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A fair and progressive carbon price for a sustainable economy

Raphaël-Homayoun Boroumand [a], Stéphane Goutte [b,*], Thomas Porcher [a], Thomas F. Stocker [c]

[a] Paris School of Business, 59 Rue Nationale, 75013, Paris, France
[b] CEMOTEV, Université Paris-Saclay, France and International School, Vietnam National University, Hanoi, Viet Nam
[c] Physics Institute, University of Bern, Switzerland, Oeschger Centre for Climate Change Research, Switzerland

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ABSTRACT

The principle of "common but differentiated responsibility", as a key concept of the United Nations Framework Convention on Climate Change (UNFCCC), acknowledges the conditions for a generally acceptable and differentiated pricing mechanism on carbon emissions. With reference to this principle, carbon price determination has become a necessary instrument for sustainable policies. Considering the development gaps and the historical responsibility of the OECD's countries, a single carbon price would raise a major issue of equity between "developed" and "developing" countries. Although from a climate perspective each molecule of CO_2 produces the same level of damage despite the nature or the location of the activity generating the emissions, all CO_2 emissions are not on an equal footing. Indeed, some are necessary to improve the lives of people in "developing" countries when others can be considered not indispensable, especially beyond a certain level of development. In this policy paper, we explain how the price of carbon should be fixed according to a reference price depending on the Human Development Index (HDI) and CO_2 emissions per capita.

The HDI criterion enables to integrate progressivity into taxation while distinguishing what is essential from what is not. By taking a reference price based on the HDI, countries with low HDIs should pay a lower carbon price. However, with same HDI levels, countries with higher CO_2 emissions should pay a penalty on the reference price.

Our policy paper analyses the benefits of a differentiated and progressive carbon pricing mechanism to facilitate intergovernmental cooperation for a more sustainable economy.

1. Introduction and literature review

The scientific consensus on anthropogenic global warming is an established fact (IPCC, 2013, 2021). The climate emergency is undeniable (Lenton et al., 2020; Stocker, 2013). Energy supply plays a crucial role in the fight against global warming. Therefore, energy decisions-makers are at the forefront of climate action.

The Intergovernmental Panel on Climate Change (IPCC), as the most comprehensive assessment of climate change, affirms that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC, 2013, 2014). This implies that without major policies aimed at substantially reducing CO_2 emissions from human activities, the planet's atmosphere could warm by at least 3 °C on average compared to the pre-industrial era. Despite its limits, the Paris Agreement at COP 21 was considered as a diplomatic success after the failure of Copenhagen in 2009 (Christoff, 2016). Indeed, any consensus seemed challenging to reach. Moreover, the agreement includes article 2 which corresponds to an aspiration to keep the global temperature on average well below 2 °C by 2100 (Morgan, 2016).

Contrary to the Kyoto Protocol, the Paris Agreement is non-binding and is based on the principle of "name and shame" counting on the reputation of countries vis-à-vis their peers and the public opinion. Each country is expected to present contributions aimed at reducing its CO_2 emissions and then improve on them over time through a formalized stocktaking process. However, results from the COP 25 in Madrid offer little hope that there is growing commitment from leading CO_2 emitting countries.

In a global economy, it is possible to relocate production activities to countries with lower environmental standards. Almer and Winkler (2017) argue that an agreement will only be effective if it is global. Indeed, if some countries cooperate while others fail to do so, reduction in the production of tradable goods with high carbon intensity in cooperating countries will reduce the production of goods of these

* Corresponding author.
E-mail address: stephane.goutte@uvsq.fr (S. Goutte).

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sectors (and therefore CO_2 emissions). However, this will be largely offset by increased production of these goods in countries that do not have a climate policy. Given that only the total CO_2 emissions of all countries are relevant to the climate, it has been argued that there is no point in pursuing a policy that simply shifts CO_2 emissions from cooperating countries to countries that have no climate strategies (Hoel, 1996).

