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BACKGROUND PAPER

**The Limits of Economic Modeling in the
FTAA Environmental Review**

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The Limits of Economic Modeling in the FTAA Environmental Review: Economists find flaws in proposed methodology

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Executive Summary

Researchers with the Global Development And Environment Institute (G-DAE) at Tufts University and the Science, Technology and Development Program at the Colegio de Mexico have submitted formal comments to the Office of the U.S. Trade Representative on the proposed methodology for its official environmental review of the Free Trade Area of the Americas (FTAA) proposal. The authors applaud the USTR for conducting an environmental review; this is an important step that should precede the adoption of any trade agreement. However, the methodology proposed for the environmental review has serious limitations. It relies too heavily on complex and controversial economic models, which are likely to produce erroneous predictions of environmental impact. It also fails to incorporate some of the most important impacts likely to result from the proposed FTAA, most notably those deriving from changes in investment rules.

In its official comments, which were submitted to the USTR January 19, the authors offered six major criticisms, followed by a list of recommendations.

1. The proposed methodology makes an unjustified distinction between “core” and “supplemental” analyses. The core is supposed to estimate the economic effects of the FTAA, and then estimate the resulting changes in environmental variables. Yet the report acknowledges in advance that the complex models that will be used for the core analysis will be incomplete and unable to perform a full assessment of environmental and health impacts of FTAA. In fact, the flawed models in use will lead to erroneous predictions if they remain the foundation for the environmental impact analysis.

2. The “computable general equilibrium” (CGE) models that are proposed for the core analysis are inaccessible to non-economists, and expensive and difficult to operate. They do not have a track record of empirical success that justifies their dominant status in the proposed environmental review. For example, leading CGE models made dramatically incorrect forecasts about the effects of NAFTA on corn and tortilla markets in Mexico. The economic theory underlying CGE models is controversial, and even advocates of CGE modeling state that their techniques are poorly suited for dynamic analysis.

3. Many of the indirect economic relationships that CGE analyses seek to represent can be captured in simpler, more transparent models. A variety of partial equilibrium techniques can avoid many of the complexities and controversies that plague CGE models. In particular, input-output relationships among industries have in the past been analyzed without the added layer of CGE techniques - and could be again.

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4. The specific models proposed for the core analysis were developed for other purposes, and are not well designed for the task of estimating the environmental impacts of FTAA.

Limitations of these models include overly aggregated economic categories, lack of analysis of areas outside the U.S., and dated base years, generally 1995-97, but in one case as far back as 1990. (Since the models will compare the anticipated effects of FTAA to the conditions that existed in the base year, an older base year means a less interesting and less relevant comparison.)

5. The proposed analysis focuses too heavily on tariff-related changes in U.S. imports and their environmental effects.

This fails to recognize that the proposed FTAA, like NAFTA, involves much more than reducing tariffs. It involves changes in U.S. export markets. (There have been significant increases in U.S. exports of meat and transgenic crops, for example, as a result of NAFTA, both of which have important environmental impacts.) The FTAA also involves rules regarding intellectual property rights, subsidies, government procurement, and investment, all of which have environmental impacts. Changes in patterns of foreign direct investment (FDI) are particularly important; NAFTA helped stimulate a tripling of Mexico's incoming FDI, which has had profound consequences for the environment.

6. Environmental impacts should be studied throughout the hemisphere, not just within the U.S.

Many environmental problems are global in scope, or inevitably involve trans-boundary effects. It is important to know whether potential environmental benefits for the U.S. come at the expense of other countries - such as "dirty" industries moving from the U.S. to other nations.

Recommendations

The decision to carry out an environmental review of the FTAA proposal is commendable, but the USTR should make substantial changes in the methodology of the review:

1. Any environmental impact assessment of the FTAA should have at its "core" a straightforward, transparent analysis drawing on a variety of available methodologies, not simply estimates based on the results of controversial and limited modeling techniques. These methodologies can include, but should not be limited to, CGE models.
2. Additional analyses should then describe their methods for estimating indirect effects. Simpler methods, including traditional input-output analyses, should be included along with CGE analyses, allowing a comparison of the results of different methodologies.
3. A peer review or expert commentary process should be created to evaluate the critical assumptions embodied in the proposed core analysis models, prior to their use.
4. The analysis should include the environmental impacts of other aspects of the FTAA beyond changes in tariffs and trade, such as expected changes in investment patterns.
5. The analysis should include the environmental impacts of the FTAA in the region as a whole, not just the U.S.

