Submission to the Joint Standing Committee on Treaties: Inquiry into the Kyoto Protocol[*]

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[*] This submission draws extensively from papers written jointly with Professor Peter Wilcoxen of the University of Texas at Austin. Some of these are listed in the references section of the paper.

1 Introduction

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was negotiated in Kyoto in December 1997. Many people believe that this protocol is a major step in the process - began at the United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992 - to reduce the future emission of greenhouse gases. Yet there are serious doubts that the Kyoto Protocol will succeed. Ironically if it does collapse, the protocol may ultimately make the attainment of the goals of the UNFCCC more difficult to achieve. The Kyoto Protocol is a risky way to proceed with climate change policy because it is not a sustainable regime under a range of plausible political and economic scenarios for the future. An alternative approach is outlined in this submission. This alternative is more likely to succeed and indeed could be implemented now in Australia with low cost. This alternative is easily adaptable to meet the Kyoto Protocol at a future date if indeed the many problems currently inflicting the negotiations could be solved. The alternative approach is consistent with the goal of the UNFCCC to reduce the future emissions of greenhouse gases in order to avert potential problems from significant climate change.

The objective of the Kyoto Protocol is to impose binding greenhouse gas (GHG) emission targets for the world's industrial economies and former communist economies of Europe ("Annex I" countries) to be achieved by the period 2008-2012. By directly binding emissions, policymakers presumably believed that they could achieve the goals of the UNFCCC through political commitment. Clearly this was perceived to be the easiest approach to follow because explicit targets can be negotiated and can be monitored. Given that fixed targets for emissions by Annex I countries have been agreed, although not yet ratified in key countries, the main issues currently being debated are how to minimize the costs of the Kyoto Protocol and how to bring developing countries into the agreement.

The issues of cost minimization and developing country participation are clearly recognized in the Kyoto Protocol. Costs are addressed through provision for international trading of emission allowances among the countries that accept binding targets. In addition, the Protocol provides for a Clean Development Mechanism, under which agents from industrial countries can earn emission credits for certified reductions from investments in "clean development" projects in

developing countries that have not taken on binding targets. Despite some recognition of the problems inherent in a regulatory approach to environmental policy which have prompted the introduction of flexibility into the Kyoto Protocol, I believe that concept of the sustainability of an international regime for climate change, has received far too little attention in the debate to date.

This submission outlines a number of issues that are fundamental to a successful reduction in future greenhouse gas emissions. Section 2 outlines the key conditions in the design of a greenhouse treaty that would be required for sustainability. The Kyoto Protocol is evaluated given these conditions and it is found to be faulty in crucial aspects. An alternative approach called the McKibbin Wilcoxen Proposal is outlined in section 3. This approach is more sustainable than the Kyoto Protocol and is more clearly in Australia's national interest because it has a known cost (which is low) in contrast to the Kyoto Protocol in which the cost to Australia is inherently uncertain but likely to be high. Section 4 presents estimates from one of the major global economic models (called the G-Cubed model[1]), of the economic implications of the Kyoto protocol for Australia - under the assumption that it does proceed. These results are presented both as an alternative to results from the ABARE model, but also to show what difference permit trading can make in a model that allows international financial capital flows and short run adjustment costs in labour markets. We compare the Kyoto Protocol without permit trading; with permit trading among Annex I countries and with global trading. These results suggest that if the Kyoto Protocol can survive the fundamental unsustainability problems that are highlighted in this submission, the protocol is likely to reduce greenhouse gas emissions. Within these assumptions, permit trading significantly reduces the cost of the protocol primarily because marginal abatement costs differ across countries and a market mechanism can help smooth these costs. The usefulness of market mechanisms is important for the design of alternatives to the Kyoto Protocol. We also find that the participation of non-Annex I countries is crucial in meeting the goals of the UNFCCC. Any regime should start explicitly with the goal of easily incorporating as wide a range of countries as possible.

What is now crucial for climate change policy in Australia is to proceed with a low cost policy that establishes clear property rights and creates the necessary legal institutions and markets for risk minimization. Incentives of the form summarized in this submission, should be put in place as soon as possible to move towards a future which is less carbon intensive than

[1] G-Cubed stands for "Global General Equilibrium Growth Model."

otherwise would be the case. Rather than trying to get a relatively better target in a badly designed international agreement, Australia should also do what it always does best – offer to the world a better idea for how to solve a global policy problem in a low cost and simple manner.

2. Designing a Sustainable Regime Within UNFCCC

a) Sustainability

The fundamental problem with climate change policy is that it must deal explicitly with the reality that every aspect of climate change is surrounded by uncertainty. The costs of addressing climate change are uncertain, the costs of climate change are uncertain and the future is inherently uncertain. The fact that there is so much uncertainty doesn't mean that doing nothing is the best policy. It is quite clear that human activity is raising global concentrations of carbon dioxide. While climatologists disagree about how much warming will occur and when it will happen, virtually no one seriously suggests that mankind can continue to emit increasing amounts of carbon dioxide into the atmosphere without any adverse consequences. At the other extreme, the idea that climate change is such an overwhelming problem that it must be stopped no matter what the costs of doing so, is also untenable given existing evidence. Frankly, too little is known about the damages caused by climate change and the costs of reducing emissions to draw this conclusion. To pretend that climate policy doesn't need to take costs into consideration is to guarantee that many governments will ultimately reject any climate change treaty.

There are both political and economic aspects to the issue of sustainability. A policy regime may collapse because of the extreme strain placed on economic adjustment or it may collapse because the incentives facing politicians change, even though economic sustainability is satisfied.

