

The Regional Impacts of the 2008-2009 Global Economic Crisis on Environmental Health

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ABSTRACT

In this study, we examine the regional impacts of the 2008-2009 global economic crisis on Environmental Health. We also look into the impacts on Environmental Health's components which include Environmental Burden of Disease Trend, Air Pollution (on humans), Water (on humans), and on their subcomponents (i.e. Child Mortality, Indoor Air Pollution, Particulate Matter, Access to Drinking Water, and Access to Sanitation). We examine six regions of the world (namely the Americas, Asia and Pacific, Eastern Europe and Central Asia, Europe, Middle East and North Africa, and Sub-Saharan Africa). Our results indicate that the "Environmental Health" indicator significantly deteriorated in all regions except for Europe. When we examine the components and the subcomponents, we find that most of them deteriorated significantly in these regions. For Europe, interestingly, our results show that Environmental Health actually improved after the crisis (although Water (on humans) and Access to Drinking Water declined). Our results imply that different regions had different reactions to the crisis. While most countries and regions could not handle the economic crisis well, it is clear that the European countries were more successful in their efforts.

Keywords: Global crisis, environment, sustainability, environmental health.

Mathematics Subject Classification: 62G10

Journal of Economic Literature (JEL) Classification : Q50, Q53, Q54, Q56, Q57, Q58

1. INTRODUCTION

The environmental Kuznets curve hypothesis states that there is an inverted U-shaped relationship between environmental health and per capita income and/or GDP. In a society, until income reaches a certain level, there is a negative relationship between income and environmental health. When that income level is reached, this relationship turns positive. Several previous papers support this hypothesis. John and Pecchenino (1994) create a model that provides a theoretical explanation of this relationship while suggesting circumstances in which both capital and environmental quality may both improve. Selden and Song (1994) find that per capita emissions of air pollutants have an inverted U-shaped relationship with per capita GDP. Grossman (1995) shows that the turning point for this relationship for most pollutants is when a country reaches a per capita income of \$8000. Stern et al. (1996) show that eventually growth reduces the environmental impact of economic activity. Galeotti (2007) supports the view that a de-coupling is possible, at least after certain levels of income. Bartz

and Kelly (2008) show that, for less developed countries, the turning point for the relationship is at a much lower level of per capita income when compared to U.S. data.

Several other studies show solely a negative relationship between income and environmental health. Ekins (1997) explains that overall environmental quality even in the richest countries is still declining. Dasgupta et al. (2006) explain that poor countries do not have the institutional capacity or political will to regulate polluters. The authors argue that climate and terrain are important. They suggest that strong environmental governance is still possible for poor countries. Acharyya (2009) finds that FDI inflow in India has a positive impact on GDP growth and CO₂ emissions.

On the other hand, several other studies show a more positive relationship between income and environmental health. Lopez (1994) contends that economic growth may decrease the degradation of natural resources if producers internalize their stock feedback effects on production. Broad (1994) examines the Philippines, and shows that, under certain conditions, poor people can become “environmental activists”. Smulders (1995) summarizes the conditions under which continuous economic growth can be achieved with limited natural resources. Spangenberg et al. (2002) argue that it is possible to develop strategies that combine economic competitiveness, and environmental health. Panayotou (2003) argues that governments should integrate economic and environmental policies while phasing out environmentally harmful subsidies. Geels (2011) explains that the economic crisis makes it difficult for countries to focus on environmental problems.

A few studies have more inconclusive results. Scruggs (1998) shows that economic and political equality may not help minimize degradation. Brock and Taylor (2005) argue that some of the previous papers are more pessimistic because they focus more on the environmental problems, while others are more optimistic because they focus on the improvement in living standards. These two views do not contradict with each other because they look from different perspectives. Van den Bergh (2011) contends that the strategy of de-growth may not be an effective strategy to reduce environmental pressure, policymakers should rather be indifferent about growth. Sokolov et al. (2019) examine the relationship between sustainable development and food security in Ukraine. They argue that efficient allocation of investment resources can be achieved if existing approaches for managing innovation and investment development are modified.

In this study, we contribute to this discussion by focusing on how a global macroeconomic event, namely the 2008-2009 global economic crisis, affects environmental health around the world through its impact on incomes. We examine the impact of the global crisis on environmental health indicators in the Americas, Asia and Pacific, Eastern Europe and Central Asia, Europe, Middle East and North Africa, and Sub-Saharan Africa. The environmental indicators that we examine are the three main components of environmental health which are “Environmental Burden of Disease Trend”, “Air Pollution”, and “Water”, and their subcomponents which include “Child Mortality”, “Indoor Air Pollution”, “Particulate Matter”, “Access to Drinking Water”, and “Access to Sanitation”.

Our objective in this study is to see how this global crisis has affected environmental health efforts in each region. For this purpose, we compare pre- and post crisis values for each region. For environmental health data, we use the dataset which was developed by Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission. The dataset covers 132 countries.

We are hoping to find the environmental health categories that are affected more negatively in each region when a global crisis hits. The findings here will help policymakers in devising strategies that would protect the areas that are hurt more in their country/region. In this study, we will also find if the economic development level of a country/region is important in that country or region's efforts in protecting the health of the environment within its borders. Are less developed regions affected more negatively when facing an economic crisis?

The paper proceeds as follows: Section 2 explains our hypotheses. Section 3 explains our data and methodology. Section 4 shows our empirical results. Finally, Section 5 concludes.

2. HYPOTHESES

We expect governments around the world to focus less on environmental health issues during an economic crisis, therefore we expect to see the environmental health indicators to deteriorate due to an economic crisis. Our first hypothesis is as follows:

Hypothesis 1: In each region, the environmental health indicator declines after an economic/financial crisis.

Similarly, in each region, we expect to see deterioration in all three components of environmental health. These are Environmental Burden of Disease Trend, Air Pollution (on humans), and Water (on humans). Therefore, our second, third, and fourth hypotheses are:

Hypothesis 2: In each region, the Environmental Burden of Disease Trend indicator and all of its subcomponents decline after an economic/financial crisis.

Hypothesis 3: In each region, the Air Pollution (on humans) indicator and all of its subcomponents decline after an economic/financial crisis.