Comments on the proposed methodology for the “Environmental Review of the Proposed Free Trade Area of the Americas”

Background: The Trade Policy Staff Committee (TPSC) of the Office of the US Trade Representative (USTR) has suggested a detailed methodology for evaluating the environmental impacts of the proposed Free Trade Area of the Americas (FTAA), and has requested public comments on that methodology. The methodology is contained in the October 2000 “Report of the Quantitative Analysis Working Group to the FTAA Interagency Environment Group” (hereafter cited as the “Working Group Report”).

Overview of comments: We welcome the fact that there will be an official environmental review of the FTAA proposal. This is an important step that should occur before the adoption of any trade agreement. However, the methodology of the Working Group Report has serious limitations, relying too heavily on extremely complex and theoretically controversial models, while slighting major categories of environmental impacts.

Our detailed comments fall under six headings:

1. the inadequacy of the proposed core analysis
2. the limitations of computable general equilibrium (CGE) models in theory and practice
3. the benefits of input-output analysis in a partial equilibrium framework
4. the drawbacks of the specific models recommended in the Working Group Report
5. the need to include exports and investment as well as imports resulting from FTAA
6. the importance of analysis covering the whole hemisphere, rather than the US alone

Following discussion of these six points, we conclude with a list of recommendations.

1. The proposed “core” analysis is inadequate, and should not form the basis for an evaluation of the environmental impacts of FTAA.

The Working Group’s proposed methodology makes a basic distinction between what it calls “core” and “supplemental” analyses. The terminology leads readers to infer that the former category is more important and more firmly rooted, but the Report never justifies this inference. The two categories could, with greater justification, be called “preliminary” and “in-depth”, conveying an entirely different message about their relative status.

In fact, the “core” analysis is particularly problematic. In that analysis, fundamental questions will be addressed:

“the economic effects, such as changes in trade, production and consumption, of the FTAA are estimated; and ... the economic effects are then used to estimate changes in some environmental variables.” (Working Group Report, p.1.)

This would be an excellent starting point, if it could be done well. Yet we are told that the supplemental analyses will be needed because it is known in advance that the core results will be inadequate. In the Working Group’s own words, the output of the core models

“...may be too aggregated to detect or fully assess important trade and environmental impacts... Also, the core analysis only covers a subset of possible environmental and health concerns.” (ibid.)

That is, the Working Group anticipates that the core results will be incomplete. Why, then, are these models the core of the analysis? It would be better to start with a comprehensive assessment of the potential environmental impacts of trade and investment, and then determine which economic methods and models are appropriate to supplement that assessment.

Given the known limitations of the models available to the Working Group, it is remarkable that there is no mention of the methodology that has already been developed by NAFTA’s Commission for Environmental Cooperation (CEC) for assessment of NAFTA’s environmental effects. Although it is not the last word on the subject, the CEC methodology is in several respects more subtle and better developed than the Working Group’s proposed approach. The CEC spent a considerable amount of time on such analyses, and has presented a number of case studies raise many interesting issues and critiques. However, the CEC’s work in this area is not even mentioned in passing by the Working Group’s report.

Additionally, the core results will apply largely or solely to the US, rather than to the 34-nation FTAA region as a whole. Crucial questions about FTAA, such as the possibility that it will encourage industry to move to “pollution havens” with lax environmental regulations, cannot be addressed by an analysis of the US alone.

Any modeling effort must start with an estimate of the direct economic effects of the FTAA treaty. Which industries will be directly affected, and by how much? Which sectors will expand and contract in the US, and in the other FTAA nations? What will be the environmental impacts of these direct economic effects?

