# Equity and Global Climate Change: Economic Considerations †

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**Abstract**

Carbon abatement in the industrialized countries is the primary means of reducing greenhouse gas emissions under the Framework Convention on Climate Change. Abatement policies in the OECD will have important implications for all countries which import and export oil, coal and energy-intensive products. Changes in terms of trade will produce perverse terms of trade effects which will encourage production of energy intensive goods in developing countries which tend to be less energy efficient.

Technology transfer programs which simultaneously compensate for spillovers and reduce the carbon intensity of production in developing countries therefore have an obvious appeal, yet it remains difficult to devise a scheme (short of a global system of tradable permits) which introduces appropriate individual incentives.

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# 1 Introduction

Policies to reduce greenhouse gas emissions will have direct effects on all countries that adopt limits. These measures will result in reductions in fossil fuel usage, and the ramifications of these changes will be felt throughout the economy. The entire world is linked by trade, so that policies in one country will also have indirect effects on other countries through changes in international markets and terms of trade. Countries with different economic and energy profiles - including their energy intensity of production, their position as energy importer or exporter, their industry mix, and their general involvement in international trade - face very different fates.

The costs of reducing emissions will vary across countries and industries and depend critically on the time scales over which change is required. For those countries that adopt emissions limits, their energy consumption per dollar of gross domestic product, especially their consumption of fossil energy, domestic energy prices, and energy trade (whether exporter or importer) matter the most. These statistics vary greatly for the current set of countries that plan to adopt limits.

For example, energy consumption per dollar of Gross Domestic Product for different countries ranges from 5,000 Btu per dollar to over 50,000 Btu per dollar. Some of these differences are accounted for by the varying industry structures in different countries - for example, energy-intensive industries are more important to the economy of Canada than to the economy of Austria. But there are also large differences in the amount of energy and carbon used per dollar of output in identical industries in different countries. Energy resource endowments differ widely across countries - some, like Australia, have abundant supplies of carbon-intensive fuels like coal; others, like Norway and France, rely heavily on carbon-free fuels like hydroelectric or nuclear power. Prices of energy also vary dramatically, in some cases reflecting differences in costs of domestically produced fuels and in other cases large taxes and subsidies. All of these factors influence the ultimate costs of reducing carbon emissions in participating countries; just as these costs differ from country to country, so do the economic impacts of compliance.

Effects of climate change policies that are communicated through international trade complicate the understanding of who benefits and who pays for these policies. Although the direct costs of reducing emissions are supposedly borne solely by the industrial countries, developing countries are also affected. Trade with the industrial world, involving both imports and exports, is critical to the economies of most developing countries. When adopters limit their emissions, they demand less energy and so cause the world demand for energy to fall, which leads to lower world energy prices. This price drop benefits non-participating, energy-importing countries but hurts non-participating energy-exporting ones. In addition, by constraining their energy choices, the countries that adopt emissions limits face economic losses. Reductions in national income in the industrial countries will reduce their demand for imports from the developing world, applying downward pressure on the prices of exports from developing countries. At the same time, rising prices of energy-intensive goods in the industrial world may apply upward pressure on the prices of energy-intensive goods imported to developing countries.

These changes are referred to generically as "terms of trade" effects - changes in the relationship between the prices paid for imports and the prices received for exports. If terms of trade move against developing countries, some of the costs of meeting emissions targets in the industrial countries will be shifted to developing countries, and vice versa. Terms of trade effects can also shift costs among industrial countries, with those facing the highest costs possibly shifting some of those costs to more fortunate industrial countries in the form of higher prices for exports and lower prices for imports.

Economics models for studying these effects must incorporate the links among markets and the global trade and savings-investment balance. Therefore, for example, an oil-exporting country that suffers from lower world oil demand and prices may be able to shift to producing other goods

for export, but only to the extent allowed by conditions in those markets and its own ability to save or borrow funds for investment.

To date, negotiations over global warming abatement strategies are focused on abatement by industrialized countries, particularly the OECD. Unfortunately, abatement opportunities within the OECD are quite costly relative to the abatement opportunities available in many non-OECD countries. This has lead to a number of suggestions for incorporating developing countries in the process. The most concrete step in this direction has been the inclusion of a "clean development mechanism" (CDM) in the treaty text. Many observers conclude that CDM should be included as one component of any multilateral agreement. Current discussions amongst negotiators appears to accept the idea of CDM within the set of nations party to an agreement to abate. It remains an open and controversial issue if this will be extended to include abatement undertaken by countries that are not party to the agreement.