Hypothesis 4: In each region, the Water (on humans) indicator and all of its subcomponents decline after an economic/financial crisis.

While we expect all regions to suffer in terms of environmental health, we expect governments in less developed regions to suffer more due to having fewer resources when compared to governments in more developed regions. Therefore, the "economic development level" of a region should matter. Our final hypothesis is as follows:

Hypothesis 5: The decline in environmental health due to an economic crisis is more significant in less developed regions when compared to the more developed regions.

The next section explains our data and methodology.

3. DATA AND METHODOLOGY

In this study, we use the EPI (i.e. Environmental Performance Index) dataset which was created by Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission ((which is available at <http://epi.yale.edu> and distributed by the NASA Socioeconomic Data and Applications Center at <http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-pilot-trend-2012>). This dataset covers 132 countries. Table 1 shows the regions/countries included in the dataset.

Table 1. Countries in Each Region

Americas	Asia-Pac.	EECA	Europe	MENA	SS Africa
Argentina	Australia	Albania	Austria	Algeria	Angola
Bolivia	Bangladesh	Armenia	Belgium	Egypt	Benin
Brazil	Brunei Dar.	Azerbaijan	Bulgaria	Iran	Botswana
Canada	Cambodia	Belarus	Cyprus	Iraq	Cameroon
Chile	China	Bosnia	Czech Rep.	Israel	Congo
Colombia	India	Croatia	Denmark	Jordan	Cote d'Ivoire
Costa Rica	Indonesia	Georgia	Estonia	Kuwait	D.R. Congo
Cuba	Japan	Kazakhstan	Finland	Lebanon	Eritrea
Dominican R.	Malaysia	Kyrgyzstan	France	Libya	Ethiopia
Ecuador	Mongolia	Macedonia	Germany	Morocco	Gabon
El Salvador	Myanmar	Moldova	Greece	Oman	Ghana
Guatemala	Nepal	Russia	Hungary	Qatar	Kenya
Haiti	New Zealand	Tajikistan	Iceland	Saudi Arabia	Mozambique
Honduras	Pakistan	Turkey	Ireland	Sudan	Namibia
Jamaica	Philippines	Turkmenistan	Italy	Syria	Nigeria
Mexico	Singapore	Ukraine	Latvia	Tunisia	Senegal
Nicaragua	South Korea	Uzbekistan	Lithuania	UAE	South Africa
Panama	Sri Lanka		Luxembourg	Yemen	Tanzania
Paraguay	Taiwan		Malta		Togo
Peru	Thailand		Netherlands		Zambia
Trin. and To.	Viet Nam		Norway		Zimbabwe
USA			Poland		
Uruguay			Portugal		
Venezuela			Romania		
			Serbia		
			Slovakia		
			Slovenia		
			Spain		
			Sweden		
			Switzerland		
			UK		

Environmental Health (EH) is one of the two main components of EPI (i.e. the other one is Ecosystem Vitality (EV)). Besides data on EH, this dataset also includes data on the three components of EH. These are Environmental Burden of Disease, Air Pollution (on humans), and Water (on humans). These components have five subcomponents and the dataset covers these subcomponents as well. These five subcomponents are Child mortality, Indoor air pollution, Particulate matter, Access to drinking water, and Access to sanitation.

Figure 1 shows the trend in EH over time. We are seeing that the trend is positive (i.e. improvement) for all regions until 2010 (except for Europe which was flat after 2004), although the improvement rate slows down in 2006-2007. After 2010, all regions seem to be flat.

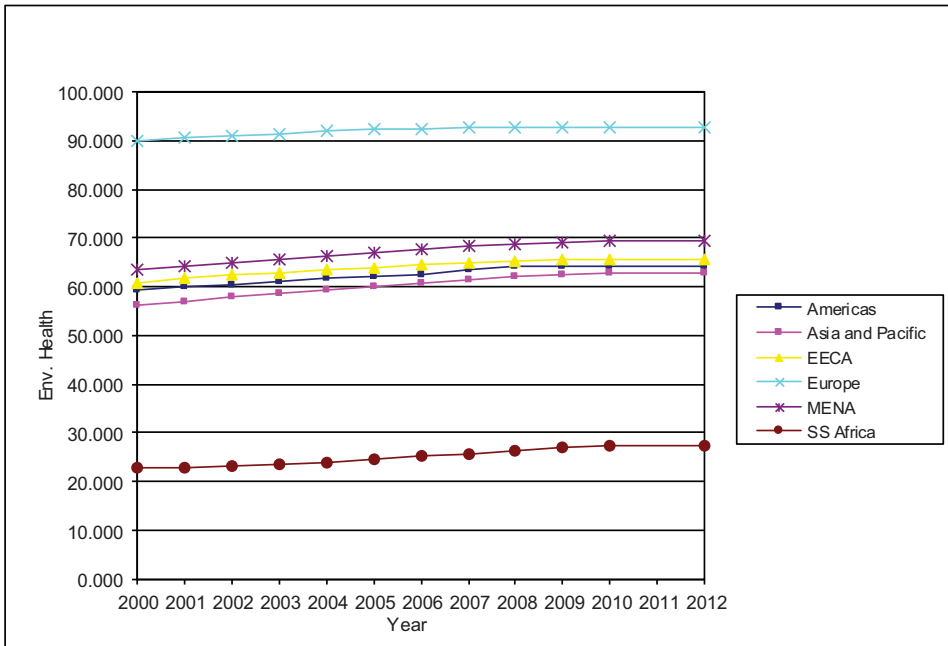


Figure 1. Environmental Health

Figures 2 through 4 show the trends in the three main components of EH over time. Figure 2 shows the trend in Environmental Burden of Disease. We are seeing that the trend is positive (i.e. improvement) for all regions until 2010 (except for Europe which was flat after 2004). After 2010, all regions seem to be flat.

