



How to implement a fair and progressive carbon price to fight climate change?

Raphaël-Homayoun Boroumand, Stéphane Goutte, Thomas Porcher, Thomas Stocker

► To cite this version:

Raphaël-Homayoun Boroumand, Stéphane Goutte, Thomas Porcher, Thomas Stocker. How to implement a fair and progressive carbon price to fight climate change?. 2020. halshs-02613281

HAL Id: halshs-02613281

<https://shs.hal.science/halshs-02613281>

Preprint submitted on 20 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

How to implement a fair and progressive carbon price to fight climate change?

Raphaël-Homayoun BOROUMAND*, Stéphane GOUTTE**, Thomas PORCHER***, Thomas F. STOCKER****

* Associate professor of economics, Paris School of Business, 59 rue Nationale, 75013 Paris.

** Professor of economics, CEMOTEV, Université Versailles Saint-Quentin, Bât Vauban, 47 boulevard Vauban, 78047 Guyancourt Cedex.

*** Associate professor of economics, Paris School of Business, 59 rue Nationale, 75013 Paris.

****Professor of Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland.

President of the Oeschger Centre for Climate Change Research

Keywords: climate, carbon, price, market, tax

Abstract

The principle of "common but differentiated responsibility", 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 one of the necessary instruments to limit global warming to a maximum of 2 °C. In this article, we propose the allocation of a carbon price per country based on the Human Development Index (HDI) and CO₂ emissions per capita. We demonstrate that under a multilateral framework, the price of carbon would be fixed according to a reference price depending on the HDI and CO₂ emissions. For example, if a country emits more than the amount allocated to its HDI level, it will have to pay a higher price than the established reference price, and vice versa. Reference prices as functions of HDIs and emissions will be estimated based on a trajectory to reach the target goal of reducing carbon dioxide emissions. A key element of our proposed scheme is that it generates national revenue allowing high-emitting countries a rapid decarbonization and developing countries (with generally lower emissions) accelerated development and early implementation of green infrastructures. Our research goal is related to documenting the benefits of a differentiated and progressive carbon pricing mechanism to ease intergovernmental cooperation.

Introduction

The scientific consensus on global warming is no longer in doubt. The climate emergency is undeniable from now on. 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 4 °C on average compared to the pre-industrial era. The Paris agreement at COP 21 had raised many hopes. Unlike the Kyoto Protocol, the Paris Agreement is non-binding and is based on the principle of "name and shame game" 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 open economy, it is possible to relocate production to countries with lower environmental standards. Almer and Winkler (2017) argue that an agreement will only be effective if it is global. Indeed, if in an agreement, 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 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 (see e.g. 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), the global agreements may be regarded as still far from having proven their effectiveness. Tirole (2016) argues that these numerous failures, particularly in the negotiations, are due to the fact that each country is encouraged to behave like a "stowaway" by delaying its reforms with the expectation of better compensations in future negotiations if it does less today. 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, an increasing number of studies has argued that a global carbon tax is the best mechanism for managing greenhouse gas emissions even if there are limits to its efficiency (see e.g. McEvoy and McGinty, 2018).

To set a price for CO_2 emissions that is compatible with the objective of the Paris agreement, i.e. the warming must be kept well below $2^\circ C$ relative to pre-industrial levels, there are two economic instruments: a carbon tax or a carbon market. In 1920, the celebrated Economist 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 the climate emergency. On the other hand, another way of pricing carbon is 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 reaching ideally 1.5 degrees maximum by 2100, then it is possible to exchange rights to pollute. The climate ambition is set by the world carbon budget and the trading of permits is supposed 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 tonnes to 10 million from 1995. Conversely, the European carbon market (EU ETS) has not demonstrated its capacity to deliver an appropriate long-term price signal for a low carbon economy resilient to climate change even if jurisdictions around the world are learning from each other (Narassimhan et al, 2018). CO_2 emissions quotas have been over-allocated and the price per tonne of CO_2 has dropped from 30 euros to a floor of 5 euros between 2005 and 2014 even if the price is higher in 2020. 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 States. Chevallier (2011) demonstrates that some fundamental principles have now been identified and confirmed by numerous empirical studies such as regulatory and political questions, market fundamentals (including the emissions/ceiling ratio, the role of fuel substitution, the weather conditions) and

macroeconomic activity. More research is needed on adjusting the carbon price to the global economic recession.