The problem of sharing the burden equitably is significantly less difficult if emission rights are tradeable. When emission rights are not tradable then it can be very difficult to find the right way to share the burden, and there can be considerable variations in the distribution of the burden which may be politically unacceptable. With the right combination of policies with respect to CDM and tradable rights, the gains from trade in carbon abatement are distributed in such a way as to mitigate the global equity problem that arises from an OECD commitment to abate. In effect, efficiency can be the handmaiden of solving the burden sharing problem. Rather than there necessarily being a trade-off between efficiency and equity, the two can be complementary in designing an attractive global arming policy.

## 2 Spillover Impacts on Developing Countries

The economic costs for developing countries under climate action by the OECD are varied but generally negative. The net impacts are a result of multiple offsetting effects: there is a loss in exports due to the GDP slowdown in the OECD countries (an "income effect"); there are offsetting competitive advantages conveyed in the production of energy intensive goods (a "substitution effect"); and, finally, there are simultaneous increases in the prices of energy-intensive imports from OECD countries and decreases in the prices of fossil fuels ("terms of trade effects").

Figure 1 illustrates a summary of the economic costs for these three groups of regions. These results, from the MS-MRT model (Montgomery et al., 1999) are indicative of results which repeatedly emerge from the models I have studied.

When we look across a range of developing countries, we find a wide range of results, as illustrated in Figure 2. In this analysis, also based on the International Impact Assessment Model, we see that the greatest burden falls upon the oil-exporting countries (Saudi Arabia, Venezuela etc.), yet there are also negative impacts on newly industrialized countries such as Malaysia and Singapore which are closely integrated with the OECD through trade. Finally, Figure 2 also demonstrates that there may be winners as a result of carbon abatement in industrialized countries. In this model, we find that India and South Korea, both energy importers, are net beneficiaries due to changes in the prices of their imports and exports.

Apart from international energy flows, the international markets for energy-intensive products are the most important channels through which carbon abatement measures are transferred to the developing countries. In order to understand why these markets are affected, we need to consider the significant differences in production technologies across countries.

Figure 3 presents energy value shares for a selection of countries and commodities. The regions include three OECD countries (Japan, Germany and the United States) and four non-Annex-B countries (China, India, Mexico and Indonesia). The commodities compared here are iron and steel

(I&S), chemicals (CRP), non-ferrous metals (NFM), and non-metallic minerals (NMM). These values exhibit considerable variation across countries, due both to differences in technology and energy prices.

An energy value share represents the price of energy inputs multiplied times quantities of those inputs and then divided by the market value of output. When we account for differences in energy prices and the composition of energy inputs[1] across countries, we find even more significant difference in the *carbon content* of these goods produced in different countries. Japan and Germany, which have energy value shares roughly equal to the US have considerably higher energy prices and consequently lower carbon intensities (see Figure 4). India, China and to a limited extent Indonesia, all have enormously higher carbon content in their energy-intensive manufactures. Heterogeneous carbon contents reflect both differences in energy prices, technology and the fossil-fuel composition of primary energy in different countries. Countries such as China and India which are heavily dependent on coal-fired electricity are inherently more carbon intensive.

The underlying reasons for these enormous differences in energy efficiency are manifold. First, these differences reflect differences in the stages in development (see Nakićenović et al., 1999). Another explanation is exchange rates. The numbers presented here are based on *market* exchange rates, whereas if the calculations were carried through with *purchasing-power-parity adjusted* exchange rates, the differences might not be so exaggerated. On the other hand, while energy-intensive goods are largely produced domestically, the trade which exists involves substantial north-south flows at market rates of exchange. Europe is a substantial exporter, and there are significant bilateral flows between the US and the developing world.

When carbon abatement is undertaken in the industrialized there are potentially substantial changes in trade flows. The basic effects are reduction in OECD exports of energy-intensive goods and increases in OECD imports of these products. These changes induce substantial changes in employment, effects which are often regionally-concentrated. Dislocations in the industrialized countries are moderated to only a limited extent by efficiency-improving policies such as permit trade.

