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The climate change negotiations: the case for differentiation

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The major elements of the climate change negotiations since the negotiation in 1995 of the Berlin Mandate to the Framework Convention on Climate Change are outlined and background on the greenhouse effect is provided in this article. It is shown that the same uniform emission reduction target for all countries is inefficient and that such targets would not lead to an equal sharing of the economic burden of achieving a given commitment to reduce greenhouse gas emissions. It is concluded that the negotiation of differentiated targets can help to solve this problem.

1. Introduction

Concerns about the potential risks of climate change have now motivated 165 countries to become Parties to the United Nations Framework Convention on Climate Change. The Convention came into force in March 1994, 90 days after ratification by the required 50 countries. The principal aim under the Convention is to stabilise the atmospheric concentrations of greenhouse gases at a level that would prevent 'dangerous anthropogenic interference with the climate system' (United Nations 1992). As a step towards this goal, Annex I Parties to the Convention (developed countries and economies in transition) committed themselves to aim to return their greenhouse gas emissions to 1990 levels by the year 2000. The question of commitments for other Parties or commitments beyond 2000 were left to the Conference of the Parties.

The first Conference of the Parties was held in Berlin in 1995. At that meeting it was agreed that it was necessary to negotiate a new legal instrument in which commitments for Annex I Parties would be specified for the period beyond 2000. The outcome of the first Conference of the Parties was the Berlin Mandate—a negotiating mandate aimed at guiding the

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negotiations on the lead-up to the third Conference of the Parties, which was held in Kyoto in December 1997.

The main aims of the Berlin Mandate negotiations were to identify policies and measures to be adopted by Annex I countries in order to control greenhouse gas emissions, to agree on emission targets and timetables for Annex I countries and to consider any coordination among Annex I Parties that may be appropriate in applying instruments and meeting targets. As part of the Berlin Mandate it was explicitly agreed that non-Annex I Parties would not be subject to any new commitments (DFAT 1997, pp. 31–2).

During the negotiations preceding Kyoto the major focus was on the emission targets to be adopted by Annex I countries and whether those targets should be uniform across countries. Many countries advocated uniform targets. For example, the European Union argued for a 15 per cent reduction in emissions from 1990 levels by 2010. Australia, Norway, Iceland and a number of other countries argued for differentiated targets. The aim was to set an overall Annex I target and then divide that target up between countries on the basis of some predetermined rule or by negotiation. The objective in Australia's proposal was to ensure that the economic burden of meeting the overall target was shared equally among parties in much the same way as the European Union had attempted to do under the so-called 'EU bubble' where it differentiated targets for its member states.

The purpose in this article is to outline briefly the important elements of the climate change negotiations and the case for differentiation of targets. In section 2 a short description of both the greenhouse effect and the important greenhouse gases is provided. This is followed by a discussion of the most contentious issues in the negotiations. The implications for Australia of particular outcomes are then described and the basis for Australia's argument for differentiation of targets is presented.

2. The greenhouse effect: some background

The greenhouse effect—the ability of the earth's atmosphere to trap some of the radiant heat that the earth emits after receiving solar radiation—means that the earth's surface is, on average, about 18°C warmer than it otherwise would be. The important natural greenhouse gases in the atmosphere are carbon dioxide (CO_2), methane (CH_4), oxides of nitrogen, ozone (O_3) and water vapour. Other greenhouse gases include chloroflurocarbons (CFCs), other halogenated compounds, carbon tetrachloride (CCl_4) and sulphur hexafluoride (SF_6).

When the earth's climate system is in equilibrium, incoming short-wave solar radiation is balanced by outgoing long-wave infra-red radiation from the earth and the atmosphere. Any change in the energy balance is referred to as radiative forcing of the climate. Sources of radiative forcing include effects that change both incoming and outgoing radiation. The most important influence on incoming radiation is the level of solar activity.

