Energy Policy 132 (2019) 38–43

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Carbon policy in developing countries: Giving priority to non-price instruments

Dominique Finon

Centre International de Recherche sur l'Environnement et le Développement (Ponts-ParisTech and CNRS), Nogent-sur-Marne, France

ARTICLE INFO

Keywords:
Developing countries
Carbon pricing
Non-price instruments
Market failures
Redistribution
Political feasibility

ABSTRACT

Carbon pricing might not be appropriate as the main element of the carbon policy package in emerging and developing countries (DCs), because the political economy constraints are greater than in developed countries. Non-price instruments and policies such as efficiency standards, market-oriented regulation, subsidies for clean technologies and public programs involving low carbon infrastructure should be preferentially developed to deal with market and regulatory failures, which are more widespread than in developed countries. These approaches are most effective in orientating technology and infrastructure, the principal means to achieving the mitigation imperative in DCs. Moreover, even if, in theory, policy packages using non-price instruments are less socially efficient than those focused on carbon pricing, they allow governments to circumvent political economy constraints, because their costs to consumers and citizens are not generalized and tend to be much less visible, while their redistributive effects are, if appropriately designed, generally not too regressive. In the end, developing a carbon policy that emphasizes non-price instruments and measures will pave the way to leverage carbon pricing as the main pillar of their future carbon policy in long term.

1. Introduction

At the 21st session of the Conference of the Parties (COP21) in Paris in December 2015, for the first time in the history of international negotiations on climate change, the vast majority of emerging and developing economies made quantified commitments to contain the growth of their domestic greenhouse gas (GHG) emissions. But what kind of carbon policy packages would be the most effective and the most relevant to the specific social, economic and institutional contexts of the different developing countries? Practitioners consider that a relevant climate policy should rely on three pillars: (i) a carbon pricing instrument, (ii) regulatory measures and subsidy policies to draw promising low-emission technologies into the technological system, and (iii) policy measures to encourage the development of infrastructure that will provide more sustainable energy consumption pathways in the fields of transportation, housing, etc. (IPCC-WG III, 2007; OECD, 2015; Fay et al., 2015). But what priority should be given to each of these three pillars?

The economic literature has certainly long argued that setting a carbon price should be the main instrument used to effectively reduce national and global emissions. It has argued that climate and energy policy grounded only in regulations, standards, public programs and public funding of R&D is intrinsically more costly than necessary, because ignorance of these measures' respective marginal cost functions leads to misallocation of resources. In addition, there is a risk that these measures will be influenced by political and administrative arbitrariness, thus leading to further divergence from socially efficient carbon mitigation pathways. It may be more efficient to focus on developing carbon pricing and making these costs explicit through carbon taxes and carbon trading, thus securing emission abatement in the places and sectors where it is cheapest (see for instance IPCC-WG III, 1995; Gupta et al., 2007; Baranzani et al., 2017; Stern and Stiglitz, 2017). The World Bank's approach to climate policy in DCs has been, and still is, focused almost exclusively on the injunction to adopt a carbon price, in the form of a tax or a cap and trade system, as demonstrated through its suggestively-named Partnership for Market Readiness program (World Bank, 2013, 2016, 2017). However, this approach ignores all the market failures and distortions that have other sources than unpriced carbon, but which are also responsible for climate change (knowledge externalities in terms of innovations, high up-front costs, behavioral biases, etc.). But this unequivocal position is increasingly subject to challenge.

Theoretical work shows that market failures and equity issues justify the use of non-pricing instruments as complements to carbon pricing in terms of the second-best approach to economics (Goulder et al., 1999; Bennear and Stavins, 2007; Lehmann, 2012; Acemoglu et al.,

E-mail address: finon@centre-cired.fr.

https://doi.org/10.1016/j.enpol.2019.04.046
Received 20 September 2018; Received in revised form 21 February 2019; Accepted 28 April 2019

2012). Moreover, while political economy constraints related to distributive issues limit the possibility and feasibility of developing carbon pricing (Jenkins, 2014), the view is strengthening from recent modelling work that a carbon price that would be sufficiently high to be effective is out of reach and that additional, second best instruments are needed (Lanbandeira and Linares, 2011). The need for every country to have a comprehensive policy package, including non-pricing instruments, has been recognized throughout the long United Nations policy consultation process, and in successive reports from the Intergovernmental Panel on Climate Change (IPCC) (e.g. IPCC-WG III, 2001, 2007, 2014).

