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Human Capital, Trade Openness and CO_2 Emissions: Evidence from Heterogeneous Income Groups

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Abstract

This study examines the impact of trade openness, urbanization, and human capital on environmental degradation using the panel data of 126 economies for the years 1971-2020. The study also extends the analysis for four sub-panels namely, high-income economies (HIC), upper-middle-income economies (UMIC), lower-middle-income economies (LMIC), and low-income economies (LIC) by using fully modified least squares (FMOLS), dynamic ordinary least squares (DOLS), fixed effects (FEM), random effects (REM), and system GMM. This study uses the environmental impact of the population, affluence, and technology (IPAT) model. The main result of the study reveals that openness to trade has a harmful impact on the environment in the global, upper-middle- and low-income economies, although it shows a benign effect on the environment in high-income economies. Moreover, trade has an insignificant influence on the environment in lower-middle-income countries, but a negative significant impact in high-income economies. Urbanization degrades the environment in all economies except in low-income economies where it improves environmental quality. Meanwhile, results also show that enhancement in human capital will lessen emissions in all economies. Human capital has the potential to curb the level of emissions in almost all income economies. Therefore, economies should invest in human capital to combat emissions.

Keywords: carbon dioxide emissions (CO_2), environmental quality, human capital, IPAT, trade openness, urbanization.

1. Introduction

The global climate change resulting from the increasing level of greenhouse gases (GHGs) has a far-reaching effect on sustainable development and environmental quality. Carbon dioxide (CO_2) emissions along with other GHGs causes global climate change and ocean acidification. Climate change leads to the melting of glaciers causing sea levels to rise. This rise in sea level threatens life on earth including plants and animal species. Some of these changes are natural, while others are influenced by humans (anthropogenic). These anthropogenic GHGs disturb the earth's atmosphere. These climate changes are measured by the amount of warming and cooling they can produce, which is designated as "radiative forcing". Changes that have a cooling impact are classified as "negative forcing", while changes that have warming impact are classified as "positive forcing". When positive and negative forces are out of equilibrium, this changes environmental quality. CO_2 emissions is the major contributor to GHGs that leads to global climate change. The CO_2 emission increased by 75% during the period 1980-2012 (IEA, 2014). For that reason, the UN-framework convention on climate change (UNFCCC, 1992) commits countries to observe and reduce their CO_2 emissions. In addition to this agreement, the Kyoto Protocol was negotiated in 1997 that commits countries to limit and reduce emissions in accordance with agreed objectives. Generally, these objectives lead to a 5 % decrease in emissions between 2008 and 2012 (first commitment period).

Therefore, several researchers explored the determinants of CO_2 emissions (Sharma, 2011; Zhang et al., 2012; Iwata et al., 2012). Some traditional studies were of the view that an increase in energy consumption plays a major role in raising the level of emissions, without considering the effect of population and technology on emissions (Shi, 2001). Contrarily, some studies consider population, affluence, and technology as the major determinants of CO_2 emissions (Cole and Neumayer, 2004; Liddle and Lung, 2010; Martínez- Zarzoso and Maruotti, 2011; Lv and Xu, 2019; Majeed & Tauqir, 2020; Nathaniel et al., 2021). The impact of economic prosperity on environmental quality took a new twist with the introduction of additional variables.

The rapid increase in urbanization and trade openness has created a huge challenge for environmental quality, as developed and developing economies are in process of urbanization and trade openness. Theoretical foundations of urbanization and the environment nexus can be explained using the insights from the following theories. First, urban environmental transition theory postulates that many environmental issues are generated when the cities grow. Therefore, environmental problems become the offshoots of growing urbanization. Second, contrary to this, the ecological urbanization theory claims that urbanization helps to resolve environmental issues by enhancing income and environmental awareness. Third, ecological modernization theory posits a nonlinear relationship between modernization the environment. That is, in the early stage of modernization (urbanization) environmental problems arise, however, the environment begins to improve with the introduction of modern and green technologies in the production processes (Majeed & Tauqir, 2020).

The empirical studies analyzing the effect of urbanization provides both positive and negative effect on environmental quality. As, Liddle and Lung (2010), (Majeed & Tauqir, 2020), and Ahmed et al., (2020) reported higher emissions caused by urbanization. In contrast, Hossain (2011) and Sharma (2011) reported a decline in emissions from urbanization. Moreover, Sheng and Guo (2016) found the heterogeneous influence of urbanization on the environment between the short and long term. They also reported a higher environment degrading effect of urbanization over the longer than the short term, signifying that environmental damages produced by urbanization would not fade away for a significant length of time.

The theoretical relationship between trade openness and the environment is debatable (Grossman and Krueger, 1995; Tahir et al., 2020; and Majeed and Asghar 2021). The association between trade and GHGs can be explained through the following effects. First, the "scale effect" suggests that as economies engage in foreign trade, the production processes and energy use are boosted. The increasing economic activities put pressure on GHGs, particularly when conventional energy sources are used for production. Second, the "composition effect" suggests that production activities, in response to trade, move into the sectors where comparative advantages persist. The net impact on GHGs mainly depends upon whether expanding sectors are less energy-intensive or not in comparison to the contracting sectors. Third, the technique effect" indicates that trade fosters the use of clean, modern, efficient, and environmentally friendly technologies, mitigating the pressure on the GHGs.

The existing literature produces mixed results on the effect of openness to trade on CO_2 emissions. On the empirical side, openness to trade plays a key role in determining environmental quality. Innumerable studies examined the role of trade on CO_2 emissions (Sharma, 2011; Hossain, 2011; Le et al., 2016; Siddique et al., 2016; Majeed and Asghar, 2021). As theoretical literature considers trade openness as favorable for environmental quality, yet empirical studies provide controversial results. In literature, both positive and negative impacts of trade on environmental quality are documented. One group of studies finds that trade supports a decline in CO_2 emissions (Antweiler et al., 2001; Hossain, 2011; Shahbaz et al., 2013; Siddique et al., 2016; Dogan and Seker, 2016). While another group of studies shows that trade would result in environmental degradation (Farhani et al., 2014; Ahmed et al., 2017; Shahzad et al., 2017; Mahmood et al., 2019; Lv and Xu, 2019).

Despite a growing literature on environmental degradation, produced by human activities there is a need to go beyond and consider other aspects like human capital to overcome environmental degradation. Human capital includes "education, knowledge, skills, work experience and competencies". Moreover, human capital can be classified into three parts; "First general human capital, that includes general education and experience; second firm specific human capital, that is combination of firm associated education, knowledge and skills; third task specific human capital, that include task related knowledge, experience, training and skills" (Kwon, 2009).