However, following the failure of the Kyoto Protocol (a binding agreement) as well as the less promising beginnings of the Paris Agreement (a non-binding agreement), these global agreements have been regarded as being still far from having proven their efficiency. Tirole (2016) argues that these numerous failures are because each country is encouraged to behave like a "stowaway" by delaying its energy mix reforms with the expectation of better compensations in future negotiations. The "polluter pays" principle as a remedy to the problem of free-riding demonstrates that each economic player should internalize the negative externalities of their CO_2 emissions. Following this, several studies have argued that a global carbon tax is the best mechanism for managing greenhouse gas emissions even if there are limits to its efficiency (McEvoy and McGinty, 2018).

To set a price for CO_2 emissions that is aligned with the Paris Agreement that aims to keep global warming well below 2 °C relative to pre-industrial levels, there are two economic instruments: a carbon tax or a carbon market. In 1920, the economist Arthur Cecil Pigou proposed a tax to protect environmental goods. Fundamentally, a carbon tax requires that countries agree on a minimum price for their CO_2 emissions and that each country collects the corresponding sums on its territory. This tax could then be readjusted with reference to a trajectory of reduction in CO_2 emissions in accordance with climate emergency.

On the other hand, an alternative way of pricing carbon is through an emission permit market (Crocker, 1966; Dales, 1968). In the first place, an emission permit market creates scarcity by capping authorized emissions. Once the carbon constraint is defined, emissions are capped with the aim of limiting global warming to +1.5 °C maximum by 2100, then it is possible to exchange rights to pollute.

Climate ambition is set by the world carbon budget while the trading of permits is expected to ensure the economic efficiency of the methods used to achieve these objectives (de Perthuis and Trotignon, 2015). As part of the fight against acid rain, a market for rights to emit SO_2 and NO_x emissions into the atmosphere was successfully launched to reduce emissions from 20 million tons to 10 million tons from 1995. Conversely, the European carbon market (EU ETS) has not demonstrated yet its capacity to deliver an appropriate long-term price signal for a low carbon economy that is resilient to climate change even if jurisdictions around the world are learning from one another (Narassimhan et al., 2018). CO_2 emission quotas have been over-allocated and the price per ton of CO_2 has dropped from 30 euros to a floor of 5 euros between 2005 and 2014, although the price is again much higher in September 2021. The European Commission has planned to review the market rules and set up an obligation for the purchase of emission rights by companies instead of their free allocation by the member states. Particularly, Chevallier (2011) demonstrates that some fundamental principles have now been identified and confirmed by numerous empirical studies such as regulatory and political issues, market fundamentals (including the emissions/ceiling ratio, the role of fuel substitution, the weather conditions) and macroeconomic activity.

According to Weitzman (2014), the price of carbon must be unique and perceived by the country in which carbon dioxide is released into the atmosphere. Further, given that all CO_2 molecules, whether emitted in the United States or in Bangladesh, have the same climate impacts, Gollier and Tirole (2015) argue that an effective international agreement should create a grand coalition in which all countries and all regions will be encouraged to set the same carbon price in their jurisdiction and a price trajectory that scientists consider consistent with the maximum +1.5 °C objective. Hourcade and Gilotte (2000) demonstrate that the price mechanism gives rise to difficulties, some of which are comparable to those based on quotas. Based on a theoretical model that captures the main practical aspects of climate policies, they demonstrate that an efficient allocation is obtained through differentiated taxes and that a uniform tax requires transfers between countries. Lastly, Edenhofer et al. (2015) demonstrate that the incentives to set emission pricing differ across countries. For instance, climate damages and reduced air pollution appear to be the main motivations for pricing emissions in China, while for the United States and the European Union, public revenue generation dominates.

