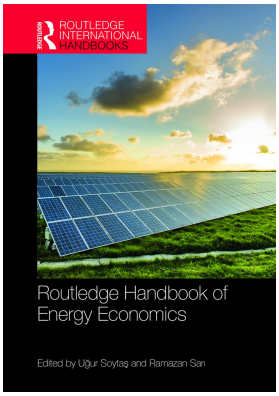

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Uur Soyta, Ramazan Sar

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The role of carbon pricing in the Paris Agreement

İzzet Arı and Ramazan Sarı

1 Introduction

Anthropogenic activities, including greenhouse gas (GHG) emissions, are very likely to cause global climate change (IPCC, 2018). In response, tackling climate change will require global cooperation and partnerships for reducing GHG emissions cost-effectively (Nordhaus, 1991). Currently, there are three key emission reduction policies: behavioral change towards sustainable consumption and production, technological shifts from high carbon to low carbon alternatives, and carbon pricing (Stern, 2007). Both technological shifts and behavioral change policies can use carbon pricing instruments such as cap and trade, carbon taxes, or regulations in order to hinder market failure and correct negative externalities arising from global climate change (Benessaiah, 2012; Clarke, 2011; Nordhaus, 1991; Perdan & Azapagic, 2011). Accordingly, carbon pricing tools should be designed for minimizing the burden of externalities and eliminating unaffordable policies.

The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement are all well-known multilateral agreements on climate change. In 2015, the Paris Agreement was adopted by countries which have a collective responsibility for 97% of global emissions (Mehling, Metcalf, & Stavins, 2017). Even though implementation rules for combatting climate change are determined by these agreements, reducing GHG emissions in a cost-effective way at the global level still needs to be clarified. After exploring sufficient bottom-up development methods in carbon pricing for signatories of the Paris Agreement, the World Bank (2017) suggested continuing the development of aspects of carbon pricing such as scope, the amount of emissions reduction, standardized units and monitoring (World Bank, Ecofys, & Vivid Economics, 2017). Although countries are familiar with carbon pricing initiatives such as cap and trade, the Clean Development Mechanism (CDM), and joint implementation in international climate agreements, the Paris Agreement contains unique emissions reduction commitments or contributions termed Nationally Determined Contributions (NDCs). A large number of NDCs include and are subject to carbon pricing.

Before the Paris Agreement was adopted in 2015, various countries had submitted and announced their NDCs. These submissions had been part of the complementary step for developing the Agreement before countries agreed on articles within the Paris Agreement itself (Ari

& Sari, 2017b, 2017a). Eighty-one countries announced the use of carbon pricing in their NDCs (UNFCCC, 2015b). This number shows that carbon pricing will be linked to countries' emission mitigation actions. However, this linkage will not be straightforward during the implementation period of the Paris Agreement, because NDCs were not submitted in a standardized common tabular format for the monitoring of actions related to carbon pricing.

Article 6 in the Paris Agreement will provide a new window for carbon pricing at the international level and this connects to a country's NDCs. Nevertheless, further discussions on Article 6 of the Paris Agreement are essential to ensure common understandings and methods until the beginning of the implementation period of the Paris Agreement. In this paper, the role of carbon pricing in the Paris Agreement and its linkages with NDCs will be addressed, specifically in the context of cost-effective emissions reduction. This reduction requires establishing a system of global cooperation among the committed countries, to support the overriding aims of the Agreement and to ensure the provision of climate finance through the operationalization of Article 6 of the Agreement. Section 2 focuses on the basics of carbon pricing, and Section 3 analyzes new regulatory frameworks for carbon pricing. Section 4 then presents carbon pricing for climate finance, and in Section 5, concluding remarks with recommendations are provided.

2 Principles of carbon pricing

Putting a price on carbon internalizes climate change externalities to the point where the marginal abatement costs of emissions mitigation is equal to the marginal damage of emissions (Clarke, 2011; Nordhaus, 1991; Perdan & Azapagic, 2011). In other words, a cost-benefit analysis of climate change can be conducted through carbon pricing (Bhattacharyya, 2011). There are two basic functions for this pricing: one is the emissions reduction abatement function as a cost function, and the second is a climate change damage function representing a clear benefit from preventing future damage (Bhattacharyya, 2011; Nordhaus, 1991). The aim is to maximize net benefit through determination of the optimum amount of total emissions reduction at the global level. In addition to minimizing the total cost of emissions reduction, carbon pricing provides a shift away from carbon intense technologies to low-carbon technologies (Bayon, Hawn, & Hamilton, 2009; Stern, 2007). Therefore, carbon pricing enables countries to achieve sustainable development at the very least (Benessaiah, 2012).

