

**UNCTAD Public Symposium 2010**  
**10 - 11 May, 2010**

**"Responding to Global Crises: New Development Paths"**

## **Inputs received**

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### **Carbon emissions and development paths: A discussion of the Kuznets environmental curve**

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#### **Abstract**

A common goal among governments is to promote socio-economic development and raise living standards of populations worldwide. As of today, some countries have achieved considerable development levels as measured by the Human Development Index (HDI). On the other hand, a large part of the world population lives in developing countries, and many still lack access to the services and goods thought to be standard in the modern society. This discussion paper engages in a critical discussion of the Kuznets Environmental Curve concept which implies a temporary increase in carbon emissions per unit of GDP as countries transition to higher development levels. The coming years will see enduring efforts for socio-economic improvements in low and mid-developed countries, but the feasibility of conventional development models is put into question. Development paths based on emission-intensive growth have to be phased-out towards a low-carbon equivalent, not only by the leading countries but most importantly in the developing world.

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# Carbon emissions and development paths: A discussion of the Kuznets environmental curve

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## Abstract

A common goal among governments is to promote socio-economic development and raise living standards of populations worldwide. As of today, some countries have achieved considerable development levels as measured by the Human Development Index (HDI). On the other hand, a large part of the world population lives in developing countries, and many still lack access to the services and goods thought to be standard in the modern society. This discussion paper engages in a critical discussion of the Kuznets Environmental Curve concept which implies a temporary increase in carbon emissions per unit of GDP as countries transition to higher development levels. The coming years will see enduring efforts for socio-economic improvements in low and mid-developed countries, but the feasibility of conventional development models is put into question. Development paths based on emission-intensive growth have to be phased-out towards a low-carbon equivalent, not only by the leading countries but most importantly in the developing world.

## 1. Introduction

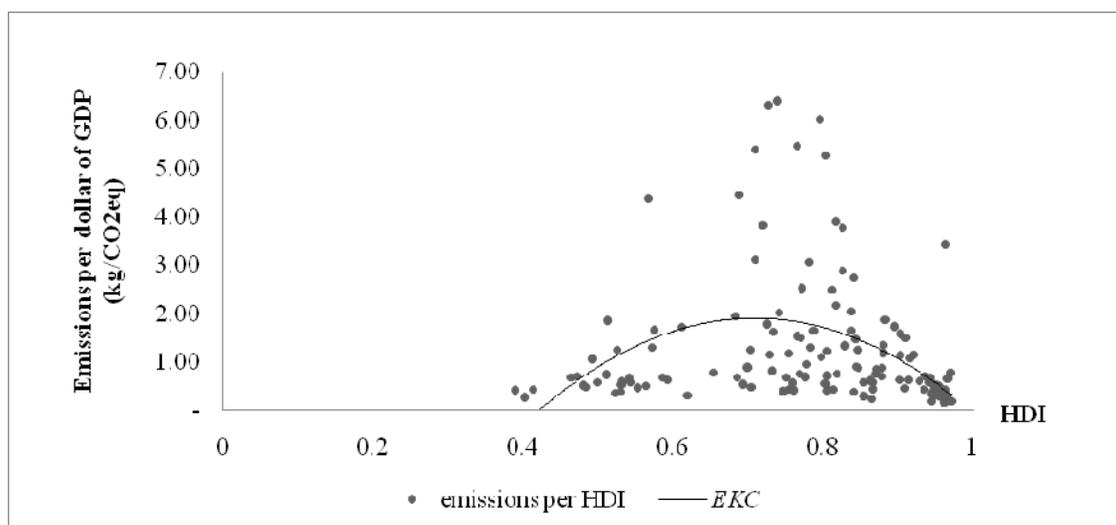
Today's leading and technologically advanced countries had a large carbon footprint associated to their economies in the recent past. It is clear that cheap energy supply has been an important propeller of economic growth in the 20<sup>th</sup> century (Holdgren, 1990). Affordable energy meant enormous progress for humankind, and this was made possible due to the increased utilization of fossil sources such as coal and oil, which remain fundamental components of the world energy matrix.

Simon Kuznets achieved notoriety finding an apparent correlation between income levels and inequality in such a way that inequality rises with economic growth up to a point when it declines (Kuznets, 1960). A similar concept has been extrapolated to environmental economics and named Environmental Kuznets Curve or *EKC* (Grossman and Krueger, 1991). Analog to the original concept, the *EKC* asserts that pollution increases with economic growth up to a certain level, after which it tends to go down (Suri and Chapman, 1998 p. 2).

**Figure 1** represents a slightly modified concept of the *EKC*, as instead of income per capita it uses the Human Development Index (HDI)<sup>1</sup> on the x-axis and narrows down the concept of pollution to emissions of CO<sub>2</sub> equivalent per unit of GDP.<sup>2</sup>

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<sup>1</sup> See: <http://hdr.undp.org/en/statistics/>



**Figure 1.** Emissions per dollar of GDP (2007) plotted against HDI for a sample of 138 countries. Sources: developed by the authors based on data from UNDP and the International Energy Agency.

