

Models and Policies and Measures

James W. Ragland
Montréal, Canada
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UNFCCC Addressed Impacts

- Article 3.2 of the Convention refers to disproportionate impacts or abnormal burden on specific groups of nations
- Articles 4.8 and 4.9 of the Convention refer to adverse effects of response measures on non-Annex I parties of actions taken by Annex I parties in the implementation of their commitments to reduce emissions
- Article 3.14 of Kyoto Protocol explicitly states that each Annex I Party shall strive to implement its commitment in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention

Impact Noted by IPCC TAR

- Abatement in Annex 1 would have “predominately adverse” impact on non-Annex 1 regions
- “Robust” finding “Emissions constraints on Annex 1 countries have well-established, albeit varied ‘spill-over’ effects on non-Annex 1 countries”
- Simulations based on Kyoto showed mixed effects among non-Annex 1
- Non-Annex 1 regions suffer smaller welfare losses under Kyoto simulations with emissions trading regimes and carbon taxes

Impact Noted by IPCC TAR

- “Analyses report reductions in both projected GDP and projected oil revenues for oil-exporting, non-Annex 1 countries.”
- “The effects on these countries can be further reduced by removal of subsidies for fossil fuels, energy tax restructuring according to carbon content, increased use of natural gas, and diversification of the economies of non-Annex 1, oil exporting countries.”

Oil Exporting Non-Annex 1 Nations Disproportionately Affected

- True of all models and all impact measures (i.e., GDP, Welfare, Revenue)
- Nations with greatest dependence on oil revenues face greatest negative impact
- Impacts attributable to adverse shifts in terms of trade and reductions in Annex 1 oil consumption

Spillover Effects Of Broad Market Based Approaches Are Well-established

- **Adverse impacts on most non-Annex 1 countries**
 - Reduction in Annex 1 income reduces demand for imports
 - Higher Annex 1 production costs increases real price of exports
 - Result is adverse shift in terms of trade for developing countries
- **Potentially beneficial impacts on non-Annex 1 exporters of energy-intensive (EIS) products**
 - Increased cost of Annex 1 EIS production increases demand and price received for EIS exports
 - Reduction in cost of energy imports reduces non-Annex 1 costs
 - Potential terms of trade improvement for large EIS exporters
- **Large adverse impacts on energy exporters**
 - Reduction in Annex 1 demand reduces oil imports and prices
 - All energy exporting countries suffer adverse effects
- **Patterns of spillover effects are governed by trade and macroeconomic relationships**

Sectoral Policies Very Important

- **Even if bottom-up policies are assumed to have no cost to the Annex 1 economy, they have adverse spillover effects**
 - Reduction in oil imports lowers world oil price and causes harm to all countries with significant oil exports
- **The degree of harm to oil exporters is directly tied to stringency of transportation sector policies**
 - Exempting transportation reduces harm close to zero
 - Greater reliance on transportation measures increases harm
- **Impacts of sectoral policies that give preferential treatment to Annex 1 industry need to be examined carefully to determine how non-Annex 1 competitors are affected**

Impact on Oil Exporters From Models Cited in TAR

| | No Trading | Trading in Annex 1 | Worldwide Trading |
|---------------------------------|---------------|-----------------------|----------------------|
| G-Cubed (oil revenue) | -25% | -13% | -7% |
| GREEN (real income) | -3% | Much Less | NA |
| GTEM (GDP) | -0.2% | <0.05% | NA |
| MS-MRT (welfare) | -1.39% | -1.15% | -0.36% |
| OPEC (revenue) | -17% | -10% | -8% |
| CLIMOX (revenue) | NA | -10% | NA |

Adverse Terms of Trade Impacts

- **As energy costs rise in Annex 1 nations their exports will reflect the higher costs**
- **Import demand from Annex 1 nations will fall for both energy and less-energy intensive goods**
- **Export prices faced by non-Annex 1 nations for energy-intensive goods will rise**

Averse Impact from Fall in Oil Use in Annex 1 Participating Nations

- **Oil demand will fall in Annex 1 nations due to higher prices (Tax Effect)**
- **World oil price will fall**
- **Oil output will decrease in response to lower prices**
- **Export earnings of oil exporters will fall due to lower prices and exports**