Recently, without denying the role of carbon pricing with respect to existing equipment and fuel substitution within the existing capital stock, but not with respect to the choice of new equipment, Tvinnereim and Mehling (2018) argue in a recent Policy Perspective in this journal that "*an exclusive focus on carbon pricing could hold back the study and deployment of other necessary mitigation policies, and may ironically contribute to stranded assets and higher costs to both emitters and society at large*." This point is all the more crucial in developing and emerging economies where political economy constraints – as well as market and regulatory failures – are more significant than in developed economies. Indeed, issues of social inequality and poverty reduction are priorities that condition the political feasibility of carbon pricing. Moreover, there is great concern everywhere to ensure that economic growth can continue and that convergence of living standards with those in developed countries is not compromised (Markandya, 2010), whatever their level of implication in the international carbon regime.

The importance of issues such as redistribution and the competitiveness of national industries, which deeply influence the acceptability of carbon pricing in emerging and developing economies, justifies the fact that the remainder of this paper defends the pre-eminence of regulations and measures over carbon pricing in these countries' carbon policy package. We can certainly fear more arbitrariness in the definition of these measures than in developed countries; certainly, a pricing-based approach leaves the operation of the pricing tool more vulnerable to market forces than to administrative and political decree and would avoid or reduce the common problem of regulatory capture being in the nature of politics. But in the end, the government of any of these countries would find itself confronted with significant opposition from all social classes and industries.

This Policy Perspective is organized as follows. Part 2 focuses on the political economy constraints on the implementation of a carbon pricing instrument in emerging and developing economies. Part 3 broadens the approach to carbon policy packages which give priority to non-pricing instruments in order to address market failures, policy failures and institutional capacity limitations in these countries. The conclusion sets out how a carbon reference price may offset the discretionary side of these measures, and can help to make sector-specific policies and measures more consistent and socially efficient over the long term.

2. Political economy constraints in developing countries

Carbon pricing mechanisms (tax, cap and trade) tend to be ineffective and socially inefficient because of the implicit cap imposed by political economy constraints, and the various adjustments (exemption, free allowances) used to resolve issues related to both distribution and competitiveness. As these are more acute in emerging and developing economies than in developed economies, carbon pricing instruments tend to be pushed much lower in the former.

The theory states that, although consumers may express a willingness to pay (WTP) for climate mitigation, given the spatial and intertemporal characteristics of climate stability as a collective good, which can lead to free-riding behavior, the amount they are actually willing to pay is well below the social benefit of mitigation (Jenkins, 2014). But in reality other factors are at play: traditional resistance to taxation, the sensitiveness of households to the direct impact of a carbon price on their expenditure through increased prices of some important goods or services such as gasoline, electricity or fuel oil, and income inequality. These factors, which are recognized in the literature (Ekins, 1999; Rivers and Schaufele, 2015; Baumgartner et al., 2017), lead to social resistance to carbon pricing that may indeed be amplified by its redistributive effects, particularly when it first affects lower-income social groups. In addition, national energy-intensive industries (EII) that are exposed to international competition are particularly sensitive to regulatory changes such as carbon pricing, particularly when such changes are not made in a similar way in other countries. EIIs thus have strong incentives to oppose any legislation aiming to implement a carbon pricing mechanism. Combined with the general public's resistance to carbon pricing, coordinated opposition from EIIs is likely to materially affect the fate of carbon pricing proposals.

Political economy factors that constrain the implementation of carbon pricing policies affect emerging and developing economies even more severely than developed economies. The higher degree of social inequality in the former is reflected in upper- and upper middle-class citizens' low level of willingness-to-pay for emissions mitigation and in opposition from political parties representing the lower classes, which anticipate the negative effect of carbon pricing on their members. Carbon pricing may lead to the impoverishment of lower middle-income groups, who are very numerous in the emerging economies and who spend a significant proportion of their budget on energy. In addition to this, companies are efficient at influencing governments, which can easily be convinced of the need to protect their national industries.

The literature on the analysis of the redistributive effects of fuel taxes could certainly provide arguments to contradict this observation. Indeed, some studies rightly show that taxes on motor fuel are globally progressive in this group of countries, because such taxation affects the upper classes first, since it is the rich rather than the poor who use energy, in particular through car ownership and use (Sterner, 2011, 2012). This would suggest that the same is true for the carbon tax. But this argument is certainly not enough to convince the lower middle classes, which are near the poverty threshold, and which are the most numerous in emerging countries, because this ignores the numerous rungs on the income ladder between the rich and the poor and the differences in their lifestyles. Many programs aimed at removing motor fuel subsidies affect lower income groups, leading to strong opposition, including riots, as pointed out by Rentschler (2015). One reason is that such programs initially affect lower-middle income groups, whose standard of living is close to that of the poorest group, given that public transportation infrastructure is inadequate in many large cities, leaving most families dependent on private vehicles (cars, motorcycles) (Bacon et al., 2010). Fossil-fuel subsidies cannot be abruptly removed on the grounds that they are unjustified instruments harmful to the climate; they must be reduced gradually in a manner that is adapted to the needs of the population. This would also be the case for a significant carbon tax on motor fuel.