From the demand side, higher educational achievement has a positive effect on environmental quality. As more educated humans demand more green goods and more likely to force the firms to reduce environmental pollution. Households with higher human capital (with tertiary education) use energy-efficient appliances that consume less energy and also install appliances that use renewable energy, thereby promoting practices that enhance environmental quality (Yao et al. 2020). From the supply side, the training of workers may result in a reduction of energy use in the production process due to strong nexus between energy and human capital (Pablo-Romero and Sanchez-Braza, 2017). Furthermore, the literature on human capital lacks consensus, which clearly shows that human capital can both have a positive and negative aspect. As human capital reduces emissions by 50% in Latin American and Caribbean countries (LACCs) and increases emissions by 50% in remaining economies (Nathaniel et al., 2021).

Since, environmental quality has become a global issue, addressing this issue requires a global empirical approach. So, this study attempts to find the influence of trade, urbanization, and human capital on CO_2 emissions in a panel of 126 economies between 1971-2020. This study's contributions lie in several points, like existing literature on human capital focused on a single country, thus the conclusion cannot be generalized at the global level. Therefore, the current analysis is an attempt to fulfill the gap by finding the influence of human capital and openness to trade on CO_2 emissions in heterogeneous income panels. Also, none of the studies in existing literature used human capital variable in the impact of population, affluence, and technology (IPAT) model, so the study explored the influence of human capital, trade openness, and urbanization using an expanded IPAT model in the context of 126 economies as well as for the different income groups.

The rest of the paper is organized as follows. The second section will give a brief review of the literature. The third section discusses the theoretical framework, data, and methodology. The fourth section reports the empirical results and discussion. The fifth section provides the conclusion.

2. Literature Review

2.1 Urbanization and Emissions Nexus

Three theories that explain the mechanism in which urbanization affects the CO_2 emissions are "ecological modernization theory, environmental transition theory and compact city theory" (Poumanyvong and Kaneko, 2010; Majeed and Tauqir, 2020). The theory of "ecological modernization" claims that an increase in urban population supports the institutional transformation of society that would result in increasing CO_2 emission (Mol and Spaargaren, 2000). This induced increase in CO_2 emissions is even higher in the regions with low level of urbanization. More granulated, the influence of urbanization on emissions at city level is explained with the "environmental transition theory". McGranahan et al., (2001) found that the higher efficiency in environmental changes in wealthier cities as they have negative intensive margin of urbanization on CO_2 emissions when compared with poor cities. Contrarily, due to the increasing demand for infrastructure, electricity, and transportation, the wealthier cities have positive extensive margin on CO_2 emission (Marcotullio et al., 2005). Therefore, the natural influence of urbanization on emission is explained with this theory. At last, the theory of compact city suggests that by improving infrastructure urbanization decrease CO_2 emission (Capello and Camagni, 2000).

The literature on the influence of urbanization on CO_2 emission shows contradictory results (Parikh and Shukla, 1995; Cole and Neumayer, 2004; Liddle and Lung, 2010;

Ahmed et al., 2020; Nathaniel et al., 2021; Majeed and Tauqir, 2021). On empirical side, Parikh and Shukla (1995) suggest that urbanization enhances CO_2 emission in selected 83 countries for the period of 1985-1986. Liddle and Lung (2010) investigated the influence of urbanization on emission in selected 17 developed economies for the period of 1960-2005. They found that urbanization boosts emissions while considering transport emissions as the regressand but insignificant impact when aggregate CO_2 emission is used as regressand. Majeed and Tauqir (2020) in 156 economies from 1990 to 2014 exhibited the CO_2 emissions enhancing impact of urbanization. Nathaniel et al. (2021) in 18 LACCs from 1990-2017 show positive effect of urbanization on CO_2 emissions, implying that urbanization degrades the environment. Cole and Neumayer (2004) examined 86 economies for the period of 1975-1998 and reported that urbanization has an insignificant influence on emissions. Similarly, Sadorsky (2014) also reported similar findings for 16 emerging economies during 1971-2009. Hossain (2011) reported contradictory results for the panel of newly industrialized countries (NIC) as urbanization degrades environmental quality in Brazil, China, India and Turkey, while improves it in Philippines, and South Africa. Sharma (2011) explored the factors responsible for CO_2 emissions in selected 69 countries based on different income panels. The result shows insignificant impact of urbanization on CO_2 emissions in all three income groups and a negative significant impact in global panel, implying that higher population increases demand for goods and service thereby, and increasing burden on natural resources. Moreover, the population growth eventually expands across landscape, lead to increase the awareness of environmental effects.

More recent studies Saidi and Mbarek (2017) using the sample of 19 emerging economies between 1990-2013 and Lv and Xu (2019) using the sample of 55 middle income economies for the year 1992-2012 supported decline in emissions resulting from urbanization. Fan et al. (2006) investigated the impact of technology, affluence and population on carbon dioxide emissions of 208 economies disaggregated according to income levels during 1975-2000. The result demonstrates inverse association between urbanization and emissions in high income economies but positive at other income levels.

2.2 Trade and Emissions Nexus

Antweiler et al. (2001) feature the three general classifications of the impact of trade on the environment including, “composition impact, scale impact, and technology impact”. Scale effect refers to increase in growth and trade would lead to higher production activities that need higher energy that results in higher emissions. The composition effect refers to the energy-intensive production activities composed of primary goods. Technological impact refers to the advancement of technology to substitute the outdated technologies that help in the reduction of emissions (Grossman and Krunger, 1995; Antweiler et al., 2001; Tahir et al., 2020; Majeed and Asghar, 2021). They found that openness to trade tends to decrease environmental quality in rich countries but improves it in poor countries as the pollution haven hypothesis proposes that trade decreases the environmental quality in low-income economies, as they have low- per capita income and capital-labor ratio, however, if pollution-intensive industries are capital intensive industries. The benefits accumulated from the lax pollution can be fixed by the relatively high price of the capital in capital scarce country as a result more trade in these countries will have a little impact on pollution intensity.