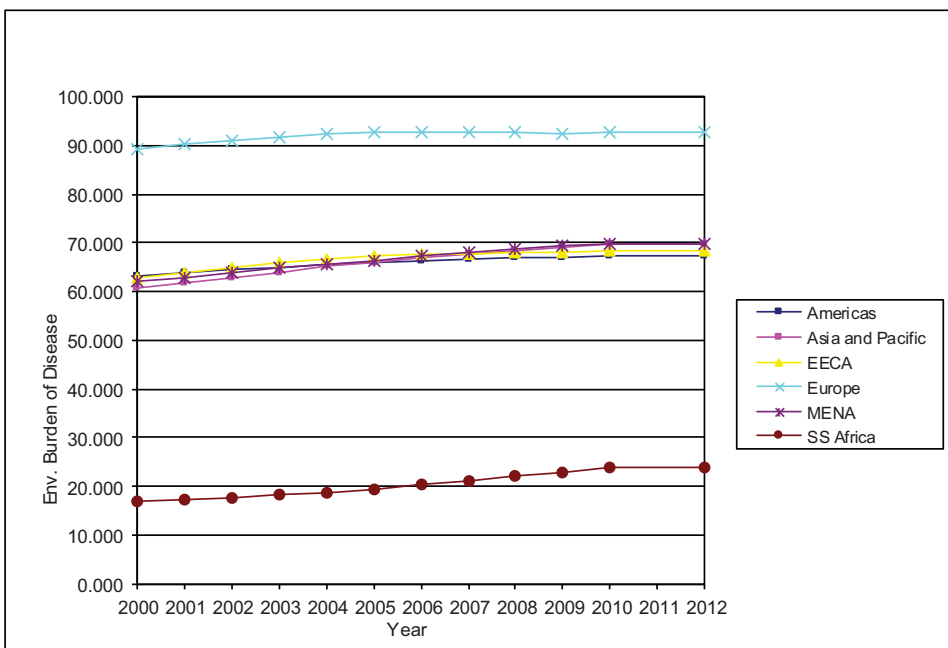


Figure 2. Environmental Burden of Disease

Figure 3 shows the trend in Air Pollution (on humans). We are seeing a slow but gradual improvement in all regions (except for EECA region) over time. EECA region was almost flat throughout the 2000-2012 period.

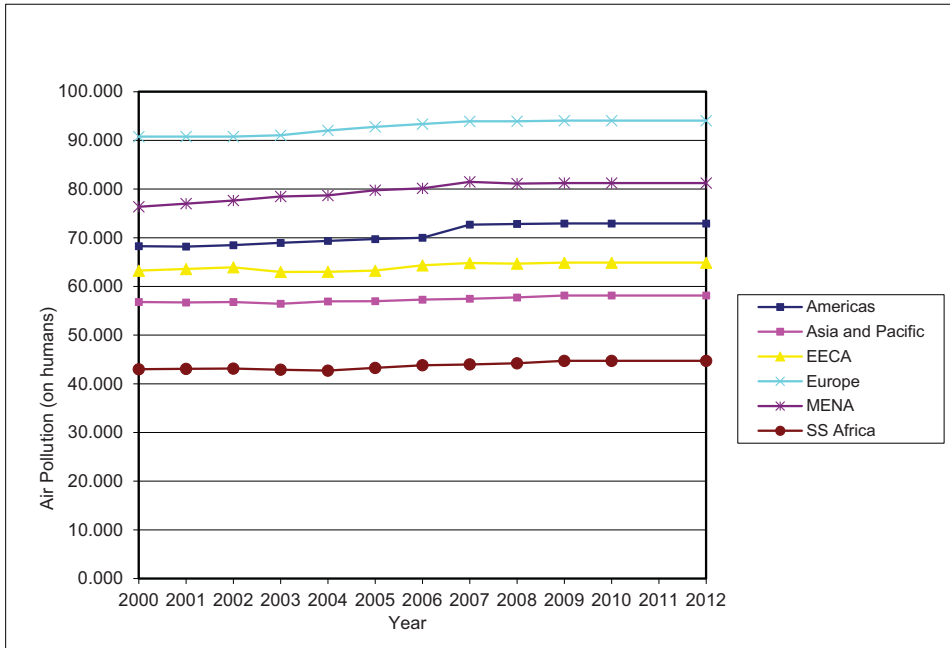


Figure 3. Air Pollution (on Humans)

Figure 4 shows the trend in Water (on humans). We are seeing that a slow but gradual improvement for all regions until 2008 (although Europe seems to be more flat). After 2008, all regions seem to be flat.

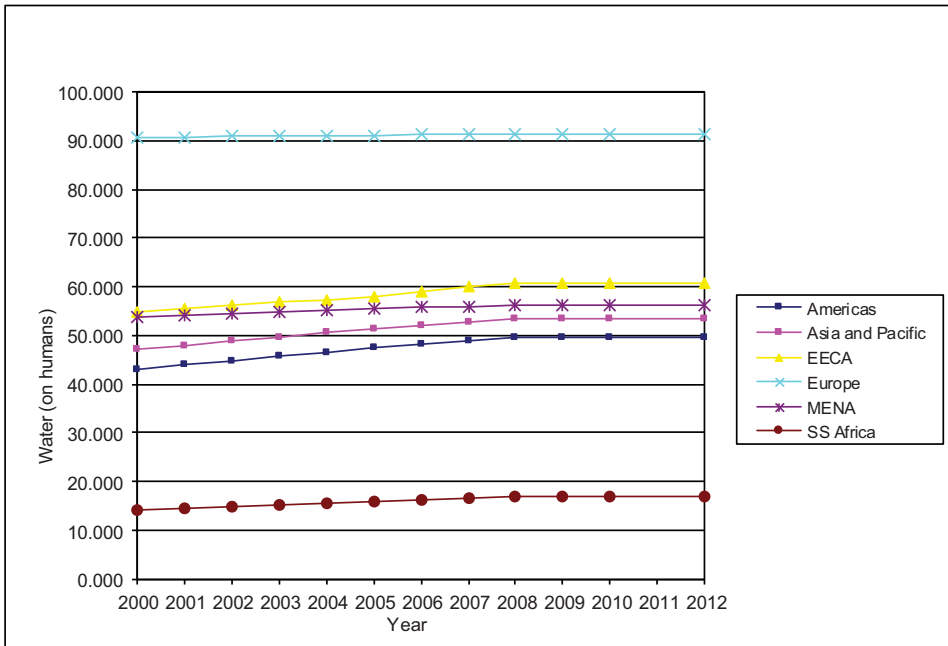


Figure 4. Water (on Humans)

Figures 5 through 9 show the trends in the five subcomponents over time. Figure 5 shows the trend in Child mortality. We are seeing that the trend is positive (i.e. improvement) for all regions until 2010 (except for Europe which was flat after 2004). After 2010, all regions seem to be flat.