Other regressive effects are to be expected from the indirect effects of a carbon tax on the prices of intermediate products used in infrastructure development, because the relative cost of energy related to the major inputs (labor, capital) is much higher in emerging and developing countries than in the OECD countries. To illustrate this, imposing a carbon price of $50/tC on cement plants could increase the final price of cement by 75% in India (from $52/t to $90/t of cement), while in Europe, where the relative cost of inputs is much higher, the effect will be limited to an increase of 22% (from $175/t to $215/tonne of cement) (Hourcade and Shukla, 2013).

One could see the spread of carbon pricing instruments throughout the world in the form of taxation or cap-and-trade as proof of the possibility of overcoming the constraint of political acceptability. This is true not only in developed countries, but also in emerging countries, as a result of the dynamics of successive Conferences of Parties (COP)

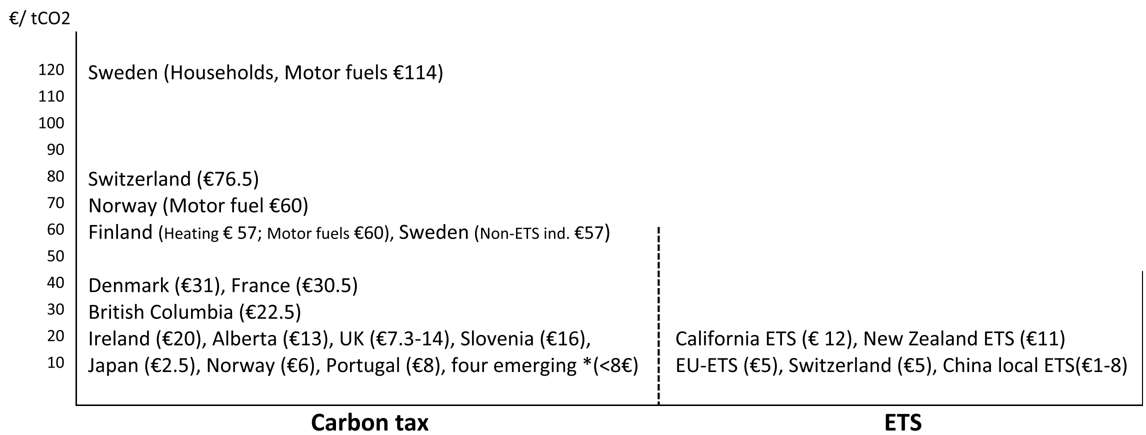

Fig. 1. Level of carbon tax and ETS prices in the world in 2017 (in €/tCO_2).*Tax in four emerging economies: South Africa (Industry €1–8), Chile (Power sector and EEIs €5), Colombia (€4) and Mexico (€1–3).
Source: World Bank Group and Ecofys (2017). *Carbon Pricing* Watch 2017

leading to countries' voluntary commitments to emissions reduction in the 2015 Paris agreement. Indeed, at the time of writing, about 40 national and subnational jurisdictions have a carbon tax and/or an emissions trading system (ETS) implemented or currently under consideration, including some emerging economies, e.g. South Africa, Chile, Colombia and Mexico (carbon taxes), and China, Kazakhstan, South Korea and Mexico (ETS) (World Bank, 2017).

But, as shown by the census of the different price levels in Fig. 1, in most cases, the price level remains quite low (less than €30 per tCO_2 for the carbon tax, less than 10€/tCO2 for the ETS prices), which makes the price-signal quite ineffective, with no planned future increases in most cases.[1] In two countries, Sweden and Switzerland, where price acceptance difficulties were circumvented by compensation based on the principle of budget neutrality with adjustment of the overall tax system, it has been possible for the carbon tax gradually increase to a high level (for households, it reached €114/tCO_2 in Sweden and €74.6/tCO_2 in Switzerland in 2017). But these are exceptions. The situation is more acute in emerging countries which have adopted a pricing instrument with prices remaining at a very low level of less than €10/tCO_2. Moreover, the effects of CO_2 pricing are made even more insignificant by widespread exemptions in the case of taxes and generous allocation of free permits in the case of ETS mechanisms. These adjustments to the instruments, necessary to make them acceptable, tend to render the price signal more ineffective.