According to Weitzman (2014), the price of carbon must be unique and perceived by the country in which carbon dioxide is actually released into the atmosphere. Further, given that all CO_2 molecules, whether emitted in the United States or in Bangladesh, have the same negative impact on the climate, 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 very maximum 2°C objective. Hourcade and Gilotte (2000) show 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 would only be appropriate if it was applied with transfers between countries. Lastly, Edenhofer et al. (2015) demonstrate that the incentives to set emission pricing differs among countries. For example, climate damages and reduced air pollution appear to be the main motivation 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 set a price on carbon, the most appropriate method is still debated. The failure of the European carbon market is evident 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 concept of the supposedly Invisible hand. Negotiating a uniform carbon price between developed and developing countries with historical differences in climate impact lead to an impasse, as shown by the failures of several UN climate conferences (COPs).

Defining a fair and progressive carbon price to fight climate heating

Setting a single carbon price that satisfies all stakeholders seems unrealistic. How could the European market mechanism be reproduced on a global scale in the negotiations (notably with the very powerful emerging countries) to fix a uniform carbon price? This is particularly irrelevant

given that the OECD countries account for about 2/3 of 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.

However, it is basically the climate debt of developed countries with regard to developing countries that makes the generalized application of a single, high carbon price unrealistic operationally. If countries choose the option of a uniform price, it will most likely be too low in order to satisfy all stakeholders. Consequently, its inefficiency will be comparable to that of the European carbon market.

One method 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. Apparently, the benchmark prices as functions of HDIs and emissions will be estimated according to a trajectory allowing to reach the target objective of reduction of carbon dioxide emissions.

The proposed methodology 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 it to make significant and rapid use of clean energies in its energy mix and to invest in low-carbon infrastructures for a green growth. Finally, “rich” countries with a high HDI and a largely service-oriented economy will pay a high price for carbon and will be

encouraged to accelerate their energy transition to a low carbon economy resilient to climate change. 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 pricing mechanism in which emerging countries will be more encouraged to cooperate because they retain (although temporary) their competitive advantage compared to industrialized countries.

Lastly, among wealthy countries, those who emit more emissions than necessary will pay a very high price for carbon. A simple comparison of the top 20 countries by HDI reveals that some countries have significant differences in CO_2 emissions for globally similar living standards. For example, France emits 4.6 tonnes of CO_2 /inhabitant compared to 16.5 tonnes of CO_2 for an American in 2014. At the same time, their HDIs remain fairly close with 0.88 for France and 0.91 for the United States. In this case, the price of US carbon would be more expensive than in France. This mechanism would also serve as an instrument so that competitiveness is no more a pretext for climate inaction. Indeed, the most sober production systems will have a lower CO_2 price and therefore higher competitiveness.

Discussion

A differentiated and progressive price for carbon has the potential to simplify negotiations and probably make it easier to find an agreement. It would also be fairer given its likelihood of placing higher impact 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. Here, Chancel and Piketty (2015) note that out of the 150 billion dollars necessary for the climate adaptation fund, 85 billion is projected to come from North America (about 0.5% of its GDP) whereas 24 billion is expected from Europe (about 0.2% of its GDP). Such transfers, although necessary, appear to be difficult to implement,

as shown by the lack of ambition on the part of rich countries to finance the climate adaptation fund. For instance, in 2016, the sums promised were less than 10 billion dollars.

Omitting the question of inequalities within developed countries, carbon pricing implies to tax carbon emissions more heavily. However, the purchasing power of certain population groups is likely to be impacted more strongly by higher taxes. For instance, the movement of “Yellow vests” in France started due to the increase in the carbon tax on automotive fuels. Fuel taxation can be perceived as unfair because it does not take into account 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 Paris region, the rate of private vehicle usage is estimated as about 13% compared to almost 80% in other regions. This difference is explained by the fact that residents in Paris benefit from a large supply of transportation facilities unlike other 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 (See e.g. Yang, Fan, Yang and Hu, 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 North West regions have the potential to reduce their CO_2 emissions by respectively 1.6% and 0.92%. To be accepted at international and national level, the determination of a fair carbon tax must therefore consider development inequalities on a global scale as well as heterogeneity in terms of mobility infrastructures within a country. Contrarily, despite an acceptance at a global scale, there would be imminent difficulties in implementation at the national level. This is consistent with the lessons of the Kyoto Protocol in which a national implementation was not feasible even after the United States ratification of the agreement.

Conclusion and policy implications

The global effect of an emitted CO₂ molecule is independent of the type of source, its location and the time of emission. However, there are important economic, social and moral differences between different sources of CO₂ emissions. For example, a CO₂ 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, it is clear that the former helps to reach several of the Sustainable Development Goals of the UN whereas the latter simply increases the challenge to reach them.