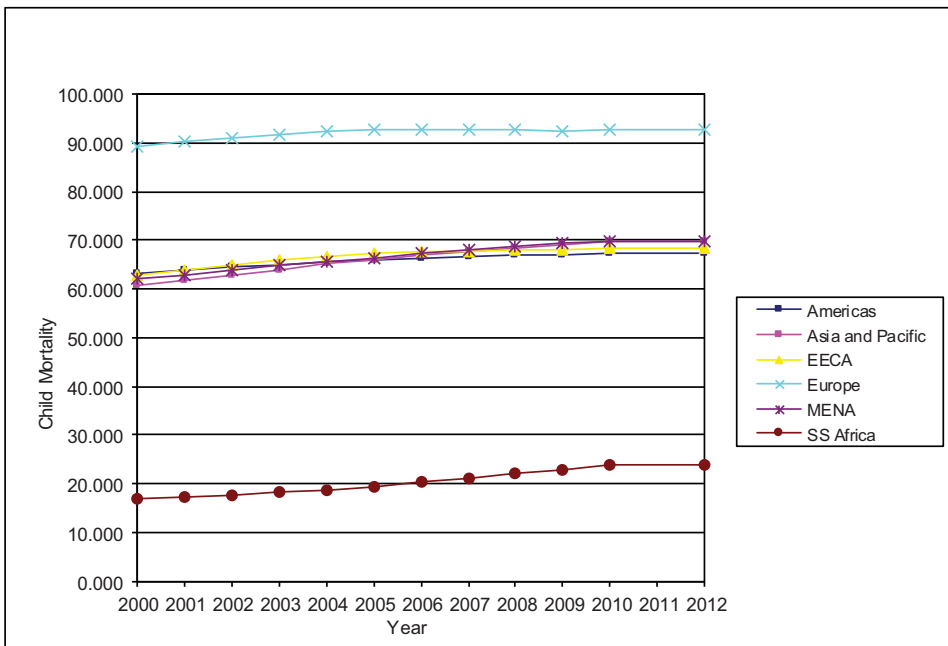


Figure 5. Child Mortality

Figure 6 shows the trend in Indoor air pollution. All regions show some improvement until 2007 (although MENA region improved the most). After 2007, all regions seem to be flat.

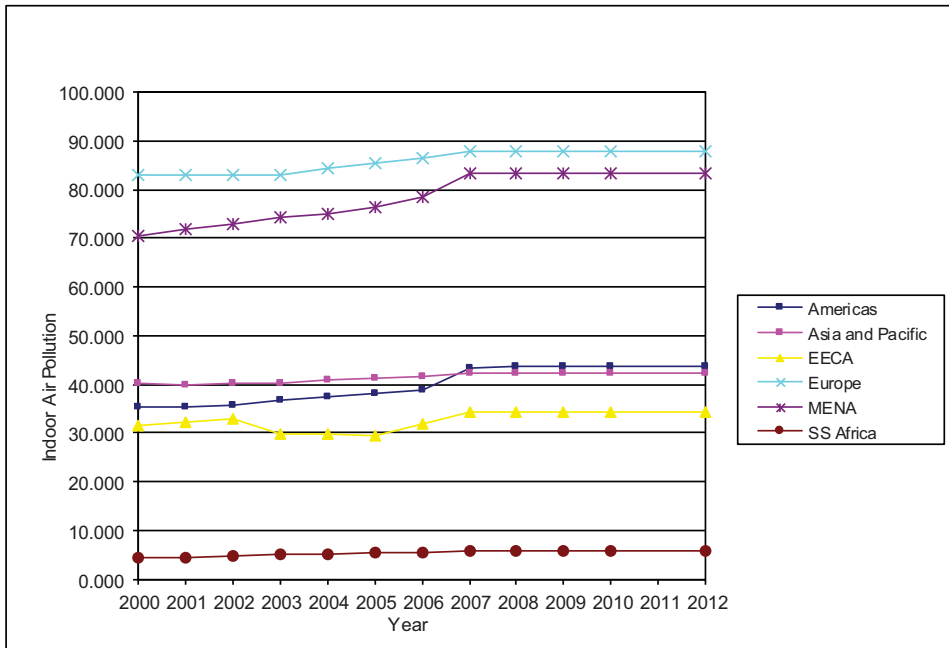


Figure 6. Indoor Air Pollution

Figure 7 shows the trend in Particulate matter. The Americas, Europe, and EECA region improved until 2005. After that, the Americas and Europe were flat, and EECA region went down. Asia and Pacific regions seems to be flat throughout the whole period. After 2005, Sub-Saharan Africa shows some improvement and MENA region declines.

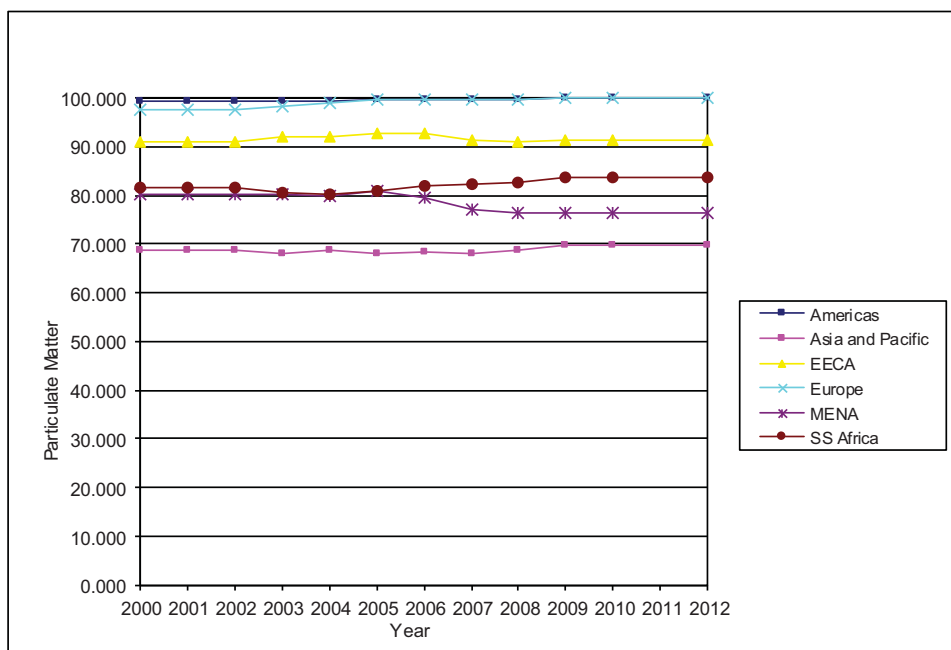


Figure 7. Particulate Matter

Figure 8 shows the trend in Access to drinking water. All regions except for Europe improved until 2008. After 2008, they seem to be flat. Europe was flat through the whole period.