3. The relevance of non-carbon pricing instruments

3.1. Effectiveness

Persistent market and regulatory failures in developing countries (DCs) which are well-documented in the energy, environment and development economics literature, are initially the same as those in the developed economies. They include capital intensiveness of low carbon investment, lack of information, imperfect regulation of energy prices, instability of international fossil fuel prices, and learning externalities in relation to the clean innovations process (Grubb et al., 2014). But all these obstacles are exacerbated in emerging economies, and *a fortiori* in less developed countries. For example, investment in low carbon equipment is more restricted due to the greater constraint on financial resources, given limited access to financial markets in a context of recurring public debt crises. This is all the more important because the environment for investing in low-carbon options is more uncertain than in developed countries, with many regulatory uncertainties in different sectors and many other prices uncertainties (property and land prices, interest rates, exchange rates). The urban dynamics that condition individual consumption of motor fuel depend on trade-offs between commuting costs and house prices, and on the future capacity of infrastructure (urban and inter-urban transportation, etc.) (La Rovere and Hourcade, 2017). It is important to underline the fact that the stakes relating to building and transportation infrastructure programs are also higher since their potential future growth means that developing countries have more room for maneuver in developing energy, urban, transportation and building infrastructures that emit less in the long term (Hallegatte et al., 2014). A similar issue relates to the purchase of efficient appliances (lighting, refrigerators, air conditioners, etc.) – rather than cheaper, poorly-manufactured versions – by the lowest social classes as they emerge from poverty. These problems can be dealt with pragmatically, seeking effectiveness through simple, compelling signals such as standards, mandates or obligations (possibly associated with flexible arrangements such as certificate exchanges), and various types of subsidy, associated with investments aimed at saving energy (direct subsidy, tax exemptions, fee-bates, etc.).

These instruments also benefit from their informational simplicity. For instance, when crucial knowledge is complex and proposed investments will have irreversible long-term effects, polluters are unresponsive to price signals while, on the other hand, they will react to the implementation of a performance standard (Russell and Vaughan, 2003). These instruments present another advantage: while it is difficult to monitor emissions through pricing instruments, monitoring technology is easy. In many cases, constraint works better than price incentives as long as it is made credible by monitoring rules (Willems and Baumert, 2003), including a penalty for non-compliance.

- *Command-and-control instruments*. Performance standards are commonly used in developed countries for cars, energy-efficient lighting or building regulations (which concern windows, ventilation and cooling systems). Technology phase-out mandates, as well as bans on sales of high-emission equipment, such as cars with fossil fuel engines and coal-fired power plants, are also increasingly used in these countries, because carbon pricing fails to disqualify existing fossil assets (coal-fired plants in particular) and to prevent new investment in high-emission vehicles. Some emerging countries have

[1] Admittedly, one could argue that, despite the low level of the EU-ETS price which varies around €5/tCO2 since 2005 to 2018, it would have shown a relatively high degree of price responsiveness in covered industries which contrasts with the relatively moderate price elasticity of individual consumers e.g. regarding fuel price increases due to carbon taxes, as it is shown by Tvinnereim and Mehling (2018). But most of the emission reductions have been achieved, not through the adoption of new low emitting equipment, but through better use of existing equipment and in the electricity sector, through the technology push of RES through ad hoc subsidization mechanisms.

begun to use these two types of instrument since the 2000s, with China leading the way (building codes, households appliance standards and labels, removal of old vehicles and very old coal-fired plants), and India (building codes on commercial building, labels, removal of old coal plants) and Brazil (public building, public lighting, etc.) following far behind. Without waiting for high motor fuel taxation, China's big, polluted cities are implementing regulations requiring the number of registered petrol and diesel engines to fall to 0% by 2050, with intermediate targets of 90% by 2020, 70% by 2030 and 30% by 2040, as in Beijing. Although this measure focuses on clean air, the reduction in carbon emissions will in fact provide a major co-benefit.

If the goal is to progressively eliminate the most inefficient and highly-emitting equipment in different categories of energy use, the option of forbidding them over the long term, thus allowing progressive adaptation, is quite effective, even if it is not theoretically efficient in economic terms, because of the clarity of the signal. However, bans on inefficient equipment must be appropriately structured. For example, measures applied to old, highly polluting vehicles should leave vehicle owners time to adapt, in exchange for subsidies.