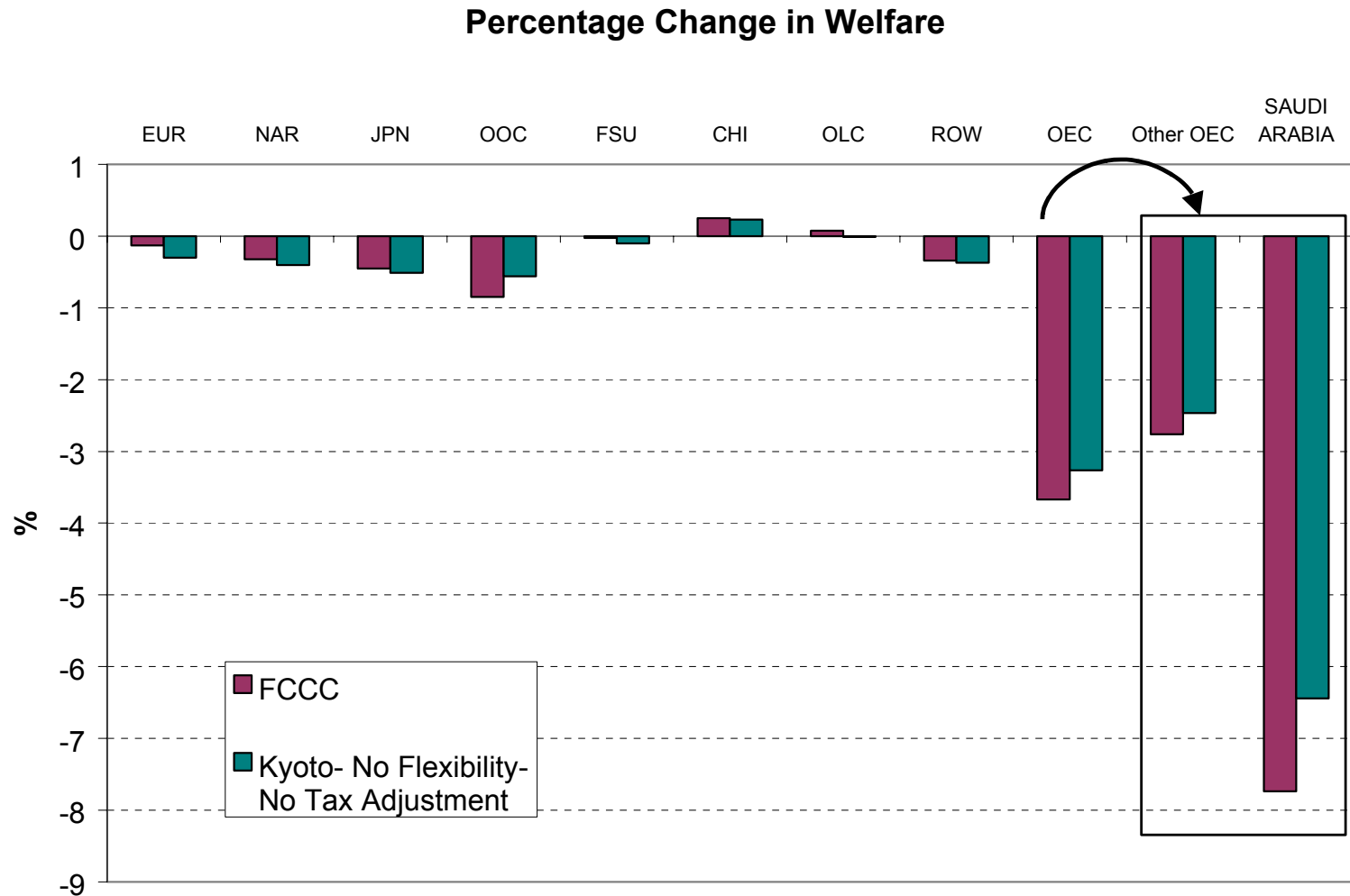
Most Models Do Not Account for Structure of Oil Sector in Exporting Nations

- Underestimates negative impact on oil exporters
- In most CGE models oil exporters are portrayed as delivering oil on a supply curve calibrated to baseline price and quantity under an assumption of perfect competition (i.e., $P = MC$)
- Infra-marginal cost of reductions in the world oil price were small due to model structure wherein calibrated input resources to the crude oil production activity were “released” for other uses as the world oil price eroded