The level of solar radiation reaching the earth's surface is also influenced by variations in the earth's orbit around the sun and the absorption and reflection of energy by aerosols in the upper and lower atmosphere. Changes in the reflective capacity of the earth's surface, brought about by desertification, land clearing and urbanisation are also important. But the most important source of anthropogenic radiative forcing—the enhanced greenhouse effect—is thought to be due to the build-up of greenhouse gases as a result of human activities such as fossil fuel burning.

The most important greenhouse gas is carbon dioxide. The concentration of carbon dioxide in the atmosphere has risen from 280 ppmv in pre-industrial times to around 360 ppmv today. It is estimated that CO_2 has directly contributed over 60 per cent of the radiative forcing due to increases in the concentrations of greenhouse gases in the atmosphere since the industrial revolution (Houghton *et al.* 1996, pp. 14–18).

Methane, released in the production of coal and natural gas, from rice paddies and ruminant animals and animal wastes, from biomass burning and from domestic sewerage treatment and landfills is the second most important greenhouse gas. The concentration of methane in the atmosphere has increased about 2.5 times since pre-industrial times. This increase in concentration has contributed about 20 per cent of the radiative forcing due to increases in greenhouse gas concentrations since the industrial revolution (Houghton *et al.* 1996, pp. 14–18).

The various greenhouse gases have different radiative effects. The effect can be quantified using the concept of the 'global warming potential' (GWP). The GWP index is defined as 'the cumulative radiative forcing between the present and some chosen time horizon caused by a unit mass of gas emitted now, expressed relative to that for some reference gas' (usually CO_2), (Houghton *et al.* 1996, p. 21). The GWPs for a range of gases are shown in table 1.

Table 1 Estimates of global warming potentials for selected greenhouse gases

Gas	Global Warming Potential (for 100-year term horizon)
CO_2	1
CH_4	21
N_2O	310
HFC-23	11 700
SF_6	23 900

Source: Houghton *et al.* (1996, p. 22).

For its mid-range emissions scenario, the Intergovernmental Panel on Climate Change (IPCC) estimates that global mean surface air temperature will rise by 2°C by the year 2100 (Houghton *et al.* 1996, p. 6). This is lower than the best estimate in 1990, primarily due to a lower emissions scenario and the inclusion of the cooling effects of sulphate aerosols. The IPCC currently estimates a rise in mean sea level of 50 cm by 2100. This is again lower than the 1990 estimate mainly due to the lower projection for temperature increase (Houghton *et al.* 1996, p. 6). These estimates remain uncertain because of imperfect knowledge of the physical processes involved and because of uncertainties about the likely level of greenhouse gas emissions over time. However, the balance of opinion among scientists seems to be that there is a discernible human influence on global climate as a result of the emission of greenhouse gases.

3. The role of fossil fuel combustion in CO_2 emissions

As discussed above, of all the gases, emissions of carbon dioxide are the most important contributor to radiative forcing. The most important contributor to carbon dioxide emissions are those arising from the combustion of fossil fuels. As a consequence, for the remainder of this article discussion will be confined mainly to the impacts of carbon dioxide emissions resulting from fossil fuel combustion.

Global emissions of carbon dioxide are forecast to double between 1990 and 2020 (Brown *et al.* 1997, p. 20). Much of this growth is the result of large increases in energy demand in developing countries (figure 1). In 1990, Annex I countries contributed almost 70 per cent of global CO_2 emissions