- *Flexible regulation based on mandates.* Mandates and obligations on technologies and non-carbon production in specific sectors are similar to the previous binding instruments: fuel suppliers (with the obligation to provide renewable energy certificates or energy efficiency certificates), electricity producers, automobile manufacturers, etc. The well-known example in the car industry is a mandate that requires manufacturers to reach a decreasing average emission standard per vehicle sold in such a way that beyond 2025 or 2030, manufacturers should include an increasing proportion of electrical or hybrid vehicles in their fleets. This mechanism could be implemented in emerging countries where a number of car manufacturers are competing in a growing market, e.g. China, India, Brazil, Indonesia, etc. Such a policy can help manufacturers and consumers minimize the costs of reducing emissions. It could use a market-based design to reduce cost, allowing manufacturers to trade compliance obligations.

Another example of a flexible "baseline-and-credit" type regulation is an average sectoral emissions performance standard, such as a requirement for reducing average emissions per tonne of cement from the entire cement industry, per tonne of steel from the steel industry, or per MWh from the power industry (as envisaged in some US jurisdictions in the former Obama administration's Clean Power Plan). While each firm would face fines for failing to meet the industry average, it could avoid these fines if it showed that it had contracted with another firm to exceed the average, thereby offsetting its failure to comply. China, and more recently Mexico and India, are applying mandates relating to energy efficiency programs in energy-intensive industries, pending the implementation of a CO_2 cap-and-trade mechanism covering these sectors in China and Mexico.

- *Subsidies on efficient and clean equipment.* Subsidies on energy-efficient and clean equipment can make particularly effective contributions to the effort to limit climate change since they concern technologies involved in the most important energy uses in low-income countries. For lighting, which accounts for a large proportion of domestic and tertiary electricity use in the LDCs (around half of such use, equating to around 50% of total electricity consumption), the transition from incandescent bulbs and fluorescent tubes to light emitting diodes (LED) which consume one ninth as much energy per bulb, would make very significant emissions savings possible as those countries grow. This could be achieved by a combination of subsidies to LED procurement, minimum efficiency standards on LEDs, and a progressive ban on sales of incandescent bulbs (UNCTAD, 2017). The development of air conditioning in domestic housing and commercial buildings in emerging economies is another case. It will become a considerable challenge as the desire for well-being increases in emerging countries (for example only 5% of Indians presently benefit from air conditioning so that its use will grow rapidly over the next few decades).[2]
- *Public programs to ensure the development of the required infrastructure.* The development of infrastructure and urban planning programs is fundamental because they are the only way to allow low-carbon systems to replace highly-emitting systems, far from the removal of fossil-fuel subsidies and implementation of a carbon tax on industrial, transportation and domestic uses. In this respect, barriers will be greater in countries with large urban sprawl and areas that are not served by convenient public transportation (Cervero, 2014; MDB Working Group on Infrastructure, 2011). In the infrastructure sectors (transportation, building, etc.), as well as in power production and networks, government planning and provision is not only important, but crucial, for achieving long-term reductions in emissions and finding a cost-effective manner of avoiding becoming locked into high-carbon building and transportation.

In conclusion, the case of India, which is eager to respect its NDC (National Determined Contribution) commitment after the COP21, but is reluctant to adopt carbon pricing,[3] provides a good illustration of a policy package that practically ignores the use of carbon pricing. India's carbon policy package is focused on ambitious energy efficiency measures, promotion of smart cities, and a vast program for the development of clean energy, particularly photovoltaic- and wind-based with targets of 100 GW and 65 GW respectively by 2022, including the development of the necessary grids and ramping up of domestic manufacturing (MOEF, 2017).

3.2. Political acceptability

Non-pricing policies circumvent acceptability constraints, because the increased cost to consumers is not generalized and is also not very noticeable in most cases, unlike the effects of carbon pricing. Their costs are only passed on in the prices of relevant products and services paid for by consumers, contrary to the carbon tax which increases the fossil fuel prices for every industrial and domestic market segment, and indirectly affects the prices of all products and services. However, the way in which consumers perceive the costs of different policy measures is also important in this search for greater acceptability. Even if the redistributive effects of standards or regulations could be convincingly demonstrated, they would stay hidden in many cases, which is an effective advantage in terms of acceptability. Average emission standards per vehicle sold, such as the US CAFE standard and the European emissions standard, may impose a higher net cost on consumers than a fuel tax with regular purchases at petrol stations, but consumers greatly favor CAFE regulations over higher fuel taxes (Davis and Knittel, 2016; Karplus, 2011). This is because on the one hand there are infrequent purchases of new vehicles for which the capital cost is amortized over

[2] While climate change will increase the already high average temperature in southern regions, air conditioners (AC) contribute directly to climate change by emissions of HFC and indirectly via emissions from fossil fuel electricity generation. In this domain, a government can initially define high efficiency standards, arrange the bulk purchase of hundreds of thousands of superefficient ACs, and then subsidize households' purchases in different ways, while gradually banning inefficient ACs from the current market. It could also mandate the installation of integrated heating, ventilation and air conditioning (HVAC) systems in public buildings, which would consume much less than ACs fitted into windows while providing the same level of comfort.

