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an Ethical Approach**

Lucas Kengmana and Jonathan Boston

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AUTHORS L Kengmana and J Boston
Institute of Policy Studies
Jonathan.Boston@vuw.ac.nz
+64 4 463 5456

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INSTITUTE OF POLICY
STUDIES

School of Government
Victoria University of Wellington
Level 5
Railway Station Building
Bunny Street
Wellington
NEW ZEALAND

PO Box 600
Wellington
NEW ZEALAND

Email: ips@vuw.ac.nz
Phone: + 64 4 463 5307
Fax: + 64 4 463 7413
Website www.ips.ac.nz

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late wider debate.

Post-2012 Burden Sharing: Towards an Ethical Approach*

Lucas Kengmana and Jonathan Boston

Abstract

This paper explores how the costs of mitigating and adapting to climate change should be shared by the international community. While it briefly surveys other desiderata for a new global agreement on climate change for the post-2012 period, its primary focus is on the ethical issues posed by the imperative to address human-induced climate change, and in particular the principles and considerations that should inform an ethical approach to global burden sharing.

The first part of the paper outlines the context surrounding the current international negotiations for a new global agreement on climate change, which is designed to take effect when the first commitment period under the Kyoto Protocol expires at the end of 2012. This includes consideration of the criteria that any new agreement must address and the relevance and importance of ethics at the international level. The second part examines burden sharing from an ethical perspective. It assesses the relevance and validity of a number of principles of distributive justice that are widely discussed in the relevant climate change literature – most notably, equality, capacity, historical responsibility, need, monetary costs and welfare costs. It then uses these principles to evaluate six proposed burden sharing frameworks. The third part considers the implications of these burden sharing frameworks for New Zealand. This includes a brief examination of the possible impacts of various proposed changes to some of the key rules underpinning the Kyoto Protocol.

Introduction

It is widely accepted that adequately addressing climate change will involve real costs for the global community, both in order to achieve effective mitigation and to adapt to its effects. Securing a comprehensive and effective international agreement to take effect after the expiry of the first commitment period (2008-2012) under the Kyoto Protocol has the potential to lower these costs. If any new agreement is to be negotiated and successfully implemented, however, it will have to allocate these costs across countries in an efficient, equitable and politically viable manner.

This paper provides an overview of the issues surrounding international burden sharing, both over the longer term and in relation to the immediate post-2012 period. Particular attention is given to the key ethical issues at stake. Part 1 outlines the context in which the current international negotiations, under the United Nations Framework Convention on Climate Change (UNFCCC), are taking place. It then identifies a number of factors that a new global policy framework for addressing climate change will have to tackle in order to be successful, and highlights why the question of equity is of critical importance.

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Part 2 examines the principles and considerations that should inform an equitable framework for sharing the burden of mitigating climate change. Our analysis proceeds as follows. First, we outline and assess the principles of distributive justice relevant to mitigation.¹ Second, we evaluate, on the basis these principles, the ethical merits of six burden sharing frameworks for mitigation. We conclude that none of the frameworks under examination fully satisfy the demands of justice because they are likely to entail developed countries taking on a smaller share of the burden than would be equitable. Given the political constraints on increasing the relative share of mitigation costs borne by developed countries, we examine whether developed countries can resolve this problem by taking greater responsibility for addressing adaptation, technology transfer and finance.

Part 3 considers briefly the implications of these six burden sharing frameworks for New Zealand. Under each of these frameworks New Zealand will be expected to take on significant mitigation responsibilities. At the same time, the nature of the rules incorporated into any new international agreement on climate change, such as the rules governing land use, land-use change and forestry, will affect the relative costs borne by different countries. Compared to most other countries, the nature and content of these rules are particularly important for New Zealand because of its distinctive emissions profile and its relatively large carbon sinks.

Part 1: Background considerations

This part of our analysis considers three separate, but related, issues. First, we summarize the current context within which a new post-2012 climate change agreement is being negotiated. This includes a brief exploration of the UNFCCC, the Kyoto Protocol and the Bali Action Plan (endorsed by the UNFCCC conference in December 2007). Second, we consider the desiderata for a new climate change agreement for the immediate post-2012 period. Third, we examine how an ethical perspective should inform the debate about international burden sharing.

The negotiating context

Significant progress has been made in recent years, partly through cooperation across the global scientific community, to understand better the causes of climate change, its likely impacts and potential solutions.² In 1988 the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC). This body is responsible for undertaking periodic, detailed assessments of the causes and consequences of climate change. To date, the IPCC has produced four comprehensive and authoritative assessments, the most recent in 2007. While vigorous debate continues on many specific scientific and policy issues, the body of evidence brought together by the IPCC provides robust evidence that the Earth's mean surface temperature is increasing and that most of this increase can be attribute to human activity – specifically the release of greenhouse gases into the atmosphere (largely from the

¹ Note that for the purposes of this discussion the terms 'distributive justice', 'fairness' and 'equity' are taken to be synonymous.

² This section draws heavily on Boston (2007).

burning of fossil fuels, such as coal, gas and oil). The reports of the IPCC have been instrumental in raising global awareness about the nature of climate change, the risks that global warming poses to major planetary systems and the policy options that are available for mitigation and adaptation.

In Rio de Janeiro in 1992, at a United Nations Conference on Environment and Development (generally referred to as the ‘Earth Summit’), the world community endorsed a document known as the United Nations Framework Convention on Climate Change (UNFCCC). This Convention, which took effect in 1994, has been ratified by 192 countries. It has, as its ultimate objective, the ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [i.e. human-induced] interference in the climate system’. The UNFCCC provides the negotiating framework for, and certain principles to guide, international cooperation on climate change. One of the central principles, as specified in Article 3 of the Convention, is that:

The Parties should protect the climate system for the present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

The Convention also provided for a negotiating body, the Conference of the Parties, and envisioned that a series of protocols (or treaties) would be crafted over the ensuing decades to give concrete expression to its fundamental objectives.

Prompted by mounting scientific evidence during the early-to-mid 1990s of human-induced climate change, the global community commenced negotiations in 1995 (under the so-called ‘Berlin Mandate’) to develop a protocol to curb the growth in greenhouse gas emissions. This eventually resulted in the crafting of the Kyoto Protocol in late 1997. The Protocol entered into force on 16 February 2005 and has been ratified by at least 175 countries, including all industrialized countries with the exception of the United States.³ Under the Kyoto Protocol, the 38 industrialized countries (known as Annex 1 Parties under the UNFCCC) agreed to fixed and legally-binding *responsibility* targets⁴ for their greenhouse gas emissions during a five-year period (2008-12); this is known as the first commitment period (or CP1). Overall, Annex 1 Parties agreed to an aggregate reduction in their emissions of 5% relative to 1990 levels. The precise target for each country is set out in Annex B to the Protocol. These targets vary quite considerably, with some countries accepting much deeper

³ It should be noted that the term ‘industrialized countries’ means slightly different things in different contexts, and is changing over time. For instance, the membership of the OECD now includes Korea, Mexico and Turkey, none of which are listed in Annex B to the Kyoto Protocol. And the list of countries in Annex B is slightly different to those in Annex 1 of the UNFCCC (see IPCC, 2007d, p.774).

⁴ Annex 1 Parties are not necessarily required under the Kyoto Protocol to reduce their *domestic* emissions by the specific targets agreed to, but rather to take responsibility for reductions of the agreed magnitude. Parties have the option, if they wish, of achieving these reductions through the purchase of Kyoto-compliant emission allowances on the international market or via the Clean Development Mechanism. For this reason, the Kyoto targets should be thought of as *responsibility* targets rather than *domestic* reduction targets.

cuts than others. For instance, New Zealand's target for CP1 is 100% of 1990 levels.⁵ By comparison, Australia's target is 108%, the European Union's is 92%, while that of the United States is 93%. In order to achieve these targets in an effective and efficient manner, the Kyoto Protocol provided for the establishment of three so-called 'flexible mechanisms' for CP1: an international emissions trading regime, the Clean Development Mechanism (CDM) and Joint Implementation (JI). For their part, developing countries agreed, under Article 10 of the Protocol, to take a range of measures designed to improve the quality of the reporting of their anthropogenic emissions and to 'formulate, implement, publish and regularly update national ... programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change'.

