ECONOMIC INTEGRATION IN THE WESTERN HEMISPHERE

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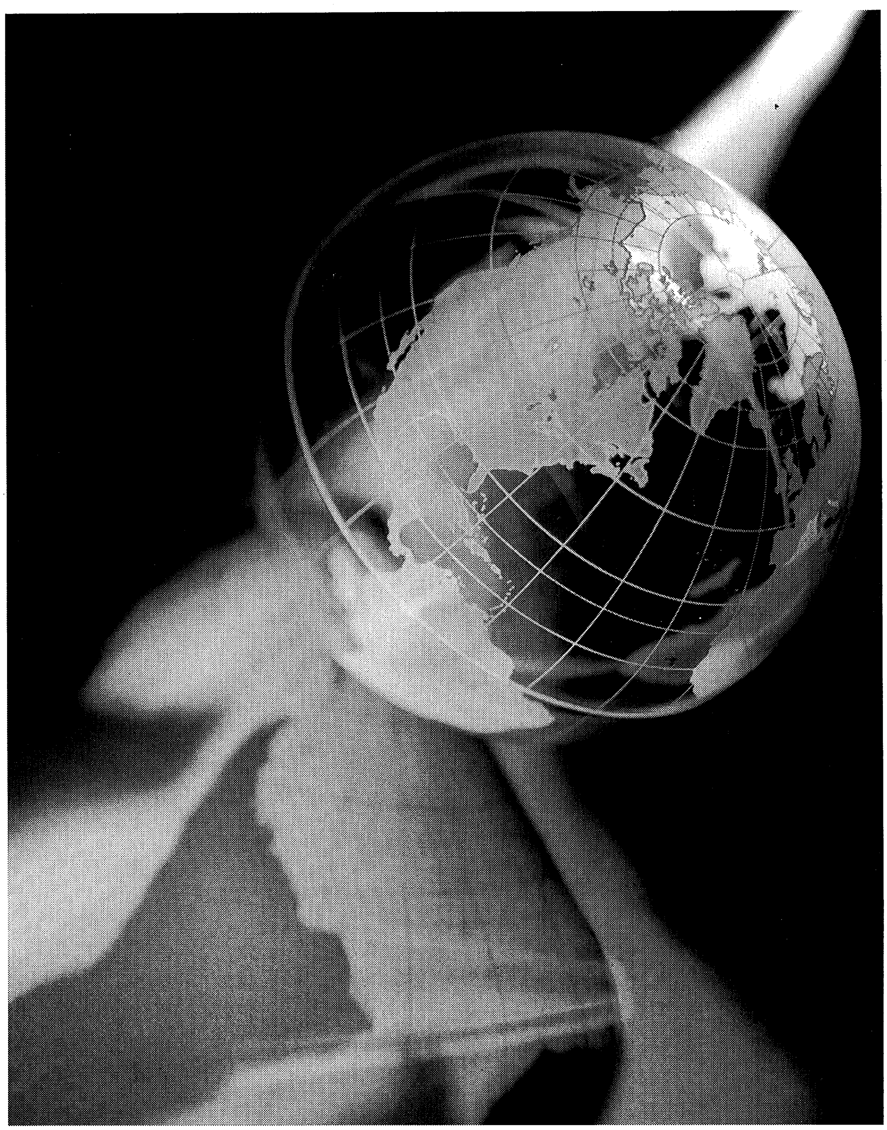

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Western Hemisphere Integration: Trade Policy Reform and Environmental Policy Harmonization

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The democratically elected leaders of the Western Hemisphere countries met in Miami in December 1994 to discuss economic integration. They had four main objectives related to the future of the region: foster sustainable economic growth; reduce trade and investment barriers; improve environmental quality; and strengthen democratic institutions. The North American Free Trade Agreement (NAFTA) and, to a more limited extent, the multi-country Uruguay Round of the General Agreement on Tariffs and Trade (GATT), had similar goals. Many in agriculture and the food industry support regional and multilateral trade reform and may promote further integration in the Western Hemisphere. They see increased business opportunities through improved market access to a large population and a region with a potential annual economic growth of nearly 5 percent.[1] Others, though, have expressed concern about trade reform. Non-governmental organizations, like Public Citizen and Sierra Club, have suggested that trade and investment policy liberalization will adversely affect environmental quality and income distribution in the region.

There are several areas of potential conflict between trade and environmental interests which may influence agriculture and the food industry. Most relate to divergent national environmental standards: for example, the competitive and trade effects of environmental regulations; the role of environmental standards in the determination of direct foreign investment and the location of production; and the use of sanitary and phytosanitary and other product standard-related regulations, including packaging and labeling requirements. This paper will focus on the competitive and trade effects of environmental regulations.

We undertake an early assessment of the potential production, consumption, trade, and environmental effects of various Western Hemisphere integration schemes. We examine two policy scenarios in the context of a multi-country, multi-sector computable general equilibrium model. First we analyze the effects on regional trade when bilateral tariffs and nontariff barriers are removed among Western Hemisphere countries. Eliminating regional trade barriers may pose some new opportunities and challenges for agriculture and the food industry. U.S. firms may be able to increase their exports and investments to their southern neighbors but they may also face increased competition. Foreign firms may export foods to the U.S. market without tariff and nontariff trade barriers and they may have lower production costs relative to U.S. firms, partly due to less stringent environmental regulation. Some U.S. agri-business interests and environmental groups, in an unusual coalition, are pressing for similar standards for competing exporters who want to export to the United States. As a matter of principle, GATT has reiterated that differing environmental compliance costs are no reason to impose trade barriers, rather they are a normal differential cost of production.

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[1] Estimated Data Resources Incorporated (DRI) as cited in Suchada Langley, "Western Hemispheric Economic Integration - From Here to There," manuscript, December 22, 1994.

