Development Discussion Papers

Central America Project Series

Economic Instruments, the Environment,
and Regional Trade Agreements:
A CGE Analysis of El Salvador in the
First Decade of the 21st Century

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Development Discussion Paper No. 763
June 2000

Harvard Institute for
International Development

HARVARD UNIVERSITY

DEVELOPMENT DISCUSSION PAPERS
CENTRAL AMERICA PROJECT SERIES
A PROJECT OF HARVARD UNIVERSITY, INCAE AND
THE CENTRAL AMERICAN BANK FOR ECONOMIC INTEGRATION

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Abstract

We consider the challenge facing countries today to be *how* to design an environmental regulatory regime that *supports* sustainable yet competitive trade-driven growth, given the trend toward regional trade agreements. Using a computable general equilibrium (CGE) approach for the case of El Salvador we examine the long-term effects of "command-and-control" environmental policy under hemispheric trade integration scenarios including (i) a "slow improvement" in trade volumes, (ii) a "NAFTA diversion" scenario, and (iii) a regional "Trade integration" scenario. These scenarios yield very different patterns of manufactures and primary goods production and therefore sectoral emissions. We take as our indicators 13 types of air, water, and soil discharge streams and compare simulations for the period 1996-2010 where an emission charge is set so that in the final year a 25-percent reduction of the relevant emission is achieved with respect to the scenario without the charge.

Under *status quo* policies, resources are excessively drawn into the dirtier sectors, with emissions growth rates often exceeding production growth rates by 30 percent. We find that economic instruments-based policies actually reduce emissions growth to rates *below* that of production and consumption growth. The tax effects were most pronounced under the "Trade integration" case. We also show that the cost in terms of output foregone is rather small with the worst cases yielding a 0.4-percentage point loss in the annual *rate* of growth. In a number of experiments the pro-environment policies actually *promoted* GDP growth, raising the rate by 0.3 percentage points. This is due to the stimulation of savings – and therefore investment – from the lump-sum transfers we use to recycle tax revenue and due to strong composition effects of trade led-growth. We also found that pollution charges on one emission type had strong complementary reduction effects across other emission streams. These results clearly justify both the CGE approach as well as the use of environmental charges as a critical part of El Salvador's policy agenda for the 21st Century.

Keywords: El Salvador, NAFTA, computable general equilibrium models, economic instruments, regional integration, trade and environment linkages.

JEL codes: F1, H2, O2, O5, Q0

Please send all correspondence to C. Zinnes at czinnes@hiid.harvard.edu or at HIID, 14 Story Street, Cambridge, MA. The authors wish to express their appreciation to Theodore Panayotou for suggesting the topic, to Francisco Acosta for research assistance, and to Jose Tavares for comments on the trade scenario. All errors and omissions are those of the authors. The results and opinions expressed herein do not necessarily reflect those of the authors' host institutions.

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1. Introduction

The world is quickly going global. For those countries that are prepared, this tendency will bring impressive growth in per capita incomes. For the rest, it may mean falling further behind and a further erosion in bargaining power to attract foreign direct investors to exploit their competitive advantages. While the focus on "international competitiveness" is all the rage[1], concretely, successful countries are adopting a number of coping strategies, including regional integration arrangements. The strategy of regional integration has many motives, including the creation of a larger market to benefit from economies of scale and scope and the signaling to foreign direct investors of a pre-commitment to more sensible monetary and fiscal policies (like a stable exchange rate).[2] However, the first step in regional integration is usually trade liberalization among members.

With a NAFTA[3]-like agreement looming in the future, the countries of Central America are prime examples of the challenges, risks and opportunities confronting developing countries in a globalizing economy. With the "peace dividend" in full swing, their singular hope is for trade-driven growth. Increasing trade requires improving international competitiveness and securing greater market access. Furthermore, while these countries are but blips on the screen when it comes to raw economic power, the richness of their environmental resources may give them a seat at the bargaining table in international affairs (see Panayotou (1999)) Their ability to bargain, however, will depend on an ability to "deliver" the environmental goods, be they retention of biodiversity or carbon sequestration. It also means that globalization will pose a particular burden to Central American policymakers on how to improve international competitiveness without destroying an important source of their country's long term economic value, the environment.[4]

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[1] See World Economic Forum (1997) for both an example of this and how business views environmental issues.

[2] See Schiff and Winters (1998) for an extended discussion of these and other integration motives. See Bhagwati and Panagariya (1996) on the issue of whether preferential trade areas really promote freer trade globally.

[3] The North American Free Trade Agreement was implemented in 1994 and includes Canada, United States and Mexico. It is somewhat unique in that it includes an environmental "side" agreement to overcome fears of turning Mexico into a "pollution haven" and to provide an orderly dispute mechanism for environmentally related trade barriers, i*nter alia*. See Schatan (1996) for a discussion of the side agreement.

[4] Grossman and Krueger (1991) essentially argued the opposite for the case of Mexico when they stressed that pollution per unit of output falls as incomes rise, a usual result of increased trade. Regardless of whether this is true, it ignores the issue of hot spots and pollution thresholds since the *quantity* of total pollution would still likely rise.

For Central America, principal (negative) channels at play for trade impacts include scale effects ("expansion of "dirty" production), composition effects (shift to manufactures and to non-traditional agricultural products), and urbanization effects.[5] While trade-induced growth can have a pernicious effect on environment[6], it is also the case that inappropriate environmental policy can raise the cost of a given level of environmental protection, thereby *reducing* international competitiveness (Panayotou and Vincent (1997;72)).

While many countries at these income levels will require a reduction in government intervention in the economy, this does not mean a reduced role for government, but a *different* role for government. Rather than remaining in the market as a producer of goods and services, the government role will be redirected toward the "software" of a market: a fair, transparent, predictable – and low-cost – legal and regulatory environment, respecting due process and defining and defending property rights. Even when there is scope for government action, such as in environmental policy, successful governments of the 21st Century will use policy instruments that encourage the most cost-effective compliance response on the part of the private sector. Historically the use of command-and-control policies has limited the scope for enterprise responses and, therefore, not provided environmental protection at the lowest social cost. In a global economy, this will have competition-reducing consequences. Among the policy alternatives include the use of economic instruments such as emission charges, product charges, consumption taxes, and subsidies.

In this paper, we examine the effectiveness of the economic instruments policy approach to mitigate the environmentally deleterious effects of trade-induced economic growth for the case of El Salvador. According to the World Bank (1996), by the mid-1990s, El Salvador had emerged from a civil war that had ravaged it for more than a decade, had stabilized its economy, and had pulled itself back from the brink of economic collapse and onto steady economic growth. However, it has an enormous task ahead of it, with GDP per capita not much different from the levels prior to the civil war. Located on the Pacific coast of Central America, it is resource-poor but has relatively abundant water resources, though these suffer from agro-

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[5] Reed (1996;16-18) argues that even the international rules of the game for liberalized trading regimes are biased against the environment.

[6] See Primo Braga (1992) for an example in the case of Brazil and Indonesia.

chemicals, industrial waste and sewage contamination in addition to watershed destruction.[7] This has been exacerbated by the deforestation of most of its territory, El Salvador having the lowest remaining natural forest cover of the region (2 percent of country land area) and one of the lowest in the world. While trade-led growth should address the poverty which has been a major ingredient in the country's environmental degradation, it is indirectly leading to a rapidly deteriorating air quality situation in the major metropolitan areas.

This paper pursues these lines of investigation by using the CGE framework to offer a new quantitative analysis of the linkages between economic activity and the environment in El Salvador. For many reasons, trade and environment issues have been often addressed by using computable general equilibrium (CGE) models.[8] Their main technical advantage lies in the possibility of combining detailed and consistent real world databases within a theoretically sound framework. They also prove to be a good tool when indirect effects are important, when distributional issues are of concern, and when key macro variables have a micro impact. A country's competitiveness stems from many complicated factors, both direct and indirect, as a result of economies of scale and scope that are often external to the firm and even to a given sector. Preferential trade agreements asymmetrically affect the competitiveness – and therefore the expansion and contraction – of different sectors, further complicating the situation. Moreover, the ensuing distributional impacts can tricky. This is of special concern given distributional issues were a source of criticism of NAFTA (see Schatan (1996)) and given the importance for El Salvador of eradicating poverty, both for its own sake and as a major cause of environmental degradation. Finally, there are macro-variables that are important for growth – such as the rental rate on capital – and need to be evaluated in a countrywide setting.