Although a consensus seems to be reached on the necessity to price carbon, the most appropriate mechanism is still debated. The failure of the European carbon market shows that the formation of a market and the determination of a price are not natural but result from underlying power relations between economic agents and the establishment of an effective regulation beyond the supposedly "Invisible Hand". Indeed, the failures of several UN climate conferences (COPs) demonstrate that negotiating a uniform carbon price between developed and developing countries with historical differences in climate impact leads to an impasse.

2. Defining a fair and progressive carbon price

2.1. The low level of acceptability of a uniform carbon price

Setting a single carbon price that satisfies all stakeholders is not fair. For Autume et al. (2016), without international transfers between governments, it is difficult to set up a uniform carbon price. The authors argue that if lump-sum transfers between governments are not possible, international differentiation of the carbon price is necessary.

The European market mechanism would be difficult to replicate on a global scale to fix a uniform carbon price. This is particularly irrelevant given that the OECD countries account for about two thirds of cumulative CO_2 emissions in the 20th century while they represent only 15% of the world population. This "climate debt" has been at the heart of the deadlock in negotiations at the various climate summits. Under these conditions, it is difficult to compel emerging or developing countries to accept a price of CO_2 equivalent to that of industrialized countries when the latter were able to develop economically without considering the carbon footprint of their economic growth.

As a first step, the OECD countries should begin to apply uniform carbon pricing. Studies by Parry et al. (2014) also show that it is in the interest of the 20 "richest" countries to set a price per ton of CO_2 that is high enough not only for climatic reasons but also for health issues related to the reduction of air pollution. The authors also show that tiered pricing of CO_2 emissions yields greater benefits than uniform pricing.

However, it is basically the climate debt of "developed" countries with regard to "developing" countries that makes difficult the implementation of a single, high carbon price. If countries choose the option of a uniform price, it will most likely be too low to satisfy all stakeholders. This was the case for the EU ETS. It may also be possible that countries that introduce a carbon tax implement other measures to offset the impact on competitiveness. For example, this may be achieved by reducing other taxes. In such case, the carbon tax could replace taxes that are necessary to finance public services or set up automatic stabilizers in the event of a crisis.

2.2. A scale of carbon prices based on the HDI and CO_2 emissions

One mechanism could be to allocate a carbon price per country based on the HDI (Human Development Index) and CO_2 emissions per capita. Under the aegis of a multilateral organization, the carbon price would thus be set according to a reference price depending on the HDI and the emissions of CO_2. For example, if a country emits more CO_2 than the amount allocated according to its HDI level, it will have to pay a higher price than the established reference price, and vice versa. Naturally, the

benchmark prices as functions of HDIs and emissions will be estimated according to the +1.5 °C objective. Since climate is a global public good, there is a need for strong global coordination on carbon policies to prevent carbon leakage and free-riding behavior. Naturally, our proposal includes all industrial sectors without any tax loopholes such as airline and maritime industries.

The proposed mechanism for estimating a fair carbon price offers several advantages. For instance, the empirical feature permits the identification of a reference scale of carbon prices according to various levels of economic development. Indeed, the principle would be a progressive price, based on HDI thresholds. The underlying idea is that of a correlation (up to a certain level of development) between CO_2 emissions and the HDI. As such, a "poor" country does not have to pay a high carbon price when it begins to develop economically. As it takes off economically, its CO_2 emissions and its carbon price will increase jointly. Even more, the escalation in the price of carbon will also encourage to make significant and rapid use of clean energies and to invest in low-carbon infrastructures for a sustainable growth. Finally, "rich" countries with a high HDI and a largely service-oriented economy will pay a high price for carbon and will be incited to accelerate their energy transition towards a carbon neutral economy. Energy decisions-makers will be encouraged to invest on green energy and infrastructures given that clean energies will gain in competitiveness.