Calculation of the direct effects is relatively simple and inexpensive. Most of the cost and complexity of the Working Group’s proposed methodology comes from attempts to automatically calculate all possible indirect effects that flow from the direct effects. Paradoxically, the core analysis focuses almost entirely on the US, where the direct effects are expected to be so small that the indirect effects could almost be ignored. Changes in trade between the US and the rest of the FTAA region are likely to amount to less than 0.5% of US GDP, implying that for US effects

“...there exists the option of foregoing the expense and time of CGE modeling and arguing based on logic and existing economic studies that the [indirect] effects are de minimis...” (Working Group Report, p.12)

This appears to be an attractive option, in view of the large costs estimated for the CGE analysis. In point 3 below, we suggest simpler ways to obtain estimates of some of the indirect impacts.

There would be greater justification for complex modeling of indirect effects in cases where the direct effects of the FTAA will be larger - generally in smaller economies. There are two

difficulties that arise here: first, detailed models are less available for the smaller economies; and second, the common style of modeling, involving CGE techniques, has numerous limitations, as we discuss in the next point.

2. CGE models are inaccessible to non-economists, expensive and difficult to operate, and do not have reliable theoretical or practical advantages that justify their predominant position in policy analysis.

CGE models have become common in applied economic analysis of policy proposals such as the FTAA treaty. The contribution of these models, beyond their theoretical rigor, is their explicit representation of interactions between all sectors of an economy. A policy change may have a direct effect on only a few industries, but changes in production and prices in those industries have indirect effects that ripple throughout the rest of the economy.

However, the benefits of CGE models are obtained only at substantial cost. Most obvious is the loss of transparency. The in-depth, “supplemental” analyses of particular environmental impacts of the FTAA may be accessible to large numbers of policy makers and analysts. In contrast, the details of the preliminary, “core” modeling will be comprehensible only to economists who specialize in CGE techniques. In fact, comprehensive CGE models with many sectors are so elaborate and difficult to develop that the Working Group feels constrained to use inappropriate models created for other purposes, simply because they are already available.

The loss of transparency and resulting dependence on specialists might be justified if the models were based on widely acceptable, exact relationships that have proven to be empirically successful in forecasting. This is roughly the situation in many areas of physical sciences and engineering. In economics, however there is nothing like a commonly accepted, empirically tested set of CGE relationships. The estimated indirect effects of trade policies inevitably rest on assumptions about the exact shape of numerous relationships, such as the price elasticities of supply in various industries, or the speed with which the labor market adjusts to shocks. Those assumptions differ from one model to the next, precisely because there is no one model that has proved to be reliably more accurate than others in practice.

The Working Group report recommends relying on CGE models for the “core” analysis as if their performance had been faultless in the past. In fact, there is ample evidence to show that forecasts based on CGE models have been quite inaccurate. The report should recommend a meaningful in-depth evaluation of CGE models’ performance. This exercise could, for example, compare the forecasts coming out of models of NAFTA in 1993-94 against the actual data on the three countries’ economies. This comparison might focus on the case of tortilla prices in Mexico. The forecast of one CGE model used to justify the inclusion of corn in NAFTA was that tortilla prices would go down because of corn imports from the US. This was expected to bring about enormous efficiency gains and improve consumer welfare as tortillas remain a staple good and their price is a major determinant of real wages. In fact, corn imports did rise, cutting domestic Mexican corn prices by 50%, but instead of going down, tortilla prices increased by more than 300% following NAFTA. The failure to accurately forecast the evolution of this critical variable arises from the assumptions embedded in the model concerning the functioning

of markets, and from the model's inability to replicate price-formation dynamics under imperfect competition.

Even the abstract theoretical rigor of general equilibrium analysis becomes problematic when examined more closely. Economic theorists have known since the 1970s that general equilibrium is seriously flawed as a model of economic dynamics, with the apparently inescapable potential for unstable or chaotic outcomes. Ironically, many advanced theorists have moved away from the general equilibrium framework at the same time that it has become the norm in applied economics². In a simpler, static context, the well-known optimality properties of competitive general equilibrium theory clearly do not apply to the real world with its oligopolies, externalities, and market failures. These growing doubts about abstract general equilibrium theory do not necessarily prove that specific applied CGE models are invalid. But they do demonstrate the need for a new theoretical explanation and rationale for the choice of empirical technique.