Some U.S. laws do impose the same environmental standards on imports as on domestic products. In some cases, the standards are allowed by international trade disciplines: GATT, for instance, permits food safety standards on domestic and imported goods for the protection of human health. The international legality of other standards, however, has been called into question and has created conflict between the U.S. and some of its major trading of its major partners. One prominent example concerning differences in national standards which affect the U.S. food industry is standards placed on harvesting tuna fish. Unlike other countries, in the U.S., the Marine Mammal Protection Act (MMPA) sets dolphin protection standards for the domestic fishing fleet and for imports from international fishing boats that harvest yellow fin tuna in the eastern tropical Pacific Ocean. This has created strife between the United States and Mexico and the European Union (which is intermediary in tuna trade).

Our second policy simulation is to remove bilateral tariffs and more closely harmonize environmental policies across the region. Harmonization can have different interpretations. Some U.S. interests would suggest that partner countries should pursue comparable environmental regulations. Others would suggest that the goal of harmonization is not to promote uniform standards, but to encourage standards that adequately protect the environment while recognizing differing environmental conditions and national preferences. We consider both alternatives: we liberalize trade and (a) establish uniform standards or (b) establish relative standards based on a country's wealth. By simulating this more profound synthesis of the economies, we are in a better position to assess the relative magnitude of the trade and environmental policy effects that could accompany Western Hemisphere regional integration.

Our results may be summarized as follows. Trade policy reform in the Western Hemisphere appears to be beneficial for all participating countries. Environmental quality, however, may decline in Mexico and Brazil, given no change in environmental policies. Relative harmonization of environmental policies appears to increase the gains from economic policy integration for these countries. Too stringent environmental regulations (i.e., absolute harmonization of policies), however, are likely to diminish the gains from economic integration.

Trade and Environmental Policy Integration: Model Background

In order to undertake the simulation exercises we extend the Global Trade Analysis Project (GTAP) framework developed by Hertel and expanded for environmental issues by Perroni and Wigle. A detailed description and specification of the GTAP model can be found in Hertel and Tsigas, ant Huff *et al*. Briefly, the model can be described as a comparative static, multi-country, computable general equilibrium (CGE) model. It is calibrated to a 1992 base so it does not reflect the policy changes that have already occurred as part of the NAFTA agreement (Gehlhar *et al.*). Our version of the GTAP model focuses on Western Hemisphere countries, food sectors, and trade and environmental policies.

Eight geographic regions and fourteen sectors are specified (Table 1). These include five individual Western Hemisphere countries: Canada, U.S., Mexico, Argentina, and Brazil and seven agriculture and food manufacturing categories: primary agriculture - grains, non-grain crops, and livestock; and food manufacturing - meat products, milk products, tobacco and beverages, and other food products.
The advantage of developing this large scope analytical model, which we refer to as TREWH (Trade and Environment in the Western Hemisphere), is that it can quantitatively assess the differential effects of trade and environmental policies across agriculture, food and other manufacturing sectors. It is limited, though, in addressing issues concerning specific commodities, firms, or industries.

To capture trade and environmental policy issues, we augmented the GTAP framework by incorporating two types of environmental data: pollution emissions and pollution abatement expenditures; we extended the model to include environmental quality and policies; and we explicitly account for the negative welfare implications of pollution.

Pollution Data

Environmental data for manufacturing is compiled separately from data for primary agriculture, although the compilation of each follows similar steps and assumptions.

Manufacturing Pollution: Pollution emissions for each region and manufacturing sector are calculated using data compiled by the World Bank under their Industrial Pollution Projection System (IPPS) (Hettige *et al.*, 1994) and data from GTAP. IPPS draws from U.S. EPA's Toxic Release Inventory for 1987 to calculate total toxic substance releases of 320 substances for all reporting plants across all media (air, water, underground, and solid waste releases). IPPS then weights pollution releases by *ordinal risk measurements* from EPA's Human Health and Ecotoxicity Database (HHED). The weighing scheme implies that the ordinal risk scale is linear: a one pound emission with risk factor 4 is equivalent to four pounds of emissions with risk factor 1. These risk-weighted total emissions are then matched with output data from the U.S. Census Bureau's Census of Manufacturing to calculate sectoral emission coefficients for the U.S. (i.e., pounds of pollutants/US $ million of output). To estimate total emission releases for each sector in all regions, these U.S.-based emission coefficients are multiplied by regional sectoral output values taken from GTAP.

Although we do generate unique total pollution emission estimates by manufacturing sector for all regions in TREWH, we assume constant sectoral emission intensities across regions. While this is not the best measure of regional pollution, it is the only one available at this point due to insufficient international data. Other international studies have used this same approach, including several studies conducted by the World Bank and OECD (Lucas, Wheeler, and Hettige, 1992; Harrison and Eskeland, 1994; Lee and Roland-Holst, 1993 and 1994; Lucas, 1994). Since there is evidence that relative sectoral pollution intensities have remained fairly constant across countries and over time (Lucas, Wheeler, and Hettige, 1992; Harrison and Eskeland, 1994), these emission estimates should provide a fairly accurate assessment of relative sectoral emissions across regions.

Agricultural Pollution: For the agricultural sectors, a similar approach is used - U.S. pollution data are calculated and used as a basis for cross-country data. Since there are no cross-media pollution data for agricultural sectors, soil erosion is used as a proxy for all forms of agricultural pollution. Average erosion rates and acres planted are from Osborn, 1995. In order to determine erosion in other regions, tons of erosion by sector in the U.S. are scaled by sector values of output in other regions relative to U.S. sector values of output. Pollution from livestock production is not estimated.