By considering existing development inequalities, this mechanism fully adheres to the principle of "common but differentiated responsibility" of the climate convention. It also allows us to get out of the current binary and obsolete vision in which industrialized countries and developing countries have climate divergences. We provide a dynamic pricing mechanism in which emerging countries will be more incited to cooperate because they retain (although temporary) their competitive advantage. Lastly, among wealthy countries, those who emit more emissions than necessary will have to pay higher prices for carbon.

As may be seen in Fig. 1, countries with HDIs above 0.7 have more heterogeneous CO_2 emissions per capita. The biggest differences in emissions are for globally similar HDI. For example, in 2016, France and the Czech Republic had similar HDI (0.894 and 0.893, respectively) but very different average CO_2 emissions per capita (Fig. 1). In this case, France and the Czech Republic will have a higher reference price, for example, than El Salvador. However, the application of a penalty on the carbon reference price will make the Czech Republic pay a higher price than France.

For close and high HDIs, there is greater heterogeneity in terms of CO_2 emissions per capita in the 30 "richest" countries (Fig. 2) than in the 30 "poorest" countries (Fig. 3). This indicates that some rich countries could reduce their CO_2 emissions without reducing their standard of living.

3. Discussion

A differentiated and progressive price for carbon has the potential to simplify negotiations and probably make it easier to reach an agreement. This mechanism would also serve as an instrument so that competitiveness is no more a pretext for inertia. Indeed, with close HDI levels, the most climate-friendly production systems will have a lower CO_2 price and therefore higher competitiveness.

It would also be fairer given its likelihood of placing higher burden on developed countries which have a greater climate debt than emerging countries. But rather than favoring transfers between countries via the funding of the green fund, the carbon tax allows the States which implement it to recover the revenue it generates for reallocation to ecological projects. It therefore appears preferable in comparison to the funding of the climate adaptation fund which would go to the biggest polluters. Chancel and Piketty (2015) note that out of the 150 billion dollars necessary for the climate adaptation fund, 85 billion are