The studies that examine the nexus between openness to trade and environmental quality provide contradictory results (Antweiler et al., 2001; Sharma, 2011; Hossain, 2011; Ozturk and Acaravci, 2013; Shahbaz et al., 2013; Farhani et al., 2014; Le et al., 2016; Ahmed et al., 2016; Siddique et al., 2016; Dogan and Seker, 2016; Saidi and Mbarek, 2017; Ahmed et al., 2017; Shahzad et al., 2017; Mahmood et al., 2019; Lv and Xu, 2019). One group of studies report that trade exerts a positive effect on CO_2 emission implying that an increase in trade openness boosts environmental degradation (Farhani et al., 2014; Ahmed et al., 2017; Shahzad et al., 2017; Mahmood et al., 2019; Lv and Xu, 2019; Ansari et al., 2020; Ragoubi and Mighri, 2021). Another group of studies shows a negative influence of trade on CO_2 emission suggesting that an increase in the trade makes the environmental quality better (Hossain, 2011; Shahbaz et al., 2013; Siddique et al., 2016; Dogan and Seker, 2016). Hossain (2011) found the linkages between openness to trade and emission for Newly Industrialized Countries (NIC) for 1971-2007. The result reveals that openness to trade decreases CO_2 emissions. Shahbaz et al. (2013) examine the impact of trade on emissions in the South African economy for the years 1965-2008. The result shows that trade improves environmental quality by reducing the growth of energy pollutants. Moreover, Siddique et al. (2016) while using south Asian countries also incorporated trade openness into the framework of CO_2 emissions. Their result reveals that trade improves the environmental quality in the South Asian region. Dogan and Seker (2016) investigated the impact of trade openness on CO_2 emissions in top renewable energy countries. Their result indicates that trade decreases emissions.

Le et al. (2016) reveal that trade has a generous impact on the environment in high-income economies but a deleterious impact in middle and low-income economies. The dissimilitude is due to differences in data, techniques, and regressors used. Similarly, Ansari et al. (2020) investigated the impact of trade openness on CO_2 emission in the top 10 CO_2 emitters using data of 1971-2013. Their result reveals that openness to trade stimulates pollution in Saudi Arabia and Canada and mitigates in Italy and the US. Ragoubi and Mighri (2021) examine the spatial impact of openness to trade on CO_2 emissions in 54 middle-income countries for the years 1996-2013. Their result reveals that openness to trade has a positive impact on emissions, while its spill-over impact is negative. Some studies such as Hossain (2011), Ahmed et al. (2016), Siddique et al. (2016), Dogan and Seker (2016) argue that trade has a benign impact on the environment. However, others believe that openness to trade is harmful to the environment (Farhani et al., 2014; Ahmed et al., 2017, Shahzad et al., 2017, Mahmood et al., 2019).

2.3 Human Capital and Emissiosn Nexus

Besides these important determinants of environmental pollution, some researchers found the nexus between human capital and environmental degradation. Human capital could become the panacea for environmental sustainability. According to endogenous growth theory, "human capital is the driver for technological innovations and complement to invest in the field of research and development" (Romer, 1990; Vandenbussche et al., 2006). Technological progress enhances efficiency in resource use and energy generation thereby promoting the use of clean energy practices and combat emissions (Churchill et al., 2019). However, if investment in capital promotes the invention of technologies including "hydraulic drilling and hydraulic fracturing" among others will worsen environmental quality.

The limited number of studies in the literature show the inconsistent sign of human capital. For instance, Bano et al. (2018), Mahmood et al. (2019), Khan (2020), Ahmed et al. (2020) examined the nexus between human capital and CO_2 emissions. More specifically, Bano et al. (2018) examine the short and long-run effect of human capital on carbon emissions in Pakistan. The period of investigation spans from 1971 to 2014. They used "ARDL and VECM" to explore the cointegration and direction of causalities among human capital and CO_2 emissions individually. The result of the causality test discloses two-way causality between human capital and CO_2 emissions in the long run while no causality in the short run. Their result also supports a decline in emissions over the long run resulting from improved human capital through education. Analyzing the influence of human capital on the environment of OECD countries for the years 1965-2014, Yao et al. (2019) reported a decline in the use of dirty energy utilization and an incline in green energy utilization.

Mahmood et al. (2019) analyzed the effect of energy use and economic prosperity on CO_2 emission with the consideration of human capital in Pakistan spanning over 1980-2014. They reported a decline in emissions resulting from human capital implying that it helps to control pollution. Similarly, Khan (2020) empirically analyzed the influence of human capital on CO_2 emission using a large sample of 122 economies for 1980-2014. The result reveals that for sustainable economic development education is required as it supports a decline in emissions. On the other hand, Cole et al. (2005) find that environmental quality improves resulting from human capital in the UK during1990-1998. Yao et al. (2020) investigate the impact of human capital on CO_2 emission using a unique data set of 1870-2014 for 20 OECD countries. Their result indicates that nexus among human capital and CO_2 emission switched from positive to negative in the 1950s and this nexus is more consistent afterward. A remarkable contribution to literature comes from Nathaniel et al. (2021) who find the mixed effects of human capital on environmental quality on 18 LACCs from 1990-2017. Human capital reduces emission in 50% of countries and increases emission in the remaining 50% of countries.

It can be concluded from the above literature that there exists a linkage between urbanization, trade, human capital, and CO_2 emissions while the effect of these determinants on CO_2 is contradictory. The present study contributes to the literature in the following ways. First, the effect of human capital on CO_2 emissions within the IPAT model is missing and it can be only limited to the country-specific and region-specific analysis. Thus, the conclusion cannot be generalized at the global level. The current study investigated the nexus between human capital and CO_2 emissions for a global panel for the very first time. Second, there is a need to find empirical evidence for different income groups by using an up-to-date data set. The current study is the first that examined the effects of both openness to trade and human capital on CO_2 in heterogeneous income groups for the year 1971-2020 within the IPAT model. Third, the current study extends the existing literature by using new techniques in the environmental research field.

3. Theoretical Framework, Methodology and Data

3.1. Theoretical Framework

The study used "stochastic, Impacts by Regression on Population, Affluence and Technology (STIRPAT) (Dietz and Rosa, 1997)" as the reference of the theoretical and analytical framework. The IPAT model is introduced by Ehrlich and Holdren, (1971). They form an equation by combining "environmental impact (I) with the population (P), Affluence (A) and level of environmental damaging technology (T)". The IPAT model relates "environmental impact to population, affluence, and technology", and has been criticized on the grounds of being a mathematical equation and not suitable for hypothesis testing, due to rigid proportionality assumption between the variables (Lv and Xu, 2019). To solve this pivotal limitation, a stochastic version of IPAT has been proposed by Dietz and Rosa, (1997) and is mentioned below.

$$I_{it} = \beta_0 P_{it} A_{it} T_{it} e_{it} \qquad (1)$$

Where, I denote "the impact, usually measured in terms of pollutants emission level", P denotes "the population", A is "the affluence", T is "technology and e is the error term". To explore the impact of trade, urbanization, and human capital on CO_2 emissions, we have modified the STIRPAT model as follows:

$$\ln I_{it} = \beta_1 lnP_{it} + \beta_2 lnA_{it} + \beta_3 lnT_{it} + \beta_4 Trade\ Openness_{it} + \beta_5 Human\ capital_{it} + e_{it} \qquad (2)$$

Whereas ln represents natural logarithm, i indicates cross-sections, t represents period, I denotes the per capita carbon dioxide emissions, P represents "the urban population", A is measured "in terms of GDP per capita", and T is "measured by energy intensity, which is calculated by using the total energy use per dollar of GDP" respectively. However, β_1, β_2, β_3, β_4 and β_5 indicate "the elasticities of environmental effect for P, A, T, trade openness and human capital", respectively.