[3] There is the exception of a small tax on domestic and imported coal of 400 rupees (US$ 8) per ton, which finances the National Clean Energy Fund dedicated to subsidizing low carbon options and energy efficiency.

monthly payments, while on the other there are frequent payments for gasoline which keep consumers well attuned to fluctuations of prices at the pump.

Examples of non-pricing measures that encounter difficulties of acceptability could obviously be found, particularly among those that are inappropriate to the social and institutional context of the country. As already mentioned, bans on inefficient equipment must be introduced very gradually, because they impact the lower middle classes first. For instance, as previously mentioned, banning old vehicles over a short timescale is inappropriate because it severely affects people from the lower middle classes, the most numerous in emerging countries. Another example is the effects of a hypothetical ban on window-fitted air conditioning units in new buildings in India, in order to reduce CO_2 emissions from residential electricity consumption. The effects of such a ban would likely fall on lower-income households unable to afford more expensive air conditioners.

There could also be a possible risk of low acceptability for flexible regulations based on a "baseline and credit" instrument because the trading price of certificates (in principle aligned with the marginal cost of compliance) could be considered too high, also assuming that it is perceived as the implicit price of avoided carbon. This would be even more the case given that this implicit price would be much higher than that of the carbon pricing (tax or permit) system set up in the country. However, this is only a hypothetical case because, on the one hand, there is not a direct correspondence between the certificates associated with an energy performance obligation and the emissions avoided (e.g. energy saving certificates in Chinese industry), and on the other hand, this correspondence is never perceived in a clear and transparent way by public opinion (e.g. in the case of average performance standards for fleets sold by car manufacturers).

4. Conclusion and policy implications

In recent years, an increasing number of papers have highlighted the inability of any carbon pricing system alone to orient the economies of developed countries towards decarbonization, and have insisted on the crucial role of complementary policies and instruments, e.g. Tvinnereim and Mehling (2018)'s recent Policy Perspective in this journal. As far as emerging and developing economies are concerned, their respective social, technological and institutional context, whatever their level of wealth, makes such a position even more meaningful. The fact that many reports insist that priority should be given to carbon pricing, even for climate policies in emerging and developing countries, reflects the excessive dominance of theoretical economics, but this viewpoint is fundamentally misleading because it is too remote from the real world.

A carbon pricing instrument cannot be the main pillar of a three-pronged carbon policy in emerging economies' climate package, and even less so in less developed economies whose carbon policy is in the first stages of implementation. Non-carbon price instruments and policies are effective substitutes for the theoretical carbon pricing which is still recommended by the international organizations. They present the parallel advantage of being more respectful of the redistributive objectives of existing energy and transportation policies, with costs only passed through to the prices of relevant products and services paid for by consumers. This should not prevent us from remaining attentive to the possible redistributive effects of each measure and avoiding inappropriate choices that may clash head-on with the lower middle classes in these countries. Moreover, developing a carbon policy that emphasizes regulations and measures will pave the way to leveraging carbon pricing as the main pillar of their future carbon policy after they have addressed the major market failures in relation to low-carbon innovations and infrastructure development. It may be added that in the initial stages of a climate policy, adding a small carbon price is also a means to develop a source of income to finance some of the policies and measures.

However, this pragmatic position does not deny the informational role that a notional carbon price can play in rationalizing climate policy. In a climate policy package, there is the obvious risk of obtaining different marginal costs of avoided emissions associated with different measures. Indeed, a reference price for carbon defined at the national level – such as those already used in eight developed countries (United States, Canada, Germany, France, United Kingdom, etc.) in the assessment of public policies[4] – could help to monitor the non-pricing instruments by limiting the heterogeneity of efforts in different domains and adjusting those whose corresponding marginal abatement cost is too high or conversely amplifying those with a marginal cost lower than the notional carbon price. Such a reference value would meet the needs of public authorities to define and evaluate the costs and benefits of public policy measures (vehicle standards, renewables subsidies, etc.) and direct public infrastructure investments in low-carbon options, also taking into account the environmental and social co-benefits of these measures, such as improved air quality in cities resulting from the promotion of non-fossil fuel cars.