A sustainable climate change policy should meet a number of basic criteria. First, the policy should slow down carbon dioxide emissions where it is cost-effective to do so. Second, the policy should involve some mechanism for compensating those who will be hurt economically without requiring massive transfers of wealth that could undermine economic stability. Third, since climate change is a global problem, any solution will require a high degree of consensus both domestically and internationally. A system that does not ultimately include developing countries will do little to achieve the goals of the UNFCCC. However, consensus is the operative word: it is not realistic to think that a rigid global centralized regulatory regime for greenhouse policy can

ever be implemented. Few countries want to relinquish sovereignty over setting their own polices especially when the policies in question can have large economic effects. Fourth, the regime must allow new countries to enter with minimum disruption and also allow a core group of countries to continue to participate even if countries exit the system at certain times. A system involving many countries that doesn't survive changing composition over time is destined to fail since the reality is that a country's commitment to that regime is a function of the commitment of political incumbents at any point of time.

Ultimately, to be sustainable over a significant number of years, a climate change treaty must be realistic.

b) The Kyoto Protocol

How does the Kyoto Protocol and the general thrust of this style of centralized regulatory regime measure up to the criteria we have laid out? The first problem with the Kyoto Protocol is the focus on achieving rigid "targets and timetables" for emissions reductions at any cost, rather than substantial reductions in emissions at reasonable cost. The problem with fixed targets was understood by some negotiators at Kyoto and thus flexibility mechanisms, such as permit trading were included in the protocol. A crucial but mostly ignored issue is that any fixed targets, for the world or for a group of countries, **even differentiated targets,** are likely to be inefficient because we really don't know what these will cost over the long period of time being discussed[2]. If the actual costs of abatement turn out to be much larger than estimated it is unlikely that countries will continue to voluntarily adhere to the Kyoto Protocol. Some form of extreme enforcement mechanism needs to be designed to hold the protocol together.

Permit trading within the Kyoto Protocol is essential to minimize these problems. However even a permit trading system could be problematic. In a series of papers (McKibbin and Wilcoxen (1997a.1997b)) we have pointed out that under some plausible scenarios for the future evolution of the global economy, the economic pressures caused by the large transfers of wealth internationally that underlie the claims over permits, could cause severe fluctuations in real exchange rates and international capital and trade flows. Whether this actually emerges as a future

[2]See McKibbin and Wilcoxen (1997a) and Kopp et al (1997) for arguments about the difference between price and quantity caps under uncertainty.

problem will depend on a number of factors but especially the ultimate price of permits and the initial allocation of permits. In particular this may be a problem if permit allocations are used excessively as a way of persuading countries to participate in an agreement. In the results shown below these effects are not so serious because there is a great deal of flexibility in the G-Cubed model that we use. But if costs turn out to be much higher than we estimate (i.e. closer to those found in other models), the problem can become serious. The main point is that we can't be sure that the economic problems we highlight will not emerge in the future.

Another problem with permit trading under the Kyoto Protocol is that the price of permits for all countries depends on the demand and supply of permits by all countries. If one participating country cheats then the value of permits for all countries will be affected. If a large country cheats then the value of permits will be debased and the system will likely collapse. There is currently no international rule of law that can prevent this from happening nor is it easy to see what credible penalties could be imposed to prevent this from happening under all possible scenarios. It is also hard to imagine why developing counties would want to participate in a centralized system like the Kyoto Protocol especially once the enforcement mechanisms are made explicit.

In addition, changing the permit allocations over time will likely lead to significant capital gains and losses to participants and substantial political pressure groups will form to influence the process of permit allocation.

Overall it seems that economically there may be potential problems with the Kyoto Protocol involving large wealth transfers between economies. More fundamentally the incentives of key players are not clearly consistent with the protocol under extreme developments, without some, as yet to be identified, enforcement mechanism.

3. An Alternative Approach: The McKibbin-Wilcoxen Proposal

In response to the problems of the Kyoto Protocol, a proposal called the McKibbin Wilcoxen (MW) Proposal has been circulating since 1997. It was recently modified to include developing countries and as an early action policy.

Rather than centralize the process of reducing carbon emissions and creating new international institutions, it is better to coordinate responses across countries (what Richard Cooper of Harvard calls an approach of agreed actions) in an explicit way so that each country would pay the same price for emitting carbon. Furthermore, it is appropriate at this stage to create

property rights over emissions of carbon dioxide from burning fossil fuels only. As much as it would be nice to have alternative gases and sinks, as in the Kyoto Protocol, it is an administrative nightmare to deal with them in the near term and adds enormous complexity to the task.[3] In the future these could likely be added without compromising the system.

The key innovation of the MW proposal is that it would create *two emissions-related assets* and associated markets for both in each country. The two assets are designed to set a long run goal for emissions and to limit the short run costs. Fortunately the two markets also create a mechanism for managing risks associated with climate change policy within each economy so that very little else needs to be done to implement a consistent and simple market-based approach to tackling the climate change issue.

The first asset is an ***emission permit***. This certificate would entitle its holder to produce a unit of carbon each year (each permit would have a date stamp and be valid only in the year issued). The second asset is an ***emission endowment,*** which is a certificate that entitles the holder to an emission permit *every year forever*. The emission endowment is like a government bond that pays a coupon of an emission permit every year. Another way to think about the two assets is that the emission endowment is like stock in a corporation whereas the emission permit is the dividend the corporation pays each year to people who hold the shares. The stock value is the expected value of future dividends.

There is a critical difference between the two asset markets. The endowment market would be one in which the supply of carbon is fixed (the goal of policy) but the price is flexible. The government cannot issue more endowments after the initial allocation but can buy back endowments in future years if the target for emissions is to be tightened. Because the endowment is the perpetual lived asset, its price will reflect the expected future price of emission permits in each year (analogously to the stock price and the dividends of a company).