3.2 Data and Methodology

The study considered data set of 126 countries from 1971 through 2020. The data has been obtained from World Bank (2021). World Bank (2021) classification has been used to categorize countries according to income level. The different income groups include 50, 32, 35, and 8 economies in "high income, upper middle income, lower middle income, and low income" panels. "Carbon dioxide emissions (metric tons per capita)" has been used as the dependent variable. The independent variables include population measured by urban population, affluence measured by GDP per capita, technology measured by$(\text{energy use} \times \text{total population}/\text{GDP})$, trade is measured by export and import as % of GDP. The data of human capital "measured by Human capital index, based on years of schooling, and returns to education" is obtained from Feenstra, et al. (2015). Table 1 provides the complete description of the concerned variables.

To estimate the influence of urbanization, openness to trade, and human capital on emissions, we applied "Fully modified ordinary least square (FMOLS), Dynamic ordinary least square (DOLS), fixed effects (FEM), random effects (REM), and System GMM (SGMM)". In pooled data, cross-sectional units vary over time. If the model is correctly specified and the errors are uncorrelated then the results obtained from OLS regression will be consistent. However, pooled OLS does not incorporate the time-specific and country-specific properties therefore we used FEM and REM. In the next step, the “Hausman test” has been used to select between FEM and REM. Furthermore, as FEM and REM do not incorporate the time-specific characteristic and the problem of endogeneity, therefore, System GMM is used to overcome these issues. FMOLS and DOLS were used in panel time series analysis of different income economies. FMOLS was introduced by Pedroni (2001) which controls endogeneity in panel data. Moreover, it can also take care of serial correlation and applied on small sample size. DOLS was introduced by Stock and Watson (1993), DOLS outperforms FMOLS (Kao and Chiang, 2001). DOLS is not only computationally simple but it also reduces biasness more than FMOLS. The static form of the DOLS approximates is much better than the statistics from OLS or FMOLS.

Table 1: Data Sources

Variable description and sources			
Variable	**Symbol**	**Measure**	**Source**
Carbon dioxide emissions	CO_2	CO_2 emissions (metric tons per capita)	World Bank (2021)
Population	URB	Urban population (% of total population)	World Bank (2021)
Affluence	AFF	GDP per capita (constant 2010 US$)	World Bank (2021)
Technology	TEC	Energy use*population/ GDP	World Bank (2021)
Trade openness	TR	Trade (% of GDP)	World Bank (2021)
Human Capital	HC	Human capital index	Feenstra, *et al.* (2015)

Table 2 provides summary statistics. The highest emissions are observed in Qatar in 2001 with the value of 67.310 metric tons per capita, while lowest in Cameroon with a value of 0.008 in 1991. In high-income countries (HIC), CO_2 emissions with 1842 observations has a maximum value of 67.310 in Qatar and a minimum value of 0.506 in Mauritius in 1982. In upper-middle-income countries (UMIC), CO_2 emissions with 1179 observations has a maximum value of 24.39 metric tons per capita in the Russian Federation in 1990 and a minimum value of 0.250 during 1971 in Paraguay. While in lower-middle-income countries (LMIC), CO_2 emissions with 1232 observations shows a maximum value of 15.138 in Mongolia in 2013 and the minimum value of 0.0084 in Cameron. Moreover, in low-income countries (LIC), for CO_2 emissions the observations available are 201 and show a maximum of 0.016 per capita for Tajikistan and the minimum of 0.0162 CO_2 emissions per capita is recorded for Congo in 2001.

Table 2: Summary Statistics

	CO_2	URB	AFF	TEC	TR	HC
Global (126)						
Mean	5.207471	58.64076	13740.28	23646389	77.16339	2.310594
Median	2.989933	60.49100	5185.036	2487929.	64.57989	2.283164
Maximum	67.31050	100.0000	111968.3	1.95E+09	442.6200	3.742114
Minimum	0.008459	4.005000	200.2979	13013.52	0.020999	1.039107
Std. Dev.	6.430292	22.19022	17375.03	1.27E+08	53.40383	0.694225
Observations	4459	4459	4459	4459	4459	4459
High-income countries (50)						
Mean	9.750547	75.62918	28763.51	3593056.	95.82659	2.845273
Median	7.778133	76.71450	26058.81	781010.5	75.38067	2.891637
Maximum	67.31050	100.0000	111968.3	67618425	442.6200	3.742114
Minimum	0.506165	32.45100	1943.877	13013.52	10.75718	1.414785
Std. Dev.	7.475084	14.12586	18277.18	8721425.	68.80477	0.495503
Observations	1842	1842	1842	1842	1842	1842
Upper middle-income countries (32)						
Mean	3.383700	58.01303	5323.591	49873229	64.04027	2.157929
Median	2.393287	58.85500	4559.326	3998269.	55.99386	2.124237
Maximum	24.39835	91.37700	19581.67	1.95E+09	220.4068	3.357158
Minimum	0.250167	17.18400	238.0147	35706.43	0.020999	1.102233
Std. Dev.	2.948451	16.95704	3107.483	2.25E+08	35.52153	0.499388
Observations	1179	1179	1179	1179	1179	1179
Lower middle-income countries (35)						
Mean	0.998237	38.60107	1524.116	30116342	64.25085	1.782314
Median	0.612165	39.03700	1351.095	5345019.	58.47547	1.694885
Maximum	15.13860	70.22100	4702.170	5.55E+08	165.0942	3.318905
Minimum	0.008459	4.005000	270.9470	18287.27	0.167418	1.039107
Std. Dev.	1.360257	15.12683	885.4350	92243603	30.99268	0.511518
Observations	1232	1232	1232	1232	1232	1232
Low-income countries (8)						
Mean	0.195640	29.69400	633.0446	14509049	62.54898	1.568315
Median	0.183361	29.84000	592.2248	5703751.	56.02223	1.441480
Maximum	0.925713	51.44400	1782.742	1.19E+08	181.5901	3.169026
Minimum	0.016280	16.18600	200.2979	1140749.	11.08746	1.082562
Std. Dev.	0.128310	7.602895	285.7814	21254295	33.95469	0.579968
Observations	201	201	201	201	201	201

4. Results and Discussion

4.1 Unit Root Results

This study applied "Levin–Lin-Chu (LLC), Im, Pesaran and Shin (IPS), Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests", to validate the stationarity of panel data. As the non-stationary data may show the spurious result. Moreover, the LLC, IPS, ADF, and PP test does not require balance data nor the same lags in individual ADF regression. All the tests have the same null hypothesis of panel unit root. The results reveal that most of the variables are stationary at level, while others become stationary at the first difference (see Table 3).