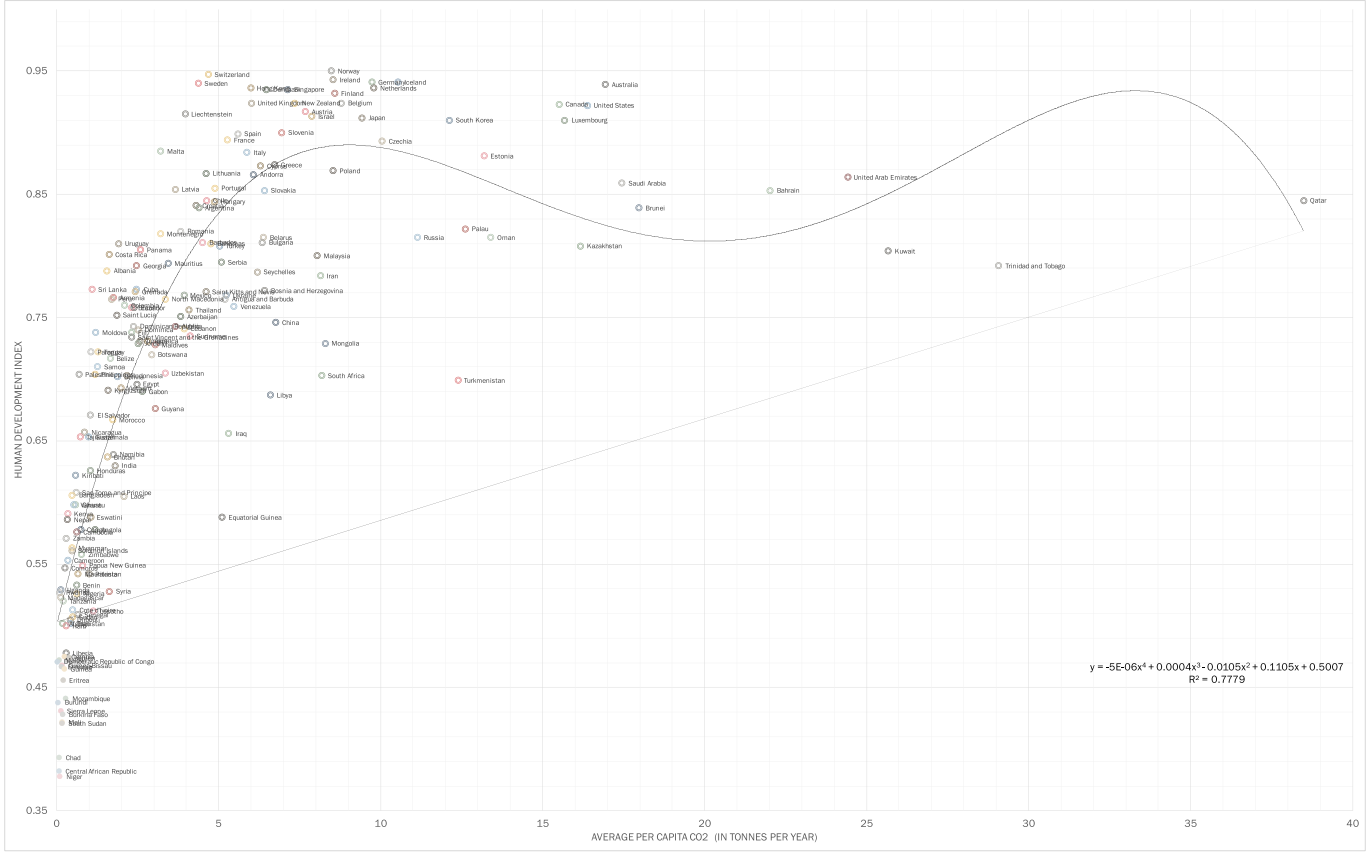

Fig. 1. CO_2 emissions per capita and HDI (2016).

