initiative (*TAI). It contains 75 legal indicators grouped into three categories. Energy intensity and CO2 production have, for

their part, been used several times in the literature to measure a country's environmental policy stringency (see Kelsey, [30]).

4.2 The Econometric Model

The estimated model is based on the work of Arceo et al. [23]. It is given by the equation:

$$y_i = \beta_0 + \beta_1 agrément_i + \beta_2 \min\_env_i + \beta_3 P_i + \delta X_i + \varepsilon_i \quad (3)$$

In this model y represents the human development index, *agreements* and *min_env* represents respectively the participation in MEAs the relative number of years of existence of the Ministry of Environment[1]. X is a matrix containing control variables and i is the country index. Sensitivity and robustness analyses of the results are carried out by introducing into this model variables that capture the effects of climate change on human development as well as the effects of individual characteristics of developing countries. The models estimated here are then as follows;

$$y_i = \beta_0 + \beta_1 agrément_i + \beta_2 \min\_env_i + \beta_3 P_i + \delta X_i + \gamma Z_1 + \varepsilon_i \quad (4)$$

$$y_i = \beta_0 + \beta_1 agrément_i + \beta_2 \min\_env_i + \beta_3 P_i + \delta X_i + \gamma Z_2 + \varepsilon_i \quad (5)$$

Z1 is a matrix that contains observations on indicators of climate change, namely, temperature instability, precipitation instability, aridity and floods. Z2 is a matrix containing observations on individual characteristics of the countries in the sample, i.e. geographical location, stage of development, dependence on natural resources. The control variables used in this study are inspired by the work of Dhrifi et al. [31]. Among these variables is *population growth*. It is measured as a percentage of the total population. We also have *GDP per capita*. This is the ratio of GDP to total population. This variable is measured in constant dollars on a 2010 basis. *Urbanization is the* population residing in urban areas. This variable is measured as a percentage of the total population and is inspired by the work of Dhrifi et al. [31]. *The natural resource rent is* measured as a percentage of GDP and corresponds to the sum of profits from the exploitation of natural resources. *Telephone infrastructure*. This is the number of mobile phone subscribers per 100 inhabitants. *Trade openness* measured by the sum of imports and exports in relation to GDP. Data on all these variables are taken from the WDI, 2018. Finally, there are governance indicators, namely, *control of corruption* and *quality of regulation, for* which data are taken from the WGI, 2017.

4.3 Descriptive Statistics

Table 1 presents the means, standard deviations, minimum and maximum observations of the variables included in this study. This table indicates that, on average, human development remains relatively low in developing countries. Indeed, the average HDI of these countries is about 0.685. This corresponds to the category of countries with average human development. This index is even lower when inequalities are taken into account. The table shows that the average Inequality-adjusted Human Development Index is about 0.557. This then reflects the existence of high inequality in these countries.

In terms of health, the average life expectancy of a child at birth is only about 57.76 years. Moreover, 22 out of every 1000 children die at birth. A figure that remains very high when compared to that of developed countries, which is around 3 children per 1000 according to UNDP [3]. In terms of education, the table shows that the average number of years of education completed by an individual at the age of 25 is 7 years. This figure is therefore lower than the number of years required to complete the nursery and primary cycles. All the above observations indicate that human development in developing countries is still very low.

Table 1 also indicates that, on average, the participation of DCs in MEAs is quite high. Moreover, the average ratio of the number of years the Department of the Environment has been in existence is about 0.69, or 69% of our study period. This would mean that the average duration of the Ministry of the Environment in DCs is 15 years. The dispersion of these variables is quite low, which means that there are no very great distances between developing countries in terms of environmental rigour. With regard to the control variables, Table 4.1 shows that natural resource rent, population growth and trade openness are on average relatively high in DCs, while urbanization, governance, infrastructure and FDI appear to be relatively low. All this leads us to question the empirical links between these variables. One may a priori think that indicators of environmental policy stringency

[1] *The relative number of years of existence of the Ministry of Environment is calculated by dividing the number of years of existence of the Ministry of Environment for each country by the length of our study period.*