Table 2, part A shows regional and sectoral pollution levels for the agriculture, food, and manufacturing sectors in the Western Hemisphere. Among the primary agricultural sectors, U.S. grains and non-grain crops have higher levels of emissions than crop production in the other countries. This reflects the larger size of U.S. crop production. In the U.S. and Canada, the grain sector is estimated to cause more pollution than the non-grain sector, although the emission levels are more equal, or even reversed (for Argentina), across the two sectors in the south.

On average, chemical manufacturing and the resource based industries generate the highest pollution emissions among industrial sectors (table 2, part A). Thus, about 80 percent of all industrial pollution emissions in our model is generated by these two groups of industries. Due to output composition differences between the northern (i.e., U.S. and Canada) and the southern countries, the resource based industries are contributing a larger share of total industrial pollution in the north. Differences in the contribution to the share of pollution occurs in other sectors as well: final manufacturing is contributing a larger share of pollution in the north, but clothing is contributing a larger share in the south. Among the food processing industries, meat production and other food production generate, on average, the highest pollution emissions. Table 2, part A shows that other food production contributes more pollution than all the other food processing sectors combined. In the north, food processing accounts for about 1.7 percent of all pollution and in the south, food processing accounts for about 2 to 3.5 percent of all pollution.[2]

Abatement Data

Manufacturing Abatement: Pollution abatement expenditures for manufacturing sectors are drawn from the Census Bureau's 1992 survey of pollution abatement costs and expenditures for U.S. manufacturers (U.S. Bureau of the Census, 1994). Operating costs by industries, at the SIC level, for all media were summed to calculate operating costs in U.S. million dollars for each sector in TREWH. In order to calculate sectoral abatement coefficients for the U.S., abatement expenditures were divided by the value of output. For the developed regions in the model (i.e., U.S., Canada, and Other Developed Economies), these abatement coefficients were multiplied by sectoral value of output and the ratio of regional per capita GDP to U.S. per capita GDP (i.e., a proxy for the valuation of environment quality across countries) to derive total abatement expenditures by sector and region. Wealthier countries value their environment to a greater extent, and have a greater weight on environmental goods. Our assumption that abatement costs across developed countries are distributed across sectors in a pattern similar to that of the U.S. is a fairly straightforward assumption if one believes that similar technological and economic conditions lead to similar abatement standards (Harrison and Eskeland, 1994).

For the developing regions, we assumed that abatement expenditures were very small in the benchmark data, reflecting either low standards or lax enforcement. The development of institutions that regulate and enforce environmental laws in the southern countries is relatively recent. For example, Mexico is establishing new norms, especially with respect to emissions of dangerous waste materials, to be brought in fine with other OECD countries (International Environmental Reporter, 1995). Other south American countries are only beginning to make progress on an environmental agenda. Chile established a ministerial agency for environmental standards in 1990, the Commission Nacional del Medio Ambiente - CONAMA (National Commission on the Environment). The 1994 Basic Law on the Environment gave CONAMA formal status to work with other agencies to establish and coordinate national environmental standards. Argentina does not have a comprehensive strategy for a national environmental plan; environmental policy decisions are scattered among a multitude of municipal, provincial, and federal agencies, most of which have little authority to mandate solutions and often overlap in their authorities. For many agencies, their greatest source of action is simply to denounce environmental transgressions (Erickson). In Brazil, the

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2 Only the direct pollution level is measured in these calculations. Hanson calculates the total emissions of a commodity, direct and indirect pollution levels (based on input requirements for each sector), and finds that food industries such as meat and poultry processing, butter, milk, cheese, dry milk, and milk processing have some of the highest emissions content of final demanded commodities.

ministries of the Environment and Agriculture are preparing guidelines for environmental regulations for the nation's farmers. The regulations will mainly focus on the prevention of soil erosion (International Environmental Reporter, 1995).

Agricultural Land Conservation: For the reduction of agricultural pollution, a program of land conservation is modeled. The U.S.'s Conservation Reserve Program is modeled as the representative land conservation program and serves as the data source for conservation acres, and average pre-program yields and erosion rates on the set-aside acres for the grains and non-grain crops sectors (Osborn, 1995). U.S. conservation payments by sector are scaled by sector values of output, intensity of chemical use and regional per capita GDP in other regions, relative to U.S. sector values of output, intensity of chemical use and GDP. The developing country regions are assumed to have relatively small land conservation programs; these regions only conserve a small portion of their land in the base period. The livestock sector is assumed to not have a pollution reduction program.

Table 2, part B shows regional and sectoral abatement expenditures for the food and manufacturing sectors and land conservation payments in the Western Hemisphere in the TREWH model. As with pollution emissions, the chemical manufacturing and resource based industries account for most of abatement expenditures in the U.S. and Canada. However, the food processing industries are estimated to account for a larger share of abatement expenditures than pollution, e.g., in the U.S. food processing contributes about 1.7 percent of total pollution, but its abatement expenditures account for about 7.7 percent of the total. Pollution reduction expenditures for agriculture are higher than those for the food processing sectors, although still significantly smaller than those for most of the non-food sectors.

TREWH Model Specification

Manufacturing and agricultural sectors emit pollutants when they produce commodities. In TREWH, the amount of pollution generated by each sector is proportional to its commodity production and these proportions do not change due to policy changes. In essence, we specify a Leontief relationship between commodity production and pollution emissions:

$$1.\ POL^r_i = a^r_i Q^r_i$$

$$2.\ POL^r_j = a^r_j Q^r_j$$

where POL = emissions,
Q = output for each sector in each region,
a = pollution coefficient for each sector in each region,
and i represents manufacturing sectors,
j represents agricultural sectors, and
r represents regions.