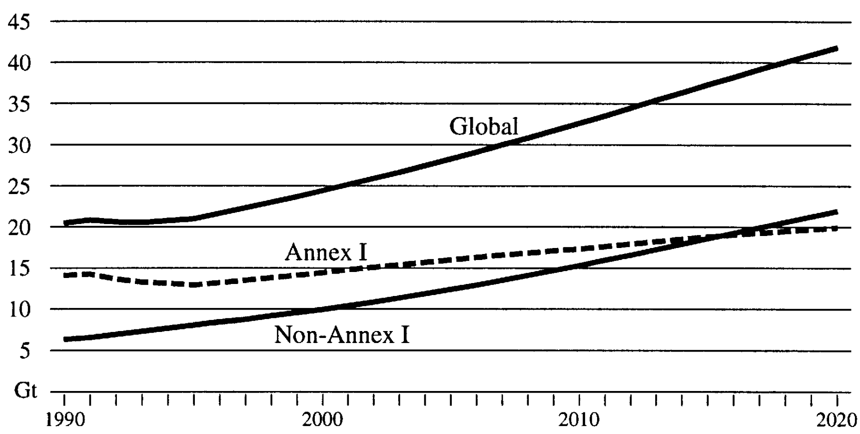

Figure 1 Carbon dioxide emissions from fossil fuel combustion: reference case

from fossil fuel combustion. However, by around 2016 emissions from developing countries are projected to overtake those from Annex I countries and by 2020 developing countries will contribute about 52 per cent of global emissions (Brown *et al.* 1997, p. 21). It follows that if the ultimate objective of the Framework Convention on Climate Change, namely, to stabilise 'greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system', is to be achieved, then at some stage it will be necessary to engage developing countries in a process designed to reduce greenhouse gas emissions. It is likely that such engagement will only occur if in setting targets recognition is taken of the stage of development (level of per person income) of non-Annex I countries and the characteristics of their economies. It follows that some form of target differentiation provides one mechanism to encourage developing countries to become involved in emission limitation strategies.

4. Coverage of gases

During the negotiations there has been considerable debate about which greenhouse gases should be counted in calculating commitments and whether all sources and greenhouse gas sinks should be covered. Much of this debate arose because of the measurement uncertainties surrounding many of the emission sources of the gases, the effectiveness of the various sinks and the values of the estimated global warming potentials of each of the gases. Emissions which can be measured with the least error are fossil fuel combustion. On the other hand, emissions as a result of the breakdown of soil carbon following land clearing are subject to wide margins of error. A number of countries such as Australia and the United States called for a comprehensive approach, that is, one where all gases, all sources and all sinks would be included. Under such proposals the final coverage is dependent on agreement on measurement methodology. Other countries, such as Japan, wished to exclude sinks (the so-called 'gross approach'). In other words, they proposed that only sources be counted and that no offsets for carbon sequestration by forests, for example, be allowed.

Some parties to the Convention wished to focus on carbon dioxide, methane and nitrous oxide only. In addition, some called for a gas-by-gas approach while others suggested a basket approach. In the former case, targets would be set for each gas whereas in the latter case a single target would be set and emissions of the various gases in each country's inventory would be weighted by the agreed global warming potentials established by the IPCC. While many of the issues raised in this debate arose out of concerns about difficulties in measurement, some were concerned to protect special interest groups. For example, a number of countries strongly resisted the inclusion of methane from agriculture, particularly rice paddies, in an effort to protect that sector.

5. The economic impact of achieving targets

In the year leading up to the third Conference of the Parties there was a widespread acceptance of the climate change science—much of the debate was about the most cost-effective way to meet targets rather than the desirability or otherwise of setting targets for emission reduction in the Annex I region as a whole. A similar approach is taken in what follows. No attempt is made to address the broader issue of assessing the overall costs of climate change itself compared with the costs of mitigation and adaptation. This subject is dealt with in the environmental impact assessment literature (see, for example, Weyant 1994; Weyant *et al.* 1995; and Reilly 1997).

A number of global general equilibrium models have been developed and used extensively to analyse climate change policies. These include ERM (Edmonds and Reilly 1983), GREEN (Burniaux *et al.* 1991), WEDGE (Industry Commission 1991), Whalley and Wigle (1991), Global 2100 (MR) (Manne and Richels 1992), G-Cubed (McKibbin and Wilcoxen 1992), CRTM (Rutherford 1993), Second Generation Model (Edmonds *et al.* 1995), EPPA (Yang *et al.* 1996), the International Impact Assessment Model (Bernstein, Montgomery and Rutherford 1996) and MEGABARE (Brown *et al.* 1997).

MEGABARE is an intertemporal general equilibrium model of the world economy. At its most disaggregated level, MEGABARE consists of equations and data that describe the production, consumption, trade and investment behaviour of representative consumers and producers in 30 regions and 41 sectors (industry groupings). Selected results from application of the MEGABARE model can be used to illustrate a range of points that became important in the negotiations before the Kyoto meeting.