We treat the market for emission permits – where the price is fixed, but the output of carbon is variable -- quite differently because the permit market is directly related to the short run cost of carbon. Every ten years there would be a negotiation between all countries in which the

[3] A cynic might think that, although a good theoretical case can be made for including multiple gases and sinks in a compehensive policy, they were actually included to kill the Kyoto Protocol because of the impracticalities of including them both through the imprecision of current techniques of monitoring them or the high transactions cost of doing so.

price for emission permits is agreed to and fixed for ten years. The price of permits would be fixed in each economy by governments selling additional permits into the market after the permits generated by the endowments have been fully utilized. Thus a producer that wants to produce a unit of carbon for domestic use can get a permit in a given year by either having an existing emission endowment, purchasing an emission endowment in the endowment market (this would be sold by another private holder of an endowment), or purchasing an emission permit in the permit market that is either supplied by a private owner of a permit or from the government.

We propose that the initial price of the annual permits – which would determine the marginal cost of emitting carbon -- be set at $US10 per ton of carbon (in 1990 dollars). The price would be the same in all markets in all participating countries, and thus the cost of removing carbon at the margin in each economy would be identical in the short run. No complicated system of international trading in permits or global monitoring would be required – addressing a central flaw in the current Kyoto Protocol. Moreover, the value of permits in Australia would not depend on how permits are generated in other countries.

In contrast, the price of endowments would be flexible, reflecting the outcome of market forces, the period of fixed permit prices in the near future, as well as the expectations of private actors as to what is likely to happen after the current negotiation period. Industry and consumers would be expected to respond to both the short run price signals (which are known for ten year periods) as well as the long run price signals (which are market determined) in making spending and investment decisions.

The purpose of separating the endowment market from the emissions market is to ensure that, over the long run, emissions do not exceed a given limit. The annual emissions permitting process cannot accomplish this objective since it operates on the basis of a fixed price (the emissions fee), not a fixed quantity.

The initial allocation of endowments would be up to each government. We propose giving a significant portion to fossil fuel industries as compensation to shareholders for the capital losses of significant structural change that will result from raising carbon prices and to galvanize support for the policy. We also would allocate a portion to every person in the economy. The initial allocation of endowments will create a natural constituency supporting climate change policies because the value of the endowments in future years will depend on the commitment of the government to pursue sound environmental policies. This would create a mechanism for enforcement of the agreement that is internal to each country.

How Can Developing Countries Be Induced To Participate?

It is important to distinguish between Annex B countries and developing countries. Failure to do so would unduly inhibit the growth of the developing world and would not attract their support for a global system that is absolutely crucial for a successful policy.

Accordingly, it is appropriate in the case of Annex B countries to use the Kyoto targets as the endowment allocation within each economy. For developing countries, however, it is only reasonable to allow endowments far in excess of current requirements (the precise levels being subject to international negotiation). With endowments greater than requirements for permits over the next several decades, the price of permits in these countries would be zero, and thus there also would be no short run costs. In contrast, the price of endowments in developing economies would be positive, since the price would reflect the expected future price of permits. Thus a price signal can be introduced to the developing world that will affect current investment plans without entailing short run costs.

A developing country can therefore begin to contribute to a reduction in emissions with a firm commitment in the form of endowments. This reduction will be realized, however, only when emissions actually bump up against the endowment limit. The faster a country's economy grows, and thus the faster pace at which emissions are growing, the more rapidly the endowment constraint will become binding.

Meanwhile, carbon intensive industry will have fewer incentives to shift from Annex B countries into developing countries in order to avoid the carbon charge in industrial countries because they would need to consider the fact that all countries will be participating in the overall emissions reduction program (of which endowments would play an important role). The differential endowment system – one for first world countries, another for developing countries – also would have the added benefit of factoring in the cost of emissions in decisions by foreign private investors when deciding whether to commit funds to developing countries.

Overall, the nationally based emissions permit and endowment program is far more appealing than the Kyoto Protocol. All institutions are created and managed within each economy. Breakdowns in the infrastructure of any given market will not spill over to markets in other countries. To be sure, there would be fluctuations in the amount of global emissions, but the critical result is that the variations would be around a downward trend. Furthermore, decentralizing responsibility for taking action to individual countries would make the whole

program more sustainable than the Kyoto alternative, which requires participation by all countries in an international permit trading regime.

Another advantage of the approach proposed here is that the negotiation every decade on the permit price allows a great deal of flexibility. Monitoring of emissions and the extent of induced abatement activities can be undertaken more easily than in a global program. If information changes then the price of permits can be changed by international agreement. The endowment market will reflect this information immediately and will enable more rapid but cost minimizing adjustment if required.

As An Early Action Proposal for Australia

Finally, the permit and endowment approach can and should be easily implemented in Australia and all other countries as an early action policy (see McKibbin(1998)). By establishing such a system with a low initial price for permits, all domestic institutions that would be required if the Kyoto Protocol would be created in the meantime. To move from the fixed price system that we propose to a flexible price system under the Kyoto Protocol, all that is required is to remove the government intervention from the permit market in 2008 and allow international trading of the permits then. Alternatively, and more likely, countries that implement the MW proposal would find that it works so well in providing price signals to consumers and industry that there will be no need to move to the Kyoto Style system over coming years.

4 Estimates of the Impact of the Kyoto Protocol on Australia

This section summarizes results from a study by McKibbin et al (1999) that was recently published in The Energy Journal - the world's leading academic journal on energy related issues.[4] It is important to stress that these results already assume the regime is sustainable and merely give the major channels through which adjustment occurs under the regime. The results also give some indication of whether the regime is economically sustainable by highlighting where large economic adjustments might be expected to occur. Several other qualifications need to be stressed when considering the results from the model protocol with the actual protocol. The model only

[4] This and other papers describing the model are available at http:\www.msgpl.com.au.

accounts for emissions of carbon dioxide from fossil fuel combustion, while the Protocol specifies targets for all greenhouse gases in carbon equivalent units.[5] Accordingly, we make the simplifying assumption that reductions in fossil-related carbon dioxide emissions will be made in proportion to the reductions required in total GHGs, and set the carbon target accordingly. For instance, the Protocol specifies a 2008-2012 average annual target for the United States of 93% of 1990 GHG emissions, which were approximately 1,600 million metric tons of carbon equivalents (MMTCe). The overall U.S. greenhouse gas target is therefore roughly 1,490 MMTCe. However, the share of fossil-related carbon dioxide in this target will depend on the marginal cost schedules for all of the gases, not just CO2. To simplify, we assume that the fossil CO2 target will be 93% of 1990 fossil CO2 emissions, or approximately 1247 MMTC. This approach ignores the likelihood that relatively inexpensive GHG reductions will be available from non-energy and non-carbon sources, but provides a useful (if conservative) first approximation of the costs of achieving the Kyoto targets.