Table 1. Descriptive statistics of the over the entire sample

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**N**	**Averages**	**Standard deviations**	**Minimum**	**Maximum**
HDI	72	0.685	0.125	0.377	0.882
Inequality-adjusted HDI	69	0.557	0.148	0.294	0.818
Infant mortality	72	21.93	17.83	1.100	65.80
Life expectancy	72	57.76	16.08	5.600	69.80
Average number of years of study completed at 25 years of age	72	6.826	3.452	1.115	13.29
Enrolment in secondary school	72	1.089	0.348	0.552	1.960
Gini Indices	64	37.37	10.90	4.100	63.10
Agreements	72	0.848	0.0718	0.512	0.990
Ministry of the Environment	72	0.689	0.239	0.130	1
Environmental Democracy	54	1.442	0.419	0.510	2.310
Floods	55	7.074	13.58	0.130	46.17
Aridity	72	52.39	21.92	3.424	88.67
Precipitation instability	72	67.81	18.48	7.545	85.47
Temperature instability	72	58.53	25.81	3.943	85.38
IQ	72	79.52	16.95	6.100	99.70
CO2 emissions	72	5.435	3.739	0.791	18.80
IDE	72	3.761	2.881	-0.140	17.50
per-capita GDP	72	118.4	251.9	1.113	977.2
Phone	72	44.47	23.11	3.190	117.5
Population growth	72	1.529	1.171	-1.167	3.790
Natural Resource Rent	72	8.153	10.10	0.161	48.64
Commercial opening	72	65.82	36.18	3.670	177.9
Urbanisation	72	47.10	22.15	3.170	93.32
Quality of regulation	72	-0.410	0.742	-1.965	1.445
Control of corruption	72	-0.553	0.628	-1.710	1.415

Source: Author

negatively affect human development in developing countries in view of the relatively high averages of these variables. It is therefore necessary to carry out econometric regressions.

5. PRESENTATION AND DISCUSSION OF ECONOMETRIC RESULTS

We present the results in three parts. First we present the basic results, then we present the results of the sensitivity analysis. Finally, we present the results of the robustness analysis.

5.1 Presentation and Discussion of Basic Results

Table 2 presents the basic results we obtain. These results show that participation in multilateral environmental agreements leads to an increase in the human development index in developing countries. Indeed, the coefficient of this variable is positive and significant. This result is consistent with the work of Weiler et al. [32].

It can be explained by the fact that MEAs, through the adaptation and mitigation policies that they generate, provide developing countries with resources that enable them to better fight climate change and its effects. on the health and education of populations (Indeed, an increase in climate change in an economy tends not only to reduce production in sensitive sectors such as agriculture, tourism, etc., but also exposes individuals in that country to numerous diseases that reduce their life expectancy and negatively affect their academic performance [14,15,18]. In addition to MEAs, we have the Department of the Environment and Environmental Democracy. Looking at Table 2, it can be seen that the Ministry of Environment does not significantly affect human development in developing countries. Environmental democracy, on the other hand, has a positive and significant effect on the human development index of developing countries. With respect to the control variables.

Table 2 indicates that co_2 production negatively and significantly affects the human development index in developing countries. This result is consistent with the findings of Bussing et al. [13] and Gilliland et al. [10] which indicate that air pollution causes diseases that not only reduce life expectancy but also reduce academic performance by increasing the frequency of school absences and behavioural disorders among individuals. In addition to $_{CO2}$ production, population growth also has a negative effect on human development in developing countries. This result is consistent with that of Dhrifi et al [31] who show that when population grows faster than resources, it amplifies redistribution problems and further reduces each individual's ability to meet his or her capabilities. The quality of regulation and urbanization, for their part, promote human development in developing countries. These results also show that governance is a key factor in explaining human development in developing countries. Indeed, the coefficient of interaction between the quality of regulation and MEAs is positive and significant. This other result indicates that the quality of regulation explains the effect of MEAs on human development. Other variables such as GDP per capita and natural resource rents also favour human development in developing countries. However, the results of these variables do not appear to be very robust since they lose their significance when certain variables are added or subtracted from the analysis.

Table 2. The effect of MEAs, the Ministry of the environment and environmental democracy on human development in developing countries