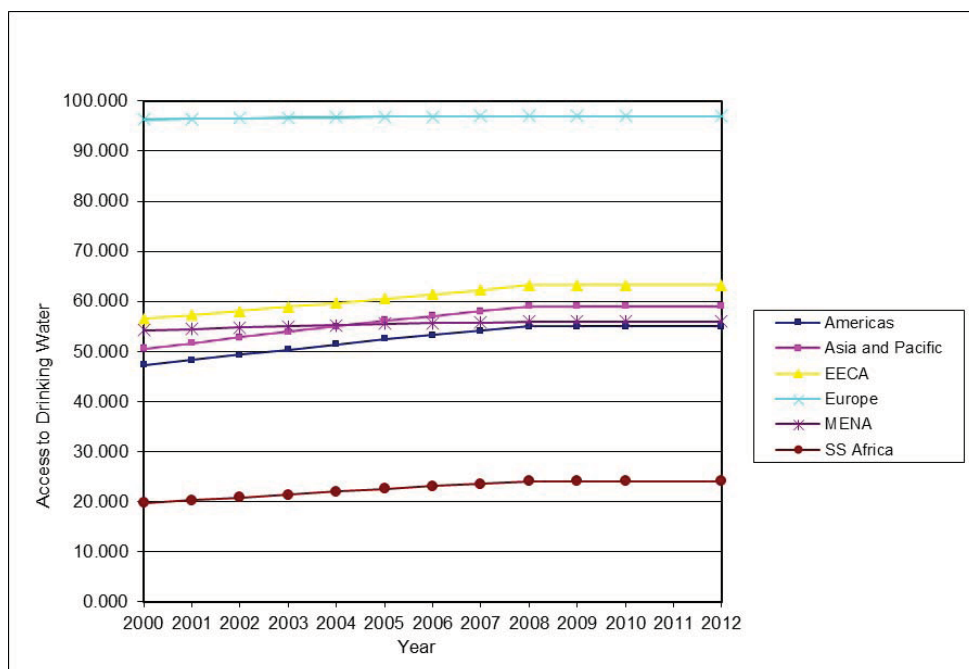


Figure 8. Access to Drinking Water

Figure 9 shows the trend in Access to sanitation. All regions show some improvement until 2008. After 2008, they seem to be flat.

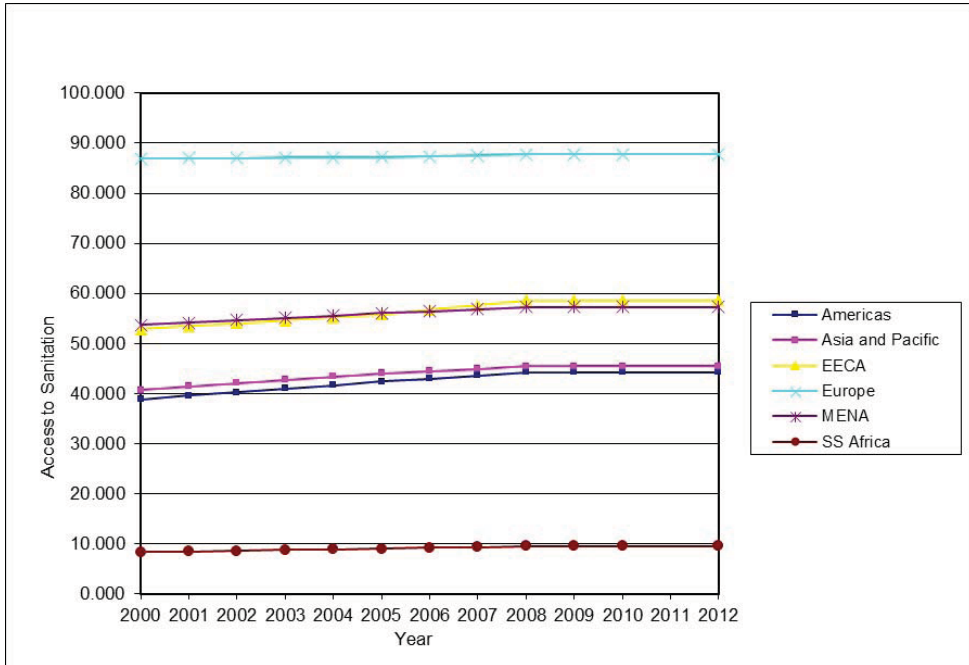


Figure 9. Access to Sanitation

By looking at these figures, we can see that most of these measures improved for all regions (except for Europe) until sometime between 2007 and 2010, and then this improvement stopped. These figures overall tell us that the 2008-2009 global economic crisis had a significant impact on these regions' EH measures.

In the next section, we will look into the impact of the 2008-2009 crisis on each of these indicators using nonparametric tests (i.e. the Mann-Whitney-Wilcoxon tests). We will compare the percentage change in each indicator during the pre-crisis period (i.e. 2007) to the percentage change during the post-crisis period (i.e. 2010). If an indicator had been improving pre-crisis but then stopped improving post-crisis, we take it as a negative impact on that indicator.

4. EMPIRICAL RESULTS

Table 2 compares the percentage change in Environmental Health (EH) in Americas pre- and post-crisis. It also compares the percentage change in the components and subcomponents of EH pre- and post-crisis. The last column shows the results of the Mann-Whitney-Wilcoxon tests.