The policy response to support employment in energy-intensive firms could take the form of sectoral subsidies (Böhringer and Rutherford, 1997) or the erection of new trade barriers. A protectionist policy would have uniformly adverse consequences for the developing world. It is a matter of debate whether tariff protection would be admissible through the WTO.

If protective tariffs were permitted, they could be quite large if they were based on the carbon contents of goods produced in the developing world, as indicated in Figure 4. Tariff actions would immediately eliminate any competitive advantage which developing countries might anticipate as a result of reductions in international energy prices and increased demand for energy-intensive goods in the OECD.

# 3 Conclusion

The message of this paper is that carbon abatement actions in the industrialized countries could have significant spillover effects for the developing countries. The qualitative nature of these effects are consistent across a range of models: there are substantial costs for energy exporters, mixed to positive effects for countries which import energy and export energy-intensive goods to the OECD, and there are largely negative impacts for regions which specialize in non-energy-intensive products and are closely connected with OECD countries through trade.

Technology transfer aid programs which compensate for adverse spillovers and reduce the car-

[1] On a equal energy-basis, coal, oil and gas produce carbon emissions roughly in the ratio 3:2:1.

bon intensity of production in developing countries have political appeal, but these types of policies may be difficult to implement in practice. There are several proposals for implementation of the Clean Development Mechanism, but the introduction of any such system will involve establishing baseline emission trajectories. Given the need for such baselines, economists would argue that the simplest solution would be to implement a global system of tradable permits. The alternative is a continual battle to overcome perverse incentives which arise whenever governments get too closely involved in the detailed allocation of scarce resources.

Finally, there is a need for vigilance on the issue of border measures. In the face of severe dislocations in isolated energy-intensive sectors, there will be substantial political support for protectionism. If implemented, these programs would be far worse for the developing countries than their full participation in a global system of tradable permits.

# References


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**Figure 1: The Distribution of Economic Costs**