The Kyoto Protocol constitutes no more than a limited step in the long journey to tackle climate change – a journey that will need to extend over many generations and require ongoing multilateral cooperation. Its authors fully recognized that constraining the growth of emissions of the developed world, while important, would never be enough to stabilize atmospheric concentrations of greenhouse gases, all the more so in a context of rapid economic growth in major developing countries such as China and India. Nor would a five-year cap make much difference to overall emissions. But those who crafted the Kyoto Protocol also recognized the necessity of actually taking a concrete step – however modest, partial and imperfect this step might be. For one thing, it was important to demonstrate that the global community could in fact cooperate in practical ways in order to achieve agreed, collective purposes. For another, it was important to put in place key institutional mechanisms, such as a global emissions trading scheme, that could lay the foundations for more substantial and effective mitigation measures in the future. Moreover, it was hoped that the Protocol would stimulate a range of domestic policy actions to address climate change – which, indeed, has been the case (IPCC, 2007, p.748).

Article 3.9 of the Kyoto Protocol provides for the negotiation of subsequent commitment periods, and specifically required the Conference of the Parties (COP) to initiate discussions on new commitments at least seven years before the end of CP1. Accordingly, at COP 11 in Montreal in late 2005 the parties established a new negotiation process. Because the United States (and at this stage also Australia) had not ratified the Kyoto Protocol, two separate bodies were created to consider post-2012 issues: an Ad Hoc Working Group (AWG) on 'Further Commitments for Annex I Parties under the Kyoto Protocol', and a 'Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention'. The latter dialogue process embraced all parties to the UNFCCC. This bifurcated negotiation process was subsequently modified at COP 13 in Bali in December 2007, with the dialogue process being transmuted into a new Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA). Both negotiating tracks have a common end date, namely COP 15 in Copenhagen in late 2009.

It is not appropriate here to consider the details of the so-called Bali Action Plan or the full complexity of the issues surrounding the efforts to secure a new global climate

⁵ During the first commitment period (2008-2012), New Zealand is permitted to emit five times its 1990 emissions levels and must take responsibility for emissions in excess of this amount (i.e. by purchasing Kyoto-compliant emission allowances).

change agreement at COP 15 (see Boston, 2008). Nevertheless, a number of points need to be emphasized.

First, there is very little time to negotiate a new agreement, especially if the aim is to avoid any gap between CP1 and a second commitment period. Bear in mind that before any new international agreement can take effect it will need to be ratified by a substantial proportion of the parties to the UNFCCC and this process is likely to take a minimum of two years (i.e. given the complicated nature of the domestic political processes that will need to be navigated in many countries). Second, there are significant differences of view between the parties over the level of ambition, both for a second commitment period and for the longer term – i.e. how much global greenhouse gas (GHG) emissions should be reduced below a business-as-usual scenario. Third, the parties are also deeply divided over how emission reductions should be achieved, including the nature of the measures that should be implemented and the allocation of responsibilities between different countries. For instance, not all developed countries accept the need for Annex 1 countries to take on new binding emission-reduction commitments, with the United States in particular preferring non-binding ‘actions’ to binding ‘commitments’. Similarly, there are major disagreements over the respective contributions of developed and developing countries. Further complicating matters is the fact that there is no agreed definition of developed and developing countries (The Third World Network, 2008).

These various disagreements are reflected in the wording of the Bali Action Plan. Under this plan, the post-2012 obligations of developed countries are stated as being:

Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives ... while ensuring the comparability of efforts among them, taking into account differences in their national circumstances

Notice, in particular, the inclusion of the words ‘commitments or actions’. In effect, this represents a weakening of the measures required for CP1. At the same time, the reference to ‘comparability of efforts’ (see Box 1) reflects a desire to ensure that if some developed countries do not take on internationally binding commitments then their domestic policy measures must be broadly comparable to the burdens being borne by other developed countries.

In relation to developing countries, the Bali Action Plan includes the following text:

Nationally appropriate mitigation actions ... in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable reportable and verifiable manner.

There has been considerable debate over what precisely these words mean, but one thing is abundantly clear: developing countries will not be required to take on binding emission-reduction commitments for the second commitment period.

Box 1: What is comparable effort?

In the Bali Action Plan, developed countries have agreed to take on:

Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives...while ensuring the *comparability of efforts* among them, taking into account differences in their national circumstances. (italics added)

This raises the question, what is comparable effort? Helme (2008) has attempted to address this question. He suggests that comparable effort might mean one of the following:

- countries take on equal marginal abatement costs;
- countries take on an equal percentage tonnage reduction of GHGs;
- countries make equal combined sectoral efforts;
- countries face an equal abatement cost per dollar of GDP;
- countries take on equal abatement costs per capita; or
- countries make an equal macroeconomic effort.

As can be seen, the more direct interpretations of comparable effort render it similar to the principles based on monetary cost identified below. However, as argued below, principles based on monetary costs have little ethical justification. As a result, for comparable effort to have moral legitimacy, it must be interpreted in one of its more nuanced forms that takes into account more than just the monetary costs that countries bear.

Factors underpinning a successful global climate treaty

While this paper is primarily focused on investigating what would constitute an equitable distribution of the burden of tackling climate change, in practice any treaty on climate change must simultaneously address a number of different, and sometimes competing, goals.⁶ There are four fundamental requirements: any treaty must be equitable, environmentally effective, cost efficient and facilitate sustainable development. Additionally, it is desirable that a treaty promotes administrative simplicity, technical feasibility, political feasibility, predictability, flexibility and adaptability. We discuss equity in Part 2; the other goals are covered briefly below.

It is crucial that any treaty is environmentally effective – that is, it must achieve the desired environmental outcome; unless it successfully contributes to reducing the growth of global GHG emissions (and hence contributes to the stabilization of GHG concentrations in the atmosphere), a global climate treaty will fail its *raison d'être*. Likewise, any deal must be cost efficient – that is, it must achieve an environmentally effective solution at the lowest possible cost, or it is likely to be rejected by those who are negatively impacted by the costs of addressing climate change. Any deal will also have to provide developing countries with a means of achieving sustainable

⁶ These goals are gleaned from Boston and Kengmana (2007) who distilled the list from the following sources: Aldy et al (2003); Bodansky (2007); Boeters et al (2007); Claussen and Diringer (2007); Höhne et al (2007); IPCC (2007a); Lewis and Diringer (2007); Neuhoff et al (2007); Okereke et al (2007); Ott (2007); Schmidt and Helme (2006); Stern (2006); Ward et al (2006); and Wolf (2006).

development as they are unlikely to accept an agreement that prevents their citizens from enjoying the fruits of economic growth.

Administrative simplicity is important, both because undue complexity will increase administrative and compliance costs and because it will exacerbate the potential for differences in interpretation, thereby causing inequitable and/or inefficient outcomes. Technical feasibility is also important as countries differ widely in their technical capacity, and in the quality and availability of relevant data. This limits the potential shape of any agreement.

Political feasibility is important since to be effective any treaty must be embedded in domestic policy. This is all the more important in a context where international enforcement mechanisms are relatively weak. What constitutes a politically feasible agreement is likely to vary greatly from country to country and will depend on the attitudes and perceptions of the populace, the nature of both the formal and informal power structures, and the political will of a country's leaders. Nonetheless, for all practical purposes, for an agreement to be politically feasible the governments of all major emitters must be reasonably confident that they are able to integrate the treaty into domestic policy without suffering major, long-term political damage.

The effects of a new global treaty should be predictable both to ensure environmental effectiveness and so that its negative impacts can be adequately addressed. Such a treaty should also be flexible in order to allow for differences in national circumstances. Finally, any treaty which is designed to cover more than one (relatively brief) commitment period needs to provide for periodic reviews and other forms of flexibility so that it can be adjusted to take account of new scientific evidence and other relevant considerations.

Box 2: Does an efficiency-equity trade-off exist in sharing the burden of climate change?

Making ethical evaluations often implies making judgements about the relative values of efficiency and equity. For example, in optimal tax theory, imposing a tax generally decreases efficiency making people substitute away from the taxed activity towards the untaxed activity. Thus, the government collects less tax than it otherwise would and individuals choose activities they otherwise would not. This leads to a deadweight loss with both parties made worse off than they otherwise (theoretically) could be.

At first glance, it seems a similar efficiency-equity trade-off exists in the case of mitigating climate change. Some countries have access to cheaper means of limiting emissions than others. As a result, it seems that a choice must be made between allocating reduction targets to those who can make the reductions at the lowest costs or to those who should bear the cost for equity reasons. That is, we must make a trade-off between efficiency and equity.

However, the cap-and-trade regime embedded in the Kyoto framework (and in the other concrete burden sharing proposals) allows us to sidestep this issue because it enables countries to trade emissions with one another. Hence, countries that can make emission reductions at a relatively low cost may reduce more than their fair

share of emissions and sell their excess emission permits to countries that cannot easily reduce emissions locally. In a perfectly competitive market, the gains arising from these transactions would be split between both parties. As a result, the division of the burden does not have efficiency implications and becomes purely a question of equity.

