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# Differentiating Emissions Targets for Individual Developed Countries: Economics and Equity

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## Abstract

A key challenge for a future climate change agreement is allocating emissions targets for individual developed countries that are perceived as equitable given differing national circumstances. Many economics-based frameworks for evaluating future targets use as a key criterion for individual country targets the notion that mitigation measures should result in similar costs (specifically, that the required mitigation actions relative to baseline emissions result in a similar percentage reduction of individual countries' GDP in the target year or period). Such an economic criterion provides a transparent and objective basis for comparison, but it does not necessarily mean that comparable targets for individual countries are also equitable. A set of thought experiments demonstrates that such an approach indeed does not reflect equity between countries. This is because future business-as-usual emissions, against which the costs of mitigation are assessed, depend on past policy choices and mitigation pathways. An approach that sets future emissions targets at a specific date based on comparable costs, without regard to past policy choices and commitments, would penalise countries that have taken early action and provides a disincentive for taking strong domestic mitigation actions in future. This analysis suggests that the choice of 'business-as-usual' emissions against which the future costs of mitigation are assessed needs to receive more attention if economic comparability is intended to also reflect equity of emissions targets over time.

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## 1. Introduction

Countries are negotiating a future global climate agreement with the aim of concluding this process in December 2009. The future agreement is expected to include quantified emission limitation and reduction objectives for developed countries, together with nationally appropriate mitigation actions by developing countries and measures on adaptation, technology and finance (UNFCCC 2007).

This article explores some options for achieving this and the equity implications of alternative approaches to setting emissions targets for individual developed countries, in particular approaches that are anchored around equalising economic impacts. The issue of targets for individual developed countries is of course only a subset of the wider challenge of agreeing on an aggregate target for all developed countries and on mitigation actions taken by developing countries, which is not discussed here.

The Bali roadmap states that efforts of developed countries should be ‘comparable’ (UNFCCC 2007). The common interpretation of this wording is not only that mitigation efforts by individual countries should be ‘amenable to comparison’, but that the level of effort by individual countries needs to be similar (Boston 2008).

It is generally accepted that for the level of effort to be similar, absolute emissions targets (expressed as percentage reductions relative to the year 1990) will need to differ between individual countries due to differences in their national circumstances. Relevant differences include historical emissions trends and intensities, natural resource endowment and energy needs, the structure of domestic industries and economic mitigation potential, and exposure of emissions-intensive economic sectors to trade competitiveness. These manifold differences represent a major challenge in determining what emissions targets for individual countries could in fact constitute ‘comparable’ or similar efforts and thus be perceived as equitable and fair. Apart from criteria related to technological mitigation potential and structure of the economy, social criteria such as average wealth of citizens (often expressed as GDP per capita) and population trends are also recognised as important in determining fairness and equity of future targets (EC 2009).

Uneven economic impacts of mitigation policies are frequently cited as a key reason why some developed countries have *not* proceeded with the implementation of stringent domestic climate policies. An intuitively attractive approach to ensure comparability of future emissions targets, and hence encourage more uniform participation by all developed countries, could therefore consist of setting targets for individual countries such that mitigation measures result in equal relative impacts on national economies across all countries.

Economic assessment models such as GAINS or FAIR estimate the direct costs for individual countries to meet specific emissions targets, relative to reference scenarios for emissions and GDP in the absence of additional mitigation policies. These models could equally be used to determine individual emissions targets for each country that would result in comparable costs for all countries (see e.g. Amann et al. 2009; den Elzen et al. 2009). Indeed, New Zealand proposed during the recent negotiations that individual country targets should be set such that each country faces a similar reduction in its projected GDP growth (NZ 2009).