Carbon tax and carbon trade are the two main carbon pricing instruments. The former sets the price of carbon and the latter sets the quantity to be reduced. Since the main principle of carbon pricing is to reduce the total cost of emissions mitigation, cost functions including marginal control cost, damages by climate change and time dynamics (discount rate, time preferences) should be further explored (Nordhaus, 1991). However, both cost and damage functions and discount rates depend on various factors such as national circumstances, uncertainty around the exact impacts of global climate change, national inflation rates, and the speed and rate of technological change (Clarke, 2011; Stern, 2007). Accordingly, the marginal abatement cost might vary among countries and even sectors within an economy (Clarke, 2011; Nordhaus, 1991). Thus, a uniform price level of carbon might not be cost-effective, so it is essential that both the carbon tax level and trade caps should be determined according to each sector's marginal abatement costs. In an ideal case, in a competitive market, the marginal abatement cost, price of a carbon tax, and trade of one quantity of carbon allowance are expected to be equal.

Under the implementation of a carbon tax and trade system, there may be an increase in the cost of carbon intense production and the price of products which are purchased by consumers in the market (OECD, 2013). Therefore, producers and consumers might prefer to reduce their overall cost through changing production or consumption patterns. For example, consumers may

prefer to buy more fuel-efficient vehicles or equipment, and producers use alternative materials rather than fossil fuels (OECD, 2013; Stern, 2007). While these preferences discourage production of emission intense products with a decreasing demand and additional price on carbon, producers will also encourage a transition to low carbon technologies and products which in turn is demanded by the market (OECD, 2013).

In a carbon tax system, an authority sets the price of carbon without any cap or allocation of allowances. There are four main advantages of carbon taxes (Bhattacharyya, 2011; Clarke, 2011; Stern, 2007). First, it minimizes total costs through converging and equalizing the marginal abatement cost of diverse sources at an upper bound price of carbon as a tax level. Second, it promotes innovation and seeks new technological change to reduce emissions in controlling part of the marginal cost curve. Third, it easily enables emissions to be monitored. Fourth, it overcomes market failure resulting in polluters paying for external costs, so carbon taxes then provide additional revenue for climate vulnerable groups while correcting market failures. The main disadvantage of the carbon tax is not to guarantee the attainment of a quantitative target for emissions reduction. Besides, a new tax might be a politically sensitive issue when applied by small and medium-sized entities (Bhattacharyya, 2011). This is because the introduction of a carbon tax requires an accountable and strong fiscal policy environment for collecting new and additional revenue from entities (Nordhaus, 2006). Therefore, the tax level should be well-monitored, due to fluctuations of inflation rates in an economy and the changing marginal abatement cost of various sectors over time.

The motivation for carbon trade is to minimize compliance costs of emissions reduction for avoiding market failure (Bayon, Hawn, & Hamilton, 2009; Perdan & Azapagic, 2011). There are three main advantages of carbon trading (Stern, 2007). First, it sets an emissions cap so that emissions targets or an explicit commitment to reduced emissions is guaranteed. Second, total cost is minimized through equalizing the carbon price to that of the marginal abatement cost in the market. Third, it provides a continuing incentive for polluters to seek ways to reduce emissions. The main disadvantage of carbon trading is that there is no fixed guarantee in the price of carbon. Thus, there might be fluctuations in the price of carbon in the market. In the case of free allocation of carbon credits or cap, it is not possible to raise revenue from trade.

The main difference between carbon taxes and carbon trading systems is that a carbon tax sets a fixed carbon price level but lets carbon emissions vary, whereas carbon trading fixes the quantity of emissions and lets the price vary (Pollitt, 2015). While the advantage of carbon trading is to reduce the risk of quantity, price volatility emerges as a disadvantage in the trade. On the other hand, carbon taxes guarantee the price of carbon but do not ensure any commitment to explicit emissions reduction by emitters (Stern, 2007). In market economies, measures should be taken for both tackling climate change and enabling better functioning market conditions. To this, price floors and ceilings, or a "price collar" can be implemented. A price floor which is equal to a carbon tax, can reduce the risk of quantity, and a ceiling which can fix the highest price via an authority, can eliminate the risks of speculative pricing. This combination of carbon taxes and carbon trading is a hybrid approach in carbon pricing (Mehling et al., 2017). The preferences for choosing better instruments for carbon pricing depends on variations among national circumstances (Stern, 2007). In the implementation of a hybrid approach, an authority should buy and retire carbon certificates to control price fluctuations, and the authority should provide additional and new certificates to eliminate price rises (Stavins & Stowe, 2017). An authority, which is responsible for monitoring carbon pricing, might suffer from either providing a benchmark for the price of carbon or allocating a fixed amount of carbon certificates among emitters. It is expected that this authority should provide both a standard price for one unit of carbon allowances and a fair allocation of carbon certificates. The former depends on the social