CGE models are particularly poorly suited for dynamic analysis. The Working Group Report mentions more than once that dynamic analysis of the path of changes over time would be preferable to the comparative static analysis offered by CGE techniques. A CGE model compares a hypothetical policy change to a fixed base year; in view of the complexity of the models, development of base year data takes time. The models proposed by the Working Group will have base years of 1995-97 in most cases; one agricultural model uses a base year of 1990.

Even in the best case, with a 1997 base year, a CGE model is not actually modeling what will happen when the FTAA treaty is adopted in the real world of 2003 or 2005. Rather, it is performing a hypothetical "what if" analysis: what would have happened if the FTAA treaty had been transported back in time and introduced into the 1997 economy? Holding everything else constant, what is the difference between "1997 without FTAA" (the base year, or actual 1997, data) and the imaginary world of "1997 with FTAA"? This question is distinct from, and less interesting than, the question of the impact of FTAA on the real world in the first decade of the twenty-first century. Yet the less interesting question is the one which the monumental CGE effort is designed to answer.

Given this limitation, it seems all the more appealing to find alternate methods to model some of the indirect effects, without relying on a CGE framework. Our next point addresses this issue.

3. Many indirect economic effects can be captured through input-output analysis in a simpler, partial equilibrium framework.

The indirect economic effects of a policy change that detailed, multi-sector CGE models seek to trace are of two distinct types. The simpler, less problematic type are the input-output (I-O) effects. The technical relations between industries are captured in an I-O matrix, which shows how much steel and rubber are needed to make a car, how much electricity is needed to make

² Frank Ackerman, "Still Dead After All These Years: Interpreting the Failure of General Equilibrium Theory", Global Development and Environment Institute Working Paper 00-01, Tufts University (available at <http://ase.tufts.edu/gdae/publications/>).

aluminum, etc. I-O analysis is a well-established, straightforward process, resting on nothing more theoretically complex than matrix multiplication (though involving huge quantities of data). If a policy change leads to the production of fewer cars, I-O analysis can calculate the resulting decrease in auto industry inputs from other sectors of the economy. I-O analysis was initially developed, and can easily be used, in a partial equilibrium framework. Use of an I-O matrix from a few years ago (which is inevitable) amounts to assuming that the quantity of steel and rubber needed to make a car, for instance, has not changed in the last few years - an unfortunate assumption to make, but a less sweeping and damaging one than reliance on a CGE model with a dated base year.

Controversies about CGE modeling arise in the other category of indirect effects, which might be called economic equilibrium effects. If fewer cars are produced and sold, will consumers buy more of something else instead? If prices change, how will consumers respond? If auto workers are laid off when production declines, where and when will they get new jobs, and at what wages? If unemployment increases, how will the Federal Reserve or other government agencies respond? In theory, these economic equilibrium effects should be modeled, but in practice there is no consensus about exactly how to proceed. Hypotheses about unemployment are particularly prone to political coloration, with some models assuming rapid, automatic return to full employment and others assuming only gradual recovery from recession. There is nothing like a widely accepted, technically defined I-O matrix that applies to economic equilibrium effects.

The complexity of the CGE models proposed for the FTAA analysis reflects their attempt to incorporate both the I-O and the economic equilibrium effects. It would be helpful to separate these categories, distinguishing:

- a) the primary effects of FTAA, such as increased trade in commodities where tariffs change;
- b) the “secondary”, or indirect I-O effects resulting from the primary effects; and
- c) the “tertiary”, or economic equilibrium effects resulting from the primary and secondary effects.

A partial equilibrium, I-O analysis could estimate the primary and secondary effects, isolating these important, noncontroversial areas from the more speculative and debatable tertiary effects.

These comments should not be taken as a blanket endorsement of all partial equilibrium models and methods. Mistakes can and have been made in a partial equilibrium context, as well as in CGE modeling. Once again, the example of corn under NAFTA is relevant. A prominent partial equilibrium model predicted that as a result of cuts in Mexico’s domestic corn prices, productive resources would be reallocated and output would be reduced. The fact is that prices did go down, but output increased and has remained at a historically high level. This cannot be attributed to price-distorting subsidies because these were drastically cut during the period. Rather, some social analyses of Mexican peasants suggest that corn is a “Giffen good”(a good whose demand falls as its price falls and therefore contradicts economic theories of *demand*) in the budgets of poor rural households, causing the perverse response to price cuts.