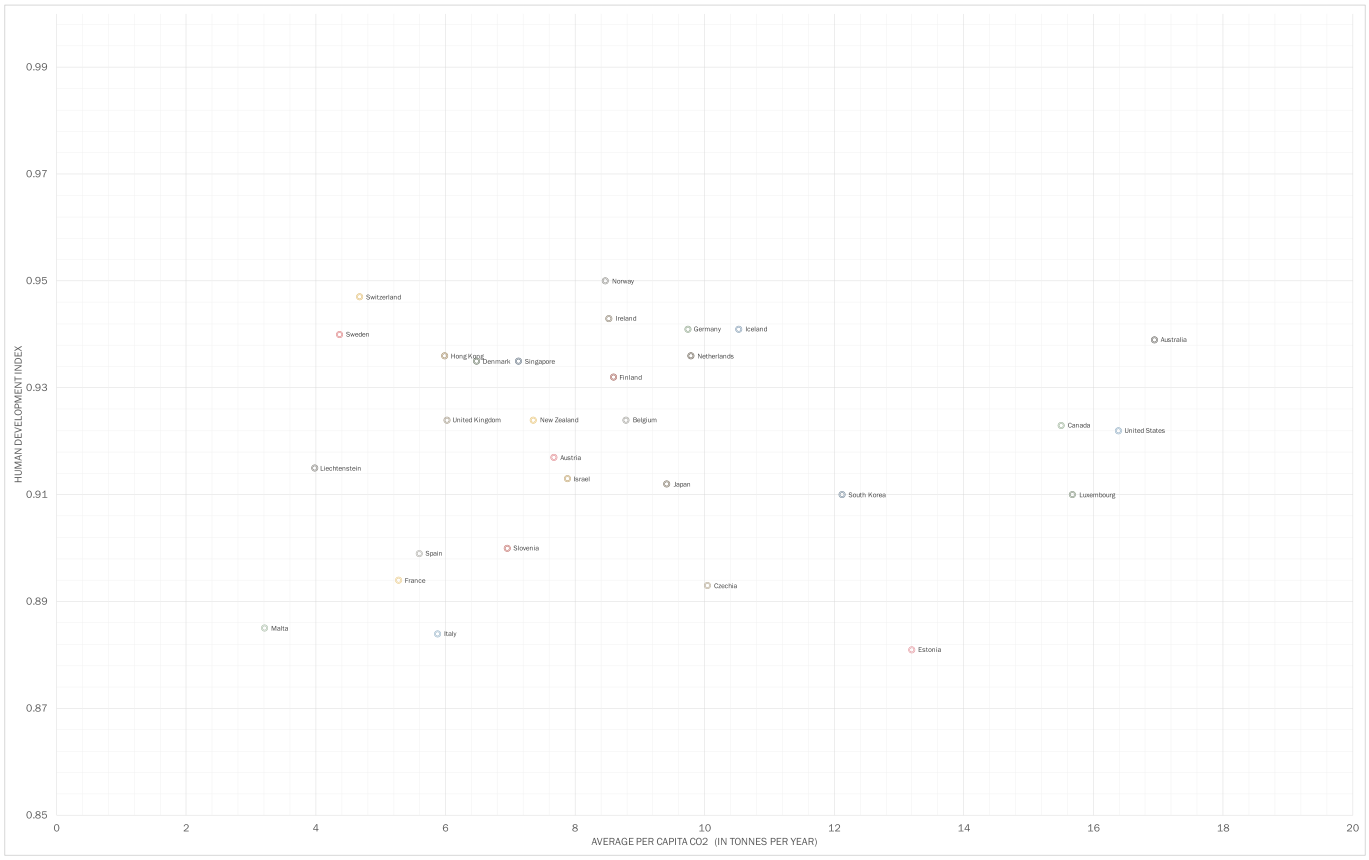

Fig. 2. CO_2 emissions per capita and HDI, top 30 (2016).

projected to come from North America (about 0.5% of its GDP) whereas 24 billion are expected from Europe (about 0.2% of its GDP). Such transfers, although necessary, appear to be difficult to implement, as shown by the rich countries' lack of ambition to finance the climate adaptation fund.

By omitting the question of inequalities within developed countries, carbon pricing implies to tax carbon emissions more heavily to reduce the use of fossil energies. However, the purchasing power of certain population groups is likely to be impacted more strongly by higher ecological taxes. For instance, the movement called "Yellow vests" in France started due to the increase of the carbon tax on automotive fuels. Fuel taxation can be perceived as unfair because it does not consider the differences in terms of public transportation between notably rural and urban populations. Depending on their living areas (city centers, suburbs, rural zones), not all citizens have the choice between using their car or using public transportation. For example, in the Paris region, the rate of private vehicle usage is estimated at about 13% compared to almost 80% in other regions. This difference is explained by the fact that residents in Paris benefit from a large array of transportation facilities unlike residents of other French regions (Boroumand et al., 2019). Furthermore, the effectiveness of taxes also depends on the elasticity of user demand (Porcher, Porcher, 2017) and on financial compensation measures for low-income households.

Furthermore, the potential of a carbon tax policy in China has been analyzed by some studies such as Yang et al., (2014). They demonstrate that the inelastic demand for fuel and the heterogeneity of industrialization and urbanization processes across regions limit the effectiveness of the carbon tax. For example, the regions in the municipalities and the North-West could also reduce their CO_2 emissions by more than 3%. In contrast, the Midland and Northwest regions have the potential only about 1.6% and 0.92%, respectively to reduce their CO_2 emissions.

To be accepted at international and national levels, a fair carbon tax must consider development inequalities on a global scale as well as heterogeneity in terms of mobility infrastructures and revenues within a country.

Despite an acceptance at a global scale, there would be difficulties in implementation at the national level. This is consistent with the lessons from the Kyoto Protocol in which a national implementation was not feasible even after the United States ratification of the agreement.