The overall economic impact of reducing greenhouse gas emissions can be measured in a number of ways including estimating the impacts on gross domestic product (GDP) or gross national expenditure (GNE). One possible summary measure is the net present value of economic losses discounted over a given period of time. The MEGABARE estimates of the net present value of losses in GNE for a number of countries over the period from 2000 to 2020 (discounted at 5 per cent) are shown in figure 2. These estimates represent the impact from stabilising carbon dioxide emissions from fossil fuel combustion at 1990 levels by 2010. The impacts on GNE year by year,

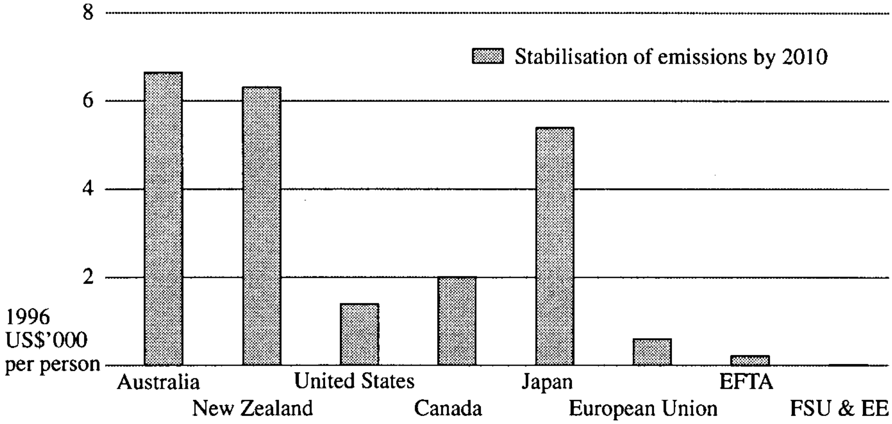

Figure 2 Net present value of GNE losses due to uniform emission reduction, 2000–2020, Annex I regions

relative to what would otherwise have occurred, are shown in figure 3. Estimates of the impacts on output sector by sector for Australia are presented in figure 4.

The economic costs associated with the imposition of a uniform emission reduction target would fall unequally on countries. These differences in costs arise principally from two sources—differences in the marginal costs of abatement and differences in the trade effects associated with the overall reduction in use of fossil fuels. Some countries, for example France, have a high proportion of their electricity sourced from the nuclear power industry. As a consequence, they have little remaining flexibility to reduce emissions from the electricity sector. Such countries are likely to have a much higher marginal cost of abatement than countries such as the United States which has a more even mix of fuels represented in its electricity sector. Other economic characteristics will also have an important bearing on the marginal cost of abatement. For example, significant attention has been paid to raising fuel efficiency in Japan as a result of experience during the oil price shocks. As a consequence, further improvements in fuel use efficiency can only be found at a higher cost than might be experienced in the Russian economy or other economies in transition. Differences in trade effects can also be illustrated with reference to Japan. Japan is a large importer of fossil fuels and as such will benefit from any fall in the world price of fossil fuels as a consequence of actions in Annex I countries to reduce the demand for coal, oil or gas.

A uniform reduction target across countries is not efficient or equitable. Because the marginal cost of abatement differs substantially across countries,