4. The specific models proposed for the core analysis were developed for other purposes, and are not well designed for studying the effects of the FTAA.

The Working Group Report envisions “that the core analysis... will be centered around the use of two existing economic models and three existing environmental models.” (p.2; the report clarifies on p.3 that one of the environmental models does not actually exist yet.) The choice of these models rests primarily on their availability and familiarity; by the Working Group’s own account, the models have serious limitations.

One of the two economic models, the Global Trade Analysis Project (GTAP) model, contains useful geographic detail but highly aggregated economic categories. In GTAP 4, calculations are performed simultaneously for 12 parts of the FTAA region. However, economic sectors are generally two-digit industries, with greater detail only in agriculture. The other model, the ITC’s “US model”, provides greater disaggregation of industry, with up to 485 sectors, but represents only the US economy. Separate calculations of the effects of FTAA tariff changes on the US economy would apparently be needed as inputs to the US model.

Moreover, both are comparative static models, offering only a snapshot of the change from a historical base year to a projected future. The base year is 1995 for GTAP 4 and 1996 for the US model; it will be 1997 for the GTAP 5 version that is currently under development. The FTAA is projected to take effect in 2003 at the earliest. Thus the Working Group’s core analysis is comparing anticipated effects of FTAA to economic conditions that existed at least 6-8 years earlier. Many other things, needless to say, will change in those 6-8 years.

Such time lags and use of a past base year may be inevitable in large-scale CGE modeling; we are not arguing that it is a unique deficiency of these particular models. But if long lags and out-of-date base years are inevitable, there is all the more reason to question the usefulness of detailed CGE modeling for policy analysis.

If the GTAP model is to be used, the current revision (the creation of GTAP 5) provides an opportunity to open the model’s workings to public view through a peer review process. What assumptions does it make about trade agreements, price elasticities, labor markets, and other key variables and relationships? Is there an opportunity to debate and change these assumptions, or is the Working Group constrained to use whatever assumptions are chosen by the GTAP team at Purdue University?

The environmental models have parallel limitations. The two currently available models are both focused solely on agriculture. One provides some geographic disaggregation but very few economic sectors, and uses a 1990 base year. The other provides greater detail on agriculture, but is confined to the 48 states of the continental U.S. The third “existing” environmental model is still under development at EPA; it could easily become the most useful, once it does literally exist.

5. The proposed analysis focuses too heavily on the environmental effects of imports, overlooking the effects of both exports and investment that will increase under FTAA.

The Working Group's approach to environmental effects of FTAA appears to be primarily concerned with the domestic effects of US imports. This ignores the environmental impacts, in the US, arising from US exports to other FTAA countries. Witness the dramatic increase in cropland devoted to transgenic crops in the US. Increasing grain exports is a key target for US trade policy, and transgenic crops will continue to expand as a result.

Another example comes from the cattle feed industry. Cattle feedlots are increasing in size (and decreasing in numbers) in the US. As more packaged meat is exported to Mexico and other FTAA countries in the future, feedlot concentration will continue to pose serious environmental problems. In addition, feed-grain demand will increase as a direct consequence of augmented exports of packaged meat to the FTAA region, putting additional pressure on the US agricultural landscape. This pressure may cause conversion of grassland and wetlands to cropland with intensive use of agro-chemical inputs. The upstream feed-grains complex in the Midwest is the region most affected by this, and the impact on soil, water, and biodiversity may include growing nitrate contamination of underground aquifers, and rising levels of phosphorus, atrazine, and other pollutants in rivers.

The elimination of tariffs and increase in trade is just one part of the FTAA agenda. The FTAA also has negotiating groups on intellectual property rights, subsidies, government procurement, and investment. However, the proposed quantitative analysis focuses solely on the potential environmental impacts of trade liberalization. Estimation of the effects of all aspects of the agreement is needed to get a full picture of the impacts of FTAA. It is particularly important to estimate the environmental impacts of changes in investment patterns. Changes in investment rules could have large (and independent) impacts on the scale, composition, and nature of technology transfer under the FTAA. However, the models currently proposed by the Working Group cannot capture these effects and may therefore produce biased or incomplete estimates of the environmental impacts of the FTAA.