Table 2. The Impact of the Global Crisis on Env. Health in Americas

Variables	2007			2010			Wilcox.
	Mean	Median	Std.	Mean	Median	Std.	p-value
Environmental Health	0.669	0.808	0.579	0.001	0.001	0.006	<0.0001
Env. Bur. of Disease	0.619	0.714	0.822	-0.001	-0.001	0.005	0.0001
Air Pollution (on humans)	0.198	0.000	0.784	-0.001	0.000	0.004	0.0095
Water (on humans)	1.675	1.658	1.275	0.000	-0.001	0.006	<0.0001
Child Mortality	0.619	0.714	0.822	-0.001	-0.001	0.005	0.0001
Indoor Air Pollution	0.487	0.000	2.337	-0.011	0.000	0.065	0.5000
Particulate Matter	0.057	0.000	0.272	0.000	0.000	0.000	0.0857
Access to Drinking Water	1.757	1.861	1.623	-0.001	-0.003	0.006	<0.0001
Access to Sanitation	1.312	1.670	1.917	-0.007	-0.001	0.020	0.0001

We are seeing that pre-crisis (i.e. 2007), the mean annual percentage change in EH was 0.669%. Post-crisis (i.e. 2010), this number is only 0.001%. This is a statistically significant drop ($p < 0.0001$). EH was improving by 0.669% in annual terms pre-crisis. This improvement fully disappeared post-crisis (only 0.001%).

We are seeing the same when we look into Environmental Burden of Disease Trend, Air Pollution (on humans) and Water (on humans). All three components of EH were improving pre-crisis. This improvement stopped post-crisis. Environmental Burden of Disease Trend was improving by 0.619% annually in 2007. This dropped to -0.001% (i.e. almost flat) in 2010. Similarly, Air Pollution (on humans) was improving by 0.198% annually in 2007. This number dropped to -0.001% (i.e. almost flat) in 2010. Finally, Water (on humans) was improving by 1.675% in 2007. This number dropped to 0.000% (i.e. flat) in 2010.

When we look at the subcomponents (i.e. Child Mortality, Indoor Air Pollution, Particulate Matter, Access to Drinking Water, and Access to Sanitation), we are seeing significant declines in the improvement rate (except for Indoor Air Pollution). The table shows that the improvement rate in EH, in all three of its components, and in almost all of their subcomponents went down significantly after the global crisis.

Table 3 compares the percentage change in Environmental Health (EH), its three components and their subcomponents in Asia and Pacific pre- and post-crisis. We are seeing that pre-crisis, the mean annual percentage change in EH was 1.302%. Post-crisis, this number is only 0.000% (i.e. flat). This is a statistically significant drop ($p < 0.0001$). EH was improving by 1.302% in annual terms pre-crisis. This improvement fully disappeared post-crisis (only 0.000%).

We are seeing the same when we look into Environmental Burden of Disease Trend and Water (on humans). These two components of EH were improving pre-crisis. This improvement stopped post-crisis. Environmental Burden of Disease Trend was improving by 1.440% annually in 2007. This dropped to 0.000% in 2010. Similarly, Water (on humans) was improving by 2.104% annually in 2007. This number dropped to 0.004% in 2010.

Table 3. The Impact of the Global Crisis on Env. Health in Asia and Pacific

Variables	2007			2010			Wilcox. p-value
	Mean	Median	Std.	Mean	Median	Std.	
Environmental Health	1.302	1.353	1.117	0.000	-0.001	0.006	<0.0001
Env. Bur. of Disease	1.440	1.256	1.407	0.000	0.000	0.006	<0.0001
Air Pollution (on humans)	-0.505	0.000	5.287	-0.001	0.000	0.010	0.3489
Water (on humans)	2.104	2.027	2.336	0.004	0.000	0.012	0.0011
Child Mortality	1.440	1.256	1.407	0.000	0.000	0.006	<0.0001
Indoor Air Pollution	0.000	0.000	0.000	-0.010	0.000	0.089	0.3794
Particulate Matter	-3.562	0.000	20.790	-5.556	0.000	23.570	0.2169
Access to Drinking Water	2.207	1.483	2.683	-0.002	0.000	0.007	0.0009
Access to Sanitation	2.284	2.309	2.334	-0.007	0.000	0.021	0.0003

On the other hand, the trend in one of the components, namely Air Pollution (on humans), did not change significantly. This indicator was declining (i.e. -0.505%) in 2007. This decline was reduced to -0.001% but this change is not statistically significant ($p=0.3489$).

When we look at the subcomponents (i.e. Child Mortality, Indoor Air Pollution, Particulate Matter, Access to Drinking Water, and Access to Sanitation), we are seeing three of them (Child Mortality, Access to Drinking Water, and Access to Sanitation) were improving pre-crisis and their improvement stopped or reversed post-crisis. The changes in Indoor Air Pollution and Particulate Matter were negative but not statistically significant. We can conclude that, in Asia and Pacific, the improvement rate in EH, two of its three components, and most of their subcomponents went down significantly after the global crisis.

Table 4 looks into Eastern Europe and Central Asia. We are seeing that pre-crisis, the mean annual percentage change in EH was 0.463%. Post-crisis, this number is only 0.001% (i.e. almost flat). This is a statistically significant drop ($p=0.0690$). EH was improving by 0.463% in annual terms pre-crisis. This improvement fully disappeared post-crisis (only 0.001%).

We are seeing the same when we look into Environmental Burden of Disease Trend and Water (on humans). These two components of EH were improving pre-crisis. This improvement stopped or reversed post-crisis. Environmental Burden of Disease Trend was improving by 0.250% annually in 2007. This dropped to -0.001% in 2010. Similarly, Water (on humans) was improving by 1.579% annually in 2007. This number dropped to 0.000% in 2010. On the other hand, the trend in Air Pollution (on humans) did not change significantly. This indicator was declining (i.e. -0.129%) in 2007. This decline stopped and slightly reversed in 2010 (0.001%), but this change is not statistically significant ($p=0.2406$).