We capture existing environmental regulations (abatement activities) for manufacturing with a set of pollution *taxes and subsidies*. We assume that each manufacturing sector faces an ad valorem environmental tax rate t, which is equal to the cost share of abatement activities relative to output. The total value of tax revenue across all manufacturing sectors equals regional sectoral abatement expenditures:

$$3.\ AB^r = \Sigma^n_i\, t^r_i P^r_i Q^r_i \,/\, P^r_I$$

where AB = abatement activities,
t = ad valorem tax rate,
P = price for each sector in each region, and
P_I = price of abatement activities.

A *fictional pollution cleaning sector* receives the tax revenues collected from the manufacturing pastors in the form of a subsidy.[3] (We assume the cleaning sector demands intermediate inputs in fixed proportions according to the input relationships in the abating sectors.) Although the environment tax rates (t in equation 3) are exogenous, the environmental tax revenues are endogenous, since sectoral production values are determined within the model. Abatement activities from the cleaning sector lower net pollution, thus increasing environmental quality.

For the agricultural sectors, pollution is reduced by taxes on the land input. Tax revenues are used into remove land from production into conservation set-asides. A fictional *land conservation sector* is developed to hold the conservation acres. The land input is therefore divided into two components: conservation acres and planted acres. A Constant Elasticity of Transformation (CET) function is used to model land use:

$$4.\ LAND^r = CET(CNSV^r, PLNT^r_{GRN}, PLNT^r_{NGR}, PLNT^r_{LIV})$$

where LAND = Total acres of land,
CNSV = Acres in conservation, and
$PLNT_j$ = Acres of land used in production of commodity j.

Each land component has distinct yield and pollution rates. Planted acres are the only land that generate pollution. The conservation sector is roughly analogous to the cleaning sector, since it reduces pollution. However, unlike the cleaning sector, it uses only a primary input rather than intermediate inputs and it prevents pollution rather than cleaning up already existing pollution. A more stringent policy with respect to agricultural pollution will cause an increase in the land area in conservation (CNSV in eq. 4), and a decline in land used for agricultural production ($PLNT_j$ in eq. 4). As a result, agricultural production will decline (Q in eq. 2) and thus agricultural pollution will be reduced.

Finally, through our specification of pollution and abatement activities, we deduce environmental quality by estimating an initial environmental endowment.[4] Environmental quality can deteriorate depending on the level and composition of output and it can improve depending on resources allocated to abatement and land conservation. By assuming that one unit of pollution degrades the environment by one unit and that one unit of abatement offsets one unit of pollution, we can establish the following relationship:

$$5.\ EQ^r = END^r - NP^r$$

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3 Services of the pollution cleaning sector are not traded across regions.

4 To establish a benchmark environmental endowment, we assume a 25 percent degradation rate for all countries, and a 65 percent cleaning rate for developed countries. For developing countries we assume a cleaning rate of 0.65 percent. The developed country degradation rate is based on Perroni and Wigle.

where EQ = environmental quality
END = endowment of environment
NP = net pollution

Net pollution is based on pollution and abatement activities in the manufacturing and agricultural sectors:

$$6.\ NP^r = \delta\,(\Sigma^n_i\, POL^r_i - AB^r) + (1 - \delta)\,\Sigma^m_j\, POL^r_j$$

where δ = weighing factor.

Our goal is to estimate the impact of policy changes on pollution by sector for each region, and abatement, net pollution, and environmental quality by region. Note that the contributions to net pollution by manufacturing and agricultural activities are weighted by a factor, δ. We estimate a weight of approximately 80 and 20 percent, respectively. We estimate 20 percent as an upper bound for agriculture's contribution to pollution. We assume that agriculture contributes 66 percent of water pollution (as a primary source, agriculture accounts for 64 percent of river pollution and 57 percent of lake pollution, USDA, 1991), and contributes only a small portion of air pollution (10 percent). Studies that estimated benefits from pollution control in the U.S. and pollution cost data in Germany have found that water pollution accounts for 13-18 percent of total pollution costs and benefits, while air pollution accounts for the remaining 82-87 percent (Pearce and Warfords 1993). Agriculture's 20 percent share is derived from summing the sector's estimated contributions to air and water pollution: (82% * 0.1) + (18% * 0.66) = 20%

The specification of pollution and the cleaning and conservation sectors are critical in determining a country's environmental policy. A more stringent policy with respect to agricultural pollution is modeled as an increase in the area of land which is set-aside for conservation. Manufacturing pollution and abatement are closely linked: if production increases, the level of pollution and environmental tax revenues will increase; greater tax revenues mean that the cleaning sector will be subsidized to a greater extent, so that pollution cleaning. A tightening of environmental regulations for manufactures, modeled as an increase in the pollution tax rates. Higher tax rates will create more pollution tax revenue, which will be used to increase the subsidy for the pollution cleaning sector. These relationships, however, only hold for the economy as a whole. At a sectoral level, our model does not target increased pollution cleaning and conservation toward a sector that has become relatively more polluting.

Table 2, part C shows benchmark values for regional and sectoral environmental tax rates for the agriculture, food, and manufacturing sectors in the Western Hemisphere in the TREWH model. Output tax rates for the manufacturing industries and land input tax rates for primary agriculture are shown. Tax rates for chemical manufacturing are substantially larger than pollution tax rates for other industrial sectors. Tax rates for the resource based industries are second in magnitude. Within food processing, beverages and tobacco have slightly higher tax rates than other sectors. The tax rate for final manufacturing appears to be smaller than the average tax rate for food processing. Nevertheless, all industrial pollution tax rates are very small.[5] Land taxes for the two primary agricultural sectors are substantial in the U.S. and Canada, and in all regions, tax rates for the grain sector are greater than tax rates for the non-grain crop sector.