According to the FTAA, the Investment Negotiation Group is "to establish a fair and transparent legal framework to promote investment through the creation of a stable and predictable environment that protects the investor, his investment and related flows, without creating obstacles to investments from outside the hemisphere." A similar set of provisions were included in NAFTA, and translated into restrictions on expropriations without due process, and obligations on host governments to follow the same standards for local companies as they do for foreign ones (such as local content requirements). NAFTA also created a new legal process allowing companies to sue governments if regulations appear to harm their businesses, a change with far-reaching implications for environmental protection.

Such changes in investment rules could have a significant impact on economic activity throughout the hemisphere. According to the World Bank, annual net foreign direct investment (FDI) inflows into Mexico more than tripled after NAFTA was passed, reaching over \$10 billion in 1998. In addition to altering the composition and output of different sectors in Mexico, such inflows have altered the trade orientation of many sectors as well.

Changes in investment rules have reshaped intra and inter industry trade under NAFTA, and will likely do the same under FTAA. Increases in FDI have direct impacts on technology choice and environmental quality. In industrial sectors where pollution is largely a function of plant vintage, flows of FDI can bring new, cleaner technologies to a host country. However, in sectors where pollution is a function of end-pipe-technologies that are costly and not required in developing countries, increases in FDI can exacerbate existing pollution problems, leading to the “pollution haven” effect. Investment-related changes to trade patterns of this kind are of potentially great importance, but are beyond the scope of the Working Group’s proposed modeling efforts. The analysis needs to be extended to include these issues.

6. Environmental impacts should be studied throughout the hemisphere, not just within the US.

It is a mistake to make assessments of the environmental impacts of the FTAA in other countries an afterthought, as the proposed analysis does. This is not only insensitive to other countries’ legitimate concerns, but also inadequate for the assessment of environmental effects within the US. In this respect, it is important to carry out studies of the impact of FTAA on global and transboundary environmental problems.

In recent years, the distinction between global and “strictly domestic” environmental problems (Working Group Report, p.20) has been blurred. Not only climate change or ozone depletion have contributed to this, but also overexploitation of fisheries, erosion of genetic resources, and loss of biodiversity. Also, the FTAA will bring in its wake significant economic change in Latin America, and this will have implications both for these countries and for the global commons.

The US has increasingly sought extraterritorial application of its own domestic environmental legislation. A key example is the well-known case of the dispute with Mexico on the tuna-dolphin problem in the eastern Pacific. From the US perspective this involves protection of an endangered species under the Marine Mammals Protection Act; from the Latin American perspective this reinforces the belief that the US is only out for itself on environmental matters, and that environmental protection in the US is a form of veiled protectionism.

Finally, it is important to know whether potential benefits for the US come at the expense of costs imposed on other FTAA countries. For instance, the CGE exercises could reveal that the composition of US industry would become relatively “cleaner” under FTAA. This result would appear to be an argument in favor of FTAA. However, a reduction in the pollution intensity of US industry would be more problematic if it is simply the result of migration of “dirty” industries to other FTAA countries. It can only help US negotiators to be aware of such issues in advance.

Recommendations:

As we said at the outset, we applaud the decision to perform an assessment of the environmental impact of the proposed FTAA agreement, but we advocate substantial changes in methodology. Specifically, we make the following recommendations for improvement in the assessment methods:

1. Any environmental impact assessment of the FTAA should have at its “core” a straightforward, transparent analysis drawing on a variety of available methodologies, not simply estimates based on the results of controversial modeling techniques. These methodologies can include, but should not be limited to, CGE models.
2. Additional analyses should then describe their methods for estimating indirect effects. Partial equilibrium I-O analyses should be included along with CGE analyses, allowing a comparison of the results of different methodologies.
3. If the GTAP model remains important to the analysis, a peer review or expert commentary process should be created to evaluate the critical assumptions embodied in GTAP 5 prior to its use.
4. The analysis should include the environmental impacts of other aspects of the FTAA beyond changes in tariffs and trade, such as expected changes in investment patterns.
5. The analysis should include the environmental impacts of the FTAA in the region as a whole, not just the US.

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