The use of such a reference carbon price will not raise issues of redistribution in emerging economies because the measures, such as the CAFE-type norms in the automobile sector, performance standards, etc. and the infrastructure programs apply to new investments and do not penalize existing assets as a carbon tax or an ETS price would do. It does not penalize the emissions of existing equipment. Thus, the use of the reference price, for instance to further increase the standard of performances of cars (by reference to the costs of additional carbon emission savings which are still below the reference price) would have far fewer redistributive effects and would not immediately affect industrial interests. This will make it possible to agree on a rapidly-increasing value necessary to trigger capital-intensive low-carbon investments and thus strengthen the instruments that have already been implemented in a coherent manner. Thus, because it does not raise the same distributive issues and does not directly affect vested interests, this reference price can be much higher than the implementable, explicit carbon price when governments of emerging economies choose to implement it to conform to international recommendations.

References

Acemoglu, D., Aghion, P., Bursztyn, L., Hemous, D., 2012. The Environment and Directed Technical change. Am. Econ. Rev. 102 (1), 131–166.

Bacon, R., Bhattacharya, S., Kojima, M., 2010. Expenditure of Low-Income Households on Energy Evidence from Africa and Asia. World Bank, Washington, DC.

Baranzani, A., Van den Berg, J., Caratini, S., Howarth, R.B., Padilla, E., Roca, J., 2017. Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. WIREs Clim. Change 8, e462. https://doi.org/10.1002/wcc.462. 2017.

Baumgärtner, S., Drupp, M.A., Meya, J.N., Munz, J.M., Quaas, M.F., 2017. Income inequality and willingness to pay for environmental public goods. J. Environ. Econ. Manag. 85, 35–61. https://doi.org/10.1016/j.jeem.2017.04.005.

Bennear, L.S., Stavins, R.N., 2007. Second-best theory and the use of multiple policy instruments. Environ. Resour. Econ. 37, 111–129.

Cervero, R., 2014. Transport infrastructure and the environment in the global South: sustainable mobility and urbanism. J. Reg. City Plan. 25, 174–191.

Davis, L., Knittel, C., 2016. Are Fuel Economy Standards Regressive? E2e Working Paper 026. (Berkeley). https://e2e.haas.berkeley.edu/pdf/workingpapers/WP026.pdf.

Ekins, P., 1999. European environmental taxes and charges: recent experience, issues, and trends. Ecol. Econ. 31 (1), 39–62.

Fay, M., Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., 2015. Decabonizing Developmeent: Three Steps to a Zero Cabon Future. World Bank, Climate Change and Development series, Washington.

Goulder, L.H., Parry, I., Williams, R.C., Burtraw, D., 1999. The cost-effectiveness of alternative instruments for environmental protection in a second- best setting. J. Public Econ. 72, 329–360.

Grubb, M., with, J.C., Hourcade, Neuhoff, K., 2014. Planetary Economics: Energy, Climate Change and the Three Domains of Sustainable Development. Routledge, London and New York.

Gupta, S., et al., 2007. Policies, instruments and Co-operative arrangements. In: Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A. (Eds.), Climate Change 2007:

[4] They have adopted a shadow price for carbon ranging between \$20 and \$60, increasing over time.

Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, pp. 746–807.
Hallegatte, S., Bangalore, M., Bonzanigo, L., Fay, M., Narloch, U., Rozenberg, J., Vogt-Schilb, A., 2014. Climate Change and Poverty: an Analytical Framework. Policy Research Working Paper 7126 World Bank, Washington, DC.
Hourcade, J.C., Shukla, P.R., 2013. Triggering the low-carbon transition in the aftermath of the global financial crisis. Clim. Policy (1469-3062) 13, 22–35. https://doi.org/10.1080/14693062.2012.751687.
IPCC-WG III, 1995. An economic assessment of policy instruments for xombatting climate. In: Change Contribution of Working Group III to the Second Assessment Report of the Inter-governmental Panel on Climate Change, pp. 397–439 (Chapter 11).
IPCC-WG III, 2001. Policies, measures and instruments. In: Climate Change 2001: Mitigation. Contribution of Working Group III to the Third Assessment Report of the Inter-governmental Panel on Climate Change, (Chapter 6).
IPCC-WG III, 2007. Issues related to mitigation in the long term context. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change, pp. 159–250 (Chapter 6).
IPCC-WG III, 2014. National and sub-national policies and institutions. In: Contribution of Working Group III to the Fifth Assessment Report of the Inter-governmental Panel on Climate Change, pp. 1147–1191 (Chapter 15).
Jenkins, J.D., 2014. Political economy constraints on carbon pricing policies:What are the implications for economic efficiency, environmental efficacy, and climate policy design? Energy Policy 69, 467–477. https://doi.org/10.1016/j.enpol.2014.02.003.
Karplus, V.J., 2011. Climate and Energy Policy for U.S. Passenger Vehicles: A Technology-Rich Economic Modeling and Policy Analysis. Ph.D. Thesis, Engineering Systems Division, Massachusetts Institute of Technology, Cambridge, MA.
La Rovere, E., Hourcade, J.C., 2017. Social value of mitigation activities and forms of carbon pricing. Working Paper CIRED 2017-60, March 2017. Accessible on. https://www.researchgate.net/publication/315818672_Social_Value_of_Mitigation_Activities_and_forms_of_Carbon_Pricing.
Labandeira, X., Linares, P., 2011. Second-best Instruments for energy and climate policy. In: Galarraga, I., González-Eguino, M., Markandya, A. (Eds.), Handbook of Sustainable Energy. Edward Elgar, Cheltenham, United Kingdom.
Lehmann, P., 2012. Justifying a policy mix for pollution control: a review of economic literature. J. Econ. Surv. 26, 71–97. https://doi.org/10.1111/j.1467-6419.2010.00628.x.
Markandya, A., 2010. Involving developing countries in global climate policies. In: Cerda E., E., Labandeira, X. (Eds.), Climate Change Policies. Global Challenges and Future Prospects. Edward Elgar, Chettenham, UK, pp. 129–145 Chap.7.
MDB Working Group on Infrastructure, 2011. Supporting Infrastructure Development in Low- Income Countries - A Submission to the G20. World Bank, Washington, DC.
MOEF (Ministry of Environment, 2017. Forest and Climate Change of India). National Action Plan on Climate Change. http://www.moef.nic.in/ccd-napcc.
OECD, 2015. Alignement of Sectoral Policies on Low Carbon Econom. OECD report, Paris.
Rentschler, J.E., 2015. Incidence and Impact: A Disaggregated Poverty Analysis of Fossil Fuel Subsidy Reform. OIES Working Paper SP36 Oxford Institute of Energy Studies, Oxford.
Rivers, N., Schaufele, B., 2015. Salience of carbon taxes in the gasoline market. J. Environ. Econ. Manag. 74, 23–36.
Russell, C., Vaughan, W., 2003. The choice of pollution control policy instruments in developing countries: arguments, evidence and suggestions. International Yearbook of Environmental and Resource Economics, vol. vol. II Edward Elgar, Cheltenham, UK.
Stern, N., Sitglitz, J., 2017. Report of the High Level Comminion on Carbon Pricing. Retrieved from. https://static1.squarespace.com/static/54ff9c5ce4b0a53decccfb4c/t/59244eed17bffc0ac256cf16/1495551740633/CarbonPricing_Final_May29.pdf.
Sterner, T., 2011. Fuel Taxes and the Poor: the Distributional Effects of Gasoline Taxation and Their Implications for Climate Policy. RFF, Washington, DC.
Sterner, T., 2012. Distributional effects of taxing transport fuel. Energy Policy 41, 75–83.
Tvinnereim, E., Mehling, M., 2018. Carbon pricing and deep decarbonisation. Energy Policy 121, 185–189. https://doi.org/10.1016/j.enpol.2018.06.020.
UNCTAD, 2017. The least developed countries report 2017, Energy and inclusive economic structural transformation. UNCTAD accessible to. http://unctad.org/en/PublicationChapters/ldcr2017_ch2_en.pdf.
Willems, S., Baumert, K., 2003. Institutional Capacity and Climate Actions, vol. 5 OECD and IEA Policy Papers COM/ENV/EPOC/IEA/SLT 2003.
World Bank, 2013. Mapping Carbon Pricing Initiatives. World Bank, Washington, DC.
World Bank, 2016. Emissions Trading in Practice: A Handbook on Design and Implementation. Partnership for Market Readiness Program. World Bank, Washington, DC.
World Bank, 2017. Carbon Tax Guide: A Handbook for Policy Makers. Partnership for Market Readiness Program. World Bank, Washington, DC.
World Bank Group and Ecofys, 2017. Carbon Pricing Watch 2017. Retrieved on. https://www.ecofys.com/en/publications/carbon-pricing-watch-2017/.