cost of carbon, namely monetizing the damage of one unit of emissions, while the latter requires grandfathering of the individual emissions of each emitter.

3 Regulation framework of carbon pricing

For the first time, the Kyoto Protocol and its flexibility mechanisms recognized carbon pricing instruments at the global level. The Kyoto Protocol, which required emissions reduction commitments among developed countries, set rules and compliance measures for monitoring the quantified emissions reduction units of developed countries between 2008 and 2012 (UNFCCC, 1998). Although the Kyoto Protocol provided flexibility mechanisms such as the Clean Development Mechanism (CDM), Emissions Trading System (ETS) and Joint Implementation (JI) to reduce carbon emissions in a cost-effective manner, it was insufficient (as it covers only 14% of global emissions) for reducing carbon emissions with market mechanisms (Ari, 2013; Mehling & Görlach, 2016; Stavins & Stowe, 2017; UNFCCC, 1998). For example, major emitters such as the United States did not ratify the Protocol, and countries not listed in the Protocol did not show any willingness to reduce their emissions (Bhattacharyya, 2011). Therefore, these inactions led to the weakening of the development of international carbon markets.

In addition to international agreements for carbon pricing initiatives, national obligations to reduce carbon emissions called for states to incorporate carbon pricing within their national territories (Mehling et al., 2017; Stavins & Stowe, 2017). Over the Kyoto Protocol period, flexibility mechanisms such as the CDM, Joint Implementation, and International Emissions Trading were established to reduce emissions using market mechanisms (UNFCCC, 1998). These pricing tools were provided to reduce price volatility and ensure transparency through standardized emission reduction units including certified emissions reductions (CERs) and emissions reduction units (ERUs) in compliance with the Protocol (UNFCCC, 1998). In the first commitment period of the Protocol, more than 1.8 billion CERs were created by over 8,000 project activities (Stavins & Stowe, 2017). This period was also called "Carbon Markets 1.0" and signified a learning period for carbon pricing (ADB, 2018). The European Union Emissions Trading System (EU-ETS) which was a well-known regional initiative, was the largest cooperation among the EU countries (World Bank, Ecofys, & Vivid Economics, 2017). While EU-ETS seemed to be a successful cooperation among developed countries within the EU (Stern, 2007), other developed countries still had significant challenges to reduce their emissions in a cost-effective manner (Bhattacharyya, 2011). Besides, emerging economies and developing countries with large carbon emissions did not stabilize their emissions.

The Paris Agreement, which replaces the Kyoto Protocol, on the other hand, seems to be an opportunity to involve all countries for carbon pricing at the global level. The lessons learned from the Kyoto Protocol period, alongside associated regional and national initiatives that address mitigation outcomes, need to be subject to a common currency system, less price volatility, and strong institutional arrangements including monitoring, reporting, verification, and accountability mechanisms (Howard & Climate, 2018). Because the Paris Agreement has hybrid features, which includes top-down monitoring, reporting, and verification processes and bottom-up commitments in the form of NDCs, the Agreement requires better functioning carbon pricing systems globally. In addition, it is important to recognize that the Agreement targets 97% of global emissions while the Protocol accounted for only 14% of global emissions (Mehling et al., 2017). Table 15.1 compares the Kyoto Protocol and the Paris Agreements in terms of carbon pricing. While the Kyoto Protocol and its market-based initiatives focuses on more developed countries with their comparatively small amount of emissions, the framework of a new climate regime through NDCs and the Paris Agreement provide flexibilities, country-based unique solutions,