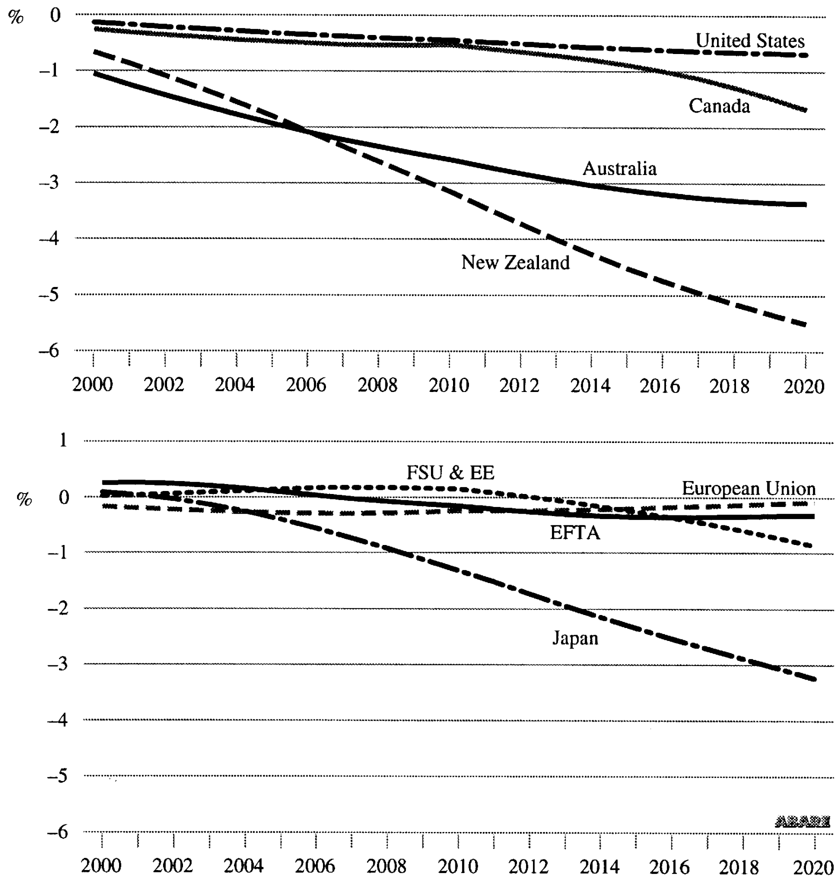

Figure 3 Change in GNE over time relative to the reference case, Annex I regions. Emissions stabilised at 1990 levels by 2010

a uniform reduction target will not be one that closely approximates a policy that equates marginal costs of abatement. As illustrated in Brown *et al.* (1997, pp. 74–6) use of an efficient economic instrument, such as Annex I tradable quotas, would substantially reduce the costs of reaching a given target compared with a uniform abatement approach.

Given that a uniform reduction target approach is neither efficient nor equitable, and given that such an approach provides no basis for engaging developing countries in undertaking commitments, Australia proposed a differentiated targets approach (DFAT 1997, pp. 72–3). Under this approach individual country targets would be negotiated with the aim of sharing the economic burden of reaching an overall Annex I target equally between Annex I Parties.

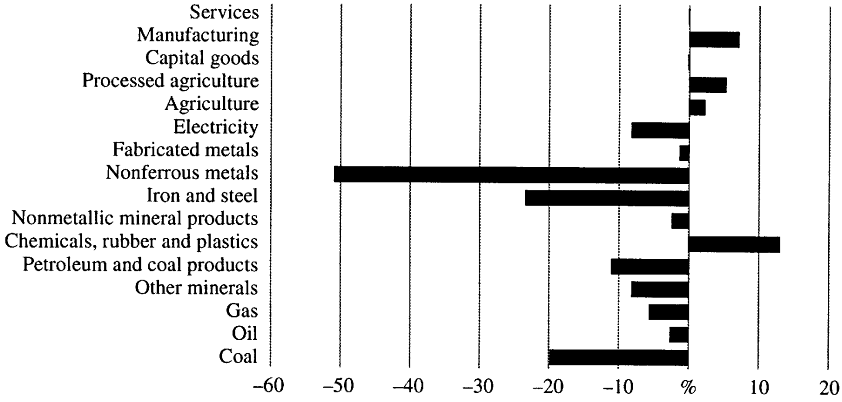

Figure 4 Change in Australian sectoral output at 2010 relative to the reference case. Stabilisation of emissions by 2010

6. Trade consequences of emission abatement

Abatement activity in Annex I countries will have trade-related consequences. If Annex I countries impose domestic policies to reduce fossil fuel combustion, the world demand for fossil fuels will fall with a consequent fall in world prices. At the same time, the production costs of emission-intensive goods will rise in Annex I countries. Such changes in relative prices have the potential to substantially affect both Annex I and non-Annex I Parties. MEGABARE estimates of the trade-related impacts of a uniform stabilisation policy on a selected group of Annex I countries are shown in figure 5. The size of these impacts depend on the trading pattern between