Although this theoretical result is promising, there are two reasons why an efficiency-equity trade-off may still arise in practice. First, developing countries do not yet fully participate in the cap-and-trade system. Instead, as outlined below, they only earn credits by taking part in the Clean Development Mechanism (CDM). Because of this, countries are not able to achieve emission reductions in a least-cost manner. Second, it is possible that market imperfections will prevent efficient outcomes. For instance, it is unclear whether markets will have sufficient liquidity to prevent market power and coercion from playing a role. If only a small number of countries are able to make emission reductions at a relatively low cost, while other countries must pay a higher price to reduce emissions locally, those able to cut emissions cheaply may hold back on their reductions to force others to pay a higher price. Similarly, if some countries are able to coerce others to trade with them by using political power, the outcome may be inefficient (as well as inequitable).

The relevance and importance of ethics at the international level

Do we have ethical responsibilities to other nations?

Before we begin to investigate the characteristics of a just global policy framework to address climate change, we must establish that ethical considerations, including the concept of justice,⁷ do in fact apply in the international realm.

Almost everyone accepts that, at least at times, there are good reasons for members of society to act ethically. That is to say, most accept that it is beneficial for people to act in a way that promotes the good of society rather than to act in a way that simply promotes their own self-interest. Some theorists argue, however, that justice does not apply on the international level. They hold that while there is sufficient consensus about ethical matters on the national level, on the international level this consensus breaks down. As a result, they suggest that countries only have minimal responsibilities in the international sphere.

John Rawls (1993) supported this position. He suggested that although countries have an obligation to promote distributive justice between their citizens, these obligations do not extend beyond national borders. This asymmetry is justified because he believed that institutions are legitimised by a hypothetical social contract. While these contracts could clearly be formed on the national level, he argued, global contracts that guaranteed distributive justice would be highly controversial. Hence he concluded that countries do not have an inherent responsibility to look after the well-being of other citizens.

⁷ Since there are a number of different uses of the terms ethics and justice, it is useful to clarify their use in this case. We take ethics to be the subject that deals with the selecting the right action from a social perspective. We take justice to be a principle or guideline that informs ethical decisions.

Michael Black (2001) offers a more contemporary defence of this position. He argues that the social contract that those who live in liberal nations implicitly agree to, includes a commitment on the part of the state to preserve where possible the autonomy of its citizens. While this agreement does not supersede other duties a state has, it implies that states should not compel their citizens to take actions unless these actions are necessary for society to function well. As such, it is perfectly consistent for countries to apply coercive force to ensure distributive justice within their own borders as this is (arguably) a necessary part of a well functioning society, without also promoting distributive justice internationally. While stopping short of concluding that countries have no international obligations, he argues that countries, without the approval of their citizens, are not justified in going any further than providing subsistence aid to other nations.

Many scholars regard the positions advanced by Rawls and Black as implausible. For example, Thomas Pogge (1989, 1992, 1994 and 2003) argues that the country where a person is born is determined solely by chance. Accordingly, it is similar to other arbitrary factors such as a person's race and gender, and thus should not be used as a basis for discriminating between people. On this basis, he concludes that it is more appropriate to form social contracts on an international level than on a national level. This implies that governments should consider global welfare rather than simply national self-interest in determining their course of action. As a result, according to Pogge, countries should take issues of global justice into account when negotiating, or indeed taking, any action on the international level.

Even if Pogge's objections are not considered to be a decisive refutation of Rawls' and Black's positions, there are two other reasons why their arguments do not apply in the case of sharing the burden of climate change. First, since climate change is a collective action problem, the only effective way it can be addressed is through global cooperation. Thus, although robust institutions for global burden sharing do not yet exist, it is in our interests to build them. As such, it is in our interest to negotiate an international social contract and such a contract must be based on equitable principles to garner large scale acceptance.

Second, it is clear that the actions of large emitters have harmed, and are continuing to harm, other countries. Therefore, developed countries have not only a distributive duty to take on greater costs than developing countries but also a moral debt for having created a problem that is adversely affecting others. Accordingly, even if considerations of distributive justice cannot play a role at the global level, in the case of climate change there are serious questions of retributive and commutative justice that must be addressed.

Will ethics play a role in the negotiation process?

Another common objection is that even if we *should* take ethics into consideration when making decisions in international negotiations, in practice this is not how nations actually behave. Instead, countries merely take into account their own self-interest. Therefore, if a particular country were to attempt to negotiate a fair outcome,

while all other countries negotiated solely from a position of self-interest, it may well end up hurting its own citizens without materially affecting the overall equity of the outcome.

However, Bruce Burson (2008) identifies three reasons why ethics plays a role in climate change negotiations. First, there are real moral concerns that are fundamental to the question of sharing the burden. Some countries and individuals can make emission cuts at lower welfare costs than others. Likewise, some countries have played a much larger role in creating the problem than others. Therefore, a negotiation that failed to take into account these factors would be rejected by those who were morally entitled to a smaller burden.

Second, the principles of common but differentiated responsibilities and of equity are clearly embedded in the UNFCCC and the Kyoto Protocol (Rajamani, 2006). Therefore, legally they must be taken into account.

Third, politically, if the division of the burden is perceived to be unjust then the outcome will not have the legitimacy necessary to be sustained over time. On the international level, a legitimacy deficit is likely to lead to costly renegotiations every time the relative influence of a major country (or block of countries) changes. On the national level, there will always be political pressure for policymakers to renege on a commitment that is perceived to impose an unfair burden on their nation.

For these three reasons, it is essential that future negotiations will need to find a genuinely just solution (or something very close), even if countries are fundamentally motivated by self-interest.

Part 2: Towards an ethical division of the burden of mitigation

Designing an ethical framework for burden sharing

In order to analyse the various concrete frameworks that have been proposed for burden sharing, we must adopt a methodology for making ethical evaluations. A relatively common approach in the literature on climate change policy starts by identifying the intuitively appealing principles of distributive justice, such as those suggested by Joel Feinberg (1973) and David Miller (1976), treating them as the foundations of analysis. This approach has some appeal since it is relatively simple to apply and it allows us to take into account a large set of principles that seem intuitively important. It suffers, however, from two fundamental weaknesses: it is unable to adjudicate sufficiently between different principles of justice and it does not allow us to reject principles of justice except on intuitive grounds. This is acceptable if all the principles of justice are widely accepted and largely consistent, but causes problems if there are many competing principles of justice on offer. When the latter is the case, we are often faced with having to arbitrate between these theories on the basis of our intuition. This can often lead to irresolvable disagreements when individuals have intuitions that conflict.

Thus, it is desirable to apply a more rigorous methodology in analysing the principles of justice. Here we will attempt to apply a technique often used in philosophical ethics of deriving principles of justice from foundational principles of normative ethics.

Having done this, we will be able to assess the strength of these principles based on their consistency with these normative frameworks. The principles that are supported by a number of normative ethical approaches can be considered strong; principles which are not supported by any can be rejected. Principles that survive this test can then be weighted against one another and other practical considerations to construct concrete policy frameworks with strong ethical foundations.

In what follows, two theories of normative ethics are used to evaluate six principles of justice that have been proposed in the literature: equality, capacity, historical responsibility, need, monetary costs and welfare costs. We then identify other practical considerations that will need to be addressed in any concrete burden sharing regime. On this basis, we assess the ethical merits of six burden sharing frameworks for mitigating climate change.

Normative frameworks

Because there are many different normative ethical frameworks to choose from, we will not consider them all, but will instead limit ourselves to considering utilitarianism and a version of deontology. However, the selection of these two frameworks is far from arbitrary since they are the dominant strands of action-guiding normative ethics.⁸

Both of these frameworks give clear action-guiding rules. Utilitarianism is a form of consequentialism and as such, it evaluates actions on the basis of their consequences. For utilitarianism, the important consequence is the overall level of happiness or welfare⁹ when each individual's utility is given an equal weighting.

Deontology rests on the belief that a set of rules (or categorical imperatives) exist that govern the way we act towards one another. Kant (1785, 1788) argued that these rules could be identified through rational reflexion and that only rules that: (1) do not treat other rational beings as means to ends; and (2) are universalisable (i.e. rules that one would wish others to use in the same circumstances) are morally acceptable. Rawls (1972) applied this approach to distributive justice, arguing that we could identify principles of distributive justice by considering what principles we would choose to govern society if we did not know in advance what position we would occupy in this society. Rawls concluded that in forming such a society, we would be interested in maximising the welfare of the least advantaged person and would only worry about the other members of society after we had done everything we could to improve this person's lot. This position is sometimes referred to as Rawlsian egalitarianism.¹⁰ Since Rawlsian egalitarianism is in many ways the political extension of deontology and its prescriptions are more clearly defined, we will use Rawlsian egalitarianism rather than deontology to assess the principles of justice below.