Table 3: Unit root test

Variables	Level	LLC	IPS	ADF	PP
Panel (126)					
CO_2	Level	-7.8151***	-5.3916***	683.571***	740.768***
	1st difference	-95.630***	-81.852***	5085.15***	5833.02***
Urbanization	Level	-11.612***	-5.4964***	816.884***	2751.80***
	1st difference	-7.1829***	-10.066***	869.434***	838.958***
Affluence	Level	-5.9892***	4.51710	472.277**	488.08***
	1st difference	-50.200***	-51.548***	3385.34***	3538.50***
Technology	Level	-76.911***	-14.519***	401.403***	446.585***
	1st difference	-54.196***	-54.291***	2832.10***	3086.44***
Trade openness	Level	-9.921***	-9.054***	721.061***	734.352***
	1st difference	-74.348***	-69.020***	4525.34***	4809.66***
Human capital	Level	-2.663***	14.617	1148.41***	538.089***
	1st difference	0.797	-3.806***	463.065***	236.187
High-income countries (50)					
CO_2	Level	-4.989***	-2.996***	237.756***	266.342***
	1st difference	-51.791***	-50.78***	1963.24***	2009.19***
Urbanization	Level	-60.959***	-54.841***	1310.59***	888.801***
	1st difference	-13.399***	-6.076***	311.25***	330.84***
Affluence	Level	-12.954***	-1.1285	244.607***	265.102***
	1st difference	-28.605***	-28.121***	1029.75***	1038.10***
Technology	Level	-3.952***	1.032	113.360	119.634
	1st difference	-41.53***	-39.192***	1245.15***	11314.78***

Trade openness	Level	5.055***	-3.1250***	190.49***	216.94***
	1st difference	-42.983***	37.805***	1492.47***	1609.63***
Human capital	Level	-18.129***	-13.170***	819.49***	389.60***
	1st difference	-5.3474***	-5.1288***	411.723***	96.0136
Upper middle-income countries (32)					
CO_2	Level	-5.533***	-4.412***	212.985***	240.03***
	1st difference	-43.139***	-38.824***	1245.11***	1533.23***
Urbanization	Level	-7.505***	-4.748***	231.10***	924.64***
	1st difference	-6.996***	-3.504***	181.95***	186.496***
Affluence	Level	-3.733***	1.2051	154.380***	129.256
	1st difference	-27.051***	-27.899***	1088.43***	1092.08***
Technology	Level	-91.612***	-30.786***	157.46***	185.64***
	1st difference	-27.347***	-28.133***	807.694***	893.49***
Trade openness	Level	-6.310***	-6.910***	231.14***	200.348***
	1st difference	-38.285***	-38.319***	1234.44***	1348.38***
Human capital	Level	1.365	9.372	41.270	64.005
	1st difference	-1.2985*	-3.038***	176.985***	61.970
Lower middle-income countries (35)					
CO_2	Level	0.177	1.582	112.83	136.14***
	1st difference	-16.022***	-27.025***	868.509***	1502.05***
Urbanization	Level	-3.0800***	0.1820	134.94*	616.64***
	1st difference	6.3189	-3.453***	195.33***	183.65***
Affluence	Level	3.2370	7.189***	70.502	47.489
	1st difference	-24.609***	-26.176***	742.54***	875.75***
Technology	Level	-5.907***	-3.991***	122.05***	130.99***
	1st difference	-24.81***	-24.563***	648.97***	774.88***
Trade openness	Level	-4.752***	-4.6904***	183.13***	225.90***
	1st difference	-35.962***	-33.65***	1086.5***	1136.95***
Human capital	Level	0.41785	9.727	34.040	68.878
	1st difference	-1.587**	-2.3025*	115.147***	70.4357

Low-income group countries (8)					
CO_2	Level	-2.469***	-2.225*	97.156***	98.238***
	1st difference	-29.232***	-30.055***	719.227***	788.55***
Urbanization	Level	-7.309***	-1.658**	105.509***	321.70***
	1st difference	-2.777***	-5.3334***	147.28***	137.960***
Affluence	Level	2.976	2.8690	47.625	46.241
	1st difference	-19.737***	-20.420***	529.99***	532.570***
Technology	Level	-0.483	2.3321	10.282	10.311
	1st difference	-10.614***	-11.85***	156.71***	157.289***
Trade openness	Level	-2.788***	-2.765***	102.51***	91.155***
	1st difference	-32.362	-28.75***	727.36***	714.689***
Human capital	Level	-0.5223	4.0957	39.919	59.11**
	1st difference	-0.6834	-2.134*	72.242***	26.0496
Probabilities * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$"					

4.2 Cointegration Results

In the next step, we use the panel cointegration test (Pedroni, 1999; Kao, 1999). Pedroni cointegration test provides seven statistics (four panel and three group based). Panel-v, rho, pp, and ADF are the panel while group statistics consist of group-rho, ADF, and PP. Pedroni cointegration lso handles endogeneity. We also used Kao cointegration test "based on two-step Engel Granger cointegration test". The ADF statistics have been adjusted for serial correlation using autocorrelation and heteroscedasticity consistent estimator. The tests reject the null hypothesis (see Table 4) of no cointegration supporting existence of long-run relationship among the variables.