Table 4. The Impact of the Global Crisis on Env. Health in EECA

Variables	2007			2010			Wilcox.
	Mean	Median	Std.	Mean	Median	Std.	p-value
Environmental Health	0.463	0.294	0.842	0.001	0.001	0.006	0.0690
Env. Bur. of Disease	0.250	0.000	0.779	-0.001	-0.002	0.006	0.0511
Air Pollution (on humans)	-0.129	0.000	0.715	0.001	0.000	0.004	0.2406
Water (on humans)	1.579	1.844	2.100	0.000	0.000	0.005	0.0070
Child Mortality	0.250	0.000	0.779	-0.001	-0.002	0.006	0.0511
Indoor Air Pollution	0.000	0.000	0.000	0.002	-0.001	0.013	0.0952
Particulate Matter	-0.245	0.000	1.067	-0.001	0.000	0.002	0.5000
Access to Drinking Water	1.502	0.000	2.548	-0.003	-0.002	0.007	0.0152
Access to Sanitation	1.210	0.000	2.864	0.002	0.006	0.006	0.2615

When we look at the subcomponents, we are seeing that the improvement in two of them (Child Mortality and Access to Drinking Water) stopped and reversed. Indoor Air Pollution was flat (0.000%) pre-crisis and turned slightly positive (0.002%) post-crisis. For Particulate Matter and Access to Sanitation, the change was not statistically significant. We can conclude that, in Eastern Europe and Central Asia, the improvement rate in EH, two of its three components, and two of their subcomponents went down significantly after the global crisis (while one of the subcomponents, Indoor Air Pollution, marginally improved).

Table 5 shows the results for Europe. The results here are interesting because, in Europe, the trend in EH actually improved post-crisis. We are seeing that pre-crisis, the mean annual percentage change in EH was -0.022% (i.e. deterioration in EH). Post-crisis, this number is 0.001% (i.e. slight improvement). This is a statistically significant change ($p=0.0906$). EH was declining by 0.022% in annual terms pre-crisis. This was reversed post-crisis.

Table 5. The Impact of the Global Crisis on Env. Health in Europe

Variables	2007			2010			Wilcox.
	Mean	Median	Std.	Mean	Median	Std.	p-value
Environmental Health	-0.022	0.000	0.33	0.001	0.000	0.003	0.0906
Env. Bur. of Disease	-0.108	0.000	0.57	0.001	0.000	0.003	0.1492
Air Pollution (on humans)	0.044	0.000	0.28	0.000	0.000	0.002	0.1616
Water (on humans)	0.097	0.000	0.50	0.000	0.000	0.002	0.0716
Child Mortality	-0.108	0.000	0.57	0.001	0.000	0.003	0.1492
Indoor Air Pollution	0.000	0.000	0.00	0.001	0.000	0.006	0.3274
Particulate Matter	0.053	0.000	0.36	0.000	0.000	0.001	0.3654
Access to Drinking Water	0.008	0.000	0.04	0.000	0.000	0.001	0.0272
Access to Sanitation	0.182	0.000	0.96	0.001	0.000	0.003	0.3671

When we look at the three components, we are seeing that there was no statistically significant change in the trend for Environmental Burden of Disease Trend or for Air Pollution (on humans). Environmental Burden of Disease Trend was declining at an annual rate of -0.108% in 2007. This reversed to 0.001% in 2010. Air Pollution (on humans) was improving by 0.044% annually in 2007. This number dropped to 0.000% in 2010. On the other hand, the change in the trend for Water (on humans) was statistically significant. This indicator was improving (i.e. 0.097%) in 2007. This improvement stopped in 2010 (0.000%). This change is statistically significant ($p=0.0716$).

When we look at the subcomponents, we are seeing that only the trend in Access to Drinking Water had changed significantly. It was improving at an annual rate of 0.008% pre-crisis. Post-crisis, this improvement stopped (0.000%). This change in the trend is statistically significant ($p=0.0272$). None of the other subcomponents (Child Mortality, Indoor Air Pollution, Particulate Matter, and Access to Sanitation) were affected significantly. We can conclude that, in contrast to the other regions of the world, in Europe, the trend in EH actually improved post-crisis (although the results for the components and subcomponents are mixed).

Table 6 looks into Middle East and North Africa. We are seeing that pre-crisis, the mean annual percentage change in EH was 0.549%. Post-crisis, this number is -0.002%. This is a statistically significant drop ($p=0.0001$). EH was improving by 0.549% in annual terms pre-crisis. This improvement fully disappeared and slightly reversed post-crisis (-0.002%).

We are seeing the same when we look into Environmental Burden of Disease Trend and Water (on humans). These two components of EH were improving pre-crisis. This improvement stopped or reversed post-crisis. Environmental Burden of Disease Trend was improving by 1.181% annually in 2007. This dropped to 0.001% in 2010. Similarly, Water (on humans) was improving by 0.528% annually in 2007. This number dropped to 0.000% in 2010. On the other hand, interestingly, the trend in Air Pollution (on humans) improved significantly. This indicator was declining (i.e. -0.544%) in 2007. This decline stopped and slightly reversed in 2010 (0.001%).

When we look at the subcomponents, we are seeing that the improvement in two of them (Child Mortality and Access to Sanitation) stopped or even reversed. We do not see any statistically significant change in the other three subcomponents.

Table 6. The Impact of the Global Crisis on Env. Health in MENA

Variables	2007			2010			Wilcox.
	Mean	Median	Std.	Mean	Median	Std.	p-value
Environmental Health	0.549	0.402	0.769	-0.002	0.000	0.006	0.0001
Env. Bur. of Disease	1.181	1.070	0.913	0.001	0.000	0.005	<0.0001
Air Pollution (on humans)	-0.544	0.000	1.217	0.001	0.000	0.004	0.0766
Water (on humans)	0.528	0.000	1.176	0.000	0.000	0.008	0.0804
Child Mortality	1.181	1.070	0.913	0.001	0.000	0.005	<0.0001
Indoor Air Pollution	0.000	0.000	0.000	0.000	0.000	0.005	0.1552
Particulate Matter	-1.353	-0.570	2.891	-0.002	-0.001	0.004	0.2295
Access to Drinking Water	0.012	0.000	1.513	0.002	0.000	0.010	0.4804
Access to Sanitation	1.023	0.000	1.846	-0.003	0.000	0.011	0.0357

Table 7 looks into Subsaharan Africa. We are seeing that, pre-crisis, the mean annual percentage change in EH was 2.288%. Post-crisis, this number is -0.002%. This is a statistically significant drop ($p < 0.0001$). EH was improving by 2.288% in annual terms pre-crisis. This improvement fully disappeared and slightly reversed post-crisis (-0.002%).