In each scenario, Annex I regions hold annual auctions of the specified quantity of carbon emissions permits in each of the years from 2008 to 2020.[6] The permits are required for the use of fossil fuels (coal, refined oil and natural gas) in proportion to the average carbon content per physical unit of each fuel. Revenues from the permit sales are assumed to be returned to households via a deficit-neutral lump sum rebate.[7] The policy is announced in 2000 so that agents have a nearly decade to anticipate the policy and adapt to it.

We first generate a baseline projection of the world economy under a no policy assumption. Given this baseline the Kyoto Protocol leads to reduction requirements in 2010 of

[5] The carbon equivalent units are specified in terms of the 100-year global warming potentials (GWPs) of carbon; e.g. a ton of methane emissions are counted as the equivalent of 21 tons of carbon (or 21 times 3.67 tons of carbon dioxide), since a ton of methane contributes roughly the same amount of radiative forcing over a century as 21 tons of carbon in the form of carbon dioxide. The permits are sold and used annually; we do not allow for banking or borrowing of emissions between years within the 2008-2012 budget period although this is permitted under the Protocol.

[6] Beyond 2020 the supply of permits is allowed to increase at such a rate as to leave the real permit price at its 2020 value.

[7] The rebate is chosen to leave the deficit unchanged. It is not necessarily equal to the revenue raised by permit sales because other changes in the economy may raise or lower tax revenue. This formulation is not equivalent to free distribution of permits (“grandfathering”) – that would be represented in a similar fashion in the model but the rebate would be set to the gross revenue raised by permit sales. Other uses of the revenue, such as cutting income taxes or reducing the fiscal deficit, would change some of the results substantially.

526 million metric tons of carbon (MMTC) for the United States, 67 MMTC for Japan, 48 MMTC for Australia, and 461 MMTC for the Other OECD countries; with approximately 27% of those reductions potentially offset by paper tons from the former Soviet Bloc.

We consider 3 alternatives in the implementation of the Kyoto Protocol including expanding the countries participating well beyond the Kyoto Protocol:

1. no international permit trading between regions;
2. international permit trading permitted between all Annex I countries; and
3. global permit trading; that is, the developing regions accept an emissions allocation consistent with their modeled baselines, and allow sales from their permit allocations to Annex I countries.

Since neither the model's behavioral parameters nor the future values of tax rates, productivity, or other exogenous variables can be known with complete certainty, these numbers should be regarded as point estimates within a range of possible outcomes. They do, however, give a clear indication of the mechanisms that determine how the economy responds to climate change policy. McKibbin et. al. (1999) examine the sensitivity of the results to key parameters.

a) Annex I Targets Met Without International Permit Trading

In this scenario, all Annex I regions meet their commitments under the Protocol. Each region is restricted to use of their allocated emissions; the permits can be traded within regions but not from one region to another.[8] This simulation allows us to measure the heterogeneity of the Annex I regions. Differences in baseline emissions growth, endowments of fossil fuels, reliance on fossil fuels for energy generation and initial fossil fuel prices mean that the regions face substantially different costs of achieving stabilization. This will be reflected in the pattern of permit prices (which will indicate the cost of stabilization at the margin) and GDP losses across regions.

The results for the Annex I policy without international permit trading are shown in Table

[8] Even though there is no trading *between* regions, trading is implicitly allowed between the countries *within* a region. In particular, the "Other OECD" region lumps together the European Union, Canada and New Zealand, so trading is

1. Key results are presented for 2005, 2010 and 2020 for the four OECD regions in the model (United States, Japan, Australia and other OECD, hereafter referred to as ROECD), as well as China and the less developed countries (LDCs).

The effects of the policy differ substantially across the regions: in 2010, permit prices per metric ton of carbon range from a low of $US87 in the US to a high of $US261 in the ROECD region. The price in Australia is $US181. ***The fact that Australia has high permit prices clearly shows why a flexible price permit trading system should not be implemented in Australia prior to joining a Kyoto style international permit trading system***. These results show that both marginal and average costs of abating carbon emissions differ substantially across countries. Since, by assumption, all regions have access to the same technologies, the differences in permit prices reflect differences in mitigation opportunities: regions which have relatively low baseline carbon emissions per unit of output, and are thus relatively sparing in their use of fossil fuels, have relatively fewer options for reducing emissions further. The differences among regions stem in part from differences in the fuel mix but also depend on the availability of alternative fuels and the extent to which baseline emissions rise above the stabilization target. Thus Australia, which has relatively few substitution possibilities and a high baseline emission trajectory (due to fairly high population growth and strong productivity growth) finds it costly to reach the 1990 stabilization target. The United States, with low energy prices, a high reliance on coal and abundant natural gas, finds it relatively cheap to change the composition of energy inputs.

The table shows results for both GDP and GNP. The GDP results indicate the extent of international shifts in production but are a poor measure of national welfare. The GNP figures are a better (although far from perfect) welfare measure because GNP reflects the total income the residents of a country and includes net income transfers to and from factors of production located abroad. Savers in countries with high costs of abatement shift some of their financial capital overseas, maintaining rates of return that otherwise would be much lower. The ordering of countries by GNP loss is the same as that by GDP loss but the dispersion of GNP losses is smaller because of the ability of agents to shift capital into higher return activities abroad.