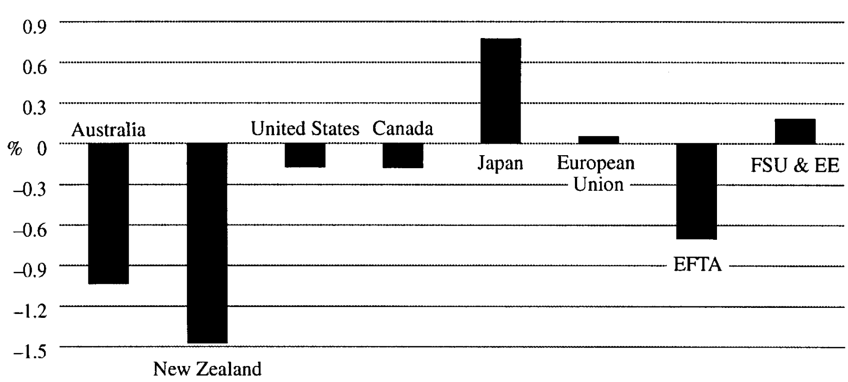

Figure 5 Trade-related change in GNE at 2010 relative to the reference case. Stabilisation of emissions by 2010

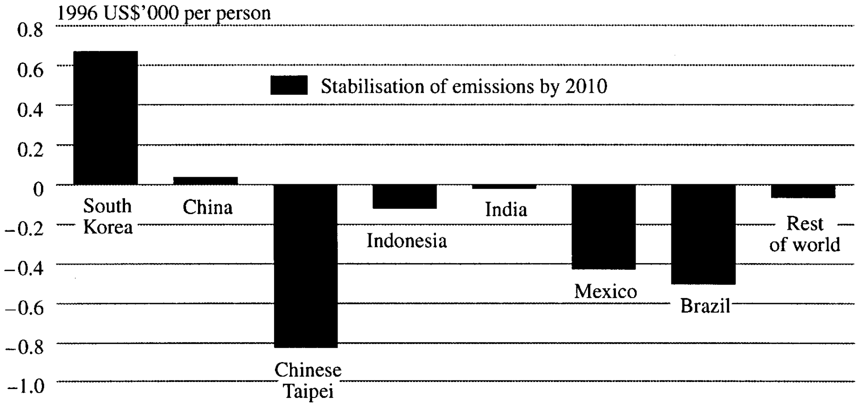

Figure 6 Net present value of GNE changes due to uniform emission reduction, 2000–2020 relative to the reference case. Non-Annex I regions

countries and the nature of that trade. For example, the strong positive terms of trade effect for Japan arise mainly as a result of the magnitude of Japan's fossil fuel imports. The strong negative trade effect for the EFTA group arises mainly as a result of the fall in the world prices of oil and gas (relative to business-as-usual) facing Norway.

The existence of the trade effects of abatement which is carried out by Annex I Parties means that there are likely to be some economic impacts felt by developing countries. MEGABARE estimates of these effects for a range of countries are shown in figure 6. A country like South Korea has the potential to gain from Annex I abatement—its manufacturing sector becomes more competitive compared with Japan and the United States. In comparison, a country such as Indonesia is likely to suffer economic losses because of its reliance on fossil fuel export revenue (all other things being equal).