Defining ‘comparable efforts’ through such models is attractive *prima facie* because it requires only baseline projections (i.e. projections in the absence of additional

mitigation measures) for emissions and GDP along with economic mitigation potentials for each country. Modelling the impacts of mitigation measures on GDP for individual countries is not trivial in practice, especially where changes in trade flows or high adjustment costs could occur in addition to the direct costs assessed by these studies. Nonetheless, such a model-based approach would be transparent and objective at least in principle, even if different models may give different answers (den Elzen et al. 2009).

However, transparency and objectivity do not guarantee that targets determined through such an approach are also equitable. This article aims to evaluate the extent to which future emissions targets based on *equal economic impacts* (specifically in the sense of ‘equal percentage reduction of projected baseline GDP in the target year’) would indeed meet fundamental notions of *equity*.

Section 2 outlines the role of thought experiments in defining and testing key equity principles, and discusses some of the key assumptions and caveats that apply to such an approach. Section 3 describes the thought experiment experiment, while section 4 applies this experiment to evaluate the ‘equal economic impacts’ criterion from an equity perspective. Section 5 discusses the results and investigates the role and definition of business-as-usual emissions. Section 6 summarises and concludes the analysis.

## 2. Thought experiments and principles of equity

Equity has many notions and definitions. What aspects are most important depends on the context in which the concept of equity is invoked, as well as the weighting that is applied to different aspects and principles of distributive justice. In the area of climate change, equity is often difficult to define particularly when countries of vastly different circumstances interact. This is the case when considering what mitigation actions developing countries could or should take while they are also dealing with other development priorities such as poverty reduction and provision of sustainable livelihoods. By comparison, aspirations and priorities within developed countries show less divergence. However, even here, determining what principles and criteria would constitute equity across the wide spectrum of differing national circumstances exhibited by OECD or Annex I countries is difficult.

A fundamental and generally accepted notion of equity is that *identical* circumstances should require *identical* responses. A supplementary notion of equity enshrined in the UNFCCC is that national circumstances matter, and hence countries that *differ* in some significant and relevant aspects should *not* face the same obligations.

In the real world, it is very difficult to establish when two countries are sufficiently similar that they should take on similar obligations, e.g. similar emissions reduction targets. Neither is it necessarily clear when two countries are sufficiently different to merit substantially different targets. The advantage of thought experiments is that they allow us to look at idealised cases where two countries can be *defined* as being equal or different in some specific and well-defined aspects, and to explore the equity implications of specific criteria and assumptions for setting future emissions targets in such idealised cases.

Because thought experiments inevitably condense the real world into simplified ‘clean’ cases, they work largely by exclusion: they can help us identify criteria and assumptions for setting future targets that would be *inconsistent* with fundamental notions of equity if they were applied as dominant principle. In other words, criteria

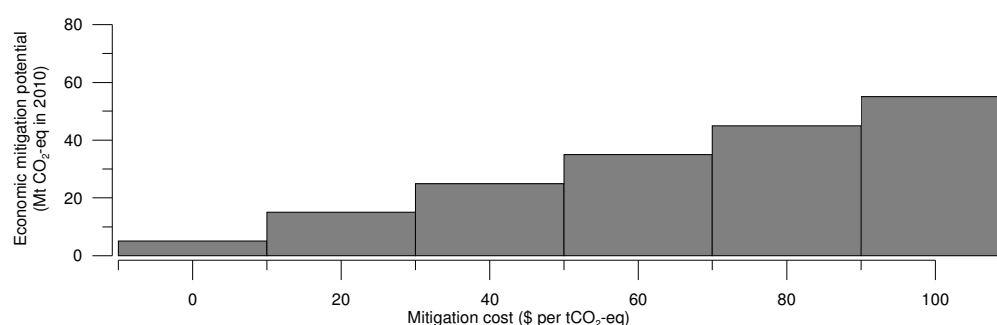
for setting future targets that are inconsistent with equity in an idealised case will also be inconsistent with equity in the real world.