Dependent variable : Human Development Index (HDI) *Estimation method: Double least squares*				
	(1)	**(2)**	**(3)**	**(4)**
agreements	0.512**	0.312**	0.796*	0.769*
	(0.248)	(0.130)	(0.438)	(0.448)
Ministry of the Environment		0.0443	0.0618	0.0626
		(0.0307)	(0.0421)	(0.0425)
Environmental Democracy			0.0592*	0.0601*
			(0.0310)	(0.0312)
Agreements*Quality of regulation				0.0545**
				(0.0265)
Population growth	-0.0524***	-0.0363***	-0.0191	-0.0195
	(0.0131)	(0.00871)	(0.0170)	(0.0172)
Quality of regulation	0.0514**	0.0297*	0.0477**	
	(0.0231)	(0.0168)	(0.0231)	
per-capita GDP	0.0317	-0.00200	0.0294*	0.0298*
	(0.0197)	(0.00914)	(0.0175)	(0.0179)
Phone	0.00125**	0.00145***	0.000715	0.000715
	(0.000590)	(0.000453)	(0.000996)	(0.00101)
Natural Resource Rent	0.00564***	0.00249**	0.00204	0.00200
	(0.00218)	(0.00118)	(0.00221)	(0.00222)
Urbanisation	0.00205***	0.00140***	0.000968***	0.000961***
	(0.000606)	(0.000374)	(0.000362)	(0.000365)
Commercial opening		0.000141	-0.000104	-0.000104
		(0.000216)	(0.000292)	(0.000294)
CO2 emissions	-0.00701**	-0.00507**	-0.0128***	-0.0127***
	(0.00334)	(0.00254)	(0.00443)	(0.00444)
Constant	0.0767	0.306**	-0.182	-0.160
	(0.275)	(0.133)	(0.383)	(0.391)
Number of observations	72	72	54	54
Sarghan statistics	0.135	0.132	0.111	0.075
R-square	0.580	0.809	0.786	0.783

*Notes: The values in parentheses represent the estimated standard deviations of the coefficients. *** , ** , * indicate significance at 1%, 5% and 10% respectively; Source: Author*

5.2 Sensitivity Analysis of Results: Taking into Account the Effects of Climate Change and the Individual Characteristics of Developing Countries

In this second phase of our analysis, we will analyse the effect of climate change and the individual characteristics of developing countries on their human development. It is also a question of verifying that taking these variables into account has little influence on the basic results that we presented above. The choice of climate change as the focus of this report is due to the fact that climate change is one of the main channels through which environmental policy stringency affects human development in developing countries. As noted above, climate change negatively impacts the health and education of those exposed to it, while MEAs provide developing countries with the technological and financial means to mitigate these effects. Table 3 shows the results achieved. It should be noted that four indicators of climate change have been selected: temperature instability, precipitation instability, aridity and floods. The results indicate that climate change negatively affects the human

Table 3. The effect of environmental policy stringency on human development in developing countries: Taking into account the effects of climate change

Dependent variable: Human Development Index (HDI) *Estimation method: Double least squares*				
	(1)	**(2)**	**(3)**	**(4)**
agreements	0.457** (0.210)	0.230** (0.117)	0.345** (0.148)	0.356* (0.215)
Ministry of the Environment		0.0397 (0.0276)	0.0426 (0.0333)	-0.0126 (0.0466)
aridity	-0.000969* (0.000587)			
Precipitation instability		-0.00175*** (0.000448)		
Temperature instability			0.000157 (0.000392)	
floods				-0.00252*** (0.000907)
GDP per capita	0.0351** (0.0146)	-0.00427 (0.0144)	0.00607 (0.0190)	0.0380*** (0.0137)
Population growth	-0.0590*** (0.0136)	-0.0393*** (0.00779)	-0.0410*** (0.00955)	-0.0631*** (0.0124)
Quality of regulation	0.0524** (0.0232)	0.0301** (0.0147)	0.0353* (0.0183)	0.0414 (0.0273)
Phone	0.000879 (0.000610)	0.00101*** (0.000380)	0.00135*** (0.000460)	0.000464 (0.000798)
Natural Resource Rent	0.00621*** (0.00200)	0.00277** (0.00120)	0.00305** (0.00146)	0.00362* (0.00210)
CO2 emissions	-0.00706** (0.00350)	-0.00409* (0.00230)	-0.00566** (0.00287)	-0.0133*** (0.00458)
Urbanisation	0.00225*** (0.000631)	0.00206*** (0.000380)	0.00169*** (0.000431)	0.00230*** (0.000593)
Constant	0.178 (0.218)	0.494*** (0.127)	0.255 (0.160)	0.196 (0.237)
Number of observations	72	72	72	72
Sarghan statistics	0.010	0 .051	1 .423	0.427
R-squares	0.564	0.866	0.797	0.715

*Notes: The values in parentheses represent the estimated standard deviations of the coefficients. *** , ** , * indicate significance at 1%, 5% and 10% respectively; Source: Author*

development index in developing countries. Indeed, the estimated coefficients of the four indicators we have selected for climate change are all associated with a minus sign (-).