Changes in investment patterns arising from abatement action are also likely to have differential impacts on economies. The expected changes in sectoral output for Japan and South Korea given an Annex I stabilisation target are shown in figure 7. The iron and steel industry is expected to be the industry sector that undergoes the largest structural adjustment in Japan. At the same time, it is this industry in South Korea that is expected to experience the largest increase in output. The MEGABARE estimates show that much of the Japanese iron and steel output that is displaced is transferred to Korea. This effect has been referred to in the literature as carbon leakage. Such leakage reduces the efficacy of any agreement. The magnitude of any carbon leakage that occurs will be determined by the coverage of countries that undertake abatement action and the nature of the economies that are excluded from any agreement to undertake reductions

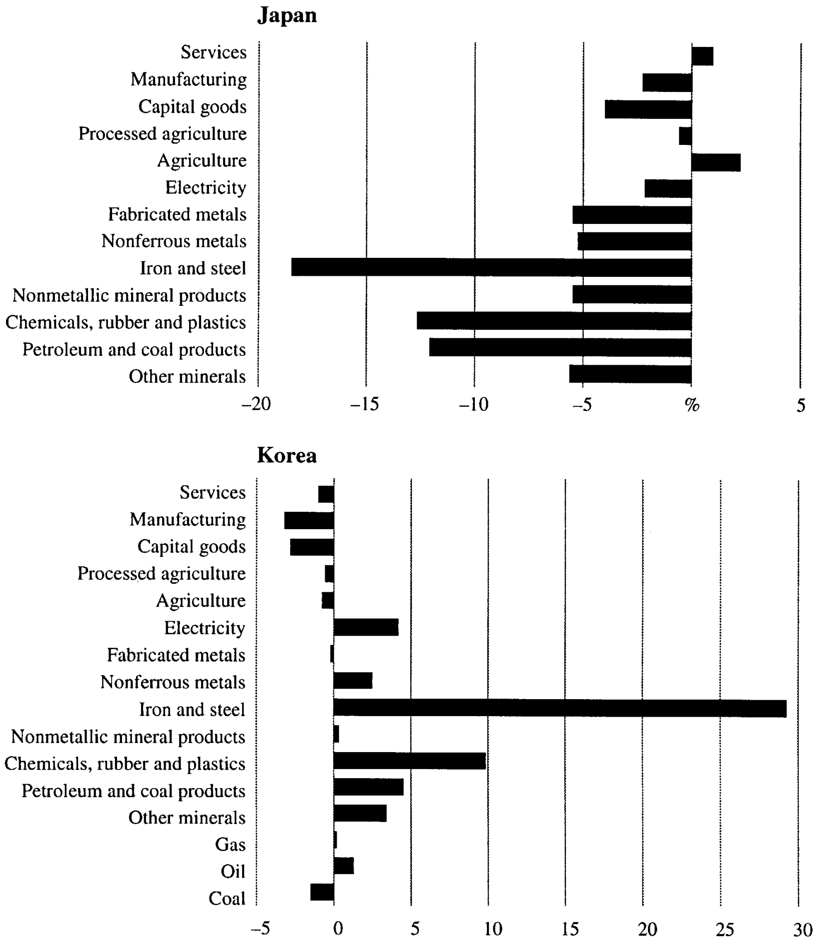

Figure 7 Change in Japanese and Korean sectoral output in 2010 relative to the reference case. Stabilisation of emissions by 2010

in their emissions. For example, for a scenario where emissions are stabilised at 1990 levels by 2010, estimates from MEGABARE suggest a carbon leakage rate of approximately 12 per cent when all Annex I Parties meet a uniform target. That is, for a reduction of one million tonnes of carbon dioxide emissions in Annex I countries, emissions would rise by 120 000 tonnes in developing countries. If emission reductions are undertaken in the OECD only, that is, there are no reductions in Russia and eastern Europe, the estimated leakage rate doubles. In other words, there is a strong estimated tendency for emission-intensive industries to shift from western to eastern Europe and Russia.

7. Conclusions

It is possible to draw a number of key conclusions from the experience of the climate negotiations that have been conducted over the last three years.