The conclusions derived from such thought experiments come with two key caveats. One is that an artful combination of several deficient criteria could nonetheless result in a pragmatic approximation of equity in the real world. The second caveat is that it is much more difficult to use thought experiments in a constructive way, i.e. to identify criteria that would support and be consistent with equity, because thought experiments necessarily oversimplify the diversity of countries' national circumstances. As a consequence, targets that appear equitable in a thought experiment could still lead to inequality in the real world due to compensating factors arising from the complexity of national circumstances in the real world.

A further limit to the specific analysis conducted in this article is that it uses GDP as measure of welfare. This approach has well-known limitations (for an overview of such concerns see e.g. Goossens et al. 2007; van den Bergh 2009). For better or worse though, GDP is the main measure by which the economic impact of climate policies is assessed in the literature, particularly in economic models such as FAIR and GAINS that were designed specifically to evaluate the direct economic impact of climate policies and emissions targets. Alternative measures of relevant economic impacts in the context of climate change have been proposed, such as Gross National Disposable Income or more comprehensive indicators such as the Index of Sustainable Economic Welfare (ISEW; Daly and Cobb 1989), but they are inevitably more complex and have not yet found their way into commonly used assessment tools and models in the area of climate policy. The caveats and concerns that apply to the use of GDP as a measure of welfare and policy evaluation apply equally to the analysis in this article.

### 3. A tale of two countries: a simple thought experiment

The analysis in this article rests on a very simple thought experiment. Consider two countries A and B that in 1990 were identical in all relevant aspects commonly used to describe mitigative capacities and equity (e.g. absolute and per capita emissions, population, GDP, mitigation potential, exposure to trade, endowment of domestic fossil fuels and renewable resources, etc). A simplified, hypothetical mitigation potential for both countries is shown in Figure 1. Assume that both countries accepted identical targets under the first commitment period (CP1) of the Kyoto Protocol (for simplicity assume 100%) and ratified the Protocol. Both face growing energy demand under business-as-usual (BAU), and hence their BAU emissions in 2010 would be 120% of 1990 levels.



**Figure 1.** Assumed economic mitigation potential for both countries A and B in 2010, for costs ranging from zero to \$100 per tonne of CO<sub>2</sub>-eq.

Let us now assume that the two countries took different policy approaches to meeting their Kyoto targets.

Country A decided to undertake only those improvements in domestic energy efficiency that can be achieved at net zero costs. It decided not to impose any price measures or additional regulations to reduce emissions and met its growing energy demand by building the most efficient coal-fired power plants instead. Its emissions in 2010 (taken as representative of CP1 emissions) with policy measures for energy efficiency are therefore projected to be 115% of 1990 levels. Country A accepts that it will overshoot its CP1 target and will need to buy credits on the international market to meet the shortfall.

In contrast, country B adopted the same zero-cost energy efficiency measures as country A but met its growing energy demand by increasing renewable energy sources and additional energy efficiency options at costs up to \$40/tCO<sub>2</sub>-eq (perhaps through a combination of a domestic carbon price and specific regulations relating to renewables targets). Based on the mitigation potential shown in Figure 1, its emissions in 2010 would be 95% of 1990 levels, which allows the sale of some surplus credits on the international market.

If we assume an international carbon price of \$30/tCO<sub>2</sub>-eq, the economic impact (expressed as direct costs relative to GDP) from the two different sets of policy approaches can be shown to be identical in 2010 for both countries (2010 is taken as proxy for policies and economic impacts over the entire first commitment period).