⁸ Virtue ethics is also a significant and growing strand of normative ethics. But it is far from clear that it is directly action guiding (Das 2002, but see Hursthouse 2001 for an example of how one might derive action guiding principles from virtue ethics). However, a number of authors especially Jamieson (1991, 1992, 1996, 1998, 2001) have argued for a virtue ethical approach to addressing climate change. Because of space limitations, we do not explore this alternative here.

⁹ The nature of welfare or happiness is a highly controversial topic. See Griffin (1988) for a good introduction to the issue.

¹⁰ Here we interpret Rawlsian egalitarianism to include any who believe in maximising the position of the worst-off, whether this is judged in terms of material welfare, cardinal utility or capabilities.

Principles of justice

Having examined the normative theories of ethical judgements, we are now in a position to analyse the principles of burden sharing that are most regularly advanced in the literature.

Equality

The first principle of burden sharing is equality. Roughly it can be expressed as the belief that, all else being equal, all individuals have an equal right to emit carbon. In practice, this is taken to imply that all countries should receive an equal per capita emission allowance provided there are no offsetting considerations.

This principle rests on very strong ethical foundations. It is consistent with both utilitarianism, which requires that we give all individuals equal consideration, and egalitarianism, which requires that all individuals are treated equally. Therefore, it should play a role in informing any concrete framework for burden sharing.

*Capacity*¹¹

The principle of capacity holds that those who have a greater capacity to reduce emissions should be required to bear the greater burden of reducing emissions. In practice, this is taken to imply that countries with a high per capita GDP should reduce their emissions by more than those with a low per capita GDP.

This principle is also largely consistent with the approaches listed above. Since the products that the wealthy will have to give up (e.g. luxury SUVs) to mitigate climate change will have a smaller impact on welfare than the products that the poor will be forced to go without (e.g. food) if they were to mitigate climate change, having the rich bear the cost will maximise overall utility.

Cecil Pigou (1932) first suggested this theoretical conclusion (i.e. that the rich should be taxed more than the poor because marginal utility from wealth was diminishing) but it subsequently received less attention because it was difficult to verify scientifically (Cooter and Rapaport, 1984). Since then, however, numerous studies of happiness (both cross-sectional and time series) have confirmed that the marginal utility from money decreases with wealth (see Layard, 2005 for an in-depth survey).

It is worth noting that most plausible approaches to discounting use a concave utility function to measure the welfare gain from consumption.¹² That is, they give greater value to increases to low levels of consumption than equivalent increases to high levels of consumption. This provides a justification for the consumption of the current generation to be valued more highly than the consumption of future generations since the latter will probably be richer than the former (unless climate change impacts are drastic). A concave utility function also implies, however, that provided that inter-personal and inter-temporal utilities are broadly analogous, developed countries

¹¹ Others sometimes refer to this principle as the 'ability to pay' principle.

¹² That is, the increase in utility from one extra unit of consumption decreases as the total amount of consumption increases.

should take on a greater share of the costs of addressing climate change than developing countries.

If developed countries object to the claim that they should bear higher costs simply because of their greater wealth, they implicitly support the treatment of utility as a linear or close to linear function of consumption (i.e. they support the claim that people value increases of wealth equally regardless of their original wealth). The only other factor that should play a role in the discount rate is the pure-time preference of consumption.¹³ Since, as Stern points out, applying a large pure-time preference on the national level amounts to little more than arbitrarily valuing the current generation's consumption higher than future generations' consumption the pure-time preference should not have a very significant impact on the discount rate (see Stern (2006), Quiggin (2006) and Rose (2007) for further discussion on this issue). A linear utility function and a small pure-time preference imply a low discount rate. Therefore, consistency requires that one must either accept a low discount rate, implying that much should be done currently to mitigate climate change, or one must accept that rich nations do have greater responsibility than poor nations to address climate change. For developed countries to do little while demanding that developing countries take on a large share of the burden is fundamentally inconsistent.

As well as being acceptable under a utilitarian framework, the principle of capacity is consistent with Rawlsian egalitarianism since it protects the welfare of the worst-off in society. The only reason capacity might not be a valid principle of justice would be if developing countries in some way contributed to their own plight, and as a result lessening their burden would create perverse incentives. There is no evidence, however, that developing countries are primarily responsible for their lack of development (although there are undoubtedly cases where specific individuals, or groups of individuals, have contributed to the poor economic performance of their countries) (Easterly, 2001).

Historical responsibility

The principle of historical responsibility requires countries to make an effort to address climate change that is proportional to their responsibility for causing the problem. In practice this is taken to imply that countries that have been larger contributors to the current stock of GHGs in the atmosphere must take on proportionately larger emission-reduction commitments.

It is unclear whether this principle can be supported by a utilitarian framework. Peter Singer (2002) argues that it can, because by making countries pay for their damage, it provides them with an incentive to take care in avoiding harm to others. It is debatable, however, whether countries could have been aware that GHGs were having a negative impact on the atmosphere prior to around 1990 (when the Intergovernmental Panel on Climate Change produced its first assessment report). Further,

¹³ It might be argued that the discount rate should be modified to take into account risk but it is not best practice to do this (Hepburn, 2006). Further, it is likely that including considerations of risk into the discount rate would actually further increase the argument to act now. This is because there is greater variance surrounding projections at high emission concentration levels than there is at low emission concentration levels. Therefore, a risk premium should be attached to the choice not to act to address climate change rather than to the choice to address climate change.

as Simon Caney (2005) points out, Eastern European countries that developed relatively early but experienced significant economic contraction during the immediate post-communist period would have to bear a fairly significant portion of the costs; yet their capacity to do so is limited. It seems contrary to the aim of maximising utility to force these costs upon them.

From a Rawlsian perspective, the fact that developed countries benefited by creating this climate problem, adds credence to call for redistribution from developed countries to developing countries. But this position faces two objections. First, it is commonly accepted that countries cannot be held responsible for their past actions because, as discussed above, they were unaware of the impact their emissions were having. Henry Shue (1992) shows, however, that this objection does not hold much weight by highlighting the distinction between moral responsibility and responsibility for damage. While knowledge is required in order to hold someone morally responsible, Shue argues that it is not necessary to hold them responsible for paying for the damage they do. He points out that if he were to spray his grass with a substance which he believed to be water but which was in fact a toxic chemical and if the resulting run off was to destroy his neighbour's lawn, he would be responsible for replacing the lawn although he could not be held morally or criminally responsible for the outcome.

A more significant objection is that those who were responsible for early GHG emissions have now passed away. It seems unfair that the children of those who caused these emissions should be required to pay for their parent's mistakes. Shue points out, however, that if the children of a thief benefit in some way from their parent's actions, they would be obliged to compensate those who had been harmed. It seems reasonable to hold that those living in developed countries have benefited in various ways from the emissions of their ancestors. Such benefits include altruistic transfers from their parents as well as the advantages of modern education and health care systems that only the governments of developed countries can provide. So these objections notwithstanding, it cannot be ruled out as a relevant consideration in sharing the burden of climate change.

Need

The principle of need appeals to the fact that individuals need to produce a certain minimal quantity of emissions simply to survive. But it is not clear how exactly this principle would be applied in practice. It might guarantee all countries a subsistence level of emission rights or it might simply require that the poorest countries are provided a level of emissions that they can survive upon.

In either case, this principle does not appear to add anything of substance to the capacity principle discussed above. Further, as Stephen Gardiner (2004) points out, it is difficult to define what would constitute a subsistence level of emissions. Individuals in developed countries with access to modern technology and the ability to substitute large amounts from discretionary spending towards emission abatement can probably subsist on relatively low levels of emissions. Individuals in developing countries, however, who do not have access to low-emission technologies may well require a higher level of emissions in order to survive.

Notwithstanding this fact, it is evident that the extra emissions produced by discretionary consumption in developed countries far outweighs any extra emissions that may result from inferior technology in developing countries. Therefore, an equal per capita distribution of emissions rights would very likely give developing countries sufficient emission allowances to provide for their subsistence level of consumption. Thus, it is not clear that the principle of need adds anything to shaping a burden sharing framework.

Monetary costs

This principle holds that countries that can achieve emission reductions at a low cost should take on more commitments than countries that face a higher cost to achieve the same reductions. In its sharpest form, it can be interpreted to mean that countries should face an equal marginal cost for emission reductions, which would lead to an efficient outcome. A different form of this principle is to require countries to take on equal total costs per capita for reductions, which is consistent with a particular form of comparable effort (see Box 1).