More generally, the social acceptability of environmental policies is crucial. Only a "just transition" which maximizes the benefits of climate action while minimizing negative social effects will be sustainable. It implies that social and environmental policies must be conjointly implemented to mobilize all stakeholders on the target of combining climate justice and social fairness. Fighting climate change is also a concern in terms of social justice to avoid social disorders. Therefore, previous socio-technical transitions are instructive about which conditions are necessary to manage smoothly the ecological transition by capitalizing on the lessons learned from previous structural transitions (Newell and Simms, 2020).

4. Conclusion and policy implications

The global effect of an emitted CO_2 molecule is independent of the source of emission, its location, as well as the time of emission. However, there are important economic, social, and ethical differences between different sources of CO_2 emissions. For example, a CO_2 emission caused by enhanced sustainable economic activity in a developing country is associated with a clear net benefit, whereas the same emission from heating poorly constructed houses in a rich country is a waste. Although both emissions contribute equally to global warming, and must be avoided, the former helps to reach several of the Sustainable Development Goals of the UN, whereas the latter simply increases the challenge to reach them.

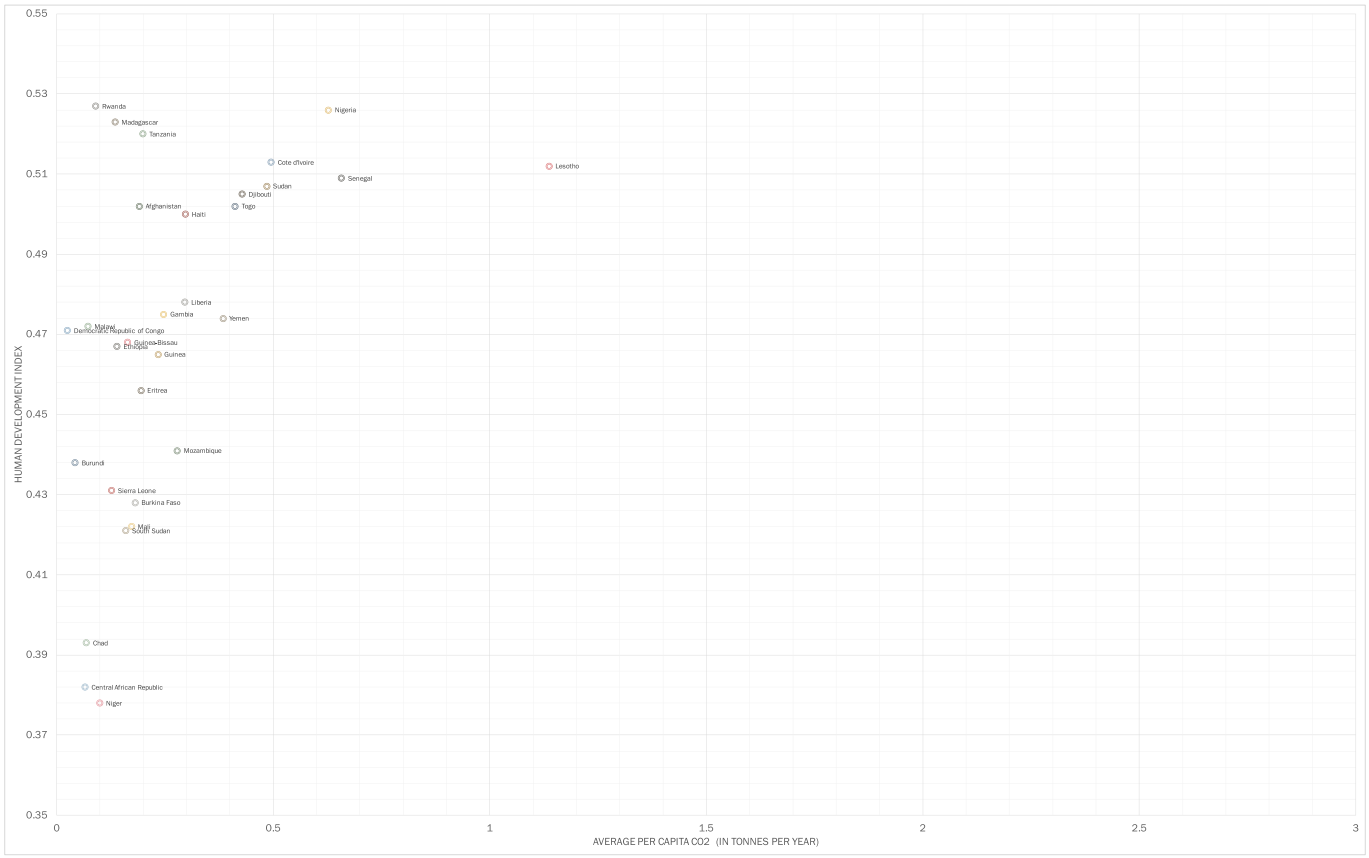

Fig. 3. CO_2 emissions per capita and HDI, bottom 30 (2016).

A differentiated and progressive carbon pricing mechanism would more easily encourage governments to cooperate since it considers the differences in development between countries. Furthermore, each country recovers the amount of budgetary revenue and therefore is free to organize transfers of goods inside its economy.

Conversely, the low funding of the climate fund is an indication that countries are reluctant to set up transfers between countries. However, putting a price on carbon will not be a miracle remedy for saving the climate. Even under the best conditions, its efficiency remains insufficient. There are many economic situations where the price signal fails to capture the expected effect, causing distrust among the populations concerned.