Table 15.1 Comparison of the Kyoto Protocol and the Paris Agreement

The Kyoto Protocol	*The Paris Agreement*
Developed countries had emissions reduction targets but the developing countries did not have emissions targets.	All countries submitted their NDCs but there is a variety of targets in the Agreement.
Strong and legally binding compliance system.	Transparency, country driven and global stock take based compliance system.
Three flexible mechanisms: 1 International Emissions Trading between countries with caps. 2 Joint Implementation project-based mechanism through ERUs between countries with caps. 3 Clean Development Mechanism based on CERs, which were created in countries without targets. Countries used CERs for their targets or carbon trading.	Article 6 of the Agreement states that any country can choose carbon pricing mechanism approaches, choosing either centralized (Article 6.4) or decentralized (Article 6.2) systems for pricing.

cooperation and partnerships for progressive emission reductions for all countries (ADB, 2018). In other words, the Paris Agreement provides cost-effective carbon emissions reduction for all countries for the first time (Stavins & Stowe, 2017). In contrast with the Kyoto Protocol, the Agreement defines comprehensive and inclusive approaches, namely the Sustainable Development Mechanism (SDM) and cooperative approaches (CA).

In the Paris Agreement, the NDCs of 81 countries announced the introduction of carbon pricing, including carbon taxes or trading systems, while meeting their commitments (Stavins & Stowe, 2017). Among these countries, top emitters such as China, Japan, and India will have plans to use carbon pricing for the first time, therefore, 55% of global carbon emissions will be explicitly subject to carbon pricing (World Bank, Ecofys, & Vivid Economics, 2017). This global tendency for cost-effectiveness in the mitigation of emissions will assist in supporting the establishment of global cooperation and partnerships among countries and public-private sectors as well (Howard & Climate, 2018). It is expected that, eventually, support for the progressive reduction of emissions through global carbon markets will lead to a global price of carbon (Stavins & Stowe, 2017).

Article 6 of the Paris Agreement outlines the scope of the new market mechanism. It detailed the linking of domestic actions with international cooperation and agreements and provides operational guidance for acquiring Internationally Transferable Mitigation Outcomes (ITMOs), which are defined under Article 6 (World Bank, Ecofys, & Vivid Economics, 2017). There are three approaches; namely cooperative approaches (Article 6.2), sustainable development mechanism (Articles 6.4–6.7), and non-market approaches (Articles 6.8–6.9) focusing on emissions limitation (Table 15.2).The main issues outlined under Article 6.2 are the promotion of sustainable development, ensuring environmental integrity and transparency, linking national emission trading systems, and avoiding double counting through robust accounting systems (Stavins & Stowe, 2017). Article 6.2 also provides guiding rules and principles to establish a carbon market at the global level. Article 6.4 is similar to international emissions trading which was established under the Kyoto Protocol.

Article 6 recognizes ITMOs for international cooperation through regional, national and local carbon pricing initiatives. Even though multilateral development banks recognize the types of

Table 15.2 Article 6 and its implications[1]

Article 6.	*Further Explanations*
Article 6.1	This paragraph highlights the importance of all kinds of voluntary cooperation to implement NDCs.
Articles 6.2 and 6.3	Article 6.2 recognizes and defines the objective of internationally transferred mitigation outcomes (ITMOs). This paragraph also generally mentions the role of the Conference of the Parties of the Paris Agreement (CMA). Articles 6.3 links to ITMOs with NDCs. However, this paragraph does not give any reference to the scope of the ITMOs, even the authorization process will be framed by countries in cooperation, through establishing a common understanding for decentralized approaches.
Articles 6.4, 6.5, 6.6, and 6.7	A new mechanism is established under the CMA. One country's ITMOs can be used another country's NDCs commitment. Double counting will be avoided through supervision of CMA. Priorities of the CMA while creating ITMOs will be defined in Article 6.6.
Articles 6.8 and 6.9	Non-market approaches are recognized in these two paragraphs. The priorities of the non-market approaches are listed, but there is no definition and scope of the approaches. The unfinished business of non-market approaches should be complemented until 2020.

ITMOs as emissions trading certificates, energy certificates, and so forth, the unit and standards of the ITMOs have not yet been defined (ADB, 2018; World Bank, Ecofys, & Vivid Economics, 2017). During the Kyoto Protocol commitments period, certain commodities for emission reductions were created such as Assigned Amount Units (AAU), Certified Emission Reductions (CER), Emission Reduction Units (ERU), but in the Paris Agreement, discussions continue to decide the standards and units of ITMOs. Unlike the Kyoto Protocol, where commodities for emissions reductions were inflexible and restricted, ITMOs are not restricted in the Paris Agreement.