Achieving emission reductions at least cost is intuitively appealing. But this outcome can be readily achieved provided market mechanisms are built into future international policy frameworks (see Box 2). Further, there is little reason to believe that allocating mitigation burdens on the basis of monetary costs will promote equity. It does not seem fair to require a country to bear a large proportion of the costs simply because it can do so at least cost.

Requiring countries to take on equal per capita costs of emission reductions seems at first sight to be a more equitable principle. There is a degree to which the cost a country faces to reduce emissions is arbitrary. Some countries have excellent sources of renewable energy and others do not; some countries are heavily reliant on sectors in which the cost of abatement is high; others are dominated by industries which face low abatement costs. It seems unjust to impose equal per capita emission reductions on countries when this approach entails high costs for some countries and low costs for others simply based on their luck of endowment.

While this claim may have merit, it is unclear whether the use of money as a metric for true cost is justifiable either from a utilitarian or a Rawlsian egalitarian point of view. In a utilitarian framework, what is important is the overall level of happiness or welfare. As discussed above, the marginal utility gained from gains in wealth tends to decrease as wealth increases. Thus, simply seeking to equalise monetary cost will not give us an accurate measure of the true costs borne by the parties.

From a Rawlsian egalitarian perspective, equalising monetary costs per capita is even less acceptable because it requires the worst-off to bear an equal cost to the best-off. The only case in which this would be acceptable is if countries only differed (economically) in the costs they faced in addressing climate change. This is far from the case in the real world where there is extreme divergence between the richest and the poorest countries in terms of per capita income.

Welfare costs

One way of saving the cost principle is to focus on welfare costs rather than monetary costs. This entails weighing the monetary costs faced by countries in reducing their emissions to take into account the relative wealth of the parties involved. At present, there is no agreed system of weights for the monetary costs at face by countries with different wealth levels.

Applied to welfare costs rather than monetary costs, the principle of least-cost reduction fares much better from a utilitarian perspective as equalising the marginal utility losses in each country would maximise total utility. Further, it would avoid punishing countries that face high costs because of their poor environmental endowments.

From an egalitarian perspective, it is not clear that the principle of equal welfare cost is a reasonable ethical principle. It fails to guarantee that the circumstances of the worst-off will improve and, in fact, allows the position of the worst-off to worsen in order to maximise overall utility. But this problem is somewhat mitigated by the fact that in practice it is likely that maximising overall utility will be consistent with raising the living standards of the worst-off in society because of the decreasing marginal utility of income.

Applying the principle of welfare costs becomes tricky if we try to take into account previous actions. Doing this raises questions about accounting for self-imposed costs, such as substantial investments in carbon-intensive technology. In the short run, developed countries may well face higher costs from reducing emissions than developing countries since in many cases they have already invested heavily in carbon-intensive technologies and infrastructure whereas developing countries, with fewer investments, can more readily choose low-carbon options. In our view, the case for giving developed countries easier targets simply because they have high sunk costs is not strong.

On balance, the principle of welfare costs appears more justifiable than the principle of monetary costs. While there are some questions surrounding its consistency with the egalitarian approach, it nonetheless can be considered a principle with a sound ethical foundation.

Applying justice in an evolving temporal context

When designing a global architecture for burden sharing, it is important to take into account the fact that the particular circumstances of countries (e.g. their level of economic development and emissions per capita) are not static but are likely to change over time, possibly significantly. Furthermore, applying the principles of justice that we have considered will have dynamic implications for the relative burden that countries should bear. For example, if a country with a proportionately large historical responsibility for climate change (e.g. the US) were to take on extra costs in the short-to-medium term in recognition of this responsibility, then in the longer term its relative culpability for accumulated emissions will diminish. It is important that a global policy framework takes these dynamic considerations into account.

Equality

The importance of the principle of equality is likely to grow over time as other considerations decline in relevance. In the absence of differentiating factors, equity requires that those who are equal in all relevant respects be treated equally.

Capacity

It is unclear whether countries' GDP per capita (and therefore capacity) will converge over time. The question of whether such convergence will occur has been long debated in development economics but so far no consensus has emerged. All that can be concluded is that if relative per capita income levels do not change, the principle of capacity will be as relevant in the future as it is currently.

Historical responsibility

Assuming that developed countries take significant steps to address climate change, the importance of the principle of historical responsibilities will diminish over time. This is because the proportion of the total GHG stock attributable to high current emitters will gradually decrease. Further, if these emitters take on more substantial mitigation efforts as a result of their greater responsibility, culpability for the future GHG stock will slowly converge across countries.

Need

Like capacity, it is difficult to assess how relevant the principle of need will be in the future. All that can be concluded is that if nothing changes, the principle need will maintain the same level of relevance (or irrelevance).

Monetary costs

The monetary costs countries face will tend to converge over time as countries are able to alter the composition their capital stock. However, it is not clear how complete this convergence will be. Asymmetries in access to renewable resources are very likely to continue. Thus, the significance of this principle will decrease over time but it will not become completely irrelevant.

Welfare costs

The importance of welfare costs will diminish over time as the differences in the monetary cost of mitigation decrease. The only difference is that changes in relative income may have an impact on the weight attached to the monetary costs that various countries bear.

Concrete burden sharing frameworks

Having identified the relevant principles of distributive justice, we are now in a position to judge how well six of the proposed frameworks for burden sharing address these principles. It is worth noting two things at this point. First, these principles of distributive justice can be operationalised by using empirical proxies (see Table 1). In the main, these proxies are uncontroversial and widely applied in the relevant literature. Second, the fact that one framework of burden sharing takes into account more of the principles of justice than another, does not imply that it is superior. Rather, what is at stake in this case is whether the framework gives appropriate weighing to the various principles.

Table 1: Empirical proxies for relevant criteria

Principles of distributive justice	Measurement index
Equality	Emissions per capita
Capability	GDP per capita
Responsibility	Historical emissions; historical responsibility for global warming
Need	Percentage of population above the absolute poverty line; percentage of population living with income below a certain level; average income of below a certain level
Equal monetary cost	The impact on GDP that the commitment will have
Equal welfare cost	The cost in terms of GDP that the commitment will have adjusted by a country's wealth.

In what follows below, we will outline and assess six frameworks for sharing the burden of mitigation.

The Kyoto Protocol: The First Commitment Period

The obligations imposed on countries during the first commitment period (CP1) of the Kyoto Protocol reflected the distinction, inherent in the UNFCCC, between industrialized (or Annex 1) countries and non-industrialized (or non-Annex 1) countries. As noted earlier, Annex 1 countries were obliged to take on binding emission-reduction commitments while non-Annex 1 countries were excluded from such responsibilities.

To some degree it can be argued that CP1 embraced the principles of capability, historical responsibility and monetary costs – but only in a very loose fashion. To quote the draft Garnaut Climate Change Review (2008, p.300):

Under the Kyoto Protocol, emissions budgets for Annex 1 countries for 2008-12 were defined as percentages of 1990 emissions, ranging within a relatively narrow band from 92 per cent to 110 per cent of base year emissions, around the average allocation of 95 per cent, with further differentiation within the European Union. Differentiation between countries was negotiated on an ad hoc basis, with little reference to underlying principles for allocation across countries, although on average richer countries signed up to larger reductions.

Annex 1 parties that fail to make the required emission reductions domestically are allowed to meet their *responsibility* targets by trading with other parties that have spare emission credits.¹⁴ While developing countries were not required to take on binding emission-reduction commitments during CP1, they are allowed to earn certified emission reductions (CERs) by participating in the Clean Development Mechanism (CDM). The CDM allows developing countries to earn emission allowances via projects which reduce emissions from a business-as-usual level. These credits can then be traded to help developed countries meet their emission-reduction commitments.

Even at the time of the crafting of the UNFCCC and the Kyoto Protocol the division of the world into two separate, distinct blocks was simplistic and failed to take proper account of the significant differences both within the industrialized block and within the developing world. To compound matters, some Annex 1 countries, even in the early-to-mid 1990s, had lower GDP per capita than some non-Annex 1 countries (e.g. certain oil rich states). Since the early 1990s, of course, many developing countries have experienced very rapid growth, while some developed countries have grown only modestly, if at all. As a result, the current picture is even more complicated than was the case when the UNFCCC was being drafted. Moreover, the rapidly changing pattern of economic development since 1997, when the emission budgets for CP1 were agreed, further calls into question the logic of the CP1 commitments.