The effect on GDP follows a pattern similar to that of mitigation costs: GDP in 2010 falls

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implicitly allowed between these countries.

slightly in the US and Japan while in Australia and ROECD it falls by 1.8 and 1.5 percent, respectively.

Examining the effect of the policy on different regions raises a number of interesting results that tend to be ignored in popular discussion of the impacts of emission permit trading. Those regions that have the largest relative abatement costs, such as Australia and ROECD, have large capital outflows because of the fall in the rate of return to capital in high abatement cost countries. ROECD, which faces the greatest cost of stabilizing emissions, has a large capital outflow, accumulating to roughly $490 billion ($95) by 2020. Most of this capital outflow goes to the United States, and also to some to developing countries, which are not controlling emissions at all. Capital flows to developing countries are limited by adjustment costs, however: it is expensive for a region with a relatively small capital stock to absorb a large flow of new capital.[9] It is relatively cheap for a large country such as the United States to absorb capital for the same reason: the costs of a given absolute change in a particular capital stock decrease with the size of the stock. Thus, relatively small capital inflows can exhaust arbitrage opportunities in developing economies. This is an important insight because it contradicts the popular perception that greenhouse abatement policies will lead to wholesale migration of industries from developed countries to non-abating developing countries. Our results show this is quite unlikely; moreover, most of the financial capital reallocation is between OECD economies.

Capital flows cause the exchange rates of countries receiving financial capital, such as the Untied States and developing countries, to appreciate and cause the Japanese and ROECD currencies to depreciate. The dollar appreciates by 25 percent relative to the ROECD currencies, but depreciates by 5 percent relative to the currency of developing countries. The ROECD currency depreciates by 30 percent relative to the developing countries. These changes lead directly to changes in export patterns. By 2010, ROECD exports of durable goods increase by about 6 percent over baseline while U.S. exports of durables fall by 11 percent. At the same time, capital flows cause Australian and ROECD GNP to fall by less slightly than GDP, since these countries' increased foreign investments offset some of the lost income from domestic production.

[9] In apparent contradiction to this statement, the results in Table 6 show an apparent net capital *outflow* from the LDCs rather than a capital inflow. The improvement in the LDCs' net foreign asset position is due to the fact that their real exchange rate appreciation leads to a decrease in the dollar value of their outstanding debt. The decrease in the value of outstanding debt outweighs policy-induced the capital inflow, leading to an apparent capital outflow.

Overall, the effect of achieving the Kyoto targets is to reduce GDP in countries with high abatement costs such as Australia, cause an outflow of capital, depreciate their exchange rates and stimulate exports. The effect on low-cost countries is the opposite: capital inflows tend to raise GDP by reducing real interest rates and stimulating domestic demand in the short run, and by raising the capital stock in the medium to long run. Capital flows also appreciate the exchange rate and diminish exports.

b) Annex I International Permit Trading

The second scenario is identical to the first except that we allow international trading in emissions permits among Annex I countries. The effect of allowing trading is twofold. First, arbitrage will cause the price of a permit to be equal in all Annex I countries. This will ensure that marginal costs of carbon abatement will be equal across countries and that Annex I emission reductions will be achieved at minimum cost. Countries with relatively low abatement costs will sell permits and abate more than in the previous scenario; countries with high costs will buy permits and undertake less domestic abatement.

In addition, trading makes possible a relaxation of the overall constraint during the 2008-2012 period because the emissions of one Annex I region, the former Soviet Bloc, are likely to be below the limit specified under the Protocol. The relaxation of the constraint means that actual emission reductions under the Protocol will be considerably lower – perhaps as much as 40% lower – with international permit trading than without it, at least during the first budget period. The particular circumstances of the former Soviet Bloc thus make it difficult to determine the pure gains from permit trading, independent of the relaxation of the constraint. [10]

Results for this scenario are shown in Table 2. In contrast to independent mitigation, international permit trading leads to a uniform permit price throughout the Annex I that rises from about $61 per ton in 2010 to $109 per ton in 2020. These prices, lower than any OECD region's marginal mitigation cost in the absence of international permit trading, lead to lower increases in

[10] Previous analysis using the G-Cubed model indicates that the pure gains from trade are on the order of 20 to 25 percent in the case OECD international permit trading. See McKibbin, Shackleton and Wilcoxen (1998b).

fossil fuel prices and considerably lower domestic reductions than in the previous case since reductions can be avoided by purchasing allowances from the former Soviet Bloc. At the 2010 permit price of $61 per ton, the former Soviet Bloc sells not only its excess allowances, 293 MMTC, but also reduces emissions to sell an additional 253 MMTC of allowances. Thus the OECD countries purchase nearly 550 MMTC of emission allowances from the former Soviet Bloc rather than undertake domestic reductions, thereby dramatically reducing the cost of meeting their commitments. These purchases particularly benefit ROECD, which uses internationally purchased allowances to meet 72 percent of its obligations and thus achieves a 77 percent reduction in its marginal abatement costs. The United States and Australia use internationally purchased allowances to meet 29 percent and 65 percent of their respective obligations, and benefit from 30 percent and 66 percent reductions in marginal abatement costs. International purchases of former Soviet Bloc allowance amount to nearly $33 billion ($95) in 2010 and rise to nearly $54 billion by 2020.

Interestingly, as the regional economies continue to grow after 2010, the demand for emission allowances increases while the former Soviet Bloc's willingness to supply them declines. As a consequence, international permit prices rise continuously after 2010, and by 2020, prices rise to $109 per ton. At this price, the United States becomes a net permit *seller*, supplying about 83 MMTC of allowances to Japan, Australia and ROECD at a total cost of nearly $9 billion, and taking an equivalent quantity of domestic emission reductions in excess of its international commitment.