Table 4: Cointegration Test

	Global (126)	High Income countries (50)	Upper middle income countries (32)	Lower middle-income countries (35)	Low income countries (8)
Pedroni cointegration test					
Panel v-Statistic	1.0502	-4.3995	-0.1071	-2.9221	0.6714
Panel rho-Statistic	-5.318***	2.7506	-2.7361***	-0.4927	-1.622**
Panel PP-Statistic	-16.269***	-0.2686	-9.9827***	-10.364***	-3.411***
Panel ADF-Statistic	-21.255***	-0.9518	-9.4957***	-15.574***	-3.325***
Group rho-Statistic	0.3259	3.6765	0.3418	-0.0760	0.5693
Group PP-Statistic	-14.756***	-7.066***	-11.114***	-15.379***	-3.20***
Group ADF-Statistic	-15.055***	-5.4238***	-8.420***	-12.727***	-2.544***
KAO cointegration test					
ADF-Statistic	-5.785***	-1.431*	-4.570***	-6.636***	-1.8408**
Residual Variance	0.017	0.0058	0.0081	0.0351	0.0401
HAC Variance	0.0107	0.0049	0.0059	0.0175	0.0257
"Probability $P< 0.01$,* $P < 0.1$** ,$P< 0.05$***"					

4.3 Discussion

Regression results obtained from FEM, REM, and SGMM are shown in Table 5. The findings of FEM indicate that urbanization and openness to trade increase emissions, while human capital decrease emissions in the global panel. The coefficient of urbanization shows a positive significant impact on CO_2 emissions at a global level as an increase of urban population by 1 percentage point is associated 0.539% increase in emissions. Urbanization results in higher emissions due to increased demand for energy and infrastructure including transportation, building, and supporting facilities (Liu and Bae, 2018). These results are consistent with Liddle and Lung (2010), who found a positive effect of urbanization on CO_2 emissions while considering transport emissions as an outcome. The coefficient of trade is positive and indicates that a 1 percentage point incline in trade openness would increase emissions by 0.0341%. The increase in trade results in environmental degradation as the environmental policies differs across countries. Ahmed et al. (2017), also reported similar findings and argued that openness to trade degrades the environment. Also of main interest is the impact of human capital on CO_2 emissions. The coefficient of human capital has a negative impact on carbon emissions. The result suggests that advancement in human capital by 1% decreases CO_2 emissions by 0.803% respectively. These results are in line with the finding of Bano et al. (2018), Khan (2020), and Yao et al. (2020). As endogenous growth theory posits that human capital is the source of technological progress which promotes investment in research and development, thereby changing production techniques, energy efficiency, and use of cleaner technologies that support decline in emissions (Yao et al., 2020).

In HIC, urbanization increases emissions by 0.560%. Openness to trade shows negative impact on CO_2 emission implying that emissions decrease by 0.085% due to a 1 percentage point increase in trade. The technique effect is dominated over the scale effect in high-income economies, as the developed countries have taken initiatives in discovering new technologies for few decades and the countries under investigation are likely to take benefits of technology through trade. Strict rules and regulations are also an obstacle in deteriorating the environmental quality. Moreover, the top renewable energy countries are interested in exports of environment-friendly goods and export of environment unfriendly goods. The benign effect of openness to trade on CO_2 emissions in HIC is in line with Majeed and Asghar (2021), Siddique et al. (2016), Le et al. (2016), Ahmed et al. (2016), Shahbaz et al. (2013) and Hossain (2011). The decline in emissions in HIC resulting from trade openness can be attributed to the shift in the production of pollution-intensive goods from developed to developing economies and the demand for these goods can be fulfilled with imports (Ansari et al., 2020). It is also noted human capital has a negative impact on emission as emissions decreases by 0.931% due to improvement in human capital by 1%, implying that advanced knowledge obtained from higher education assist the innovations in pollution control technologies and lowers the cost of implementing them.

In UMIC, an increase of 1 percentage point in the urban population would results in 0.095 % higher emissions in UMIC. Cole and Neumayer (2004) and Ahmed et al. (2020) also reported similar findings. A 1 percentage point increase in trade is associated with a 0.0367 % increase in CO_2 emissions. The scale effect dominates over the technique effect in UMIC. In UMIC, trade can affect environmental quality due to an upsurge in energy demand, resulting in environmental degradation. Furthermore, under the Kyoto protocol developing economies were not imposed restrictions related to emission reduction as it might have an adverse impact on their growth, and contribution of developing economies to emissions has been low when compared to developed economies (Ansari et al., 2020). The positive effect of trade is similar to Shahzad et al. (2017). Urbanization contributes to CO_2 emissions in UMIC. Human capital decreases emissions. A 1 % enhancement of human capital declines CO_2 emissions by 0.614 %.

In LMIC, urbanization has a positive impact on environmental deterioration and escalates emissions by 0.586% resulting from a 1 percentage point increase in urban population. All estimators consistently show an insignificant influence of trade on emissions in LMIC. These outcomes are inconsistent with the Heckscher-Ohlin trade theory that argue that an increase in trade would boost consumption and production enhancing environmental degradation. However, these results are consistent with the studies of Sharma (2011) and Saidi and Mbarek (2017) who found an insignificant impact of openness to trade on emissions. A 1% incline in human capital declines emissions by 0.561 %.

In LIC the result reveals that with a 1 percentage point incline in urbanization in LIC, CO_2 emissions will decrease by 1.122 %. These results are similar with the findings of Martínez-Zarzoso and Maruotti (2011) in developing countries, Sharma (2011) in selected 69 countries and Saidi and Mbarek (2017) in emerging countries. With a 1 percentage point increase in trade openness emissions escalates by 0.328%. These findings coincide with Ahmed et al. (2017), Le et al. (2016), and Sharma (2011). As the increase in trade activities accelerate economic growth that would lead to more energy consumption and results in environmental degradation. An increase in human capital by 1% will decline emissions by 0.620%. These results are consistent with the findings of Wang and Xu (2021).

Our results are consistent across techniques (REM, and SGMM) except for the impact of human capital that indicates an insignificant impact on the environmental quality of UMIC and LIC while contributes to higher emissions in the case of LMIC respectively.