While the Kyoto Protocol makes provision for further commitments periods following the expiry of CP1, it contains little guidance on how the burden of reducing global emissions should be shared over the long run. Much the same can be said with respect to its parent document, the UNFCCC. Indeed, while Article 3 of the Convention refers to ‘common but differentiated responsibilities and respective capabilities’, it does not enunciate in precise terms how these responsibilities should be ‘differentiated’, or which responsibilities are ‘common’ and which are ‘differentiated’. Arguably, most of the principles of justice considered in this paper are compatible with the provisions of the UNFCCC, but the Convention does not attempt to weigh these principles: this is a matter for the parties to negotiate. To complicate matters, it has other limitations, some of which have already been noted. In our view, there is no case, in ethical terms, for setting future emission-reduction targets and commitments in the manner adopted for CP1. At the same time, the wording of the Convention and the Kyoto Protocol in relation to burden sharing is sufficiently flexible to accommodate a range of post-2012 frameworks. Accordingly, a more ethical approach would not necessarily be incompatible with existing international instruments.

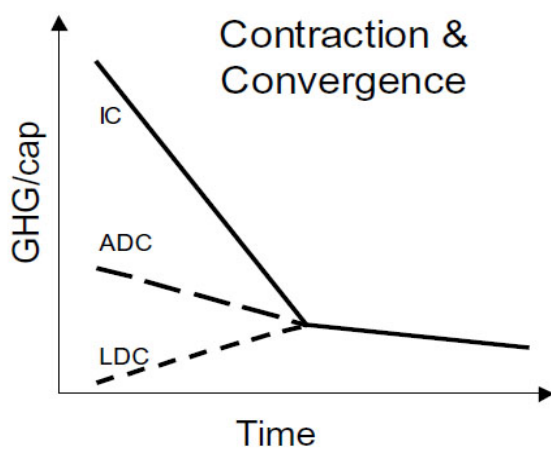
Contraction and convergence

The Contraction and Convergence (C&C) approach is built on the premise that human equality is the core ethical principle for determining how the burden of mitigation should be shared. In distributing the burden of mitigation, it first determines the level of emissions per person consistent with the requirement to stabilize GHG concentrations in the atmosphere. Having done this, it imposes emission-reduction

¹⁴ These may have come from developed countries that have reduced their emissions more than required or from developing countries through the CDM.

trajectories on all countries above the average that require them to converge to the desired level of emissions per capita by a given date while ensuring that these reduction paths are consistent with achieving an acceptable level of GHG concentrations. Countries that are well above the acceptable per capita emission level receive steep reduction trajectories while those close to the target receive flatter reduction trajectories (see Figure 1). Countries below the average are allocated more than they currently need in recognition of their ethical claim on those emissions. This triggers a reallocation of resources from developed countries to developing countries, providing developing countries with an incentive to support the agreement. Emissions trading between countries is permitted. Hence, those countries with per capita emissions below their reduction targets may sell their permits to other countries that fail to make the necessary reductions.

Figure 1: Contraction and convergence



Note: IC - Industrial countries, ADC - Advanced Developed Countries and LDC - Least Developed Countries.

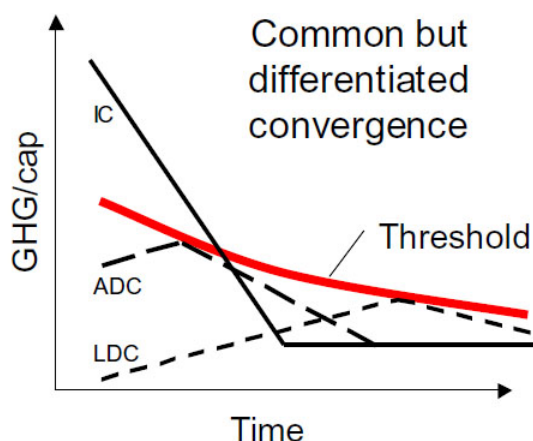
Source: Höhne, Phylipsen, and Moltmann (2007), p. 14.

In the long run, this approach focuses on the principle of equality giving no consideration to the other principles of justice. In the short run, however, it balances the principle of equality against considerations of short-term monetary costs. It is a very cost efficient framework since all parties are included in the system from the beginning and it is likely to be environmentally effective for the same reason. It is also a relatively straightforward system to negotiate since there is a clear methodology for determining each country's share of the global burden. Partly because of these virtues, the C&C approach has found favour in many quarters, and has recently been supported by the Garnaut Climate Change Review.

Common but differentiated convergence

The Common but Differentiated Convergence (CDC) modifies the C&C approach to better account for capacity and historical responsibility in the short run. Instead of requiring all countries to begin emission reductions immediately, it allows non-Annex I countries to increase their emissions until they reach a percentage threshold of the global per capita average which should be declining over time (see Figure 2). Because developing countries are not originally bound by emission reduction targets, they do not receive excess emission allowances, except via the CDM (or some equivalent mechanism). In all other ways, the approach is the same as C&C.

Figure Two: Common but differentiated convergence



Note: IC - Industrial countries, ADC - Advanced Developed Countries and LDC - Least Developed Countries.

Source: Höhne, Phylipsen, and Moltmann (2007), p. 14.

Judged against C&C, CDC fares better when importance is placed on the principles of capacity and historical responsibility. In other words, if these principles are considered relevant, then CDC must be judged superior to C&C because it better takes into account these principles.¹⁵ If not, then CDC should be considered inferior because of the efficiency and effectiveness losses it implies.

The staged approach

The staged approach divides countries into groups similar to the Annex I/non-Annex I division in the UNFCCC and assigns them different types of targets according to their grouping. Countries in the less well-off groups are assigned less stringent targets than the countries in the better-off groups. In setting these targets, negotiators must ensure that the overall effort is consistent with achieving an acceptable GHG stabilisation target.

Various proposals have been suggested for differentiating between countries and assigning targets (Claussen and McNeilly, 1998; Gupta, 1998; Storey, 2002; Höhne et al., 2003; Bodansky, 2003; Ciqui et al., 2003; Gupta et al., 2003; and Ott et al., 2004). For illustrative purposes we present the proposal outlined in Blok et al (2007). Under this proposal countries are divided into four groups based on their levels of emissions per capita. Countries in the first group receive 'no lose' targets which allow them to earn emission credits for beating their targets but impose no penalties should they miss them. The second group of countries are given intensity targets which require them to reduce their emissions per unit of GDP. The third group are required to take on stabilisation targets which require them to stabilise their emission levels within a certain timeframe. The final group are given emission-reduction targets. Under this proposal, the level of these emission targets is adjusted to ensure that the overall volume does not exceed the desired level. As countries grow economically over time, they will move into higher groups and be expected to take on more stringent targets. Because of its flexibility, the staged approach can take into account any or all of the

¹⁵ Although it still might not give adequate consideration to either of these principles.

principles of justice discussed above. On the downside, this could make negotiations very complex.

The Brazilian proposal

The Brazilian proposal was originally submitted by Brazil in 1997 (UNFCCC, 1997). It builds on the framework of the Kyoto Protocol but calls on Annex I countries to accept emission-reduction commitments that take into account their responsibility for the increase in GHG concentrations in the atmosphere. Thus, countries' reduction targets depend on their historical contribution to GHG concentrations.

The appropriateness of this approach depends on the significance of historical responsibility relative to the other principles of justice. Even if it is correct, however, to give historical responsibility a high weighting, the Brazilian proposal suffers from the fact that it is difficult to estimate historical emissions and thus difficult to apportion blame in an accurate manner. For such reasons, this approach has not generated widespread support.

The triptych approach

The triptych approach allocates emission rights to Annex I countries primarily on the basis of monetary cost. However, instead of setting reduction targets through negotiation, it specifies a formula for dividing the burden between countries. In doing this, it analyses countries' sectoral composition and treats emissions from the various sectors differently. A number of formulae have been proposed (e.g. Blok, Phylipsen, and Bode, 1997; Phylipsen, Groenenberg, and Blok, 1998; Groenenberg, Phylipsen, and Blok, 2001; Hohne et al., 2005) which cover a range of sectors. These included heavy industry, power, domestic consumption, industry, waste, agriculture, land use change, and forestry.

Three sectors were covered in the original triptych proposal (Blok, Phylipsen, and Bode, 1997): heavy industry, power, and domestic consumption. Emissions from heavy industry and power were assumed to face upward pressure from rising GDP but downward pressure from improved efficiency (though these would adjust at different rates). Emissions from domestic consumption were expected to converge to an equal per capita level across countries over time. These sector reductions are then added together to determine a country's overall emission reduction target.

Because this approach does not take into account any of the other principles of justice, it lacks a strong moral foundation. However, it may be better able to encourage widespread international buy-in because it addresses a large number of concerns developed countries have and it does not impose excessively heavy costs on any country.