An enormous literature has emerged on these issues which we can only touch on here. Linkages between trade and environment are surveyed in Dean (1993) and analyzed in a CGE context in Lee and Roland-Holst (1994) and Perroni and Wigle (1994). Copeland (1994) looks at the case of a small, open economy and Anderson and Strutt (1994) look at the case of a large developing economy in a world CGE model framework. The examination of environmental regulation and competitiveness *per se* is surveyed in Jaffee *et. al.* (1995) and critiqued in

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[7] The environmental assessment in this paragraph is based on USAID (1997) and Panayotou (1997), which also provide detailed agendas for its amelioration.

[8] For an example in Central America closest to our approach, see Dessus and Bussolo (1998) on Costa Rica.

Repetto (1994). The issue of the pollution intensities of developing countries production and trade patterns is taken up in Hettige, Lucas and Wheeler (1992) and in Tobey (1990).[9]

There are several key features of El Salvador's trade patterns that bear on the present analysis. First, at 66 percent, its merchandise exports are the most intensive in manufactured goods in the CACM[10]. Second, this intensity belies a dichotomy: the comparable figure for its trade with the United States and the European Union is between 35-50 percent and with Central America and Mexico is almost 100 percent. Finally, Mexico's recent entry into NAFTA will have many trade creation and trade diversion implications for El Salvador's exports in the region.

We, therefore, evaluate the effectiveness of the economic instruments policy approach under three stylized trade integration scenarios in which El Salvador's trading partners are aggregated into four groups: United States, Mexico, (other) Central America, and the Rest of the World (ROW). The first is a "slow improvement" scenario in which El Salvador's trade with its partners continues to grow at the historical trend of the first half of the 1990s for each partner. The second is the "NAFTA diversion" scenario. Here, Mexico's entry into NAFTA allows Mexico to capture Central America's trade share with the United States and redirects El Salvador's trade to Mexico itself, filling the void left as Mexican products are sold in the higher priced US market. The third is the "regional integration" scenario. Here, El Salvador succeeds in getting preferential access to United States markets either by joining an FTAA[11], through a bilateral agreement with the United States, or by an agreement between NAFTA (or the US) and CACM.

Over the period 2000-2010 we examine the effects on GDP, trade and production composition, and emissions. We take as our indicators 13 types of air, water, and soil discharge streams. For the three trade scenarios under existing command and control environmental policies, we find that resources are drawn into the dirtier sectors, with industry investment patterns also adjusting accordingly. We find that once environmentally related damages are accounted for, the gains to regional integration are attenuated. We then analyze several alternative policies to mitigate these negative growth effects, including product charges,

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[9] This is the so called "pollution haven" hypothesis.

[10] The Central American Common Market includes Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua.

consumption taxes, tariffs, and subsidies on international transactions. We show that these policies not only reduce the negative costs of growth but also may actually promote GDP growth itself.

The following section describes the most important features of the model. Section 3 presents the main linkages between the El Salvador economic structure and its environment as they result from a basic run of the model. Section 4 describes and simulates the benchmark scenarios, where no environmental policy is altered. Against it, scenarios of alternative environmental policies are contrasted in section 5. We end with a summary and conclusions as well as an agenda for future research.

2. The Model

The model used in this paper[12] is calibrated on data contained in a social accounting matrix (SAM) estimated for the year 1996[13]. The version of the SAM used here includes 1 household category, 36 sectors, 2 labor types, 4 separated trading partners. This 1996 SAM resulted from merging a more aggregate SAM with an Input-output and then updating the resulting matrix from 1990 to 1996 using a series of additional data from national accounts and international statistics. The basic dataset for the model also includes emission data for 13 different pollutants. The model is dynamic and solved recursively for the years 1996, 1997, 1998, 1999, 2001, 2004, 2007, and 2010. The following sub-sections briefly illustrate the model's main characteristics.

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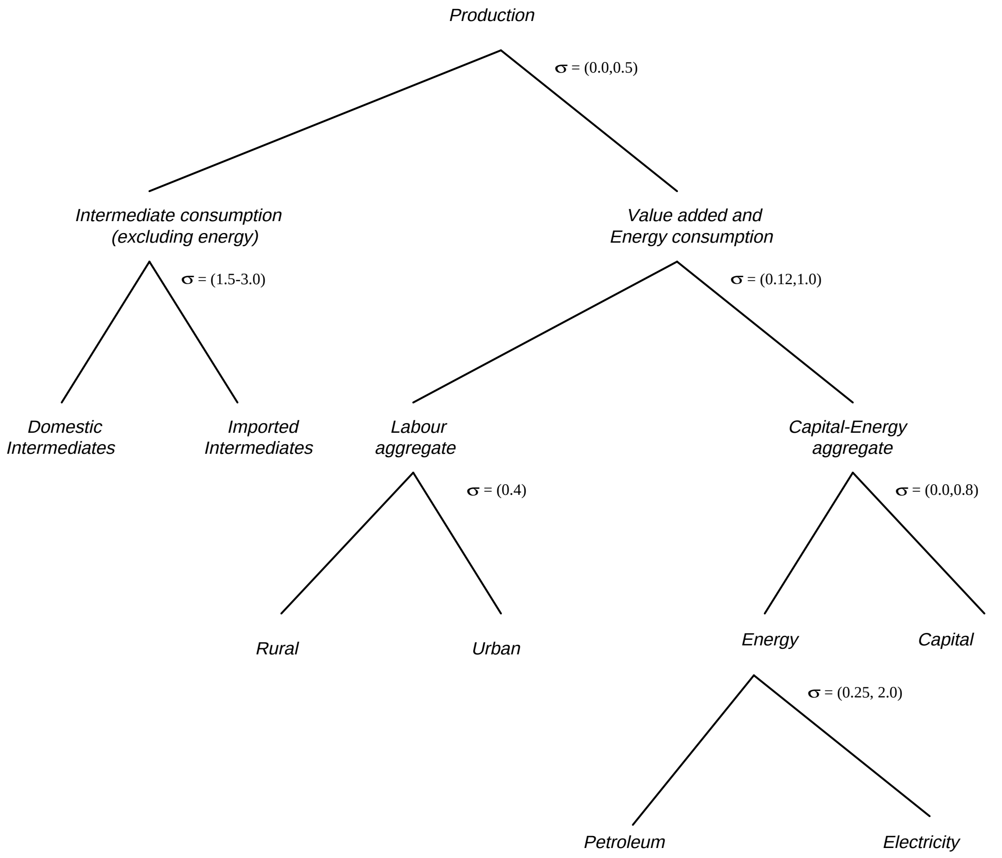
[11] There is a concerted effort to follow NAFTA with a hemispheric (or parts thereof) Free Trade Area of the Americas. See Summit of the Americas (1996), "Joint Declaration", Second Ministerial Trade Meeting, March 21, Cartagena, Colombia. (Also available at www. natlaw. com/ pubs/ summit3.htm).

[12] The general design and structure of the model framework used here is more fully described in Bussolo (1998).

[13] We updated the input-output table for El Salvador for 1990 of the Central Bank of El Salvador (1991), which is described in detail in Abrego (1999).

Figure 2-1: Nested Production Function



- CES substitution elasticities are differentiated by capital vintage, new capital (higher) elasticities are shown to the right of the comma.
- No substitution is possible among intermediates. Domestic products can be substituted with the corresponding foreign ones.

Production

The Constant Elasticity of Substitution (CES) constant returns to scale production function is a nested structure taking into account the assumed substitution possibilities in the choice of production factors. Output results from two composite goods: non-energy intermediates and energy plus value added. The intermediate aggregate is obtained combining all products in fixed proportions (Leontief structure). The value added and energy components are decomposed in two parts: aggregate labor and capital, which includes energy. Labor is a composite of 2 categories. The capital-energy bundle is further disaggregated into its basic components.[14] By

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[14] The particular production function of this model treats energy separately from the other intermediate inputs. Energy use is typically highly polluting and the specific nesting structure adopted here allows monitoring more

distinguishing between "new" and "old" vintages, the capital existing at the beginning of each period, or already installed, can be separated from that resulting from contemporary investment (putty/semi-putty production function).[15] Finally, the energy aggregate includes two energy substitutes: oil and electricity. Figure 2-1 depicts the nested decision process in the choice of production factors.