Table 5: Results of FEM, REM and SGMM

Estimator	Variables	Global (126)	HIC (50)	UMIC (32)	LMIC (35)	LIC (8)
FEM	Urbanization	0.539***	0.560***	0.0954*	0.586***	-1.122***
		(0.0336)	(0.0878)	(0.0558)	(0.0647)	(0.251)
	Affluence	1.052***	1.037***	1.103***	1.276***	1.425***
		(0.0201)	(0.0296)	(0.0260)	(0.0492)	(0.160)
	Technology	0.540***	0.486***	0.630***	0.334***	1.167***
		(0.0154)	(0.0193)	(0.0201)	(0.0421)	(0.148)
	Trade Openness	0.0341***	-0.085***	0.0367***	-0.0225	0.328***
		(0.0099)	(0.0271)	(0.0100)	(0.0220)	(0.0602)
	Human Capital	-0.803***	-0.931***	-0.614***	-0.561***	-0.620**
		(0.0245)	(0.0374)	(0.0319)	(0.0636)	(0.296)
REM	Urbanization	0.632***	0.590***	0.115**	0.608***	-0.545**
		(0.0335)	(0.0862)	(0.0584)	(0.0619)	(0.232)
	Affluence	0.973***	0.953***	1.023***	1.165***	0.779***
		(0.0193)	(0.0286)	(0.0265)	(0.0457)	(0.132)
	Technology	0.421***	0.419***	0.526***	0.219***	0.400***
		(0.0141)	(0.0183)	(0.0190)	(0.0342)	(0.0978)
	Trade Openness	0.0282***	-0.066**	0.0357***	-0.0190	0.396***
		(0.0102)	(0.0273)	(0.0106)	(0.0221)	(0.0651)
	Human Capital	-0.694***	-0.849***	-0.498***	-0.389***	-0.440**
		(0.0239)	(0.0364)	(0.0322)	(0.0579)	(0.206)
Hausman Test		0.0000	0.0000	0.0000	0.0000	0.0000
SGMM	Urbanization	0.0410*	0.0129	0.108	0.677***	-0.0448
		(0.0421)	(0.0551)	(0.450)	(0.231)	(0.0553)
	Affluence	0.0337*	0.0400*	0.726**	0.611***	0.268***
		(0.0205)	(0.0222)	(0.311)	(0.209)	(0.0846)
	Technology	0.00894*	0.0165**	0.171**	0.0171	0.0211
		(0.0053)	(0.0064)	(0.066)	(0.133)	(0.0174)
	Trade Openness	0.0199**	-0.0192	0.211**	-0.0283	0.154***
		(0.0078)	(0.0128)	(0.100)	(0.118)	(0.0546)
	Human Capital	-0.033***	-0.049***	-0.219	0.534*	0.00227
		(0.0126)	(0.0250)	(0.251)	(0.290)	(0.0372)

"Standard errors in parentheses; Probabilities *** $P < 0.01$, * $P < 0.1$, ** $P < 0.05$, HIC: High-income economies, UMIC: Upper middle-income economies, LMIC: Lower middle-income economies, LIC: Low-income economies"

The study also employed FMOLS and DOLS due to the presence of cointegration among variables. The FMOLS results show that urbanization has a positive impact in the global panel and across all income groups except in LIC where urbanization results in a decline in the level of emissions. Trade openness has a positive influence on CO_2 in the global panel, UMIC, and LIC, while negative impact in HIC and insignificant impact in LMIC. Moreover, the results also suggest that an increase in human capital will result in improved environmental quality in the global panel as well as in HIC, UMIC, and LMIC, however, the influence of human capital is insignificant on the emissions of LIC.

Similarly, the DOLS results also confirm the findings of FMOLS. The coefficient of urbanization shows a positive impact on emissions in the global panel and LMIC and negative impact in LIC while the insignificant impact in HIC and UMIC. The coefficient of trade shows that an increase in trade worsens the environmental quality in the global panel, UMIC, and LIC but it improves environmental quality in HIC. The negative sign of human capital suggests enhancement of environmental quality in all income countries except LIC where it shows an insignificant impact on emissions.

Table 6: Results of FMOLS and DOLS

Estimator	Variables	Global (126)	HIC (50)	UMIC (32)	LMIC (35)	LIC (8)
FMOLS	Urbanization	0.466***	0.212***	0.0929***	0.620***	-0.963***
		(0.0220)	(0.0553)	(0.0015)	(0.0468)	(0.2126)
	Affluence	1.093***	1.091***	1.099***	1.304***	1.239***
		(0.0128)	(0.0178)	(0.0041)	(0.0351)	(0.1375)
	Technology	0.568***	0.537***	0.622***	0.334***	0.988***
		(0.010)	(0.0116)	(0.0039)	(0.0303)	(0.1261)
	Trade Openness	0.030***	-0.119***	0.024***	-0.0191	0.373***
		(0.0061)	(0.0162)	(0.0061)	(0.0152)	(0.0495)
	Human Capital	-0.787***	-0.861***	-0.610***	-0.588***	-0.387
		(0.015)	(0.0233)	(0.00067)	(0.0453)	(0.2608)
DOLS	Urbanization	0.329***	0.142	0.1211	0.665***	-1.121***
		(0.099)	(0.1296)	(0.5444)	(0.1959)	(0.3418)
	Affluence	1.043***	0.897***	1.682***	1.339***	1.424***
		(0.053)	(0.0409)	(0.0890)	(0.1354)	(0.2179)
	Technology	0.667***	0.827***	0.460***	0.279*	1.166***
		(0.043)	(0.0306)	(0.1010)	(0.1087)	(0.2006)
	Trade Openness	0.049*	-0.109**	0.163***	-0.0415	0.327***
		(0.028)	(0.0354)	(0.0439)	(0.0734)	(0.0818)
	Human Capital	-0.635***	-0.520***	-1.548***	-0.4505*	-0.620
		(0.066)	(0.0532)	(0.1214)	(0.1756)	(0.4028)

Standard errors in parentheses; Probabilities *** $P< 0.01$, ** $P < 0.05$, * $P < 0.1$, HIC: High income economies, UMIC: Upper middle income economies, LMIC: Lower middle income economies, LIC: Low income economies

Finally, findings are summarized in Table 7 to make comparison easier. The main finding of the study includes: Firstly, our result shows that urbanization contributes to emissions in the global panel as well as in HIC, UMIC, and LMIC, while urbanization decreases CO_2 emission in LIC. Secondly, openness to trade has a positive significant effect in the global panel as well as in UMIC and in LIC while it has a negative impact in HIC, but the influence of trade on emissions is insignificant in the case of LMIC. Thirdly, human capital has a negative significant impact across all income groups.

Table 7: Summary of the Results

	Global (126)	HIC (50)	UMIC (32)	LMIC (35)	LIC (8)
Urbanization	(+) ✓	(+)✓	(+) ✓	(+) ✓	(-) ✓
Affluence	(+) ✓	(+) ✓	(+) ✓	(+) ✓	(+) ✓
Technology	(+) ✓	(+) ✓	(+) ✓	(+) ✓	(+) ✓
Trade Oppenness	(+) ✓	(-) ✓	(+) ✓	(-)	(+) ✓
Human Capital	(-) ✓	(-) ✓	(-)✓	(-) ✓	(-) ✓

✓ denotes statistical significance and (-)/(+) denotes it has positive or negative effect

5. Conclusion

Carbon dioxide emissions can negatively affect environmental quality. To overcome the emissions, different measures are required across different income groups. In this regard, human capital has the potential to improve environmental quality. Therefore, this study examined the influence of urbanization, trade openness, and human capital on environmental degradation across different income groups, spanning over 1971-2020. The study used FEM, REM, SGMM, FMOLS, and DOLS.