An ethical assessment of the burden sharing frameworks

All the burden sharing frameworks discussed above either fail to integrate developing countries comprehensively into a cap-and-trade system or fail to distribute the costs of mitigation fairly between developed and developing nations. It is clear from the principles of justice considered in this paper that developing countries should, at the

very least, have per capita emission allowances that are equal to those of developed countries. This follows from the principle of equality. In fact, a good case can be made, on the basis of the principles of capability, historical responsibility and equal welfare costs, that most developing countries should have per capita emission allowances that are larger, on average, than those of developed countries – at least for a period of time.

Somewhat surprisingly, all six of the frameworks considered here either do not fully include developing nations within a global emissions cap-and-trade regime or allocate such countries substantially fewer emission rights per capita over the short-to-medium term than their ethical entitlement. For instance, under a C&C approach the average citizen of China would receive fewer emission rights over the next 50 years or so than their counterparts in the US. Neither of these outcomes is desirable. The first causes losses in efficiency and increases the risk that mitigation efforts will not be environmentally effective. The second, *ceteris paribus*, is not equitable and is likely to be rejected by developing countries.

Nonetheless, it is difficult to find an alternative method of distributing the burden of mitigation. Even if the political leaders of developed countries were willing to commit to taking on these costs, it is likely to prove political untenable for them to do so, because addressing mitigation will impose immediate, significant and transparent costs on the citizens of developed countries. Furthermore, although all of the burden sharing frameworks are theoretically efficient, provided emission rights can be traded, market imperfections may prevent the cap-and-trade system from functioning in a fully effective manner (see Box 2). Hence, it may be wise from an efficiency perspective to avoid situations where certain countries are heavily dependent on purchasing emission rights in order to meet their international obligations.

Given these constraints, is there an alternative way for developed countries to meet their ethical responsibilities? One solution is for these countries to take on an even greater share of the global effort required to address adaptation, technology development and transfer, and the financing of climate change action. As discussed in Box 3, by comprehensively addressing some of the inequities of the current situation through contributing more to finding solutions to the challenge of adaptation, developed countries can reduce the size of their mitigation responsibility. Further, developed countries are in a position to share technologies that abate emissions and to bear the cost of developing new, more efficient low-carbon technologies. They also have the financial capacity to ensure that those who need it are able to access finance to address climate change. Thus, it is both possible and desirable to implement one of the suggested burden sharing frameworks and still come close to an equitable outcome if developed countries take on greater efforts in the other core areas of addressing climate change.

It might be objected that at present developed countries are not only doing less than their fair share with respect to mitigation but they are also doing less than their fair share with respect to adaptation, technology transfer and finance. Equally, it may be no more feasible politically for them to increase their efforts in these areas than it is for them to expand their mitigation efforts. While there may be some truth in these claims, there are a number of reasons why it is likely to be easier for developed countries to take additional actions in these other areas in place of tougher mitigation

commitments. First, unlike most mitigation efforts, the costs of addressing adaptation (and technology transfer and finance) are more likely to be borne directly by governments (and thus indirectly by all taxpayers) rather than directly by emitters. Politically, therefore, measures to assist developing countries to adapt to climate change may be easier to implement than those associated with more stringent mitigation efforts. Second, technology transfers are likely to have productivity spillovers that increase output in developing countries leading to win-win situations. Third, developed countries have access to capital at lower costs and therefore can finance climate change efforts (whether mitigation or adaptation related) more cheaply than developing countries, thereby producing mutually beneficial results.

Box 3: The relationship between the principles of justice in mitigation and adaptation

Most of the literature on burden sharing applies the various principles of justice discussed above to the question of mitigation. However, such principles can also be applied, with minimal amendments, to the question of who bears the cost of adaptation.

In doing this, however, it becomes clear that the degree to which a principle is applied in the case of mitigation affects the extent to which it should be applied to adaptation. This is most evident in the case of the principle of historical responsibility. If countries take on mitigation in proportion to their responsibility for the current problem, they have less of a duty to take on a greater responsibility when it comes to adaptation. Conversely, if countries are willing to cover the full costs of adaptation in proportion to their responsibility for climate change, it is less clear that they must take on more stringent mitigation targets.¹⁶

Similarly, although not as straightforwardly, it seems that there is some potential to apply the other principles of justice less stringently in one area while applying them more stringently in the another.

Far from being merely a procedural detail, however, real benefits may flow from applying some principles of justice to mitigation and others to adaptation. For example, applying the principle of historical responsibility solely to adaptation has several advantages. First, it is consistent with the polluter-pays principle which is often applied to other environmental issues. Second, it would produce incentives for countries to actively reduce their emissions now even if other countries do not take similar steps, because by doing so they would reduce their share of the cost of adaptation in the future.

¹⁶ Of course, there are likely to be few cases in which countries fully negate their historical emissions with future mitigation efforts or in which countries bear the full cost of the impact of their previous actions, including the costs of adaptation. Accordingly, the principle of historical responsibility is likely to remain of continuing relevance.

Part 3: Implications for New Zealand

This section of the paper considers the implications of these different frameworks for New Zealand. It also explores the implications of changes in the rules and parameters surrounding such issues as GHG emission accounting, base years, and land use, land-use change and forestry. Changes to the current Kyoto rules and parameters are likely to be controversial because their impact will vary from country to county (i.e. there will be winners and losers whatever the change). Because of the complexity of the issues, we will limit ourselves to making qualitative judgements about the relative cost of the different frameworks rather than attempting to estimate a quantitative figure for costs. Likewise, we will not attempt to set out in concrete terms precisely what New Zealand should do from an ethical perspective. Nevertheless, it is clear on the basis of the principles considered in Part 2 that New Zealand will need to take on a large share of the burden of mitigation in per capita terms.

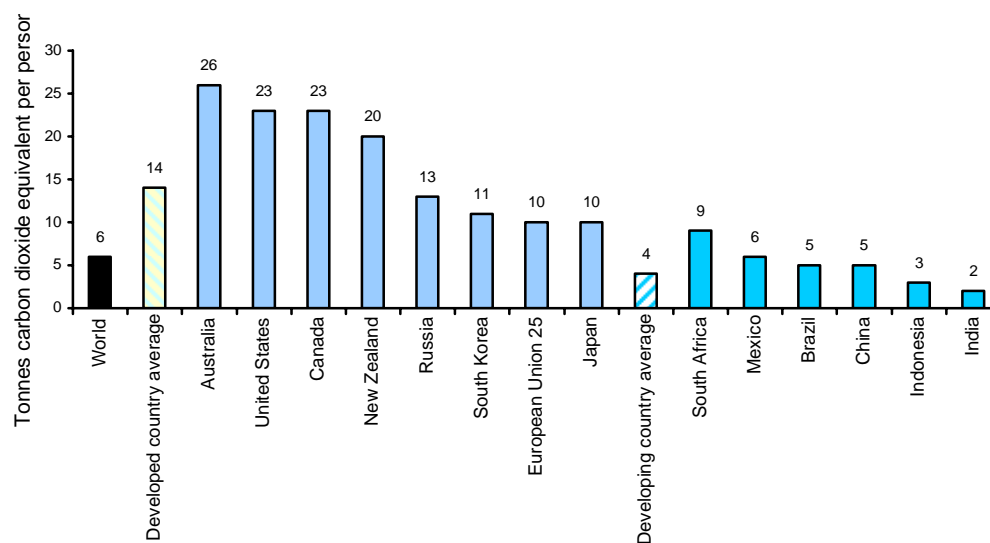
The previous discussion has highlighted that none of the frameworks considered is superior in all respects. Further, it demonstrated that mitigation effort should not be thought of in isolation from effort in adaptation, technology transfer and finance. This means that in determining the level of mitigation effort a variety of considerations need to be taken into account.

New Zealand will face different mitigation costs depending on which broad framework of burden sharing is used. Moreover, the nature and content of the burden-sharing framework will have a greater impact on New Zealand than many other developed countries because of its unique emissions profile and relatively large carbon sinks.

Contraction and convergence

Because of New Zealand's relatively high level of per capita emissions (see Figure 3), a C&C approach is likely to place a large burden on New Zealand in the short-to-medium term. Thus, if the international community decides to set a target that requires developed countries to reduce their emissions (or at least take responsibility for reducing emissions) by 25% by 2020 relative to 1990 levels (and recent scientific evidence suggests that a cut of at least this amount is necessary to avoid drastic climate change), it is likely that New Zealand will be required to take on a 'responsibility' target of a comparable nature.