Another difference between the Kyoto Protocol and the Paris Agreement concerns the categorization of activities in countries and whether they are eligible to be involved in global carbon initiatives or not. The Kyoto Protocol recognizes only Annex I countries of the UNFCCC that were eligible without hosting mitigation projects for the Clean Development Mechanism. Accordingly, non-Annex countries could host mitigation projects, but Annex I countries could not benefit from mitigation projects as a host partner in the Kyoto Protocol (UNFCCC, 1998). On the contrary, there is no classification or categorization of that kind of hosting criteria in the Paris Agreement. Therefore, any country will be eligible to participate in mitigation projects either as a host country or as a project developer in other countries. This flexibility in participation will enable a global price for carbon to be set.

4 Climate finance and carbon pricing

The motivation for putting a price on carbon is to decarbonize economies, including through encouraging low-carbon technologies, reducing energy demand, changing consumer behavior, and shifting to sustainable production patterns (Pollitt, 2015; Stavins & Stowe, 2017). While people face a social cost as a result of their actions, through putting a price on carbon as a tool to monetize the damage of carbon emissions (Stern, 2007), carbon pricing is also a revenue raising opportunity to finance and support further low-carbon development (World Bank, Ecofys,

& Vivid Economics, 2017). For example, in 2017, more than USD 33 billion revenue was raised in carbon pricing through carbon taxes, auctions allowances and payments to meet compliance (World Bank & Ecofys, 2018).

In 2017, the number of total carbon pricing initiatives stands at 51 with 11 GtCO2e, representing 20.0% of global GHG emissions (Carbon Pricing Leadership, 2018). The total value of this carbon pricing, including taxes and trades, reached US$ 81.68 billion in 2017, and price per unit of carbon was between USD 1 and USD 140/tCO2e (World Bank & Ecofys, 2018). Therefore, the provision of a carbon price signal, the use of carbon finance in cost calculations, and international agreements to regulate carbon reductions are all essential elements for increasing the share of emissions that are subject to carbon pricing.

The transition to low-carbon development requires USD 700 billion of investment by 2030 (World Bank, Ecofys, & Vivid Economics, 2017). This amount is an incremental part of the total climate investment required, so additional finance should be mobilized by innovative climate finance mechanisms such as carbon pricing (World Bank, Ecofys, & Vivid Economics, 2017). Domestic finance should be the main contributor of this investment, with carbon taxes and trading systems included as a part of the effective mobilization of domestic finance (World Bank, Ecofys, & Vivid Economics, 2017). This mobilization also reduces the marginal cost of emission reductions and the transaction cost of carbon certificates (World Bank, Ecofys, & Vivid Economics, 2017).

In addition to domestic finance, there are still some challenging issues and pressing questions, such as "who will provide the climate finance?" or "Which countries are eligible to use climate finance that is provided by developed countries for combating climate change ?" for accessing international finance such as grants, aid and concessionary funds. These questions originate from discussions on divergence and the definition of "developed/developing" countries and the classification of "Annex-I/non-Annex" countries in the UNFCCC. Similarly, this dichotomous approach in the climate negotiations has been continuing since the post-2012 climate negotiations (Aldy & Stavins, 2012; Bodansky, Chou, & Jorge-Tresolini, 2004). Since the negotiations did not clarify a developed and developing countries distinction in the context of climate finance, these challenges do not seem to be finalized. Though there is no clear definition and considerable divergence among countries commitments to contributing climate finance (Ari & Sari, 2017a, 2017b), Annex II countries in the UNFCCC will, however, routinely co-provide finance to developing countries (UNFCCC, 1992).

This challenging discussion so continues for accessing finance from the Green Climate Fund (GCF), which was established in 2010 in order to finance projects that combat climate change (UNFCCC, 2011).The GCF's priorities are to finance developing countries, in particularly, the least developed and most vulnerable countries. However, the Paris Agreement does not refer to any list of those countries. Although the developed and developing country division is clearly recognized within the operational articles of the Agreement, negotiations on the implementation phase of the Paris Agreement still rely on an Annex-based categorization of countries. Discussions on sources of climate finance and eligibility criteria for accessing to finance seem to continue until the beginning of the Paris Agreement. Unless this problem is solved during the implementation phase of the Paris Agreement, this challenge will negatively affect the performance of countries with regards to tackling climate change.

5 Conclusion

Climate change is one of the biggest global challenges and tackling climate change urgently requires emissions reduction. As mentioned in the introduction, there are three main actions that directly address emissions reduction. These are technological change in production, changing

behavioral activities, and carbon pricing (Stern, 2007). The national and international commitments of countries to tackle climate change calls for the greater use of carbon pricing instruments. As a market instrument, carbon pricing provides cost-effective emissions reduction. Carbon pricing and its innovative approaches will also have opportunities to mobilize required finance for tackling climate change.