The findings of the study show that CO_2 emissions, urbanization, affluence, technology, trade openness, and human capital are cointegrated. Urbanization has a heterogeneous effect on environmental quality, it leads to improved environmental quality in low-income countries while degrades it in all other panels. The decline in environmental quality caused by urbanization is consistent with the findings of Nathaniel et al., (2021), Majeed and Tauqir (2020) Liu and Bae (2018), and Liddle and Lung (2010) while contradicts with Lv and Xu (2019), and Saidi and Mbarek (2017). The difference in findings originates from the fact that how urbanization is managed. Unplanned urbanization leads to an increase in energy demand and resource exploitation while managed urbanization has a positive impact on environmental quality. Trade openness increases environmental degradation for the global sample as well as in upper-middle-income and low-income economies while improves environmental quality in other income groups. The increase in environmental deterioration resulting from trade openness coincides with the findings of Ragoubi and Mighri (2021), Mahmood et al., (2019), Lv and Xu, (2019) and Ahmed et al., (2017) while contradicts with Majeed and Asghar (2021), Siddique et al. (2016), Ahmed et al., (2016) and Hossain (2011). Human capital is inversely related to emissions in all samples, implying that an increase in human capital improves environmental quality. Our results are in line with the findings of Wang and Xu (2021), Mahmood et al. (2019), Bano et al. (2018), and Cole et al. (2005) however, in contrast to the findings of Nathaniel et al. (2021) who reported heterogeneous findings. The reason behind the difference in the impact of human capital on emissions is due to the proxy used for human capital. Furthermore, Yao et al. (2020) provided evidence that the impact of human capital on emissions changed from positive to negative after 1950 due to the importance of education as before this time period primary education was more common however after this period secondary and tertiary education got more importance and has a more profound impact on environmental quality.

5.1. Contribution of the Study

The available literature on urbanization, trade, and human capital shows us the importance of their effects on environmental degradation. However, to the best of our knowledge, the global analysis of 126 economies with IPAT modelling is missing in the current literature. The present study examines the relationship between human capital and CO_2 for the global panel using IPAT model for the very first time. Furthermore, the present study is the first that examined the effects of both trade openness and human capital on CO_2 in heterogeneous income groups. Moreover, this study extends the existing literature by employing advanced techniques in the environmental research field.

5.2. Policy Implication

The results have a very important policy implication: Our findings reveal that omitting urbanization from the analysis does not contribute to emissions controlling strategies as the theories of ecological modernization highlight both positive and negative effects of urbanization on the environment. Urbanization supports economic prosperity but at the cost of increased energy consumption and environmental degradation. Therefore, improvements in energy use and planned urbanization can be helpful in combating emissions. Second, trade reduces environmental degradation in high-income countries once it reaches a certain level. This is important because a higher level of economic growth and trade strengthens the institutional framework creating incentives for firms. Therefore, addressing this issue may lead to higher energy efficiency and the import of green technologies that help in climate mitigation. Therefore, trade can support improved environmental quality through the inflow of green technologies. Third, the present study suggests that the countries can reduce carbon dioxide emissions through human capital accumulation. As human capital is improvement in skills through education, therefore, an increase in secondary education will increase skilled labor. Educated and skilled labor use modern technologies, resulting in efficient resource utilization and energy efficiency, thereby mitigate emissions.

5.3. Limitations of the Study and Future Research Directions

This study has certain limitations and proposes some directions for future research; First, the environmental degradation is measured by carbon emissions however future studies can use NO_x (oxides of nitrogen), SO_2 (Sulphur dioxide), CO (Carbon monoxide), and ecological footprints. Second, the study measured human capital with education-based indicators only, and the gains from on job training, work experience, and learning by doing are not incorporated. Third, this study does not incorporate regional and country-specific analysis. Fourth, the study employs unbalanced data techniques due to data limitation, future studies can extend this study by employing second-generation techniques for other groups of countries.

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APPENDIX

Country Grouping

No.	HIC	UMIC	LMIC	LIC
1	Australia	Albania	Algeria	Congo, Dem. Rep.
2	Austria	Argentina	Angola	Ethiopia
3	Bahrain	Armenia	Bangladesh	Haiti
4	Barbados	Belize	Benin	Mozambique
5	Belgium	Botswana	Bolivia	Niger
6	Brunei Darussalam	Brazil	Cambodia	Sudan
7	Canada	Bulgaria	Cameroon	Tajikistan
8	Chile	China	Congo, Rep.	Togo
9	Croatia	Colombia	Cote d'Ivoire	
10	Cyprus	Costa Rica	Egypt, Arab Rep.	
11	Czech Republic	Dominican	El Salvador	
12	Denmark	Ecuador	Eswatini	
13	Estonia	Gabon	Ghana	
14	Finland	Guatemala	Honduras	
15	France	Indonesia	India	
16	Germany	Iran, Islamic Rep.	Kenya	

17	Greece	Iraq	Kyrgyz Republic	
18	Hong Kong SAR, China	Jamaica	Lesotho	
19	Hungary	Jordan	Moldova	
20	Iceland	Kazakhstan	Mongolia	
21	Ireland	Malaysia	Morocco	
22	Israel	Maldives	Myanmar	
23	Italy	Mexico	Nepal	
24	Japan	Namibia	Nicaragua	
25	Korea, Rep.	Paraguay	Nigeria	
26	Kuwait	Peru	Pakistan	
27	Latvia	Russian Federation	Philippines	
28	Lithuania	Serbia	Senegal	
29	Luxembourg	South Africa	Sri Lanka	
30	Malta	Thailand	Tanzania	
31	Mauritius	Turkey	Tunisia	
32	Netherlands	Venezuela, RB	Ukraine	
33	New Zealand		Vietnam	
34	Norway		Zambia	
35	Panama		Zimbabwe	
36	Poland			
37	Portugal			
38	Qatar			
39	Romania			
40	Saudi Arabia			
41	Singapore			
42	Slovak Republic			
43	Slovenia			
44	Spain			
45	Sweden			
46	Switzerland			
47	United Arab Emirates			
48	United Kingdom			
49	United States			
50	Uruguay			