Substitution elasticities reflect adjustment possibilities in the demand for factors of production originating from variations in their relative prices. Consider particular values[16]: 0.00 between intermediates and value added with *old* capital plus energy; 0.50 between intermediates and value added aggregate incorporating *new* capital plus energy; 0.12 between aggregate labor and *old* capital-energy bundle; 1.00 between aggregate labor and *new* capital-energy bundle; 0.40 among different types of labor; 0.00 between *old* capital and energy; 0.80 between *new* capital and energy; 0.25 among different sources of energy associated with *old* capital; 2.00 among those associated with *new* capital.

Income Distribution and Absorption

Labor income is allocated to households according to a fixed coefficient distribution matrix derived from the original SAM. Likewise capital revenues are distributed among households, corporations and rest of the world. Corporations save the after-tax residual of that revenue.

Private consumption demand is obtained through maximization of household specific utility function following the Extended Linear Expenditure System (ELES).[17] Household utility is a function of consumption of different goods and saving. Income elasticities are different for each household and product and vary in the range 0.20, for basic products consumed by the household

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closely energy-related emissions. Moreover bundling energy together with capital is motivated by the fact that new technologies, embodied in new capital goods, are usually energy saving (i.e. energy substituting).

[15] In the short run capital is usually sector-specific, whereas in the long run it can be perfectly mobile across sectors. The "vintages" approach allows integrating in the present dynamic model both short run capital immobility and long run capital mobility. In the modeled economy new capital (equal to the previous period's level of investment) is perfectly mobile and old capital only partially mobile across sectors. Another advantage of the "vintages" approach is that it allows introducing different degrees of substitutability of capital with other factors. In fact, old capital vintage is less substitutable with energy, labor and other inputs than new capital. Both these features add realism to this environment and trade model where enhanced openness should increase investment opportunities and new capital goods should embody cleaner technologies and greater adjustment possibilities.

[16] These elasticities are derived from the most recent relevant literature. In fact, they are mostly derived from background studies done for the construction of the OECD GREEN model. See for instance Burniaux, Nicoletti and Oliveira-Martins (1992).

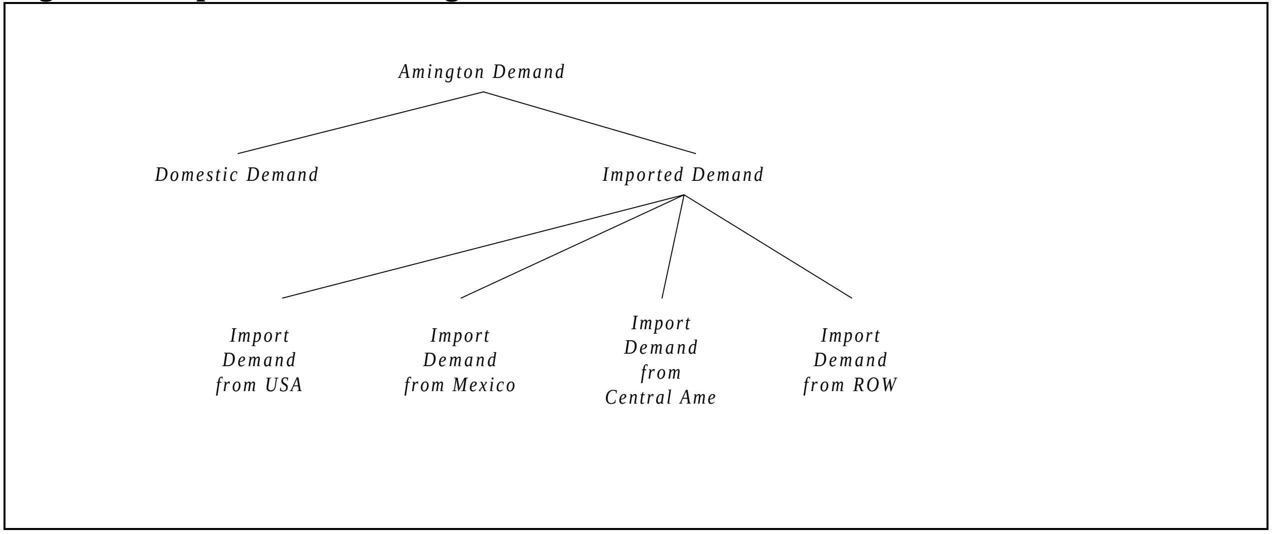
[17] A useful reference for the ELES approach is found in Lluch (1973).

with highest income, to 1.30 for services.[18] Once their total value is determined, government and investment demands[19] are disaggregated in sectoral demands according to fixed coefficient functions.

International Trade

In the model we assume imperfect substitution among goods originating in different geographical areas.[20] Imports demand results from a CES aggregation function of domestic and imported goods. Export supply is symmetrically modeled as a Constant Elasticity of Transformation (CET) function. Producers decide to allocate their output to domestic or foreign markets responding to relative prices. The model implements a two-stage procedure for determining both import demand and export supply. For imports consider Figure 2-2. At the first stage aggregate demand is decomposed into a domestic component and an aggregate import component. At the second stage, aggregate import demand is allocated across the various trading partners.

Figure 2-2: Import demand nesting



Export supply is treated in a symmetric fashion (see Figure 2-3). Producers allocate production between domestic sales and aggregate export sales. At the second stage, aggregate

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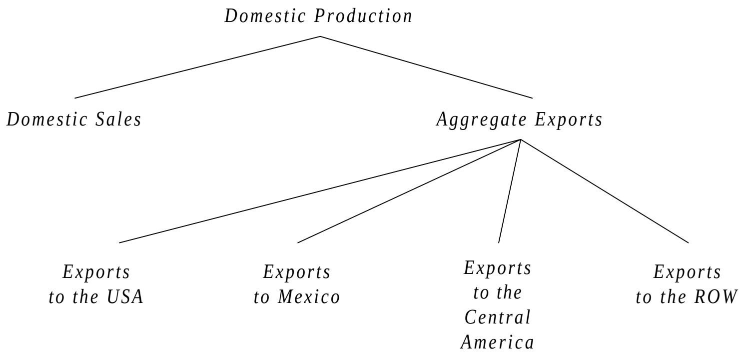
[18] Among the various sources for these elasticities see Blanciforti and Green (1983), Eastwood and Craven (1981), Lopez (1989) and Maki (1988).

[19] Aggregate investment is set equal to aggregate savings, while aggregate government expenditures are exogenously fixed.

[20] See Armington (1969) for details.

exports are sold to the various trading partners based on the relative price the exporter can receive in each market.[21]

Figure 2-3: Export supply nesting



As El Salvador is unable to influence world prices, the small country assumption holds, and its imports and exports prices are treated as exogenous. The balance of payments equilibrium is determined by the equality of foreign savings (which are exogenous) to the value for the current account. With fixed world prices and capital inflows, all adjustments are accommodated by changes in the real exchange rate: increased import demand, due to trade liberalization must be financed by increased exports, and these can expand owing to the improved resource allocation. Price decreases in importables drive resources towards export sectors and contribute to falling domestic resource costs (or real exchange rate depreciation).

Model Closure and Dynamics

The equilibrium condition on the balance of payments is combined with other closure conditions so that the model can be solved for each period. Firstly consider the government budget. Its surplus[22] is fixed and the household income tax schedule shifts in order to achieve the

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[21] Elasticities between domestic and foreign products are of comparable magnitude for imports demand and exports supply. Their values are 3.00 for agricultural goods, 2.00 for manufactured goods and 1.50 for services. Similar values are used for the second nesting.

[22] Its initial value is determined in the 1990 SAM in Central Bank of El Salvador (1991).

predetermined net government position. Secondly, investment must equal savings, which originate from households, corporations, government and rest of the world.