1. The main debate today is about the most cost-effective way of dealing with the enhanced greenhouse effect. Although there are continuing uncertainties about the science of climate change and there is a need for ongoing scientific research, policy-makers have signalled a willingness to take some action now.
2. If global greenhouse emissions (and therefore the atmospheric concentrations of these gases) are to be controlled, there is a need for inclusion of developing countries in the group of countries undertaking commitments on abatement. Developing countries will contribute over 50 per cent of global carbon dioxide emissions by 2020.
3. A uniform reduction target is inefficient and will not lead to an equal sharing of the economic burden of achieving a given commitment to reduce emissions. Substantial reductions in abatement costs can be achieved with the application of economic instruments such as an international tradable quota scheme.
4. An agreement that attempts to impose disproportionate economic costs on some Parties will not be implemented effectively by all Parties. Such an agreement has the possible added disadvantage of failing to provide a mechanism to encourage developing country participation. Some attempt needs to be made to provide a mechanism to share the costs of abatement equally. This can be done by negotiating different initial targets for each country depending on country characteristics or, in the case of a tradable quota scheme, negotiating the initial allocation of permits.

8. Postscript

The third Conference of the Parties to the United Nations Framework Convention on Climate Change, scheduled for 1–10 December 1997, concluded, after protracted negotiations, with an agreement on the Kyoto Protocol on 11 December 1997. The Protocol will be open for signature by Parties between 16 March 1998 and 15 March 1999 at United Nations Headquarters in New York. Subsequent to signature, Parties will have the option of ratifying the Protocol. (The Protocol will be open for accession from 16 March 1999). The Protocol will enter into force 90 days after the date on which 'not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted in total for at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance, approval or accession'.[1]

In many respects the Protocol, like the Convention itself, is a framework. Much detail remains to be negotiated on a range of issues including sinks (Article 3.4), joint implementation between Annex I Parties (Article 6), guidelines for the review of implementation of the Protocol by Parties (Article 8.4), details of the operation of the Clean Development Mechanism (Article 12.7), emissions trading (Article 16 bis) and mechanisms for dealing with non-compliance (Article 17).

The main features of the Protocol are as follows.

1. Agreement has been reached that Annex I Parties in aggregate will reduce their greenhouse gas emissions by at least 5 per cent from the 1990 level by 2012. This commitment contains a number of elements. First, the Protocol mandates reductions in 6 species of gases: carbon dioxide; methane; nitrous oxide; hydrofluorocarbons; perfluorocarbons; and sulphur hexafluoride (Annex A). For the purposes of calculating emission reductions these gases will be weighted by their estimated 100-year global warming potentials and total reductions will be expressed in terms of carbon dioxide equivalents. The percentage change in emissions committed to by each Party is set out in Annex B to the Protocol. These commitments are differentiated ranging from an 8 percentage point reduction in emissions from the 1990 base to a 10 percentage point increase.
2. Parties may act jointly to fulfil their commitments (Article 4), that is, there is provision in the Protocol for the continued existence of the 'EU bubble' or the possibility for the formation of other bubbles among Parties. The members of the European Union have committed jointly to an 8 per cent reduction in their aggregate emissions compared with 1990. EU members will be required to agree individual targets and to notify these targets at the time of ratification.
3. Commitments are to be calculated on the basis of net changes in greenhouse gas emissions from sources and removals by sinks. Any removals by sinks counted towards meeting commitments are to be limited to those arising from direct human-induced land use change and forestry activities undertaken since 1990.

[1] Article 24, Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations FCCC/CP/1997/L.7/Add.1.

4. Annex I Parties shall adopt policies and measures to meet their commitments but the Protocol does not mandate the adoption of particular policies or measures or harmonisation of those measures.
5. The Protocol makes provision for the transfer of emission reduction units on a project by project basis between Annex I Parties only (Article 6). This mechanism was previously referred to as 'joint implementation' or 'activities implemented jointly' and there was the earlier possibility that such transfers would be allowed between Annex I and non-Annex I Parties. The possibility of transfers between Annex I and non-Annex I Parties is now covered by the Clean Development Mechanism which is defined in Article 12.
6. The Protocol allows for Annex I Parties to meet part of their emission reduction commitment through emissions trading with other Annex I Parties. As mentioned above, the details of the emissions trading scheme are yet to be negotiated.

Much of the detail yet to be negotiated will fall to the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of the Protocol which will meet in conjunction with the respective bodies to the Convention. These bodies will report to the Meetings and Conferences of the Parties. The fourth Conference of the Parties will be held in Buenos Aires in November 1998.

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