The economic impacts of the Protocol are generally significantly reduced by both the equalization of marginal mitigation costs and permit prices under an international permit trading regime, as well as by the reduction in overall mitigation due to the sale of former Soviet Bloc's excess allowances. Japanese GDP costs in 2010 are cut from 0.6 percent to 0.4 percent, Australia's from 1.8 percent to 0.7 percent, and ROECD's from 1.5 percent to 0.6 percent. Permit trading has little effect on non-participants: results for China and the developing countries are very similar to the no-trading case.

Exchange rate changes are similar in sign but generally larger in magnitude than under the no-trading scenario. The Japanese and ROECD currencies, in particular, depreciate somewhat

more, while the currency of the developing region has a larger appreciation. This happens because the countries buying permits must ultimately pay for them with additional exports, either immediately or in the future. Thus, the purchasing country's current account must eventually move toward surplus by an amount corresponding to the value of the permits.[11] The changes in real exchange rates are necessary to accommodate the changes in trade balances.

Permit trading reduces the OECD's overall GNP costs of meeting their commitments under the Kyoto Protocol by about 63 percent in 2010, from $272 billion to $128 billion, or by $143 billion.[12] On the basis of previous analysis using G-Cubed of OECD permit trading without former Soviet Bloc participation, we estimate that roughly 60 percent of these benefits are due to relaxation of the constraint, while the other 40 percent constitute true gains from trade. If we also take into account the spillover effects on China and the LDCs, the world GNP costs of meeting Kyoto commitments is cut by 52 percent from $241 billion to $115 billion, or by $125 billion. These 2010 GNP gains are very unequally dispersed, however: the U.S. [13] gains only $14 billion, and Australia and Japan only $5 billion each; while the ROECD region gains $102 billion. Chinese and LDC GNPs are almost completely unaffected.

c) Global Trading

In the final scenario, we assume that the non-Annex I developing countries agree to distribute annual quantities of domestic emission permits consistent with their baseline emissions, and to allow these permits to be traded on international markets.[14] These results are contained in Table 3. The consequence of bringing developing countries into the trading regime is that Annex I countries can purchase emission allowances from owners in developing countries. These owners, in turn, would be willing to sell allowances to Annex I buyers only if the allowance price exceeded

[11] This shifting of resources between economies due to changes in property rights is known in international economics as the "transfer problem" is the subject of a large literature.

[12] We do not provide estimates of GNP effects for the former Soviet Bloc because of the difficulties mentioned previously.

[13] The U.S. experiences a small GDP loss from trading in 2010 is due to business cycle effects stemming from our assumption that wages adjust slowly: the sharp increase in U.S. energy prices under the trading scenario temporarily reduces labor demand relative to the no-trading case.

[14] As with the Annex I regions, we assume that developing regions sell a fixed number of permits at auction on an annual basis, and return the revenues to households as a lump-sum payment.

the marginal cost to the owners of undertaking emission reductions within the developing countries. The market process would thus lead to least cost reductions on a global scale: emission reductions would be taken wherever, they are cheapest, but Annex I countries would pay for them.

Full global trading cuts the permit cost to $23 per metric ton of carbon (MTC) in 2010 and $37 per MTC in 2020, and has only small effects on the Annex I economies. In 2010, the OECD regions achieve 75 to 90 percent of their targets through international purchases of emission allowances. Moreover, since wider availability of emission allowances reduces permit prices, OECD regions are able to purchase international permits at a lower overall cost than in the preceding scenarios: in 2010, international permit sales total $20 billion in the global trading case, about 60% of the $33 billion value of former Soviet Bloc international permit sales in the Annex I trading case. China provides about 300 MMTC of these allowances, and the other LDCs provide about 195 MMTC; the former Soviet Bloc provides another 410 MMTC. Nearly all of the reductions in China and the LDCs are achieved through reductions in coal use. Thus, one of the crucial effects of expanding from an Annex I trading regime to global trading is to transfer mitigation from oil-related emissions to coal. As a result, oil exporting countries experience only very modest losses in exports and revenues. Finally, global trading eliminates the possibility of carbon leakage.

The reduction in mitigation costs and the equalization of mitigation costs across regions greatly reduces the international macroeconomic effects of the Kyoto Protocol, compared with the previous scenarios. Except for Australia, OECD regions experience GDP and GNP impacts of at most 0.4 percent. Capital flows, exchange rate impacts and trade effects are all considerably lower. Relative to the no-trading case, aggregate OECD GNP costs in 2010 are cut by 78 percent from $233 billion to $51 billion; and relative to the Annex I trading case, costs are cut by 59 percent. All OECD regions benefit from cost reductions.

5 Conclusion

This submission has provided evidence from a global economic model, that if the Kyoto Protocol can be made binding there is likely to be a reduction in greenhouse gas emissions at relatively low cost if permit trading is implemented and if all countries and not just Annex 1

countries participate. The appeal of an international permits program is strongest if participating countries have very different marginal costs of abating carbon emissions – in that situation, the potential gains from trade are largest. Our results show that within the Annex I and globally, abatement costs are indeed quite heterogeneous. The marginal cost of meeting Kyoto targets in Australia measured in terms of own GDP loss is roughly 4.5 times that of the United States (keeping in mind that a simple adjustment has been made to the Kyoto targets to account for the non-carbon dioxide gases and sinks that are excluded from the model). Also a large quantities of relatively inexpensive emission reductions are available from the former Soviet Bloc and non-Annex I developing regions. These differences in abatement costs are caused by a range of factors including different carbon intensities of energy use, different substitution possibilities and different baseline projections of future carbon emissions. Because of these differences, international trading offers large potential benefits to parties with relatively high mitigation costs such as Australia.