The dynamic structure of the model results from the equilibrium condition between savings and investment. A change in the savings volume influences capital accumulation in the following period. Exogenously determined growth rates are assumed for various other factors that affect the growth path of the economy, such as: population and labor supply growth rates, labor and capital productivity growth rates and energy efficiency factor growth rate. Agents are assumed to be myopic and to base their decisions on static expectations about prices and quantities. The model dynamics are therefore recursive, generating a sequence of static equilibria.[23]

Emissions

Emissions are determined by either intermediate or final[24] consumption of polluting products. In addition, certain industries display an autonomous emission component linked directly to their output levels. This is introduced in order to include some polluting production processes that would not be accounted for by only considering the vectors of their intermediates consumption. It is assumed that labor and capital do not pollute. Emissions coefficients associated with each type of consumption and production are derived from a previous study[25] on the determinants of polluting intensity for the US and here adapted to the El Salvador case.[26] A change in sectoral output, or in consumption vectors, both in levels or composition, therefore affects emission volumes. Formally, the total value for a given polluting emission takes the form:

$$E = \sum_i \sum_j \alpha_j C_{i,j} + \sum_i \beta_i X_i^{Output} + \sum_j \alpha_j X_i^{Armington}$$

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[23] The model's long-run properties are discussed in the technical appendix.

[24] Final consumption, in this context, is restricted to households, government and investment demand. Exports are not considered since the analysis is limited to *local* emission.

[25] See Dessus, Roland-Holst, van der Mensbrugghe (1994). Instead of focusing on pollution output at individual industrial sources, they advocate moving back up the production process. Factories producing pollution can be numerous and very dispersed geographically. The evidence reported in their study indicates that only a few commodities are responsible for determining pollution levels when they are consumed as intermediates. Their econometric estimates indicate that over 90 per cent of the variation in emission of most toxic pollution can be explained by consumption of less than a dozen intermediate commodities. Their calculations are based on a 345 sector US input-output table (see Reinert and Roland-Holst (1992)) and on the 1987 IPPS (Industrial Pollution Projection System) database developed at the World Bank for the US (Hettige, Martin, Singh, Wheeler (1994)).

[26] The actual values used in the model are shown in Annex A and Annex B.

where i is the sector index, j the consumed product index, C intermediate consumption, X^{Output} output, $X^{\text{Armington}}$ final consumption (at the Armington composite goods level), α_j the emission volume associated with one unit consumption of product j and β_i the emission volume associated with one unit production of sector i. Thus, the first two elements of the right hand side expression represent production-generated emissions, the third one consumption-generated emissions.

There are 13 types of polluting substances. Their volume is independently determined and measured in metric tons. Toxic emissions in air (TOXAIR), water (TOXWAT) and soil (TOXSOL) depend primarily on the consumption of chemicals (especially fertilizers for water pollution), oil derived products and mineral products. Bio-accumulative emissions differ from the previous ones for their long term effects on bio organisms, due to their high lead (or other heavy metal) concentration. Again, these are distinguished according to the medium where they are released: into the air (BIOAIR), water (BIOWAT) and soil (BIOSOL). These emissions are a result of the use of mineral and metal products, generally found in construction-related sectors. There are 5 types of toxic substances released in the air: sulfur dioxide (SO2), nitrogen dioxide (NO2) and carbon monoxide (CO), volatile organic compounds (VOC) and suspended particulates (PART). Their levels depend primarily on fuels consumption: oil and coal derived products. Finally, two additional categories of water polluting substances are considered: suspended solids (SS) and those measured by their biochemical oxygen demand (BOD). These emissions are related to the consumption of mineral products.

The household utility functions do not include among their arguments any term directly related to environmental qualities. In other words, pollution levels are assumed not to explicitly affect household utility. Despite the theoretical validity of the utility-environment relationship, empirical applications would require estimates for utility values that household assign to environmental qualities. Unfortunately statistical information on which these estimates can be based is still too limited.[27] Likewise, environmental degradation is not assumed to affect production factors productivity. Productivity gains resulting from new investments in greener technology are not measured in this model[28]. Thus, the potential gains from environmental protection policies are almost certainly going to be under-estimated.

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[27] See Perroni and Wigle (1994) for details.

[28] The authors are in the process of extending this model in this direction.

Policy Instruments

The model includes a variety of important instruments of economic policy: direct and indirect taxes on production, consumption and revenues, tariffs and other taxes and subsidies on international transactions. Each of these taxes/subsidies is differentiated by sector, product, household, production factor, consumption type or income source. A uniform tax on each unit of polluting emission (for type of toxic substance) is also introduced and paid by the polluter agents. This tax can be endogenously determined if specified levels of emission (abatement) are to be targeted, otherwise it can be exogenously fixed. In this latter case, emissions levels become endogenous.

3. Economic Activity and Environment in El Salvador

A single-country CGE model has been constructed to investigate the introduction of green taxes in El Salvador. The country's need to improve environmental regulatory policy in its drive for strengthening its international competitiveness in the face of a rapidly globalizing trade environment make El Salvador an especially instructive case study.

From a static perspective, the top panel of Table 3.1 depicts the estimates for the sectoral emission intensities for production in 1996, i.e. the volume of emissions per unit of output. The El Salvador economy has been aggregated (for a summary presentation) into 8 macro sectors: polluting primary (PollPrim), non polluting primary (NPollPrim), agricultural food derived products (AgriFood), light manufacturing (LightMan), highly polluting manufacturing (PollMan), other manufactured products (OthMan), polluting services (PollServ) and services with low rates of pollution (NPlServ).[29] The last column displays economy-wide averages weighted by sectoral outputs, the middle 3 rows show respectively per cent shares of sectoral production, export to output, and import to demand ratios. The bottom panel shows the same information in another format. Here we observe the row normalised emission coefficients: for each type of emission, the sectoral coefficient is compared to the economy-wide average set equal to 100.

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[29] Polluting primary includes export agriculture and mining. Non Polluting primary consists of grains, livestock and forestry. Agricultural food derived products include 4 sub-sectors diary, meat and fish products, and milling. Light manufacturing is composed of 8 sectors, including processed sugar, textiles, printing and wood products. Highly polluting manufacturing aggregates chemicals, oil refinery, and mineral derived products. Other manufacturing is composed of iron and steel and metal production, equipment and machinery, paper, rubber and plastic industries,

From this summary table, it is possible to observe the distribution of emissions intensities across sectors. This depends on the initial input-output structure of the El Salvador SAM (for the term $\alpha_j C_{ij}$) and on the vector of output (for the term $\beta_i X_i^{\text{Output}}$). A sector *i* would then have a higher pollution intensity (E/X_i^{Output}) the more polluting intermediates it consumes and the higher the value of its own β_i coefficient. By considering the relative weights shown in Table 3.1 (last three rows), it is also possible to see which are the most polluting industries in volume terms and what might be the environmental consequences of changes in competitiveness.

Consider first pollution intensities. Excluding SO2, NO2 and CO (for brevity "NOX"), the aggregate PollMan records the highest ranking among the five macro-sectors. A tax proportional to emission intensities will therefore result in higher production costs for this sector which in the base year accounts for almost 10 per cent of total output. A specifically targeted tax levied on NOX emissions is likely to affect mostly the polluting services (and within them especially transport services). Polluting services' share of output is quite large and their contraction, due to higher indirect taxes, may have more serious effects on aggregate GDP growth.

One can also consider the effect of increased trade and regional integration on emissions by looking at the export and import dependency ratios. For instance, given the relatively high import to demand ration of Polluting manufacturing (69%), one may expect that increased openness may lead to substitute even more imported for domestic goods (for this particular macro-sector) resulting in lower local emissions. Clearly the final result will depend on the initial level of protection and the sectoral resource distribution, which will ultimately determine its comparative advantage and specialization due to trade liberalization.

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electrical durables. Polluting services are electricity production and distribution, construction, transport, and other services. Non-polluting services are commerce, tourism, communication, and banking and insurance.