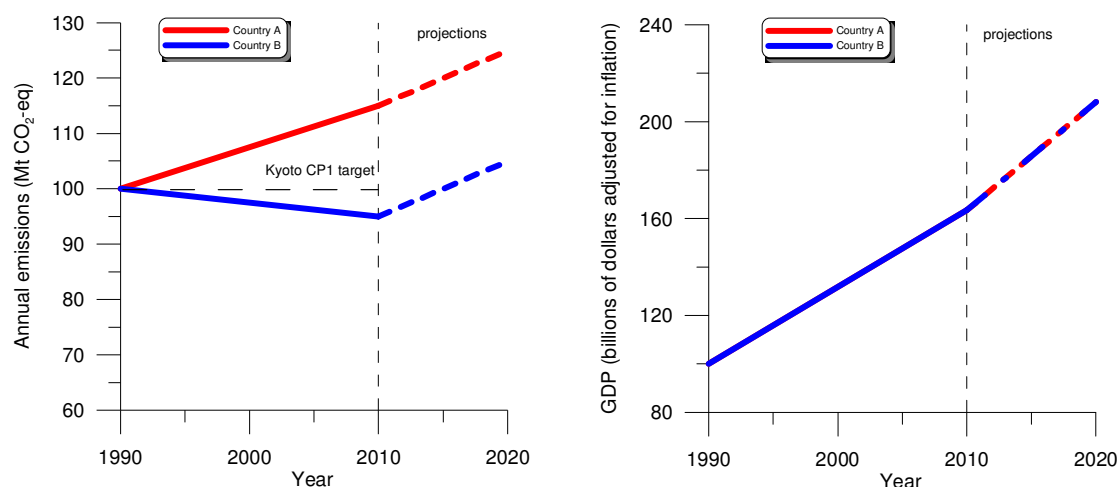
The reasons why the two countries chose two different economic and policy paths might be due to different political philosophies of the governments in power during crucial decision periods, or the influence of different groups on climate change policies at the time thus reflecting the electorate views at the time. The key point of this thought experiment is that these differences in policy approaches are not determined by differing national circumstances, but rather reflect national choices and social and political preferences.

The different choices made by countries A and B lead to the same economic outcome during CP1 and could therefore be regarded as equally rational. Both are not optimal from an economic perspective (country A leaves low-cost mitigation potential untapped, while country B incurs domestic mitigation costs that are somewhat greater than the international price of carbon), but they are not implausible given recent experiences with policy choices made in different countries across the OECD.

Let us now look forward to 2020. Both countries' access to natural resources remains identical, and hence they have the same access to renewable and/or fossil fuel power generation to meet further growth in energy demand. One can therefore assume that in the absence of additional future climate policies (i.e. under 'business as usual' by the standard meaning of the term), both countries could expect the same absolute growth in emissions relative to their domestic emissions in 2010. For this thought experiment, assume that this BAU increase in emissions would amount to another 10 MtCO<sub>2</sub>-eq by 2020 in each country, hence country A's BAU emissions in 2020 are 125%, while those for country B are 105% (both relative to 1990).

Figure 2 summarises the thought experiment. All specific assumptions are obviously arbitrary, but they are self-consistent. Hence this thought experiment can now be used to test the extent to which targets that would result in equal economic impacts on both countries by 2020 would indeed satisfy the two fundamental notions of equity defined

above – namely that identical countries should be treated identically, and countries that differ in significant aspects should be treated differently.



**Figure 2.** Emissions (left) and GDP (right) for countries A and B in the thought experiment. The projections in GDP are based on 2.5% annual GDP growth from 1990 to 2020, the economic mitigation potential shown in Figure 1, and an international carbon price of \$30/tCO<sub>2</sub>-eq. The climate policy choices of countries A and B leading to different net domestic emissions are discussed in the main text.

#### 4. Are targets based on ‘equal economic impacts’ equitable?

If future emissions targets for individual countries were set such that both countries face the same relative impact on their GDP in 2020, the target for country B in 2020 (relative to its 1990 emissions) would be significantly lower than for country A. For the specific thought experiment discussed here, an (arbitrary) aggregate target of 30% reduction by 2020 relative to 1990 would imply a 20% reduction target for country A and a 40% reduction for country B (i.e. emissions targets of 80% and 60%, respectively, relative to 1990) if economic impacts are to be the same for both countries, assuming the same mitigation potential continues to apply for both countries in 2020 as for 2010 (see Figure 1).