Consumer Utility and Environmental Quality

In order to determine a country's valuation of a clean environment, we specify a *super-household* which derives *utility*, from private and government consumption, savings, and environmental quality (Hertel and Tsigas, and Perroni and Wigle, p. 9).[6] In particular, we assume that utility from the environment and utility from market goods are normal goods; and that total welfare is an increasing function of its components. We model the super-household's utility with a Constant Elasticity of Substitution (CES) function:

$$7.\ U'^{r} = F(U^{r}, EQ^{r})$$

where U' = overall utility of the super-household,
U = utility from private and government consumption and savings, and
EQ = utility from environmental quality.

Overall utility, U^r, will increase, if benefits associated with a higher level of utility from market goods, U, exceed any losses associated with a deterioration of environment quality, EQ (i.e., pollution less abatement).

Two parameters are needed for specifying the CES utility function: a distribution parameter and an elasticity of substitution. The distribution parameter is based on how each region values its market and non-market (environmental quality) goods. Following Perroni and Wigle, we use consumption shares (ratios of market and non-market expenditures over total expenditure) to determine the distribution parameter. For the second parameter, we assume that consumers in each country do not find the two types of goods to be very substitutable.

Policy Integration Scenarios

In our policy integration scenarios the three NAFTA countries (Canada, U.S., and Mexico) form an extended free trade agreement with the MERCOSUR countries of Argentina and Brazil.[7] Although this supposition abstracts from the current discussions with Chile as potentially the next country to accede to NAFTA, it does reflect the inclusion of the five largest countries in the Western Hemisphere, which have an aggregate GDP of nearly $7 trillion, and a population of approximately 550 million.

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5 The tax rates only account for operating costs. In the U.S> in 1992, in addition to pollution abatement operating costs of $19 Billion, firms spent $8 billion on pollution abatement capital expenditures (U.S. Bureau of the Census, 1994). Developing country regions, which may lack pollution control infrastructure, would need to install capital before they could introduce abatement.

6 Although consumers often gain satisfaction from decreases in foreign or global pollution, in the TREWH model, we only allow domestic pollution levels and environmental quality to enter a region's utility function.

7 The MERCOSUR (Southern Cone Common Market) trade agreement was established in 1991 and, upon completion, it will completely integrate the economies of Argentina, Brazil, Paraguay, and Uruguay.

As noted in our introduction, we designed our policy integration scenarios to:

(I) eliminate import tariffs and other barriers for trade between the five Western Hemisphere countries (i.e., the U.S., Canada, Mexico, Argentina, and Brazil), and

(II) eliminate import barriers as in (I) coupled with *harmonization* of environmental policies.

Since there are different interpretations of what harmonization means, we pursue two harmonization schemes:

(II.A) *absolute* harmonization: each southern partner (i.e., Argentina, Brazil, and Mexico) imposes environmental regulations that duplicate U.S. environmental regulation, adjusted for domestic production levels, and

(II.B) *relative* harmonization: each southern partner imposes environmental regulation similar to U.S. standards but adjusted for its own valuation of file environment and domestic production levels.

Although we know that citizens in developing countries value environmental quality, in our benchmark data, we assume that these countries have low levels of environmental protection, either due to market or government failures (see table 2, parts B and C). The inclusion of environmental policy harmonization in integration scenarios captures the role of newly-formed international institutions that provide pressures to compensate for market and government failures. In fact, sometimes even simply the negotiation of integration agreements fosters environmental protection: both Mexico and Chile began to strengthen their environmental legislation and enforcement when NAFTA and NAFTA expansion have been discussed. Table 2, part D shows the pollution tax rates which we will impose in Mexico, Argentina, and Brazil for simulation (II.B) where environmental policies for manufacturing are harmonized in a relative sense.

The critical factors in determining the impact of regional trade integration are the magnitude of import barriers and the initial trade shares.[8] In the GTAP database, import barriers reflect the level of tariffs and nontariff barriers in effect during the Uruguay Round negotiations. Comparing bilateral trade barriers, the U.S. and its partners tend to have relatively greater import protection rates in the food sector relative to other sectors (Table 3). U.S. food industry rates vary from an ad valorem equivalent high of 100 percent in milk products; to 18 percent in meat products; 4 to 15 percent in beverages and tobacco; and 7 percent in other food products. The rates differ across trading partners due to compositional differences in bilateral trade. Canadian import protection placed on U.S. meat and milk products is also large, 136 and 22 percent, respectively. Among the other Western Hemisphere trading partners, Brazil has the highest level of tariff equivalent rates on U.S. food products, ranging from 25 to 85 percent, followed by Argentina and Mexico, with import tariff/nontariff rates ranging from 3 to 18 percent. The U.S.'s Western Hemisphere trading partners also tend to have relatively high rates of protection on primary agricultural sectors. Given these

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[8] Assumptions on model closure are also important factors in influencing the numerical results. First, we have assumed that land, labor, and capital are fully employed, although relative price changes create reallocation of resources across sectors. Labor and capital are fully mobile domestically, but they are not allowed to migrate to foreign regions. Land is used for agricultural production and conservation purposes. Second, we have assumed that foreign savings are a limiting factor in changing the balance of trade. Our third closure assumption relates to government revenue and expenditures; we assume that a decline in tariff revenues causes savings and private and government consumption to decline by the same proportion; that pollution tax revenue collected from manufacturing is fully allocated to the cleaning sector, and that enough taxes are levied on farmland, to maintain a constant area of land for conservation.

relatively high rates of protection, we would anticipate liberalization to have significant effects on the region's trade flows.