We are seeing the same when we look into all three components of EH. All of the three components were improving pre-crisis. This improvement stopped or even reversed post-crisis. Environmental Burden of Disease Trend was improving by 4.311% annually in 2007. This dropped to -0.005% in 2010. Similarly, Air Pollution (on humans) was improving by 0.679% annually in 2007. This number dropped to -0.001% in 2010. Finally, Water (on humans) was improving by 2.406% annually in 2007. This number dropped to 0.002% in 2010.

When we look at the subcomponents, we are seeing significant declines, even reversals, in the improvement rate (except for Indoor Air Pollution). The table shows that the improvement rate in EH, in all three of its components, and in almost all of their subcomponents went down significantly after the global crisis.

Table 7. The Impact of the Global Crisis on Env. Health in Sub-Saharan Africa

Variables	2007			2010			Wilcox.
	Mean	Median	Std.	Mean	Median	Std.	p-value
Environmental Health	2.288	2.149	1.106	-0.002	0.002	0.014	<0.0001
Env. Bur. of Disease	4.311	4.265	1.589	-0.005	-0.002	0.019	<0.0001
Air Pollution (on humans)	0.679	0.000	1.757	-0.001	-0.002	0.008	0.0094
Water (on humans)	2.406	2.134	1.934	0.002	0.001	0.033	<0.0001
Child Mortality	4.311	4.265	1.589	-0.005	-0.002	0.019	<0.0001
Indoor Air Pollution	1.067	0.000	4.889	-0.076	-0.024	0.174	0.1433
Particulate Matter	0.686	0.000	1.847	0.000	0.000	0.004	0.0287
Access to Drinking Water	2.434	2.433	1.966	-0.004	-0.001	0.018	<0.0001
Access to Sanitation	2.176	1.895	2.237	-0.005	-0.024	0.052	<0.0001

5. CONCLUSION

In this study, we examine the impact of the 2008-2009 global economic crisis on environmental health indicators in six regions of the world. These regions are the Americas, Asia and Pacific, Eastern Europe and Central Asia, Europe, Middle East and North Africa, and Subsaharan Africa. We use a dataset created by Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission. This dataset covers 132 countries.

Using nonparametric tests, we compare the pre-crisis period to the post-crisis period. Our results show that the main "Environmental Health" indicator significantly deteriorated in all regions except for Europe. For Europe, interestingly, our results show that this main "Environmental Health" indicator actually improved after the crisis.

In the Americas, all three components of environmental health ("Environmental Burden of Disease Trend", "Air (on humans)", and "Water (on humans)") declined significantly after the crisis. In this region, four of the five subcomponents declined significantly. Child Mortality, Particulate Matter, Access to Drinking Water, and Access to Sanitation declined significantly, while the drop in Indoor Air Pollution was not significant.

In Asia and Pacific, "Environmental Burden of Disease Trend" and "Water (on humans)" declined significantly after the crisis. However, "Air (on humans)" did not decline. In this region, three of the five subcomponents declined significantly. Child Mortality, Access to Drinking Water, and Access to Sanitation declined significantly.

In Eastern Europe and Central Asia, "Environmental Burden of Disease Trend" and "Water (on humans)" declined significantly after the crisis. However, "Air (on humans)" did not decline. In this region, Child Mortality and Access to Drinking Water declined significantly. On the other hand, interestingly, "Indoor Air Pollution" improved.

In Europe, only "Water (on humans)" declined significantly after the crisis. "Environmental Burden of Disease Trend" and "Air (on humans)" did not decline. In this region, out of the five subcomponents, only "Access to drinking water" declined significantly.

In Middle East and North Africa, "Environmental Burden of Disease Trend" and "Water (on humans)" declined significantly after the crisis. However, "Air (on humans)" actually improved. In this region, Child Mortality and Access to Sanitation declined significantly.

Finally, in Sub-Saharan Africa, all three components of environmental health ("Environmental Burden of Disease Trend", "Air (on humans)", and "Water (on humans)") declined significantly after the crisis. In this region, four of the five subcomponents declined significantly. Child Mortality, Particulate Matter, Access to Drinking Water, and Access to Sanitation declined significantly, while the drop in Indoor Air Pollution was not significant.

In this study, we show which environmental health categories are affected more negatively in each region when a global crisis hits. We suggest policymakers to focus on these specific categories when facing the possibility of an economic crisis.

Our results indicate that different regions had different reactions to the crisis. While most countries and regions could not handle the economic crisis well, it is clear that the European countries were more successful in their efforts. Therefore, although we find that a deterioration in a region's GDP due to an economic crisis causes environmental health efforts to decline, the development level of the region may protect it from this decline (like we are seeing for Europe). We conclude that, even in bad economic times, more developed countries/regions are able to continue their efforts due to their abundance of resources.

Previous papers including Grossman (1995), Stern et al. (1996), Galeotti (2007), and Bartz and Kelly (2008) show that the per capita income level in a country has an interacting effect on the relationship between economic growth and environmental degradation. These papers show that when a certain income level is reached (for example, states that for most cases, when \$8000 per capita income is

reached), the relationship between growth and environmental degradation changes direction. For countries with a per capita income level of less than \$8000, growth negatively affects the environment. However, when they reach this income level, growth starts positively affecting the environment. Here, in this study, our findings support that view. Our results show that, European countries (most with high levels of per capita income) were able to protect themselves from environmental degradation during the global economic crisis. In other words, our findings indicate that per capita income level (when it is high) has a positive effect on environmental efforts.

Our findings indicate that the financial health of a country is very important for environmental efforts in that country. A big economic/financial crisis like the 2008-2009 crisis may easily drain the financial resources of countries, and this in turn will likely have a negative impact on the environment. As our results show, only the higher income countries have enough funds to support the efforts during a big crisis. Therefore, we suggest low income countries to set up a fund that would deal with environmental quality issues when a crisis hits.

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