Despite the attractiveness of permit trading , I argue that the Kyoto Protocol is fatally flawed because it does not address the problem of sustainability. A number of ways in which the protocol may collapse are presented above. The most obvious example is the collapse of the permit price if a relatively large country reneges on the agreement. This submission has also proposes an alternative policy that is designed to achieve the goals of UNFCCC but is more likely to be sustainable because it addresses some of the fundamental weaknesses of the Kyoto style approach to environmental policy. This alternative approach relies on a decentralized but coordinated system of emission permit and endowment markets that are maintained by individual governments within their national borders. We remove the problems of international permit trading while using market mechanisms as a basis for our proposal in a way that addresses both the economic and political sustainability issues directly in regime design. Australia could proceed with the McKibbin-Wilcoxen Proposal as an early action policy either as an end in itself or while the negotiations over how to solve the many problems of the Kyoto Protocol continue. The key is to give industry and consumers some degree of certainty in the short run so that longer run investment decisions can begin to reduce Australia's reliance on carbon now.

It would have been better to have the debate about the sustainability of a regime, designed to meet the goals of the UNFCCC, before the political negotiations produced a protocol with the flaws that potentially exist in the Kyoto Protocol. Nonetheless, it is not too late to have this debate, especially when one considers that the possible collapse of the Kyoto Protocol over the next decade will make the development of a realistic policy that actually slows greenhouse

emissions, that much harder to achieve.

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Table 1: Annex I Commitments Without International Permit Trading

	United States	Japan	Australia	Other OECD	China	LDC's
2005						
Permit price ($95)	--	--	--	--	--	--
Carbon emissions	1.9%	-2.4%	-0.1%	-1.8%	-0.9%	1.7%
Coal consumption	0.7%	-0.8%	0.0%	-0.6%	-0.8%	0.2%
Oil consumption	3.1%	-3.3%	-0.1%	-2.4%	-1.0%	2.6%
Gas consumption	1.9%	-0.7%	0.0%	-1.5%	-1.5%	1.8%
GDP	0.4%	-0.3%	0.1%	-0.2%	-0.3%	0.3%
Investment	2.9%	-0.5%	0.6%	-2.0%	-1.0%	2.7%
Exports	-8.6%	3.4%	-0.3%	7.6%	17.2%	-21.5%
Exchange rate	10.8%	-6.5%	0.7%	-12.9%	-4.7%	15.4%
Net foreign assets (Bil. $95)	-$244	-$49	$16	$184	$20	$78
GNP	0.3%	-0.3%	0.1%	0.0%	-0.2%	0.5%
2010						
Permit price ($95)	$87	$112	$181	$261	--	--
Carbon emissions	-29.6%	-20.6%	-37.5%	-32.7%	-0.7%	3.3%
Coal consumption	-51.9%	-43.6%	-55.1%	-49.6%	-0.8%	0.3%
Oil consumption	-15.6%	-14.2%	-18.4%	-29.5%	-0.4%	5.1%
Gas consumption	-12.6%	-4.6%	-19.4%	-18.2%	-1.2%	3.4%
GDP	-0.4%	-0.6%	-1.8%	-1.5%	-0.2%	0.4%
Investment	0.8%	-1.3%	0.2%	-3.8%	-0.4%	2.9%
Exports	-10.7%	1.2%	-4.5%	5.8%	8.1%	-25.1%
Exchange rate	10.5%	-5.8%	2.1%	-13.5%	-4.7%	15.9%
Net foreign assets (Bil. $95)	-$451	-$55	$29	$370	$34	$141
GNP	-0.6%	-0.5%	-1.6%	-1.3%	-0.1%	0.7%
2020						
Permit price ($95)	$101	$162	$230	$315	--	--
Carbon emissions	-35.7%	-27.6%	-44.1%	-39.1%	-0.7%	3.1%
Coal consumption	-59.7%	-56.5%	-64.7%	-58.4%	-0.7%	0.2%
Oil consumption	-19.8%	-19.6%	-21.2%	-35.1%	-0.4%	4.8%
Gas consumption	-17.9%	-6.7%	-23.9%	-24.0%	-1.1%	3.4%
GDP	-0.5%	-0.7%	-1.8%	-1.6%	-0.2%	0.4%
Investment	0.9%	-1.4%	0.3%	-3.5%	-0.7%	2.5%
Exports	-12.2%	1.3%	-6.7%	4.1%	4.7%	-20.7%
Exchange rate	11.0%	-7.0%	5.0%	-13.0%	-5.0%	15.7%
Net foreign assets (Bil. $95)	-$489	-$104	$48	$490	$43	$184
GNP	-0.7%	-0.7%	-1.5%	-1.3%	-0.1%	0.7%

Source: McKibbin et. al. (1999)