The specific amount of emissions reductions for either country would obviously depend on the aggregate target that developed countries have to meet and the assumed international price of carbon. The specific targets could also be affected by differences in mitigation potential for the two countries in 2020 arising from the different energy development paths of the two countries from 1990 to 2010. However, even if we assume that country B has exhausted all its low-cost mitigation options and hence now faces a steeper cost curve for emissions reductions to 2020, a simple calculation shows that this would not be sufficient to close the gap between the two targets. The conclusion that country A would face a weaker 2020 target compared to country B, if economic impacts of these targets are identical, is robust across a range of assumptions regarding details of their mitigation potential up to 2020.

Obviously, some commentators and countries would argue very strongly that different targets of 80% and 60% relative to 1990 would not be *equitable*, despite the ‘comparability’ of economic impacts. This contrary perspective might contend that both countries should face the *same* emissions target relative to 1990, because both countries started out being identical in 1990 and always had the same access to resources as well as information about climate change and possible future targets.

Hence giving country A a target that differs from that of country B could be seen as conflicting with the fundamental equity principle that identical national circumstances require identical commitments and hence identical emissions reductions targets. From this perspective, different past climate policy choices do not qualify as ‘different national circumstances’ that could justify different targets for the future on the basis of equity.

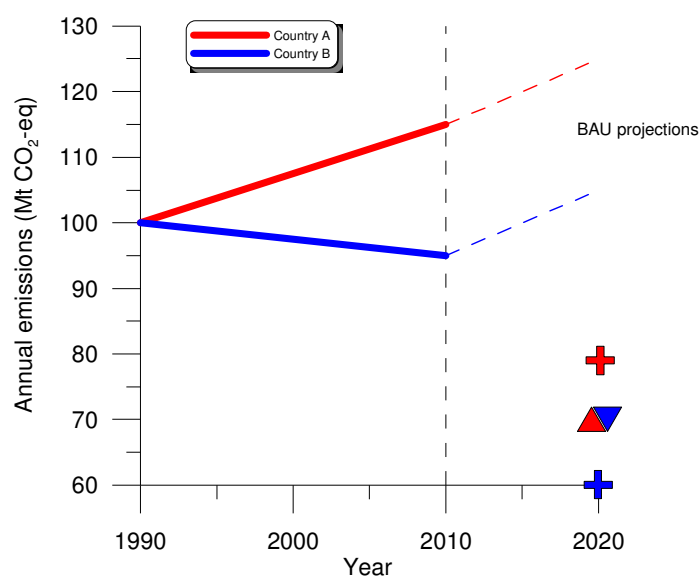
Both perspectives can claim to be motivated by fundamental notions of equity. The first case employs the notion that all countries should face identical economic costs from future (CP2) emissions targets relative to their projected baseline GDP. However, for this criterion to be ‘equitable’, one must presume that any differences in absolute targets derived through such an approach reflect real differences in national circumstances, namely mitigation costs relative to BAU emissions.

The second case employs the notion that countries that started out being identical should face identical emissions targets at all times, as long as their national circumstances do not diverge due to events outside their control. Table 1 summarises the costs and emissions for these cases. Note again that the mitigation potential itself is assumed in this thought experiment to be identical for both countries, including availability of and access to mitigation technologies, international competitiveness issues etc. The differences in mitigation costs and potentials between the two countries result entirely from different strategies employed to meet the same emissions target in CP1 and hence result in different BAU projections for CP2.

**Table 1.** Comparison of emissions, targets and costs for countries A and B in the thought experiment. The mitigation potential from Figure 1 is assumed in both CP1 and CP2. During CP1 a price of carbon of \$30/tCO<sub>2</sub>-eq is assumed for international transfer of credits.