Most Models Do Not Account for Structure of Oil Sector in Exporting Nations

- If we acknowledge that oil is being sold above short-run marginal cost, then the cost of reductions in the world market oil price are more pronounced.
- MS-MRT results
 - Welfare loss estimates doubled with accurate capital value share (Exporters earn scarcity rents that are lost when oil exports and oil prices decline)

Saudi Arabia Faces Largest Welfare Loss



2005 Bonn Meeting Update

- Across all scenarios, oil exporters suffer the largest adverse effects
 - Loss to oil exporters is consistently larger than impact on any Annex 1 region
- The degree of harm to oil exporters is directly tied to stringency of transportation sector policies
 - Exempting transportation reduces harm close to zero
 - Greater reliance on transportation measures increases harm
- Other non-Annex 1 countries are affected as expected
 - Large exporters of energy-intensive goods may gain through improved competitiveness, but these gains would be erased if Annex 1 countries protect industries
 - The rest of non-Annex 1 countries suffer adverse affects

Models' Shortcomings

- **Gaps in Data Sets**
- **Limited Coverage of Regions**
- **Assumptions and Applicability**
- **Separation of Policies' Impacts**
- **Reliance on Long-Term Climate Scenarios from Climate Models**

2002 Bonn Workshop Recommendations

- More modeling proposed, with improved detail on welfare impact, terms of trade and socio-economic impacts on individual developing countries
- Improve the assessment of the impact of implemented response measures by means such as:
 - (a) Data sets (technology, energy data, economic and social indicators);
 - (b) Development of assumptions that are widely accepted based on standardized approaches;
 - (c) Verification of existing data;
 - (d) Address implemented policies in addition to potential policies and measures;
 - (e) Establishment of a consistent baseline data set.

Model Types

| Economy Model | Energy/Carbon Model | | |
|------------------------------------|---|-----------------------------------|--------------------|
| | Fuel Supplies & Demands by Sector | Energy Technology Detail | Carbon Coefficient |
| Aggregate Production/Cost Function | | CETA MERGE GRAPE MiniCAM | FUND RICE |
| Multisector General Equilibrium | MIT-EPPA Worldscan SGM G-Cubed | ABARE-GTEM AIM MS-MRT | |
| Multisector Macroeconometric | Oxford | | |

CGE Models Well Established

- **Most near-term reductions in greenhouse gases will come from curbing fossil fuel demand. Given the structure of energy markets and the role that these inputs play in many economic functions, determining the economic costs of abatement is a general equilibrium problem.**
- **Theoretical foundation (Arrow, Scarf)**
- **History of use in international trade negotiations**
- **Agricultural trade assessments**
- **Uruguay Round**
- **WTO hearings and assessments**

Need to Measure Adverse Impacts

- **Models' uncertainty reflection of the complexities and interdependencies of the relationships of the physical, social and economic forces at work**
- **Models don't produce the uncertainties, they make them transparent and provide a means of estimating the magnitude of the uncertainty**
- **Differences in the models' results are reflections of the importance and effects of specific assumptions**
- **If not models, then what?**

How to Move Forward and Improve Models

- **Improved Data**
 - **Need for standardized and authenticated (GTAP type standard) data sets for major non-Annex 1 nations (especially OPEC and other oil exporters)**
- **Research, analysis and modeling of transportation sector elasticities and the impact of technological developments**

How to Move Forward and Improve Models

- **Consistent basis for analysis of PAM between models**
 - **Cap and Trade**
 - **Carbon Tax**
 - **Regulatory Policies**
 - **Technology Policies**

How to Move Forward and Improve Models

- **Accurate modeling of the oil sector capital structure in oil exporting non-Annex 1 nations**
- **Consistent modeling of world oil market**
- **Recognition of the critical role oil export revenues play in most OPEC Nations**
- **Inclusion of world oil resources, E&P economics and the development of oil supply curves by regions**

How to Move Forward and Improve Models

- **The models should take into account sequestration technologies**
- **Means and methods for consistent comparisons of model output have to be developed**
- **Sensitivities of results to underlying assumptions**