Trade Policy Integration

Our integration scenario (I), in which we completely remove regional import barriers, indicates regional trading patterns are indeed promoted with liberalization. The U.S. increases its exports of crops and livestock, although imports of livestock outweigh exports. Of the food sectors (excluding primary agriculture), the U.S. mainly increases its bilateral exports to Western Hemisphere countries in meat, milk, and other food products, totalling nearly $2 billion (Table, 4 Parts A and B.). Exports are mainly fresh or frozen bovine, chicken, turkey, and pig meats; nonfat dry milk, butter, and cheese (mostly to Mexico); and fruits, vegetables, and oilseed products. U.S. imports increase across all our food product categories, particularly beverages (malt beverages), tobacco, and other food products, for a total of approximately $2.3 billion (Table, 4 Parts C and D). Thus, the balance of U.S. food trade declines by US$ 425 million. The balance of U.S. manufacturing trade improves, but the overall U.S. trade balance declines by US$ 193 million. U.S. exports to the Western Hemisphere region increase $43.3 billion relative to an increase in imports of $33.8 billion.

Trade Policy Integration and Harmonization of Environmental Policies

Next we impose environmental policy harmonization in addition to trade integration. The trade flow results under the harmonization scenarios are similar to the trade policy integration scenario. Production changes are also similar to those under the earlier scenario. Harmonization policies thus appear to have little additional effect on production and trade flows. The question then arises why there are such small trade effects when the Western Hemisphere trading partners adopt stricter environmental regulation. The answer lies in the costs of environmental regulation in the U.S.: they are very small relative to variable costs of production. For the chemical sector, the environmental abatement operating costs are around 1.25 percent; for all other sectors they are less than 1 percent. Hence, the estimated environmental sectoral tax rates for the United States, Canada, Mexico, Argentina, and Brazil are small.

Two caveats to this finding are in order. First, we have limited our analysis to pollution abatement operating expenditures as reported to the EPA by manufacturing firms. These data may not reflect all industry costs associated with reducing pollution. Second, as stated earlier, we have specified our model with aggregated sectoral classifications; hence, average pollution abatement expenditures are used for each aggregated sector. A more specific examination of an industry or firm may reveal larger costs of environmental regulation than the average for an aggregated sector.

Welfare Changes

Next we turn to changes in welfare in each region. In scenario I, trade liberalization affects relative prices across sectors and countries and, as a result, influences the composition of agricultural and manufacturing output in each country. Since pollution depends on the sectoral output mix, it is not clear what the effect of regional trade liberalization will be on pollution. In the agricultural sector, the U.S. incurs more pollution as production of grains wad non-grains expands (first column in Table 5). Other Western Hemisphere partners experience a decline in agricultural pollution because of resource allocation away from crops to other sectors, ie., livestock and manufacturing industries. U.S., Mexico, and Brazil endure small increases in pollution from manufacturing while Argentina, Canada, other Latin America, other

Developed Economies, and Rest-of-World regions enjoy a small decrease in pollution (second column in table 5). Argentina and Canada alter their product mix to less polluting sectors accounting for less pollution from manufacturing. Finally, the U.S. and Canada increase their transfers to the pollution cleaning sector because more environmental tax revenues are collected (third column in table 5).

The regional changes in welfare are reported in Table 5 in both percent chances from the base period and in dollar terms (columns 6 and 7, respectively). With regional integration (scenario I), each participating country augments welfare in the range of 0.085 to 0.476 percent or US $ 9.244 billion for the region as a whole. These gains only reflect the static efficiency gains from integration and not any dynamic gains from new investments in human and physical capital, technological innovation, and economies of scale.[9] Note that environmental utility declines for Mexico and Brazil since pollution is increasing, a result of a liberalized output mix and no change in environmental policies. Argentina, on the other hand, alters its product mix so that there is less pollution and environmental welfare increases slightly. This is in spite of no change in environmental policy. For the United States, there is essentially no change in environmental welfare because there is a neutral effect on environmental quality; the increase in pollution generated by changes in the output mix is almost offset by the increased efforts in pollution cleaning. This finding is sensitive to our parameter specification suggesting that further analysis is required to draw any firm conclusions.

In the harmonization scenarios, Mexico, Argentina, and Brazil experience very large increases in abatement activities, as they adopt environmental regulations promoting abatement and land conservation. In the trade integration and relative harmonization scenario (Scenario II.B in Table 5) environmental and overall welfare increases for each Western Hemisphere country (except the U.S. where there is a small decrease in environmental quality). Trade liberalization contributes more of the benefits than the imposition of environmental regulations, although this result is also sensitive to our model specification. When the Latin American partners implement environmental regulations consistent with U.S. valuation of environmental quality (scenario II.A in Table 5), then overall welfare gains are diminished relative to scenarios I and II.B. U.S. type environmental regulations lead to substantial gains in welfare from a cleaner environment, but they appear to be too costly for Mexico, Brazil, and Argentina.

Summary and Conclusions

In this paper we have used a multi-country, computable general equilibrium framework to obtain a preliminary assessment of economic integration in the Western Hemisphere. We find that economic integration appears to be beneficial for the U.S economy and for all participating countries. We also find that environmental quality declines for Mexico and Brazil, given no change in environmental policies.

We then examine the implications of coupling economic integration with more stringent environmental controls in the southern Western Hemisphere countries. We find that environmental regulations appear to increase the gains from economic policy integration for these countries suggesting that they have not internalized their domestic environmental externalities. A regional integration pact may help facilitate the internalization process. We also found that too stringent environmental regulations (i.e., like those in the U.S.) are likely to be resisted because they diminish the gains from economic integration. Thus, Western

[9] Brown, Deardorff, Hummels, and Stern consider these additional factors which can contribute to welfare gains in Western Hemisphere integration.

Hemisphere integration and environmental policy harmonization generates welfare gains to participants as long as the environmental policy changes in the southern countries reflect their valuation of environmental quality.