Table 3.1: Sectoral emission intensities for production - 1996 (Tons per 106 Colones)

	PollPrim	*NPollPrim*	*AgriFood*	*LightMan*	*PollMan*	*OthMan*	*PollServ*	*NPollServ*	*Total*
TOXAIR	2506.8	1310.7	308.0	4044.3	9359.3	1701.9	6007.3	1250.8	3498.4
TOXWAT	7014.4	3444.1	690.1	4548.5	16151.3	5974.2	16303.7	3558.5	7983.1
TOXSOL	8267.3	3114.7	779.9	4548.5	52940.9	4482.1	21065.3	4364.2	12499.5
BIOAIR*	2.5	1.1	0.2	1.6	118.5	13.8	7.1	0.2	13.3
BIOWAT*	0.2	0.0	0.0	0.2	6.5	0.1	1.8	1.3	1.4
BIOSOL*	49.5	20.0	1.7	14.6	2515.7	121.4	99.6	2.2	256.1
SO2	14301.8	2732.7	1712.8	8238.5	19572.1	3894.9	44746.2	10040.6	17685.0
NO2	8753.8	1668.6	1050.6	5053.8	12088.3	2244.0	27423.8	6160.1	10839.8
CO	5333.2	1046.6	623.7	3166.2	14580.9	1470.1	16440.9	3644.3	7153.7
VOC	3747.5	2507.3	266.1	3877.9	10772.7	2708.7	6819.9	1411.7	4070.9
PART	2406.5	459.2	288.6	1440.1	3142.3	621.6	7535.2	1691.9	2969.7
BOD	81.3	31.1	6316.9	3.0	4374.4	745.4	115.3	0.4	801.1
TSS	4476.8	1715.2	67.7	163.3	241254	2409.2	6347.0	23.8	23005.7
Output %	**5**	**9**	**5**	**13**	**9**	**6**	**24**	**29**	**100**
X/Output	**49**	**1**	**1**	**20**	**14**	**21**	**11**	**5**	**12**
M/Demand	**67**	**6**	**14**	**25**	**69**	**131**	**9**	**3**	**22**
Normalized coefficients									
TOXAIR	72	37	9	116	268	49	172	36	100
TOXWAT	88	43	9	57	202	75	204	45	100
TOXSOL	66	25	6	36	424	36	169	35	100
BIOAIR*	19	8	1	12	890	104	54	2	100
BIOWAT*	16	3	1	14	465	6	126	90	100
BIOSOL*	19	8	1	6	982	47	39	1	100
SO2	81	15	10	47	111	22	253	57	100
NO2	81	15	10	47	112	21	253	57	100
CO	75	15	9	44	204	21	230	51	100
VOC	92	62	7	95	265	67	168	35	100
PART	81	15	10	48	106	21	254	57	100
BOD	10	4	788	0	546	93	14	0	100
TSS	19	7	0	1	1049	10	28	0	100

Although production activity is the dominant environmental agent in the economy, final consumption of goods and services can equally cause considerable pollution, especially for specific emission categories. Analogous results of emissions intensities for consumption are shown in Table 3.2. These estimated intensities refer to consumption of final goods (and services) and do not consider households' waste. Except for water bio-accumulative, consumption generates emissions only in correspondence of polluting manufactured products, as in the case of consumption of refined fuels or chemicals, polluting primary and other manufacturing. Bio-accumulative metals and toxic waste released through consumption, similarly to production, usually degrade soil.

Table 3.2: Sectoral emission intensities for final consumption - 1996 (Tons per 106 Colones)

	PollPrim	*NPollPrim*	*AgriFood*	*LightMan*	*PollMan*	*OthMan*	*PollServ*	*NPollServ*	*Total*
TOXAIR	739.2	0.0	0.0	0.0	40779.2	5356.7	0.0	0.0	4835.3
TOXWAT	911.3	0.0	0.0	0.0	121597.6	681.7	0.0	0.0	12658.2
TOXSOL	5377.8	0.0	0.0	0.0	132702.8	1969.2	0.0	0.0	14102.5
BIOAIR*	14.0	0.0	0.0	0.0	0.0	27.6	0.0	0.0	3.6
BIOWAT*	0.8	0.0	0.0	0.0	0.0	0.0	71.2	0.0	22.0
BIOSOL*	301.1	0.0	0.0	0.0	0.0	229.3	0.0	0.0	36.1
SO2	758.8	0.0	0.0	0.0	258584.7	0.0	0.0	0.0	26715.3
NO2	330.3	0.0	0.0	0.0	158650.7	0.0	0.0	0.0	16386.1
CO	1204.2	0.0	0.0	0.0	93836.4	0.0	0.0	0.0	9726.5
VOC	664.1	0.0	0.0	0.0	63330.3	0.0	0.0	0.0	6559.3
PART	105.9	0.0	0.0	0.0	43573.0	0.0	0.0	0.0	4500.9
BOD	526.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1
TSS	29013.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	997.9
Cons %	**3**	**7**	**8**	**14**	**10**	**11**	**31**	**15**	**100**
Normalized coefficients									
TOXAIR	15	0	0	0	843	111	0	0	100
TOXWAT	7	0	0	0	961	5	0	0	100
TOXSOL	38	0	0	0	941	14	0	0	100
BIOAIR*	392	0	0	0	0	771	0	0	100
BIOWAT*	4	0	0	0	0	0	323	0	100
BIOSOL*	834	0	0	0	0	636	0	0	100
SO2	3	0	0	0	968	0	0	0	100
NO2	2	0	0	0	968	0	0	0	100
CO	12	0	0	0	965	0	0	0	100
VOC	10	0	0	0	966	0	0	0	100
PART	2	0	0	0	968	0	0	0	100
BOD	2908	0	0	0	0	0	0	0	100
TSS	2908	0	0	0	0	0	0	0	100

4. The Benchmark Scenarios

In this section we explore the environmental consequences of trade-led growth under a series of three alternative, though stylized, trade scenarios in which the government pursues exist *status quo* (command and control) environmental policies. These scenarios refer to the cases of “slow improvement” in export growth, “NAFTA diversion”, and “trade integration”. These, in turn, are based upon on several simplifying hypotheses regarding the definition of a plausible evolution for the El Salvador economy. After first describing these growth hypotheses and their benchmark emissions implications, we then describe each trade scenario and end by comparing the output and emission effects from their simulations. To simplify the comparisons below we refer to the case of *status quo* environmental policies in conjunction with the “slow improvement” trade scenario as the “business-as-usual” (BaU) scenario.

We wish to stress that the simulations in this paper should not be considered as a forecast exercise, for CGE models are not adequate forecast tools. In fact, the definition of a trade-induced growth path, supported by exogenous assumptions, serves the purpose of establishing scenarios with no policy interventions. Impacts of different environmental policies are then evaluated against these reference scenarios by measuring the variations in the economic aggregates. Fixing values for exogenous variables within a realistic confidence interval seems to imply no major consequences: the relative variations of the different economic aggregates measured during the evaluation of alternative policies with respect to the reference scenario seem uninfluenced by those *a priori* choices.

Growth hypotheses

Crucial growth rates have to be fixed in order to define the reference scenario. The GDP growth rate up to the year 2010 is exogenously determined so that the capital productivity growth rate can be estimated.[30] Yearly growth rates are assumed so that throughout the period average growth rate is estimated at 4.11 percent, population and labor force are supposed to grow at the same exogenously fixed rate of 2 per cent per year[31].

A further hypothesis concerns the monetary transfers among agents in the economy and public expenditures. These are taken to be growing at the same rate as GDP. The government budget surplus is assumed to stay constant in monetary terms relative to the base year during the simulation period[32]. Lastly we hypothesize exogenously increasing annual growth rates for energy efficiency factor at 1 percent and for labor productivity at 0.5 percent. Apart from the latter assumptions about efficiency, no other modification affects the current technology. However, current technology can become less polluting because of factor substitution due to changes in tax structure, production and consumption. We now examine the joint evolution of El Salvador economic activity and pollution in the BaU scenario.

Growth and emissions

The joint evolution of economic activity and emission volumes can be seen in Table 4.1 where the long-term pollution elasticities with respect to production and consumption are depicted. These are measured as the ratio of the yearly average growth rates of polluting

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[30] In the reference scenario real GDP growth rate is fixed and the capital productivity growth rate is endogenously determined. In the alternative policies simulations the previously estimated capital productivity growth rate is exogenous and GDP growth rate becomes endogenous.

[31] The forecasts here are taken from IMF (1998).

[32] This means that it decreases in real terms and as a percentage of GDP.

emissions to those of production (and consumption, during the period 1996-2010) obtained in the BaU scenario, i.e. without any change in environmental policy.

Notice in the case of production that, with the exception of BOD, aggregate pollution grows more intensively than economic production, as the elasticities are above unity. In other words, the BaU evolution of the economy in El Salvador will result into an exacerbation of environmental problems, especially the case of NOX emissions. This is also the case for consumption, though here TSS follows BODs and the worst offenders are now the BIO pollutants (BIOAIR, BIOWAT, BIOSOL) rather than NOX emissions. Finally, we point out that the relative weights of production and consumption generated emissions do not vary significantly during the simulation period.