Floods, on the other hand, are the cause of the displacement of populations who find themselves exposed to precarious living conditions. These two phenomena combined have a third consequence, which is the reduction of production in certain sectors of the economy such as agriculture, livestock and tourism. This further exposes people in developing countries to problems of poor nutrition and food insufficiency. In addition to these two indicators, aridity also significantly affects human development, while the effect of temperature instability is insignificant. However, the inclusion of climate change indicators in our analysis has considerably reduced the estimated coefficients of our variables of interest while improving their significance. This then reflects the importance of these variables in our analysis.

With regard to the individual characteristics in the analysis, Table 4 shows the results obtained. This table indicates that the individual characteristics of developing countries significantly affect their human development. Indeed, geographical location and stage of development are the variables with the greatest impact.

Dependence on natural resources does not significantly affect human development in developing countries. With regard to geographical location, this variable positively affects human development in developing countries. It should be recalled that this variable has four modalities, namely: Africa, Europe, Asia and Latin and Central America. In the regression, Africa is considered as the reference category. The results show that the effect of MEAs on human development depends on the region in which the country is located. The positive sign of this variable indicates that the average human development of African countries is lower than that of Asian, European and American countries. This result shows that MEAs are more conducive to human development in Asian, Latin American and European countries than in African countries.

The second variable we are interested in is the development stage. This variable also affects human development in a positive way. It should be recalled that the stage of development variable has three modalities: least developed countries (LDCs), developing countries (DCs) and emerging countries. We consider LDCs as a reference category. The results of this variable show that human development is an increasing function of economic development. The positive sign of the variable indicates that the difference in average human development between developing and least developed countries is positive. The same is true for the difference in average human development between emerging economies and LDCs. This shows that human development in developing and emerging countries is higher than in LDCs.

5.3 Analysing the Robustness of Results: The Decomposition of the Human Development Index

The third phase of our analysis consists of decomposing the Human Development Index into several components and measuring the effect of environmental policy stringency indicators on each of these components. We select three components of human development, namely health (life expectancy and infant mortality), education (average number of years of schooling completed by an individual aged 25 and the secondary completion rate) and inequality (Gini index).

Table 5 presents the results obtained. This table tends to confirm the results we obtained on the global human development index. The results show that participation in multilateral agreements increases life expectancy and secondary completion rates in developing countries. The results also show that MEAs reduce child mortality, income inequality and the average number of years of schooling completed by an individual aged 25. The effect of the Ministry of the Environment on all of these components is insignificant except for life expectancy. The results also show that unstable rainfall and aridity increase the infant mortality rate and inequality, respectively. These results, like the previous ones, thus indicate that environmental policy stringency promotes human development in developing countries. On the one hand, it increases the level of health of individuals in these countries. On the other hand, it reduces the adverse effects of climate change on the academic performance of learners. It also reduces income inequalities between individuals in these countries. After having thus analyzed the

effect of Environmental policy stringency on human development in developing countries, we analyze in the following section of this chapter the effect of environmental policy stringency on the vulnerability of developing countries to climate change.

Table 4. The effect of environmental policy stringency on human development in developing countries: taking into account the effects of climate change

Dependent variable: Human Development Index (HDI) and Development Index Inequality-adjusted human development index (IHDI)
Estimation method: Double least squares

	Human Development Index			IDHI
	(1)	**(2)**	**(3)**	**(4)**
Agreements	0.779***	0.441*	0.681	0.512*
	(0.288)	(0.243)	(0.454)	(0.262)
Ministry of the Environment	0.0200	0.0387	0.0396	-0.0263
	(0.0369)	(0.0314)	(0.0428)	(0.0367)
Environmental Democracy	0.101***	0.0243	0.0789**	0.00902
	(0.0293)	(0.0268)	(0.0389)	(0.0332)
Geographic location				
Asia	0.0640*			0.176***
	(0.0376)			(0.0387)
Europe	0.107			0.328***
	(0.0691)			(0.0662)
Latin and Central America	0.109***			0.151***
	(0.0386)			(0.0378)
Stage of development				
PVD		0.407***		0.490***
		(0.0973)		(0.135)
Emerging countries		0.389***		0.441***
		(0.0957)		(0.128)
Dependence on natural resources			0.0382	
			(0.0301)	
per-capita GDP	0.0266***	0.0659***	0.0338	0.0795***
	(0.00879)	(0.0143)	(0.0226)	(0.0192)
Natural Resource Rent	0.00243	-0.00193	0.00117	-0.000684
	(0.00192)	(0.00185)	(0.00225)	(0.00204)
Urbanisation	-0.000253	0.000151	0.000925**	-0.000501
	(0.000504)	(0.000350)	(0.000378)	(0.000495)
CO2 emissions	-0.00878**	-0.00511	-0.0140***	-0.000935
	(0.00373)	(0.00338)	(0.00516)	(0.00418)
Constant	-0.282	-0.138	-0.138	-0.382
	(0.293)	(0.257)	(0.414)	(0.272)
Number of observations	54	54	54	54
R-squares	0.843	0.864	0.774	0.907