Country	Emissions				Costs for CP1 target (100% of 1990)			CP2 target (aggregate: 70% of 1990)	
	1990	2010 BAU	2010 actual	2020 BAU	Dom.	Int'l	Total	Equal costs	Equal emissions
A	100	120	115	125	\$0	\$450	\$450	80%	70%
B	100	120	95	105	\$600	-\$150	\$450	60%	70%





**Figure 3.** Emissions and targets for countries A and B for two different ways of setting equity-based targets. Crosses indicate targets resulting in equal impacts on GDP in 2020; triangles indicate targets that result in equal absolute emissions in 2020. Both sets of targets result in aggregate emissions reductions of 30% below 1990 levels for the two countries. In the case of identical costs, countries A and B would face the same reduction in their GDP in 2020 but have different emissions targets of 80% and 60%, respectively, relative to 1990. In the case of identical targets, both countries would face targets of 70% relative to 1990 levels but the reductions in GDP would be much greater for country A than for country B.

## 5. The role of past action and future ‘business-as-usual’ in determining equitable emissions targets

Can we make sense of these contradictory results, or do they simply demonstrate that ‘comparability’ (in the sense of ‘equity’) is in the eye of the beholder and can claim no more objective basis? Can we reconcile the contrasting results?

It might be tempting to argue that country B should indeed face lower costs during the second commitment period because it took ‘early action’ on climate change, whereas country A failed to implement strong domestic policies and hence should be ‘penalised’ with higher costs in CP2. Recognition of ‘early action’ indeed forms part of the proposal by the European Commission for setting targets for individual countries in CP2 (EC 2009).

It is difficult to see how such an approach, especially if formulated in moralistic or reward/penalty terms, could hold up. Flexibility mechanisms such as the CDM and international emissions trading are key components of the Kyoto architecture. As long as country A meets its obligations and has sufficient units to surrender at the end of the first commitment period, it would be inappropriate to speak of ‘policy failure’ in country A. In contrast, one can assume that exceeding its target was a conscious and well-argued domestic policy decision. Nor is there necessarily any virtue in country B’s undershooting its target, because the assumed sale of credits would allow the increase of emissions in other countries within the capped Kyoto system and hence result in the same net emissions outcome globally as the strategy of country A during the first commitment period.

The political choice of meeting CP1 targets through international credit transfers instead of domestic abatement can therefore not be regarded as policy failure.

Differences between countries' domestic emissions and their CP1 targets can not in themselves be used, at least not on principles of equity, to differentiate the future targets or costs that countries A and B should face.

From a different angle though, the past actions of countries A and B do have an important bearing on how the equity of targets can be interpreted and the two different results for future targets could be reconciled.

The thought experiment demonstrated that the different BAU emissions in 2020 cannot necessarily be regarded as due to different national circumstances but reflect and embody past policy choices. Given the long lifetime of capital infrastructure, choices with regard to e.g. energy systems can influence BAU emissions well into the future. As a result, the notion that BAU emissions are an objective baseline against which the *equity* of efforts to reduce emissions can be compared is not tenable, because different treatment from an equity perspective would require differences that are or have been essentially outside a country's control.

Even though it was argued above that it would be wrong to fault country A for 'policy failure', it would appear appropriate to refer to 'policy myopia'. Country A chose to use international credit transfers to meet its obligations despite scientific advice and information on the need for more stringent targets in CP2 and beyond. From this perspective, country A's domestic climate policy choices for CP1 are not equally as effective as those of country B, but reflect poor decisions in light of potential future more stringent emissions targets that are now becoming a reality.

Climate policy requires an iterative decision-making process (IPCC 2001). Successive policy choices create path-dependent future mitigation costs and options (IPCC 2007). The challenge of designing optimal national climate change policies is to minimise mitigation costs over time; as a consequence, abatement strategies need to take not only immediate but also future emissions targets and costs to meet those targets into account. From this perspective, the increased costs resulting for country A from the more rapid emissions reductions required in CP2 than for country B do not constitute an inequity, rather it is the result of applying equity as consistently across time and holding countries to account for their past choices.