Table 4.1: Emission elasticities - Benchmark scenario 1996 – 2010

	Production	*Consumption*
TOXAIR	1.19	1.08
TOXWAT	1.24	1.08
TOXSOL	1.26	1.09
BIOAIR	1.25	1.63
BIOWAT	1.09	1.68
BIOSOL	1.23	1.51
SO2	1.30	1.09
NO2	1.30	1.09
CO	1.29	1.09
VOC	1.18	1.08
PART	1.30	1.09
BOD	0.95	0.79
TSS	1.22	0.79

The analysis of the decomposition of emission by origin can also be instructive. Three types of effects are distinguished in the variation of emission levels: the *composition effect* takes into account the modification of the proportion of polluting products in the aggregate output; the *technological effect* reflects changes in pollution due to alteration in the production technology; and the *scale effect* describes the impact of increased volumes of output on the environment.

Consider the following identity, which simply states that total emission (for each type of pollutant) is equal to the sum of sectoral emissions:

$$E = \sum_i E_i = \sum_i \left(\frac{X_i^{Output}}{X_{tot}^{Output}} \frac{E_i}{X_i^{Output}} X_{tot}^{Output} \right)$$

The total variation in emission levels can then be measured as the sum of the mentioned three effects by differentiating the shown identity:

$$\partial\, E = \sum_i \left[\partial \left(\frac{X_i^{Output}}{X_{Tot}^{Output}} \right) \frac{E_i}{X_i^{Output}} + \partial \left(\frac{E_i}{X_i^{Output}} \right) X_i^{Output} + \partial \left(X_{Tot}^{Output} \right) \frac{E_i}{X_{tot}^{Output}} \right]$$

where ∂ is the differential operator, E total emission volume, X_{Tot}^{Output} total output (in real terms), E_i the sectoral emission volumes and X_i^{Output} the sectoral outputs. A similar formula is used in the case of emissions originating from final consumption.[33]

The determinants of variations in the levels of emissions due to changes in production or consumption vectors are displayed in Table 4.2. Observing the values in the *scale effect* column, it clearly emerges that the predominant role in environmental degradation (across all types of emission) is played by the increase in activity volumes. The proportion of polluting goods and services produced and consumed expands from 1996 to 2010 (as shown in Annex C(1)), thereby increasing, with the exception BOD, the aggregate pollution volumes (*composition effect*). Finally, in spite of the small efficiency gain in energy use, production technologies appear to be slightly dirtier at the end of the simulation period because of some substitution in production factors (*technology effect*).

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[33] In this case, the technological effect is absent, given that each component of final consumption is associated to an emission coefficient invariant with time. The emission volumes variation due to a modified consumption vector takes the form:

$$\partial\, E = \sum_i \left[\partial \left(\frac{X_i^{Armington}}{X_{Tot}^{Armington}} \right) \frac{E_i}{X_i^{Armington}} + \partial \left(X_{Tot}^{Armington} \right) \frac{E_i}{X_{tot}^{Armington}} \right]$$

where $X_{Tot}^{Armington}$ is total final consumption (of the Armington composite good) in real terms and $X_i^{Armington}$ final consumption in real terms of product *i*.

The actual mechanics of the technology effect deserve some additional elaboration. The production technology specification was briefly described in the previous section, but it is worthwhile highlighting again some of its important characteristics. In the current CGE model, production technology is defined as a combination of intermediate inputs and primary factors. Some substitution among these two groups is possible, while intermediate inputs are combined among themselves in fixed proportions. The primary factor bundle is composed of three substitutable components: energy, capital and labor, with energy producing toxic emissions when used. Energy is furthermore decomposed in oil products and electricity, with each of them having different polluting characteristics. Therefore a producer may reduce its emissions at any of the described levels by substituting intermediates and factors, by replacing energy with non-energy factors, or, finally, by switching among energy sources. Actual substitutions result from alterations in relative prices of the constituents (intermediates and factors) and relative prices are changed, among other things, by indirect tax variations.

Even if this specification succeeds in capturing a complex adjustment process, some important links between pollution and technology still are not precisely taken into account. For instance, innovation or technology transfers, which may explain how substitution among factors and inputs can be realized, are not explicitly modeled. Moreover, emissions reductions, environmental management systems, cleaning, and other end-of-pipe techniques are not considered. The basic mechanism is governed by an endogenous response to changes in relative prices of factors and inputs and its flexibility is limited by empirical substitution elasticities.

In summary, with no policy intervention, economic activity growth results in a significant increment of emissions despite output and consumption shifts towards less polluting products and the implementation of cleaner technology.

Table 4.2: Decomposition analysis of emission variations, 1996-2010 (BaU scenario)

	Production			*Consumption*		
	Composition	*Technology*	*Scale*	*Composition*	*Technology*	*Scale*
Variation in Volumes (1000 metric tons)						
TOXAIR	615.3	177.6	6808.0	221.4	0.0	4053.8
TOXWAT	1739.5	527.8	16030.2	604.6	0.0	10632.1
TOXSOL	3199.1	659.1	25409.5	790.7	0.0	11937.7
BIOAIR	3.9	0.1	26.9	1.6	0.0	4.1
BIOWAT	0.1	0.0	2.5	10.4	0.0	25.9
BIOSOL	72.0	1.1	513.2	12.2	0.0	38.5
SO2	5029.5	1474.0	37116.9	1431.2	0.0	22561.7
NO2	3101.2	904.1	22770.3	878.6	0.0	13839.1
CO	2010.0	536.5	14918.6	515.7	0.0	8210.0
VOC	630.8	217.7	7843.4	298.5	0.0	5497.8
PART	841.7	248.3	6230.8	241.3	0.0	3801.2
BOD	-41.9	0.9	1320.9	-2.1	0.0	12.9
TSS	6222.9	51.6	45765.4	-114.3	0.0	710.4
Variation in percent						
TOXAIR	8	2	89	5	0	95
TOXWAT	9	3	87	5	0	95
TOXSOL	11	2	87	6	0	94
BIOAIR	13	0	87	27	0	73
BIOWAT	4	1	95	29	0	71
BIOSOL	12	0	87	24	0	76
SO2	11	3	85	6	0	94
NO2	12	3	85	6	0	94
CO	11	3	85	6	0	94
VOC	7	2	90	5	0	95
PART	11	3	85	6	0	94
BOD	-3	0	103	-19	0	119
TSS	12	0	88	-19	0	119

The stylized facts leading to the trade scenarios

There are several key features of El Salvador’s trade patterns that influence our choice of stylized trade scenarios for the present analysis. These include the structure of its merchandise trade, who its main trading partners are, and the likely dynamics of existing and upcoming regional integration schemes on the hemispheric agenda.

Table 4.3: Manufacturing share of merchandise exports of selected countries, 1996

*Country (*CACM)*	*Manufactures share (percent)*
Brazil	54
Chile	15
Costa Rica*	24
Honduras*	9
Guatemala*	28
Mexico	78
Nicaragua*	20
United States	78
El Salvador*	**43**
Trade with: United States	31
Central America	75
Mexico	74
Rest of World	23

Source: World Bank World Development Indicators, 1998 and SAM

Table 4.3 illustrates two key points about El Salvador’s trade structure. First, at 43 percent in 1996, its merchandise exports are the most intensive in manufactured goods in the CACM. Second, this intensity belies a dichotomy: the comparable figure for its trade with the United States and the European Union is between 23-31 percent and with Central America and Mexico is 75 percent.

We next consider the export shares to El Salvador’s partners as presented for the period 1990-1996 in

Table **4.4**. We first note that the ROW share has remained relatively fixed over the period. Second, over the period 1990-1993 (representing something of a pre-NAFTA equilibrium after a decade of civil wars in the region), exports to the United States grew at 2.4 percent annually. Exports to Mexico over this period grew at about 45 percent annually while those to the rest of Central America grew at 15 percent.