Figure 3: Per capita greenhouse gas emissions, 2004



Source: Claussen (2007), based on data from the International Energy Agency. Reproduced in Boston and Kengmana (2007).

While these cuts would be costly, it is important to note that this framework is very likely to be both environmentally effective and economically efficient and, as such, it may represent the best case scenario if New Zealand is serious about cutting emissions.

Common but differentiated convergence

This approach would have similar implications to C&C but would increase the cost New Zealand faces. This is because in the short-to-medium term developed countries would be expected to bear a greater proportion of the mitigation effort. Against this, if such an approach is more likely than C&C to induce developing countries to sign up to a global treaty, then these costs may be justifiable.

The staged approach

Under a staged approach, New Zealand is likely to be required to take on a less stringent responsibility target than it would under either C&C or CDC. This is because it is more likely to take into account the cost of reducing emissions in different countries. Because the current costs of reducing emissions from the agricultural sector are relatively high and because potential gains from energy efficiency are limited in New Zealand since a large proportion of its energy comes from renewable sources, it faces mitigation costs that are above the developed world average. Against this, the staged approach is likely to be less environmentally effective and economically efficient than either C&C or CDC, so there is a risk that New Zealand will face greater costs for adaptation and mitigation in the future.

The Brazilian approach

It is unclear whether taking historical responsibility into account will have a significant impact on the share of the burden borne by New Zealand. This is because its responsibility for historic emissions (in CO₂ terms) as a percentage of total global responsibility is probably similar to its current percentage contribution to global CO₂ emissions. There is, however, significant uncertainty surrounding current projections of historical responsibility, and currently there are no accurate projections of historical responsibility in CO₂e terms, largely because it is very difficult to estimate previous levels of non-CO₂ GHG emissions.

Although basing a new global climate treaty on considerations of historical responsibility may be less expensive for New Zealand than other approaches, the difficulties surrounding measurements of past emissions and the risk that it will not be environmentally effective reduce its attractiveness. As a result, it would not be a prudent approach for New Zealand to advocate.

Triptych

For the reasons mentioned above, New Zealand is likely to face lower costs in frameworks that take into account the cost and feasibility of emission reductions because of the unique challenges it faces (see Boston 2007a, esp. chapters 8-10). On the one hand this approach may attract significant buy-in for developed countries as it limits the cost any single country must bear. On the other hand, it is unlikely that developing countries would be prepared to take on similar targets given their relative lack of capacity and historical responsibility. In any event, this approach is largely inconsistent with the principles of justice identified above.

Impacts of rule changes

New Zealand will also be affected by any changes to the rules that govern how emissions are accounted for in the Kyoto Protocol. Although it is difficult to analyse the ethical merit any such rule changes because one cannot straightforwardly apply the principles of justice to them, it is important for any future treaty to be as complete and as consistent as possible. As a result, each of the areas below merit further consideration.

LULUCF

The science and issues surrounding land use, land-use change and forestry (LULUCF) are complex.¹⁷ Because of this complexity, the rules governing LULUCF in CP1 have, 'gaps and anomalies...that make no sense from either a climate or a land management point of view' (Macey 2007, p. 182).

Changes to the rules related to the accounting of forestry are of particular importance to New Zealand. At present, countries do not earn credits from the emission

¹⁷ This section draws upon Ward and James (2007).

reductions attributable to forests planted before 1990. Furthermore, reforestation is only recognised if it takes place at the location of the original forest.

New Zealand stands to gain if either of these rules is modified. It will gain from changes to the rules surrounding pre-1990 forests because it has significant pre-1990 forests. Likewise, it will benefit from extra flexibility with respect to rules about where forests may be replanted. This will allow New Zealand to allocate its land between forestry and agriculture (and other uses) in an optimal manner. Finally, including developing countries in LULUCF agreements will benefit New Zealand by increasing the value of its timber exports.

Global warming potentials

To simplify the setting of reduction targets and the trading of emission rights, the IPCC provides a method for aggregating GHGs into a single unit, CO_{2e}. In particular, the UNFCCC has used the second IPCC's report's best estimates of the Global Warming Potential (GWP) of each GHG over a 100 year period and used these to set conversion ratios for converting GHGs into CO_{2e}.

The scientific estimates of the GWPs of the various gases change as science evolves; as a result the IPCC's current best estimates of the GWP of various gases differ from the estimates used to set the conversion ratios. Thus, there exists a trade-off between the accuracy gained from using the most up to date measure of GWP and the unpredictability caused by changing emission ratios. Further, there are questions about the choice of a 100 years time horizon: it is not clear that we should only be interested of the effects of gases over their first 100 years. Changing the time horizon radically changes the conversion ratios of short lived GHGs such as methane. Using 100 years as the time horizon does not account for the fact that in the long run emissions of CO₂ (which are not fully removed from the atmosphere by natural processes) must fall to zero while emissions of other gases (are fully removed) merely need to be reduced to a stable level.

The profile of New Zealand's responsibility targets will be significantly shaped by the way GWP is accounted for in a future treaty. Any increase in the time horizon used will reduce the size of New Zealand's CO_{2e} emissions, as current best measure show that the conversion ratio drops from 25 to 7.6 for methane and from 298 to 153 for nitrous oxide if a 500 year time horizon is used. However, New Zealand's CO_{2e} emission levels stand to rise if conversion ratios are updated to current best estimates since the GWP of methane is now calculated to be approximately 20% greater than measured in the second IPCC report. This will be partially offset by the fact that the GWP of nitrous oxide has fallen over by approximately 3%; however the relative size of the shifts implies that New Zealand's total emission level will go up as a result of this shift.

It is often assumed that New Zealand will gain from shifts that decrease its CO_{2e} emission levels and will lose from approaches that increase its CO_{2e} emission levels. However, this view is somewhat too simplistic since in the burden sharing frameworks discussed above involve setting percentage targets from a base line emission level. As a result, any drop in emission levels will also decrease the quantity of emission rights New Zealand is allocated.

Base year

It is possible that future agreements will use 2000 or 2005 as a base year rather than 1990. Although there is no strong ethical basis for this shift, it will allow countries that have had large increases in emission levels since 1990 to meet their likely post-2012 targets more easily. For such reasons, Canada, Japan, the United States, and Australia may well favour such a change. A shift in the base year would certainly help New Zealand, as its emissions have increased substantially over recent years.

Population growth

It is unclear what weight, if any, should be given to population growth in calculating national emission targets. On the one hand, weighing targets on the basis of population growth would be consistent with the claim that all people have an equal right to emit. Further, it would avoid punishing countries that currently have young populations (and/or significant inward migration flows), since these countries naturally tend to have high population growth rates. On the other hand, tying emission allowance to changing population levels would weaken incentives for countries to limit their population growth – a step that may well need to be considered in the long term. New Zealand's population is projected to grow at rate higher than the developed countries' average but will probably grow slower than the developing countries' average¹⁸. Therefore, New Zealand will probably benefit from taking into account population growth if only developed countries take on targets but it is ambiguous whether New Zealand would benefit if both developed and developing countries take on targets.

Bunker fuels

Neither international aviation nor maritime emissions were included in CP1, partly because of the complexities of the issues. However, future commitment periods will almost certainly need to contain some method of dealing with these emissions. Because of New Zealand's distance from other countries, it will be affected disproportionately if bunker fuels are included in any post-2012 agreement.

Conclusion

To sum up, the following conclusions deserve note. First, ethical considerations, including well-established principles of justice, have a strong role to play in designing global policies to mitigate climate change, and are highly relevant to the current negotiations for a new climate change agreement.

Second, of the six principles of justice considered in this paper, some clearly have a stronger ethical foundation than others. Additionally, some principles are more relevant to the issues surrounding climate change mitigation and adaptation than others. In particular, the principles of equality, capacity, historical responsibility and welfare costs deserve serious consideration in formulating any burden sharing framework.

¹⁸ Although large uncertainties surround projections of developing countries population growth rates

Third, all of the major proposed burden sharing frameworks are open to criticism on the grounds that, at least in the short run, they give inadequate weight to one or more of the most relevant principles of justice. Unfortunately, frameworks that give stronger weighting to the most relevant principles seem politically unfeasible – largely because they would require most developed countries to undertake a larger mitigation burden than they are prepared to accept. One partial solution would be for developed countries to accept a disproportionate share of the costs related to adaptation, technology transfer and financing. But this is also likely to be politically difficult.

Finally, our analysis of the principles of justice point to the need for New Zealand to accept responsibility for a relatively large share of the costs (on a per capita basis) of addressing climate change. It is also evident that the magnitude of the costs New Zealand will face under any post-2012 agreement will depend significantly on the rules governing emission accounting and related matters.

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