To fight global warming, there is need for massive investments in clean energies as well as the energy renovation of buildings on a large scale. A systematic consideration of the climate impact of all economic agents is crucial to break the link between economic growth and carbon emissions. The planet is at a critical point which imposes a major change in energy systems, production processes and consumption behaviors. Incentive-based mechanisms such as carbon pricing are necessary but not sufficient to meet this challenge. We believe on the necessity to significantly develop climate finance as an efficient mechanism for a selective and green economic growth.

Our article is related to documenting the benefits of a differentiated and progressive carbon pricing mechanism that would ease intergovernmental cooperation and modify the global energy mix by fostering the competitiveness of clean energies.

The proposed mechanism is an efficient mean to radically change energy supply and consumption patterns given that energy prices will integrate the cost of climate damages. Carbon pricing will modify decision-making processes and investment strategies. On the corporate side, it will impact not only energy firms but also the energy/electricity consumption patterns of most firms and organizations, far beyond electricity-intensive firms.

Further research is needed to establish a precise value scale for carbon prices based on the HDI and per capita CO_2 emissions. This will involve forming groups of countries based on an average HDI and average CO_2 emissions per capita, which will be associated with a benchmark price. Penalties on each reference price will be established so that countries, with an equivalent HDI, but with higher emissions, pay a higher carbon price. This scale of reference prices may be subject to reassessment in line with the UNFCCC stocktake process..

Ecological urgency is transverse to all economic and political decisions. Therefore, the environmental crisis should not be considered as a separate issue. Unfortunately, the level of economic research on ecology remains insufficient (Spash, 2017; Gills and Morgan, 2020).

The ecological urgency must be put on top of the economic education and research agendas to develop new economic mechanisms for fair and efficient environmental policies.

Authors statements

Raphaël-Homayoun BOROUMAND: Conceptualization, Methodology, Investigation, Supervision, Writing- Reviewing and Editing. **Stéphane GOUTTE**: Conceptualization, Methodology, Investigation, Supervision, Writing- Reviewing and Editing. **Thomas PORCHER:** Conceptualization, Methodology, Investigation, Supervision, Writing-Reviewing and Editing. **Thomas F. STOCKER:** Conceptualization, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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