Table 4.4: Export value (mlns US$) annual growth and shares for El Salvador's major trading partners, 1990-1996

Year	1990	1991	1992	1993	1994	1995	1996	Avg '90-6	Avg '90-3	Avg '94-6
United States	-0.025	0.010	0.024	0.088	-0.176	0.093	-0.015	0.000	0.024	-0.033
Share	0.339	0.339	0.341	0.303	0.217	0.200	0.192	0.276	0.331	0.203
Mexico	0.237	0.723	0.235	0.600	0.313	-0.619	0.625	0.302	0.449	0.106
Share	0.008	0.014	0.017	0.022	0.025	0.008	0.013	0.015	0.015	0.015
ROW	0.820	-0.095	-0.313	0.460	0.620	0.480	-0.181	0.256	0.218	0.306
Share	0.348	0.312	0.211	0.251	0.353	0.442	0.353	0.324	0.281	0.383
CACM	-0.018	0.116	0.308	0.202	0.103	0.020	0.298	0.147	0.152	0.141
Share	0.304	0.336	0.431	0.423	0.405	0.350	0.442	0.385	0.374	0.399

Source: Table 2622, CEPAL (1998) and authors' calculations.
Notes: Averages are unweighted.

Finally, Mexico's recent entry into NAFTA will have many trade creation and trade diversion implications for El Salvador's exports in the region. Though Central America – and El Salvador in particular – has historically exported little to Mexico, trade diversion theory provides reason to believe that NAFTA will lead to a "radical" redirection in Central American exports.[34] Through NAFTA, Mexico has gained access to a higher priced protected market for its output and has had to lower its own tariff barriers to the rest of the world. Following Leamer *et. al.* (1992), we postulate that this leads to two effects. First, Mexico has the incentive to export all its relevant output to the high-priced United States market and to import for domestic consumption the same goods from low-priced third markets. Second, Mexico's trade liberalization encourages exports from the ROW and El Salvador to be diverted to Mexico.

The net impact of these two effects on El Salvador interestingly depends on the size of Mexico's export supply response relative to Asia. Assuming Asia remains the marginal supplier to the United States (i.e., that Mexico remains "small" relative to Asia), the prices El Salvador will receive for its exports to the United States should remain unaffected but the quantity exported should fall as Mexico's share increases due to its preferential US access. If Mexico is able to increase its production so much as to squeeze Asian exports out of United States markets for key El Salvadorian products, then both the prices El Salvador receives and the quantity it sells in the United States will be reduced.[35] Whether El Salvador continues to receive the same prices for its exports to Mexico as before NAFTA depends on whether the ROW is also squeezed

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[34] This section follows closely the arguments put forward by Leamer *et. al.* (1992).

[35] Growth in Pacific Rim exports to the United in the 1990s so far suggests it is unlikely that Mexican supply would be so large as to drive down United States prices below Asian prices, hence discouraging any Central American exports to the United States for goods in which it competes.

out of the Mexican domestic market. The latter could happen only if Central American-diverted exports to Mexico cause prices to fall below ROW prices or if Mexico decides to erect non-tariff barriers on the rest of the world (Asian) imports.

These stylized facts lead us to formulate three stylized trade integration scenarios in which El Salvador's trading partners are aggregated into four groups: United States, Mexico, (other) Central America, and the ROW. They include the "slow improvement" scenario, the "NAFTA diversion" scenario, and the "Trade Integration" scenario and are described in the next section.

In practice, the sectoral (i) export demand forecasts for manufactured goods ($X^{M}_{i,c,t}$), primary goods ($X^{P}_{i,c,t}$), and services ($X^{S}_{i,c,t}$) with partner c for year t for each scenario are derived in a number of steps using the assumptions in Table A.2. First, we compute the overall merchandise export demand ($X_{c,t}$) by applying the growth assumptions for each partner (g_c) to the previous year's value (starting with the actual 1996 value). We then calculate the manufacturing share ($m_{c,t}$) by adjusting the previous year's value (again, starting with the actual 1996 value) by our forecast adjustment (a_c). Together, these yield the partner's manufacturing export demand. We then allocate this total demand across the manufacturing sectors in the SAM according to the 1996 sectoral export shares for manufactured exports ($s^{96}_{i,c}$) to the partner. The "predicted" total partner manufacturing export value is then subtracted from total merchandise forecast to determine the increase in primary goods exports, which is allocated to the primary good export demand sectors in an analogous fashion ($r^{96}_{i,c}$). The overall growth rate (g_t) is computed as a weighted average across all partners and then used to increase the previous year's figure for the sectoral demand for exported services ($X^{S}_{i,c,t}$). Mathematically for each scenario (we drop the scenario index) we compute:

$$X_{c,t} = X_{c,t-1}\,(1+g_c)$$

$$m_{c,t} = m_{c,t,-1} + a_c$$

$$X^{M}_{i,c,t} = X_{c,t}\, m_{c,t}\, s^{96}_{i,c}$$

$$X^{P}_{i,c,t} = [X_{c,t} - (X_{c,t}\, m_{c,t})]\, r^{96}_{i,c}$$

$$g_t = (\Sigma_c\, g_c\, X_{c,t}) / X_t \quad , \text{ where } \quad X_t = \Sigma_c\, X_{c,t}$$

$$X^{S}_{i,c,t} = X^{S}_{i,c,t-1}\, g_t$$

The "Slow Improvement" business-as-usual scenario

Under the "Slow Improvement" scenario, we assume that NAFTA will have a minimal effect on El Salvador and that historical trade shares to partners will be maintained. We further assume that El Salvador's trade with its partners continues to grow at the historical trends of the first half of the 1990s for each partner as shown in Table 4.4.[36] In particular, we take real growth in merchandise exports over the period 1996-2010 (the g_c) to be 5 percent per annum for the United States and the ROW and 15 percent per annum for the rest of Central America and Mexico. Moreover, we assume that historical trends in the composition of manufactured merchandise exports continue. Thus, (for the a_c) there is no change in El Salvador's Central American and Mexican export composition but the figure for the United States and the ROW increases by half and by one-third percentage point per year, respectively, over the period to reflect a convergence to the associated figures for Brazil and Mexico. Table A.2(a) in the annex provides the growth and share estimates for 1997-2010 that result from these assumptions.

The "NAFTA diversion" business-as-usual scenario

In the "NAFTA diversion" scenario, we assume that Mexico's entry into NAFTA allows Mexico to capture some of Central America's trade share with the United States. This redirects El Salvador's trade to Mexico itself, filling the void left as Mexican products are sold in the higher priced US market. However, following the Leamer arguments presented in section 0 we further assume that Asia remains the marginal supplier (Mexico remains "small") for the United States so that El Salvador still exports to it, albeit at a reduced rate. In fact, comparing the average growth and export share figures for exports to the United States in Table 4.4 for the periods 1990-93 and 1994-96 (NAFTA implemented) suggests a decline in both as a result of NAFTA. The figures for Mexico are less persuasive here, primarily because the NAFTA-period average reflects the exogenous nosedive that Mexican manufacturing production took in 1995. We translate these assumptions into annual growth rates of 3 and 5 percent for exports to the United States and the ROW and of 15 and 35 percent for CACM and Mexico. We retain the "Slow Improvement" assumptions for export composition, namely, that there is no change in El Salvador's Central American and Mexican export composition but the figure for the United States and the ROW increases by half and by one-third percentage point per year, respectively, over the period.

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[36] In the case of Mexico, we used a lower-than-historical rate se we believe that the strong growth in the early 1990s reflected a post-civil war "catch-up" to the long-term rate we propose here.

The "Trade Integration" business-as-usual scenario

In the "Trade Integration" scenario, El Salvador succeeds in getting preferential access to United States markets either by joining an FTAA[37], through a bilateral agreement with the United States, or by an agreement between NAFTA (or the US) and CACM. This should modify the "NAFTA diversion" effects of Mexico's preferential access into the United States markets. First, the diversion of El Salvador's exports from the United States to Mexico due to NAFTA will reverse though due to hysteresis they will remain higher (25 percent) than under the "Slow Improvement" scenario (15 percent). Second, the strong growth with the CACM (15 percent) under the "NAFTA diversion" scenario will be weakened to rates below the "Slow Improvement" scenario (10 percent), reflecting diversion of trade from within the region back to the United States. Third, and as a result, export growth to the United States will greatly increase, rising to 20 percent from low single-digit growth in the previous scenarios. Exports to the ROW remain at the "NAFTA diversion" levels of 5 percent.