Table 1: Regional ant Sectoral Classification in TREWH

Region	Sector
Canada (CAN)	Grains (GRN)
United States of America (IJSA)	Non-grain Crops (NGR)
Mexico (MEX)	Wool and Odder Livestock (LIV)
Argentina (ARG)	Resource Based Industries (RBI)
Brazil (BRZ)	Meat Products (MEA)
Other Latin America (OLA)	Milk Products (MIL)
Other Developed Economics (ODV)	Beverages and Tobacco (BVT)
Rest-of-the-World (ROW)	Other Food Products (OFP)
	Clothing and Textiles (CLO)
	Chemicals and Metals (CHM)
	Final Manufacturing (FMN)
	Services (SRV)
	Pollution Cleaning
	Land Conservation

Table 2: Sectoral Pollution Emissions and Abatement Expenditures in the Western Hemisphere

A. Pollution Emissions (in thousand tons for primary agriculture; pounds for manufactures)

	CAN	USA	MEX	ARG	BRZ
Grains	138184.	1106790.	192394.	96442.	274598.
Non-grain Crops	89542.	675410.	196761.	201007.	274365.
Resource Based Ind	1517370.	11554900.	499190.	588704.	927089.
Meat Products	7329.	45499.	9889.	6264.	8630.
Milk Products	18575.	107674.	4611.	12217.	14210.
Beverages/Tobacco	5234.	46152.	4923.	7889.	5274.
Other Food Products	35863.	333233.	44288.	38222.	48281.
Clothing	181725.	1371640.	161470.	246289.	336754.
Chemicals	1240670.	10673300.	818583.	995859.	1678970.
Final Manuf.	419403.	3902930.	134574.	125112.	289145.
Total Industrial	3426170.	28035300.	1677530.	2020550.	3308350.

B. Abatement Expenditures (in US $ million)

	CAN	USA	MEX	ARG	BRZ
Grains	114.256	1087.530	0.214	0.163	0.232
Non-grain Crops	80.498	721.577	0.225	0.350	0.238
Resource Based Ind	518.156	4689.100	0.315	0.566	0.445
Meat Products	30.119	222.199	0.075	0.072	0.049
Milk Products	21.223	146.199	0.009	0.039	0.022
Beverages/Tobacco	25.317	265.299	0.044	0.107	0.035
Other Food Products	64.461	711.799	0.147	0.193	0.122
Clothing	34.527	309.700	0.056	0.131	0.089
Chemicals	787.449	8050.500	0.961	1.780	1.498
Final Manuf.	277.747	3071.600	0.164	0.233	0.269
Total	1953.753	19275.503	2.210	3.634	2.999

C. Benchmark Environmental Tax Rates (on land use for primary agriculture; on output for industry)

	CAN	USA	MEX	ARG	BRZ
Grains	11.7682%	25.6836%	0.0085%	0.0137%	0.0077%
Non-grain Crops	7.1850	9.1319	0.0049	0.0078	0.0056
Resource Based Ind	0.3927	0.4667	0.0007	0.0011	0.0006
Meat Products	0.2342	0.2784	0.0004	0.0007	0.0003
Milk Products	0.2571	0.3055	0.0005	0.0007	0.0004
Beverages/Tobacco	0.2806	0.3334	0.0005	0.0008	0.0004
Other Food Products	0.2696	0.3204	0.0005	0.0008	0.0004
Clothing	0.1685	0.2003	0.0003	0.0005	0.0002
Chemicals	1.0352	1.2302	0.0019	0.0029	0.0015
Final Manuf.	0.2649	0.3148	0.0005	0.0007	0.0004

D. Harmonized Environmental Tax Rates (on output for manufactures)

	CAN	USA	MEX	ARG	BRZ
Resource Based Ind	0.3927%	0.4667%	0.0727%	0.1106%	0.0552%
Meat Products	0.2342	0.2784	0.0434	0.0660	0.0329
Milk Products	0.2571	0.3055	0.0476	0.0724	0.0361
Beverages/Tobacco	0.2806	0.3334	0.0519	0.0790	0.0394
Other Food Products	0.2696	0.3204	0.0499	0.0759	0.0379
Clothing	0.1685	0.2003	0.0312	0.0475	0.0237
Chemicals	1.0352	1.2302	0.1916	0.2916	0.1456
Final Manuf.	0.2649	0.3148	0.0490	0.0746	0.0372

Table 3: U.S. - Trading Partners Bilateral Import Barriers

	U.S. Protection				Partner Protection			
	CAN	MEX	ARG	BRZ	CAN	MEX	ARG	BRZ
Grains	7%	4%	4%	4%	13%	31%	17%	11%
Non-Grain Crops	8	19	7	7	36	1	14	51
Livestock	18	18	15	18	21	2	18	1
Resource Based Ind	1	1	3	2	5	9	21	2
Meat Products	18	18	18	18	22	5	12	30
Milk Products	100	100	100	100	136	10	10	35
Beverages/Tobacco	15	4	6	11	7	18	10	85
Other Food Products	7	7	7	7	7	3	16	25
Clothing	11	15	12	11	21	17	38	60
Chemicals	6	8	6	16	10	6	21	11
Final Manuf.	3	4	5	4	8	12	26	29
Services	0	0	0	0	0	1	0	0

Table 4: U.S. Bilateral and Global Trading Patterns

A. Base Level - Value of U.S. Exports

	CAN	MEX	ARG	BRZ	Western Hemisphere	All Regions
			US $ million			
Grains	102	654	5	155	917	10861
Non-Grain Crops	1281	776	31	66	2155	11070
Livestock	216	363	5	25	609	2531
Resour.Based Ind.	7251	3607	127	728	11713	42011
Meat Products	532	631	2	3	1167	4434
Milk products	24	143	2	4	173	411
Beverages/Tabacco	131	98	40	5	275	6750
Other Food Product	1882	980	35	115	3012	11125
Clothing	1919	1560	148	87	3714	13036
Chemicals	14519	6905	662	1330	23416	73200
Final Manuf.	46781	20605	1958	3658	73001	248215
Services	6391	6038	938	1650	15017	135060
ALL COMMODITIES	**81029**	**42359**	**3953**	**7828**	**135169**	**558704**