Although intuitive and elegant, the *EKC* can be misleading as it could drive policy makers into thinking that the solution for environmental problems, including climate change, is simply to “get rich” and overcome emission-intensive transition stages when higher development levels are achieved (Tierney, 2009). Promoting economic growth alone is no guaranteed solution for environmental problems, as the next sessions will explore.

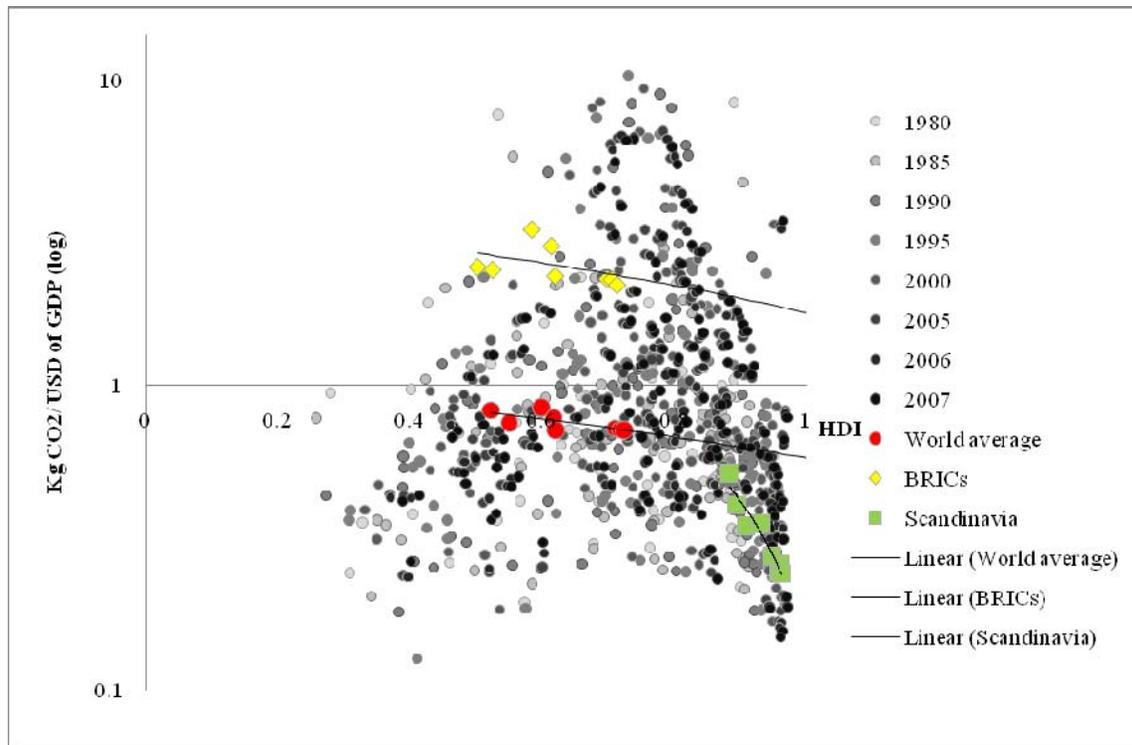
## 2. Heterogeneous development paths

Overall, countries have achieved substantial progress measured by their HDI evolution from 1980 to 2007. Virtually all countries in the world advanced their HDI rankings, although not at the same pace. However, a similar pattern in emission reductions per unit of economic output has not taken place. **Figure 2** represents a 138-country inter-temporal plot of HDI against emissions per unit of GDP, highlighting three selected groups: (1) The world average, (2) BRICs<sup>3</sup> and (3) Scandinavian countries (as a proxy of advanced economies).

While Scandinavia experienced dramatic reductions in its level of emissions per unit of GDP, the overall world figure indicates only a modest decrease in emissions per dollar. This is especially evident in the case of BRICs, which had emissions figures above the world average during the period analyzed (1980-2007). Current trend of emissions reduction (per unit of GDP) will not match IPCC recommendation of a maximum 2<sup>0</sup>C temperature increase unless current emissions reductions trend is accelerated.

<sup>2</sup> The usual practice of measuring progress by focusing on income levels is valid, but as to capture broader (and perhaps more important) dimensions of development the author believes HDI better serves the purpose.

<sup>3</sup> BRICs stands for Brazil, Russia, India and China.