The alternative interpretation of the results of this thought experiment, that country A should indeed be given a lighter target than country B, would be counterproductive to the overall objective of the UNFCCC as expressed in the Bali Action Plan to achieve stringent emissions reductions in aggregate for developed countries in the order of 25 to 40% below 1990 levels (UNFCCC 2007). If targets were differentiated purely on the basis of mitigation cost relative to BAU baselines, this would create a perverse incentive for developed countries to not undertake domestic abatement measures and use their growing domestic emissions as an argument to accept less and less stringent targets in future commitment periods in the name of equity.

## **6. Conclusions for the real world**

This article used a thought experiment to evaluate the equity implications of an approach that sets emissions targets for developed countries under CP2 of the Kyoto Protocol such that they would face the same direct costs as a percentage of their GDP.

The thought experiment assumed two countries with identical national circumstances that make different policy choices on how to meet their CP1 targets, and who consequently have different BAU emissions in 2020. If both countries were to face

the same relative mitigation cost in CP2, the country that took less domestic action in CP1 would be given a lighter target during CP2. This is in obvious contrast to the equity principle that similar countries should be treated similarly and hence should face similar targets in future.

The paradoxical outcomes can be reconciled by recognising that climate policy requires cost minimisation across an extended period of time, not just for one specific point in time. Past policy choices influence future BAU emissions and thus influence the future costs to meet any given emissions target. Differing BAU emissions and mitigation costs in the second and subsequent commitment periods are therefore not necessarily the result of differing national circumstances but can also result from past policy choices.

Using the cost of mitigation relative to BAU emissions to differentiate future targets for developed countries is therefore not sufficient to ensure the equity of such targets, even if the resulting future costs of mitigation are similar for different countries. This is clearly the case in the idealised thought experiment where two countries were defined as being identical in their national circumstances but having made different past policy choices about how to meet CP1 targets.

Given that in the real world, no two countries are the same with regard to either their national circumstances or their policy choices, we can safely conclude that equalising costs for CP2 is not sufficient to ensure equity in the real world either. To be clear, different mitigation costs relative to non-mitigation baselines for different countries in the real world may well be due to different national circumstances. But if the comparability of mitigation costs is seen as an equity principle, then costs would need to be determined not against a simple baseline projection, but against a baseline that represents true ‘national circumstances’ rather than a mix of national circumstances and domestic policy choices that reflect political and social preferences. In practice, it will be exceedingly difficult to reconstruct the baseline emissions that would have applied if not dedicated climate policy had been implemented, and to separate out the effect of climate policies from those prompted by other non-climate concerns. As a result, the only robust conclusion that can be drawn is that in practice, comparability of economic impact of mitigation measures does not constitute a robust criterion for the equity of mitigation targets between developed countries.

This analysis does not argue that the goal of equalising economic costs in itself is inequitable, but it emphasises that comparability of costs *on its own* does not constitute or ensure equity of targets. This does not negate the fact that equalising costs may be highly relevant in the political economy of reaching an agreement and ensuring support from domestic constituencies.

These conclusions have important implications for the principles on which future targets are based for individual countries. Comparing future targets mainly based on equal mitigation costs would create the perverse incentive for countries to minimise their domestic emissions reductions so that they would have to accept only weaker targets in subsequent commitment periods. Apart from active ‘gaming’ of the system, such an approach would also generally create a disincentive for strong mitigation actions because it effectively penalises those countries that have taken the strongest domestic mitigation actions in the past. Such an outcome would be clearly counterproductive to the UNFCCC principle of developed countries taking the lead.

This analysis underscores the need to assess the wider implications of frameworks and criteria for the allocation of targets. Achieving equity in future agreements will inevitably remain a multi-faceted approach rather than following simplified formulae. The analysis in this article shows that even highly transparent and objective approaches that have intuitive appeal, such as equalising economic impacts of mitigation, can lead to inequitable and possibly even counterproductive outcomes if they were regarded as dominant principles to allocate targets, given the complexity of circumstances that countries face in the real world.

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