GDP Impacts in 2010

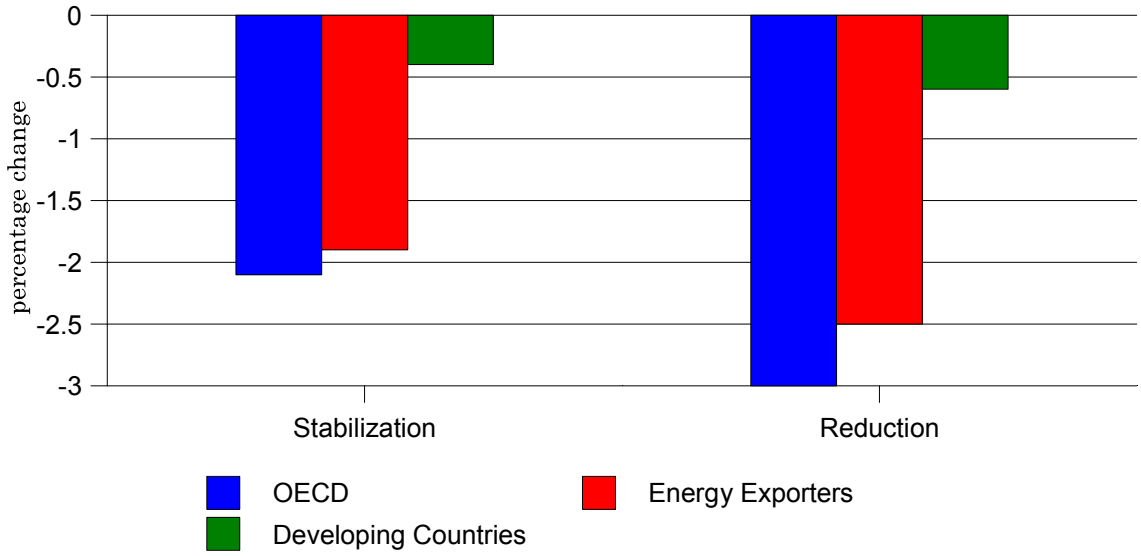
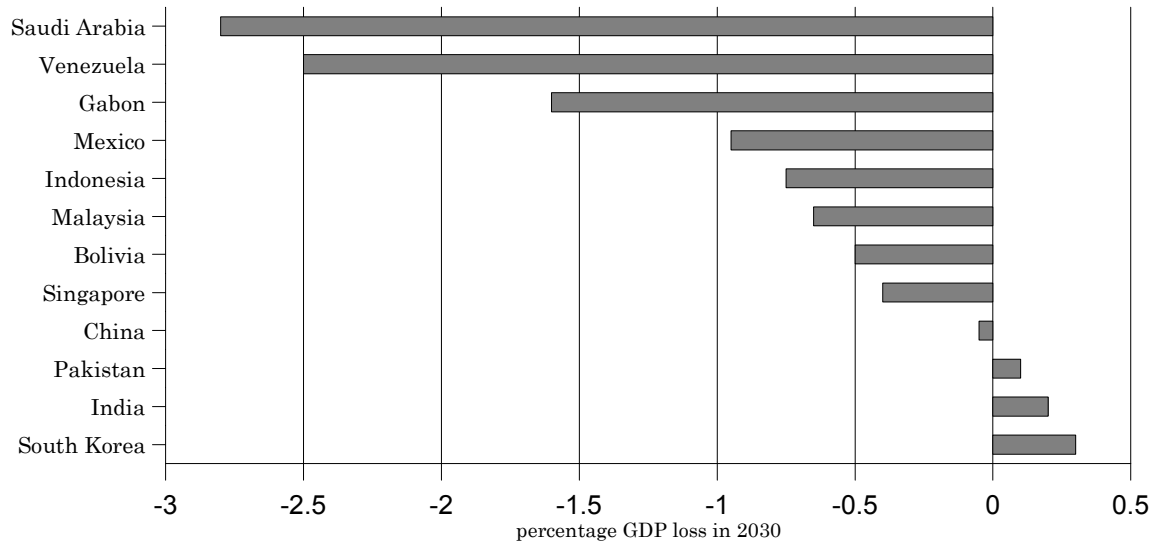
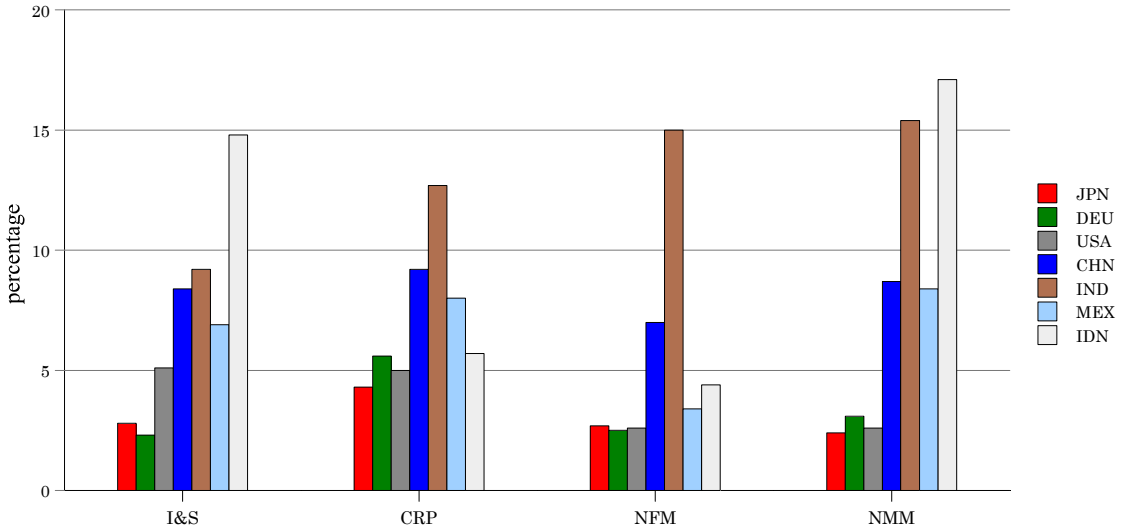



**Figure 2: Impacts on Selected Non-Annex 1 Countries**



## Figure 3: Energy Value Shares




## Figure 4: Carbon Content of Energy-Intensive Goods