**Figure 2.** Emissions per unit of GDP plotted against HDI levels. Plot of 138 countries for 8 sampled time periods. Regional and world weighted averages according to respective populations. Based on data from IEA and UNDP (2007)

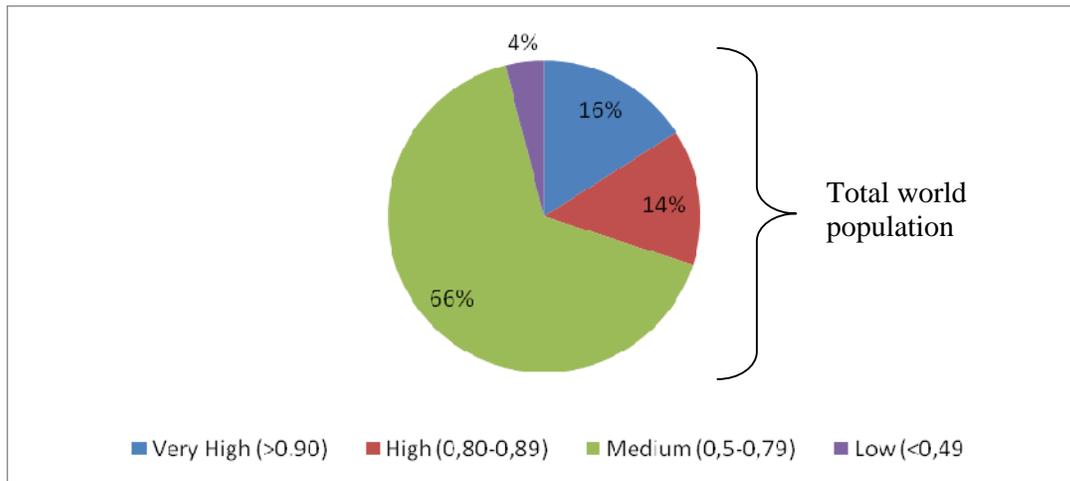
So why should we not rely on development (i.e. the natural advances of HDI) alone as to drive down emissions? The answer relies on basically two aspects: (1) development paths are mutually-dependent and different among the developing and the developed countries and (2) system constraints.

Mutual dependency means that the very own driver of the liberalized global economy – specialization on comparative advantages – can mean more rigid emission patterns for some countries than others. In addition to specific geographic conditions, the movement of goods between countries is key for their economies to be able to reduce their emission footprints. As noted by Suri and Chapman (1998), exporting countries can increase their emission intensity (upward slope in the *EKC* curve) while importing countries can reduce their emission intensity (thus contributing to the downward slope in the *EKC* curve). By having a larger share of the service sector in the overall economy, developed countries apparently manage to outsource emissions while still retaining profitable economic activities inside their markets. This is important to have in mind, as the initial perception about why developed regions such as Scandinavia have low emissions per unit of GDP should not be considered as the result of a mere shift towards renewable energy or higher energy efficiency.

Concerning system constraints, it can be said that the planet has a carbon budget<sup>4</sup>, that is, a maximum amount of emissions which could take place without triggering costly climate change. This means we cannot afford to wait for emissions per unit of GDP to naturally go down. As represented in **Figure 3**, developing countries (HDI < 0,89) concentrate 84% of the world population. As such, the planet's carbon budget will have long expired when (and if) the economies of these nations achieve today's Scandinavian emission levels. In other words,

<sup>4</sup> See: <http://www.globalcarbonproject.org/>

business as usual, overall HDI values will most likely retrocede if a fossil-intensive path is pursued by the populous developing world.



**Figure 3.** World population according to the Human Development Index (HDI). Based on data from the International Energy Agency (IEA) and UNDP.

### 3. Conclusion

The last three decades were marked by substantial improvements in human development, but at a high environmental cost. The emergence of large countries such as China and India has put the future growth trajectories of countries akin in the global spotlight. The developing world cannot evolve through the same channels as today's advanced economies did, because doing this would trigger negative environmental externalities which would then cancel what has been achieved.

The concept of Kuznets Environmental Curve (*KVC*) stimulates reflection on why countries appear to follow a path of increasing pollution, before achieving cleaner economic output at higher development stages. A critical interpretation of the curve suggests it is not an ominous path for all nations, but perhaps an expression of the mutual dependency between developing and developed countries. The concept is nevertheless useful for promoting the debate on alternatives, as low-carbon development paths are needed to accommodate higher welfare levels in our resource-constrained planet.

The political dilemma in attributing a fair burden-sharing for climate change mitigation between countries is a painstaking debate. Changing conventional development paths require broad policy and technological tools at various levels. One lesson can be inferred from the analysis, though: action needs to emerge from both sides. Via liberalized trade, advanced countries can shape the pattern of emissions in the developing world. On the other hand, developing countries have the de-facto power to steer future trends of global carbon emissions due to their growing economies and large populations.

## References

Grossman, Gene M. Krueger, Allan. (1991) *Environmental Impact of a North American Free Trade Agreement*. Working Paper 3914. NBER.

Holdgren, John P. (1990) *Energy in Transition*. Scientific American p. 157

Kusnetz, Simon (1960) *Income and inequality*.

Suri, Vivek. Chapman, Duane. (1998) *Economic growth, trade and energy: implications for the environmental Kuznets curve*. Ecological Economics 25, p. 196

Tierney, John (2009) *Use Energy, Get Rich and Save the Planet*. The New York Times April 20, 2009.

Data sources: UNDP (HDI), Various (GINI), IEA (2007 country and emissions statistics)