Carbon tax and trade are the main instruments widely used in countries. Both approaches are based on reducing carbon emissions in a cost-effective manner and monetizing the damage of carbon emissions (Stavins & Stowe, 2017).Carbon pricing not only reduces GHG emissions, but also encourages the development of climate friendly technologies and products in place of carbon intense ones, alongside discouraging emissions intense production and consumption styles (OECD, 2013).Both carbon tax and trade systems rely on national policy frameworks for climate change. Integrating climate change concerns into other sectoral polices and choosing a carbon tax, trade or hybrid approach will minimize the overall cost of emissions reduction within a country. This integration should be considered within all dimensions of sustainable development, namely economic, social, and environmental. Putting a price on carbon should not lead to rising poverty among low-income groups of societies, and it should not hinder competitiveness among entities. Therefore, both tax and trade are designed according to all aspects of national circumstances. In order to achieve an effective carbon tax level, the marginal abatement cost of entities, inflation rate of an economy, and the total required emissions reduction should all be taken into account. According to these dynamics, the tax level should be reviewed and updated accordingly. In addition, the revenues from carbon taxes should be used to finance climate change related projects.

Carbon trade is a market-based instrument so the price of carbon allowances are normally determined in the market. The cost of emissions reduction is reduced through maximizing benefit. In a competitive market carbon prices might not be easily volatile, so the marginal abatement cost might determine the price of carbon. Therefore, the marginal cost of emissions reduction can be equal to the marginal damage of emissions. This rule also provides transparency and predictability with regards to the price of carbon as a commodity. Policy makers, investors, and individuals might not hesitate to involve themselves in carbon pricing. This provides new ideas, such as personal carbon trading to widen participation of all of society in carbon markets (Fawcett & Parag, 2010). Providing that carbon trades are internationally possible without any discrimination, the global cost mitigation will be minimized (Clarke, 2011).

At the international level, carbon pricing has been applied since the Kyoto Protocol. However, the Kyoto Protocol was not a successful agreement for carbon pricing. The scope of projects, the number of participant countries and the various inactions of major emitters are some of the root causes of this failure to realize a global system of carbon pricing. Notwithstanding the established institutional framework of flexibility mechanisms within the Kyoto Protocol, flexibility mechanisms focused on only 14% of global emissions over the first commitment period of the Kyoto Protocol. Recently, the Paris Agreement has opened a new window to universalize a comprehensive and widespread carbon pricing system. It seems that the Paris Agreement and its Article 6 might provide this opportunity for all countries. However, there are many unclear issues on carbon pricing such as the linkages between NDCs, standards of carbon units for markets, scope and additionalities of emissions reduction projects. It is expected that these issues will be overcome by 2020. In addition, there is a significant deficiency for climate finance. The principle of common but differentiated responsibilities and respective capabilities (CBDR-RC) is the common guide for both the UNFCCC and the Agreement to fairly allocate responsibilities such as providing climate finance (UNFCCC, 1992, 2015a). Developed countries and the big emitters

are mainly responsible for this deficiency problem. Thus, as a compensation, they should provide a significant part of the finance to the GCF.

In conclusion, carbon pricing in the Paris Agreement enables cost-effective emissions mitigation policy options and provides additional revenue raising for climate actions. In line with the spirit of the new climate agreements framed by the Agreement and the common objective of "no one left behind", all countries should be open to cooperation for global goals for climate change.

Future works can analyze and evaluate the benefits of carbon pricing on some sectors such as electricity generation, transportation, manufacturing industries, and agriculture. Further research and their associated results on these sectors can accelerate the usage of carbon pricing instruments. Future studies can focus on establishing global accounting system proposals for carbon credits and allowances, to monitor and verify global transactions of carbon pricing based commodities. In order to avoid double counting and determine the true price of carbon, a transparent system including a global dashboard for carbon trading is essential. Future researches can assist in developing linkages between total reduced GHG emissions via carbon pricing instruments, and through exploring the effectiveness of global climate funds including the GCF and initiatives of multilateral development banks. The results of this kind of research can the further quantify the impacts of relevant funds and market based instruments on the mitigation of GHG emissions.

Note

1 Further explanations in Table 15.2 are based on Article 6 of the Paris Agreement.

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