Against this background, imposing a carbon price at a global level when the majority of CO₂ emissions are not subject to any constraint must take into account its realities. A differentiated and progressive carbon pricing mechanism would more easily encourage governments to cooperate since it takes into account 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 evident fact that countries are reluctant to set up transfers between countries. However, putting a price on carbon will not be the miracle cure for saving the climate, a global public good. Even under the best conditions, its effectiveness remains insufficient. For instance, there are many economic situations where the price signal fails to capture the expected effect, causing distrust among the populations concerned (e.g. the demonstrations of the “Yellow vests” in France). For fighting efficiently against global warming, there is a need for massive investments in clean energies as well as the thermal renovation of buildings. 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 production processes and consumption behaviors. Incentive-based mechanisms such as carbon pricing are necessary but not sufficient to meet this challenge.

References

- Almer, C., Winkler, R. (2017), Analyzing the Effectiveness of International Environmental Policies: The Case of the Kyoto Protocol, *Journal of Environmental Economics and Management*, 82: 125–151,
- Boroumand, RH., Goutte, S., Péran, T., Porcher, T. (2019). Worker mobility and the purchase of low CO2 emission vehicles in France: a datamining approach. *European Journal of Comparative Economics*, 16 (2), 171-205.
- Chancel, L., Piketty, T. (2015). Carbon and inequality from Kyoto to Paris: Trends in the global inequality of carbon emissions (1998–2013) and prospects for an equitable adaptation fund. Working paper Paris School of Economics. <http://piketty.pse.ens.fr/files/ChancelPiketty2015.pdf>
- Chevallier, J. (2011). Carbon price drivers: an updated literature review. *International Journal of Applied Logistics (IJAL)*, 4(4), 1–7.
- Crocker, T. D. (1966). The structuring of atmospheric pollution control systems. *The economics of air pollution*, 61, 81-84.
- Dales, J. H. (1968). Pollution, property & prices. Toronto : University of Toronto Press (111 pages).
- de Perthuis, C., Trotignon, R. (2015). Le climat, à quel prix ? Odile Jacob (152 pages)
- Edenhofer, O., Jakob, M., Creutzig, F., Flachsland, C., Fuss, S., Kowarsch, M., Lessmann, K., Mattauch, L., Siegmeier, J., and Steckel, J.C. (2015). Closing the Emission Price Gap. *Global Environmental Change*, 31, 132–143.
- McEvoy, D.M., McGinty, M. (2018). Negotiating a uniform emissions tax in international environmental agreements. *Journal of Environmental Economics and Management*, 90, 217-231.
- Gollier, C., Tirole, J. (2015). Negotiating effective institutions against climate change. *Economics of Energy and Environmental Policy*, 4, 5–28.
- Hoel, M. (1996): Should a carbon tax be differentiated across sectors? *Journal of Public Economics*, 59 (1), 17-32
- HOURCADE (J.-C.), GILOTTE (L.), 2000. - "Differentiated or uniform international carbon taxes : Theoretical evidences and procedural constraints ». In CHICHILINSKY, G. et HEAL, G. (eds.). Environmental Markets. New York: Columbia University Press, Chap. 8.
- IPCC, 2013. Summary for Policymakers, In: Stocker, T.F., et al. (Eds.), Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of

the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pages 1–30.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pages

Narassimhan, E., Gallagher K., Koester S., Rivera Alejo, J., (2018). Carbon pricing in practice: a review of existing emissions trading systems, *Climate Policy*, volume 18, issue 8, Pages 967-991

Pigou, A. C. (1920). The Report of the Royal Commission on the British Income Tax. *The Quarterly Journal of Economics*, 34(4), 607-625.

Porcher, S., Porcher T. (2018). Fuel taxes and consumer behaviour: a Markov-switching approach. *International journal of global energy issues*, 41(1-4), 14-24.

Tirole, J. (2017). Economics for the Common Good. Princeton University Press . (576 pages)

Yang, M., Fan, Y., Yang, F., Hu, H. (2014). Regional disparities in carbon dioxide reduction from china's uniform carbon tax : a perspective on interfactor / interfuel substitution. *Energy*, 74, 131-139.

Weitzman, M. (2014). Can Negotiating a Uniform Carbon Price Help to Internalize the Global Warming Externality? *Journal of the Association of Environmental and Resource Economists*, 1(1), 29–49.