*Notes: The values in parentheses represent the estimated standard deviations of the coefficients. *** , ** , * indicate significance at 1%, 5% and 10% respectively; Source: Author*

Table 5. Effect of environmental policy stringency on the components of human development

Estimation method: Double least squares					
	Health		**Education**		**Inequalities**
Dependent variables	**Life expectancy**	**Infant mortality**	**No. of years of studies at age 25**	**Completion From secondary school**	**Index of GINI**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
agreements	39.63*	-48.20*	-18.94***	2.112***	-0.158**
	(22.32)	(27.47)	(6.753)	(0.725)	(0.0799)
Ministry of the Environment	9.859*	-0.242	0.0467	0.278	8.481
	(5.368)	(6.564)	(1.567)	(0.171)	(7.996)
per-capita GDP	0.174	-3.329*	-1.354***	-0.0348	-1.827
	(1.646)	(1.959)	(0.488)	(0.0530)	(3.011)
Population growth	-1.572	5.759***	-2.008***	-0.0498	-0.133
	(1.551)	(1.807)	(0.440)	(0.0477)	(2.101)
Quality of regulation	2.923	-6.181	-0.418	0.0697	2.761
	(3.370)	(4.152)	(1.004)	(0.109)	(2.938)
Phone	0.250***	-0.132	-0.0514**	0.00742***	
	(0.0773)	(0.0981)	(0.0234)	(0.00260)	
Natural Resource Rent	0.293	-0.726***	-0.131**	0.00579	-0.0927
	(0.218)	(0.275)	(0.0661)	(0.00691)	(0.287)
Urbanisation	0.159**	-0.230**	0.0119	0.00281	0.0600
	(0.0688)	(0.0901)	(0.0191)	(0.00208)	(0.0885)
Commercial opening	-0.00238	-0.0419	0.00995	-0.000325	-0.0634
	(0.0414)	(0.0509)	(0.0125)	(0.00142)	(0.0446)
CO2 emissions	0.196	1.533**	0.247*	0.0125	0.701
	(0.495)	(0.607)	(0.147)	(0.0210)	(0.457)
Temperature instability	-0.0141				
	(0.0579)				
Precipitation instability		0.273**			
		(0.110)			
aridity					0.170*
					(0.102)
Constant	1.201	59.69**	29.87***	-1.381*	36.49***
	(22.22)	(28.56)	(6.738)	(0.721)	(11.38)
Number of observations	72	72	72	72	69
Sarghan statistics	0.010	0.035	0.895	0,.07	1.f305
R-squares	0.553	0.673	0.474	0.482	0.296

*Notes: The values in parentheses represent the estimated standard deviations of the coefficients. ***, **, * indicate significance at 1%, 5% and 10% respectively; Source: Author*

6. CONCLUSION

In a context where human development is the priority of sustainable development in developing countries, as indicated by Boidin [2], this article analysed the effect of environmental policy stringency on human development in developing countries. The objective was to analyse and explain the effect of multilateral agreements, the Ministry of the Environment and Environmental Democracy on the human development index. To achieve this objective, we used a sample of 72 developing countries. The oven period is from 1995 to 2017. The analysis is carried out in cross-section. The estimation technique used is double least squares. The results we arrive at show that multilateral environmental agreements, MEAs and environmental democracy, promote human development in developing countries. Indeed, in addition to increasing the human development index, MEAs reduce child mortality, income inequality and secondary school completion rates. In addition to this, the results also show that unstable temperatures, rainfall,

floods and aridity explain the level of human development in developing countries. Similarly, the level of development and geographical location of developing countries also impact on their human development. In view of these findings, we recommend that developing countries further promote environmental policy stringency by participating in MEAs and ensuring environmental rights and freedoms for their populations. However, it is also necessary for the latter to increase their level of governance in order to fully benefit from the effects of their participation in MEAs.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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