Table 2: Annex I Commitments With International Permit Trading

	United States	Japan	Australia	Other OECD	China	LDCs
2005						
Permit price ($95)	--	--	--	--	--	--
Annual permit sales (Bil. $95)	--	--	--	--	--	--
Carbon emissions	1.4%	-2.7%	-0.3%	-2.1%	-0.6%	1.8%
Coal consumption	0.6%	-1.0%	-0.3%	-0.6%	-0.6%	0.2%
Oil consumption	2.3%	-3.7%	-0.7%	-2.9%	-0.8%	2.7%
Gas consumption	1.5%	-0.7%	-0.8%	-1.7%	-1.2%	1.9%
GDP	0.3%	-0.2%	0.0%	-0.2%	-0.2%	0.3%
Investment	2.3%	-0.6%	-0.3%	-2.2%	-0.6%	3.0%
Exports	-6.9%	3.6%	1.1%	8.9%	11.5%	-22.8%
Exchange rate	8.9%	-7.1%	-0.6%	-14.4%	-2.4%	16.6%
Net foreign assets (Bil. $95)	-$139	-$28	$22	$242	$16	$67
GNP	0.2%	-0.2%	0.0%	-0.1%	-0.2%	0.5%
2010						
Permit price ($95)	$61	$61	$61	$61	--	--
Annual permit sales (Bil. $95)	-$9.4	-$1.5	-$1.9	-$20.3	--	--
Carbon emissions	-20.9%	-13.0%	-13.0%	-9.1%	-0.5%	2.6%
Coal consumption	-36.0%	-24.2%	-18.7%	-12.1%	-0.5%	0.4%
Oil consumption	-11.8%	-10.4%	-6.7%	-9.0%	-0.4%	4.0%
Gas consumption	-8.8%	-2.9%	-6.8%	-5.6%	-0.7%	2.9%
GDP	-0.2%	-0.4%	-0.7%	-0.6%	-0.1%	0.4%
Investment	0.8%	-1.0%	-0.3%	-2.4%	-0.3%	2.8%
Exports	-7.6%	2.5%	-0.8%	8.0%	5.7%	-23.7%
Exchange rate	8.5%	-6.7%	-0.4%	-14.7%	-2.1%	17.5%
Net foreign assets (Bil. $95)	-$304	-$12	$36	$476	$29	$121
GNP	-0.5%	-0.4%	-0.8%	-0.6%	-0.1%	0.7%
2020						
Permit price ($95)	$109	$109	$109	$109	--	--
Annual permit sales (Bil. $95)	$9.0	-$4.4	-$4.6	-$53.7	--	--
Carbon emissions	-33.3%	-18.6%	-18.4%	-13.0%	-0.4%	2.7%
Coal consumption	-54.5%	-35.4%	-26.8%	-17.8%	-0.4%	0.4%
Oil consumption	-19.9%	-14.3%	-9.2%	-12.3%	-0.3%	4.2%
Gas consumption	-16.6%	-4.5%	-10.0%	-8.3%	-0.6%	3.1%
GDP	-0.5%	-0.5%	-0.9%	-0.7%	-0.1%	0.5%
Investment	0.5%	-1.1%	-0.2%	-2.4%	-0.4%	2.7%
Exports	-9.1%	2.2%	-1.9%	7.3%	2.7%	-20.2%
Exchange rate	9.1%	-7.1%	0.5%	-15.0%	-2.1%	17.9%
Net foreign assets (Bil. $95)	-$390	-$22	$47	$614	$40	$165
GNP	-0.7%	-0.5%	-1.1%	-0.7%	0.0%	0.7%

Source: McKibbin et. al. (1999)

Table 3: Annex I Commitments With Global Permit Trading

	United States	Japan	Australia	Other OECD	China	LDCs
2005						
Permit price ($95)	--	--	--	--	--	--
Annual permit sales (Bil. $95)	--	--	--	--	--	--
Carbon emissions	0.6%	-1.2%	-0.1%	-0.9%	0.9%	0.8%
Coal consumption	0.2%	-0.3%	0.0%	-0.3%	0.9%	0.4%
Oil consumption	1.0%	-1.7%	-0.4%	-1.3%	1.2%	1.1%
Gas consumption	0.7%	-0.3%	-0.4%	-0.8%	1.8%	0.7%
GDP	0.1%	-0.1%	0.0%	-0.1%	0.4%	0.1%
Investment	1.0%	-0.2%	-0.3%	-1.0%	2.4%	1.1%
Exports	-2.9%	1.5%	1.0%	4.1%	-27.2%	-8.7%
Exchange rate	3.7%	-3.1%	-0.6%	-7.0%	12.4%	6.1%
Net foreign assets (Bil. $95)	-$54	-$8	$12	$106	-$38	$25
GNP	0.1%	-0.1%	0.0%	0.0%	0.3%	0.2%
2010						
Permit price ($95)	$23	$23	$23	$23	$23	$23
Annual permit sales (Bil. $95)	-$8.9	-$1.2	-$1.0	-$9.3	$7.0	$4.5
Carbon emissions	-7.4%	-4.2%	-4.9%	-3.4%	-19.1%	-7.9%
Coal consumption	-13.3%	-8.9%	-7.0%	-4.5%	-22.0%	-13.3%
Oil consumption	-3.6%	-2.8%	-2.4%	-3.3%	-3.3%	-5.6%
Gas consumption	-3.0%	-1.0%	-2.9%	-2.2%	-10.4%	-2.0%
GDP	-0.1%	-0.1%	-0.3%	-0.3%	-0.6%	-0.2%
Investment	0.4%	-0.3%	-0.2%	-1.0%	0.6%	0.1%
Exports	-3.4%	0.8%	-0.3%	3.6%	-22.6%	-9.7%
Exchange rate	3.6%	-2.8%	-0.6%	-7.2%	10.9%	6.5%
Net foreign assets (Bil. $95)	-$115	-$2	$20	$208	-$71	$51
GNP	-0.2%	-0.1%	-0.4%	-0.2%	-0.4%	0.0%
2020						
Permit price ($95)	$37	$37	$37	$37	$37	$37
Annual permit sales (Bil. $95)	-$21.1	-$3.9	-$2.5	-$25.2	$24.3	$17.1
Carbon emissions	-11.4%	-6.1%	-6.5%	-4.6%	-24.9%	-11.1%
Coal consumption	-19.2%	-12.8%	-9.7%	-6.3%	-28.7%	-17.8%
Oil consumption	-6.2%	-4.2%	-3.1%	-4.4%	-4.9%	-8.2%
Gas consumption	-5.5%	-1.5%	-3.5%	-3.0%	-13.5%	-3.6%
GDP	-0.1%	-0.2%	-0.3%	-0.3%	-0.7%	-0.3%
Investment	0.3%	-0.4%	-0.1%	-1.0%	0.3%	0.0%
Exports	-3.9%	0.7%	-0.7%	3.3%	-20.0%	-9.0%
Exchange rate	3.6%	-3.4%	-0.4%	-7.5%	15.0%	7.0%
Net foreign assets (Bil. $95)	-$155	-$13	$25	$263	-$66	$78
GNP	-0.3%	-0.2%	-0.4%	-0.3%	-0.1%	0.0%

Source: McKibbin et. al. (1999)