B. Scenario I - Change in Value of U.S. Exports

	CAN	MEX	ARG	BRZ	Western Hemisphere	All Regions
			Percent Change			
Grains	37	73	60	43	64	4
Non-Grain Crops	82	8	51	365	64	10
Livestock	37	14	109	-1	22	3
Resour.Based Ind.	17	27	103	6	21	4
Meat Products	70	18	48	176	42	10
Milk products	1480	43	52	203	245	101
Beverages/Tabacco	44	109	49	1910	105	1
Other Food Product	19	9	68	-4	15	1
Clothing	144	100	368	594	145	38
Chemicals	25	20	82	32	25	6
Final Manuf.	26	30	104	137	35	7
Services	2	7	4	-1	4	-2
ALL COMMODITIES	**27**	**27**	**85**	**82**	**32**	**5**

Table 4: U.S. Bilateral and Global Trading Patterns (continued)

C. Base Level - Value of U.S. Imports

	CAN	MEX	ARG	BRZ	Western Hemisphere	All Regions
			US $ million			
Grains	349	5	11	0	364	494
Non-Grain Crops	385	1407	52	569	2413	8518
Livestock	1177	381	10	9	1577	2140
Resour.Based Ind.	28326	6762	301	1043	36432	96499
Meat Products	679	20	201	58	957	3143
Milk products	17	0	10	0	27	515
Beverages/Tabacco	914	288	55	257	1513	5811
Other Food Product	1589	514	235	672	3010	8912
Clothing	1308	1888	201	1639	5037	56723
Chemicals	15796	3402	269	1597	21064	79390
Final Manuf.	46973	19857	130	1999	68959	286559
Services	12723	6106	158	422	19409	70079
ALL COMMODITIES	**110235**	**40630**	**1632**	**8266**	**160762**	**618783**

D. Scenario I - Change in Value of U.S. Imports

	CAN	MEX	ARG	BRZ	Western Hemisphere	All Regions
			Percent Change			
Grains	19	-1	0	7	18	11
Non-Grain Crops	28	74	13	23	53	10
Livestock	63	54	35	67	61	38
Resour.Based Ind.	1	-2	5	11	1	2
Meat Products	72	64	62	76	70	12
Milk products	1369	1296	1287	1404	1338	46
Beverages/Tabacco	100	5	15	75	75	13
Other Food Product	29	26	19	30	28	7
Clothing	107	134	93	113	118	7
Chemicals	21	35	19	94	29	6
Final Manuf.	22	25	48	42	24	5
Services	-2	-5	-6	1	-3	2
ALL COMMODITIES	**17**	**24**	**38**	**59**	**21**	**5**

Table 5: Simulation Results for Pollution Emissions, Abatement, and Welfare

Scenario I
Trade Policy Integration

	Agricultural Pollution	Manufacturing		Percent Change in Welfare			Change in Welfare*
		Pollution	Abatement	Environment	Other	Total	
Canada	-3.459%	-0.020%	1.789%	1.132%	0.226%	0.266%	$1403.
USA	0.265	0.169	0.263	-0.016	0.091	0.085	4485.
Mexico	-0.549	0.528	2.350	-0.101	0.362	0.340	998.
Argentina	-0.584	-0.233	1.191	0.104	0.390	0.369	734.
Brazil	-1.205	0.799	1.342	-0.132	0.508	0.476	1624.
OLA	-0.222	-0.124	-0.286	0.048	-0.312	-0.306	-677.
ODV	0.187	-0.079	-0.117	-0.010	-0.052	-0.049	-5111.
ROW	0.044	-0.101	-0.099	0.024	-0.091	-0.086	-2580.
World							877.

Scenario II.A
Trade Policy Integration and Absolute Harmonization of Environmental Policy

	Agricultural Pollution	Manufacturing		Percent Change in Welfare			Change in Welfare*
		Pollution	Abatement	Environment	Other	Total	
Canada	-2.836	-0.030	1.792	1.099	0.228	0.267	$1407.
USA	0.854	0.170	0.268	-0.054	0.087	0.079	4179.
Mexico	-26.189	0.349	65552.	116.019	-0.389	-0.265	-777.
Argentina	-26.089	-0.066	42611.	76.099	-0.717	-0.517	-1028.
Brazil	-29.051	1.065	85747.	151.251	-0.736	-0.612	-2087
OLA	0.318	-0.249	-0.372	0.045	-0.261	-0.255	-566.
ODV	0.544	-0.079	-0.117	-0.034	-0.063	-0.061	-6336.
ROW	0.207	-0.137	-0.126	0.023	-0.095	-0.090	-2696.
World							-7904.

Scenario II.B
Trade Policy Integration and Relative Harmonization of Environmental Policy

	Agricultural Pollution	Manufacturing		Percent Change in Welfare			Change in Welfare*
		Pollution	Abatement	Environment	Other	Total	
Canada	-3.409	-0.019	1.792	1.129	0.226	0.266	$1403.
USA	0.313	0.171	0.266	-0.019	0.091	0.085	4476.
Mexico	-20.825	0.497	10132.	18.932	0.266	0.391	1148.
Argentina	-20.844	-0.198	10023.	18.930	0.192	0.394	783.
Brazil	-21.705	0.827	10034.	18.731	0.386	0.511	1743.
OLA	-0.179	-0.128	-0.286	0.046	-0.308	-0.302	-669.
ODV	0.217	-0.078	-0.116	-0.012	-0.053	-0.050	-5223.
ROW	0.057	-0.103	-0.100	0.024	-0.091	-0.086	-2580.
World							1081.

* Change in total welfare in dollar values is measured US $ million.

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