We believe that regional integration would have some lasting effects on the composition of El Salvador's exports to it partners as well. First, it would speed up the trend toward higher value-added exports to the United States since El Salvador would be able to capitalize on its sources of competitive advantage, namely its lower labor costs of manufacturing and close distance to market which hitherto had been restricted by tariff walls. Thus, we assume a one-percentage point annual rise in the share of manufacturing in merchandise exports to the United States (double that of the other two scenarios). On the other hand, the removal of trade barriers in Mexico for El Salvador's agricultural goods should allow El Salvador's excessively low primary goods share of merchandise exports to move toward levels commensurate with its level of development. Concretely, we implement this by *decreasing* the share of manufacturing in merchandise exports to Mexico by half a percentage point per year over the forecast period. In keeping with the trend growth assumption for ROW export growth, we maintain El Salvador's export composition to the ROW at 1996 levels over the forecast period.

The "Trade Integration" scenario is the only scenario in which we postulate that there is a change in *import* policy related to the trade liberalization requirements of integration. In particular, under this scenario we assume that El Salvador reduces its average tariffs to Mexico,

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[37] There is a concerted effort to follow NAFTA with a hemispheric (or parts thereof) Free Trade Area of the Americas.

the United States and Central America to zero by the year 2007. In fact, this has been done more for form than substance, since El Salvador's tariff levels even in 1996 are quite low[38] and simulations reveal little effect of lowering further.

Comparing the business-as-usual scenarios

Simulating model for the three trade scenarios under existing, *status quo*, environmental policies, we may compare the output and pollution consequences under the assumptions presented at the beginning of this section. For tractability, the "slow improvement" scenario is used to dynamically calibrate the model and the other two trade scenarios are contrasted with respect to this first scenario. The main results are contained in Table 4.5, Table 4.6, and Table 4.7. As is seen they confirm the insights highlighted in section 0.

At the most aggregate level, we see in the first row of Table 4.5 that average annual real GDP growth over the period 1996 to 2010 are very similar across the three stylized scenarios, with "Trade Integration" showing a slightly better performance. This lack of major differences in growth is fairly standard for this type of model since shocks do not really affect growth in productivity (no endogenous growth effect) and growth depends only on efficiency gains (better allocation of resources) and factor accumulation.

Consider now the output growth rates for the macro-sectors. Again these are still quite similar for the "Slow improvement" and "NAFTA diversion" scenarios and start to differ for the "Trade integration" scenario. This is clearly emphasized in the bottom half of Table 4.5 when, instead of comparing the growth rates, we compare the values of the final year of the scenarios with respect to the final year value of the "Slow improvement" scenario. Here we can see, for instance, that in "Trade integration" scenario the value for the year 2010 of polluting primary output is 16.4% higher than the same value in the "Slow improvement" scenario, whereas, for the same sector, the "NAFTA diversion" scenario registers a decrease of 2.2%. This is a clear consequence of the assumptions made on export demand growth.

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[38] The trade-weighted average tariff was just above 5 percent in 1996.

Table 4.5: Macro sector growth rates for each scenario and variation from "slow improvement" scenario under business-as-usual environmental policies

	"Slow Improvement"	*NAFTA Diversion*	*Trade Integration*
Yearly Average Growth Rates			
RGDP	0.041	0.041	0.042
PollPrimary	0.039	0.037	0.050
NPollPrimary	0.037	0.037	0.038
AgriFood	0.032	0.032	0.031
LightMan	0.041	0.041	0.044
PollMan	0.061	0.061	0.057
OthMan	0.074	0.075	0.065
PollServ	0.059	0.060	0.061
NPollServ	0.054	0.054	0.054
Percent variation in 2010 simulation wrt "Slow Improvement" scenario			
PollPrimary	-	-2.2	16.4
NPollPrimary	-	-0.3	1.8
AgriFood	-	-0.1	-1.6
LightMan	-	-0.2	3.3
PollMan	-	0.2	-5.3
OthMan	-	0.9	-11.1
PollServ	-	0.3	2.1
NpollServ	-	0.1	-1.0

That this is shift in output composition leads to different environmental consequences for the "NAFTA diversion" and "Trade integration" scenarios should not be a surprising result given the values of emission intensities reported in Table 3.1 and Table 3.2. This is confirmed by looking at the emission/growth elasticities in Table 4.6. While the "Trade integration" elasticities are only slightly higher elasticities than for the other scenarios – especially for the NOX and Tox, they are significant over the long simulation period. This can be examined more in detail in Table 4.7 where we have disaggregated the emission growth into its composition, technology, and scale effects. We now see one reason explaining the small differences for the two scenarios: the composition effects cancel out and scale effects and technology effects are similar for the two scenarios. The canceling out occurs since the "Trade integration" scenario produces more polluting primary goods ("PollPrimary") *but* less polluting manufactures ("PollMan").

Table 4.6: Elasticities with respect to production (growth rate of emissions/growth rate of XP) and consumption (growth rate of emissions/growth rate of consumption) under business-as-usual environmental policies

	"Slow Improvement"	*NAFTA Diversion*	*Trade Integration*
Elasticities wrt Production (Growth rate of Emissions/Growth rate of production)			
Tox	1.24	1.24	1.27
Bio	1.23	1.24	1.23
NOX	1.30	1.30	1.35
Air	1.23	1.23	1.27
Wat	1.22	1.22	1.21
Elasticities wrt Consumption (Growth rate of Emissions/Growth rate of Consumption)			
Tox	1.09	1.09	1.09
Bio	1.58	1.58	1.59
NOX	1.09	1.09	1.08
Air	1.08	1.08	1.08
Wat	0.79	0.79	0.79

In summary, the basic observation is that El Salvador risks a specialization in dirty production under the three stylized benchmark trade scenarios explored here if no corrective environmental policy is adopted. This is a consequence of sectoral output growth rates and emission elasticities. We illustrate a final example of this, again referring to Table 4.5 in the case of the "Slow improvement" scenario. The polluting manufacturing macro-sector grows at 6.1 percent (above a GDP growth rate of 4.11 percent) and shows the highest values of emission intensities across all emission types (from Table 3.1) while, conversely, the Agrofood macro-sector, which is the least polluting macro sector, grows at only 3.2 percent.

Table 4.7: Decomposition of emission variations, 1996-2010

	"NAFTA Diversion" wrt "Slow Improvement"						**"Trade Integration" wrt "Slow Improvement"**					
	Production			*Consumption*			*Production*			*Consumption*		
	Composition	Technology	Scale	Composition	Technology	Scale	Composition	Technology	Scale	Composition	Technology	Scale
	Variation in Volumes (1000 metric tons)						*Variation in Volumes (1000 metric tons)*					
TOXAIR	625.8	178.5	6828.5	224.4	0.0	4059.7	780.3	192.8	7008.1	227.6	0.0	4130.5
TOXWAT	1774.7	530.5	16090.4	612.6	0.0	10647.6	2031.0	569.6	16409.8	604.3	0.0	10820.0
TOXSOL	3269.3	662.6	25518.7	800.7	0.0	11955.9	3646.4	713.0	25976.1	783.4	0.0	12143.0
BIOAIR	4.0	0.1	27.1	1.6	0.0	4.1	3.7	0.1	26.8	1.7	0.0	4.3
BIOWAT	0.1	0.0	2.5	10.4	0.0	25.9	0.1	0.0	2.5	10.3	0.0	26.2
BIOSOL	73.9	1.1	515.7	12.2	0.0	38.6	70.4	1.4	511.9	13.2	0.0	40.1
SO2	5129.4	1482.1	37278.9	1450.8	0.0	22596.7	6201.5	1587.3	38551.2	1351.8	0.0	22897.0
NO2	3161.9	909.1	22869.1	890.6	0.0	13860.6	3813.5	973.6	23643.1	829.9	0.0	14044.8
CO	2051.3	539.5	14984.4	522.8	0.0	8222.8	2435.3	578.3	15440.4	486.8	0.0	8332.1
VOC	644.8	218.7	7868.9	302.3	0.0	5505.5	733.1	235.4	7981.6	311.0	0.0	5605.0
PART	858.4	249.7	6257.9	244.5	0.0	3807.1	1039.4	267.4	6472.7	227.9	0.0	3857.7
BOD	-39.4	0.9	1325.0	-2.1	0.0	12.9	-71.4	1.3	1290.7	-2.1	0.0	13.1
TSS	6381.3	52.2	45984.8	-113.9	0.0	711.2	6175.6	69.8	45755.8	-116.1	0.0	721.4
	Variation in percent						*Variation in percent*					
TOXAIR	8	2	89	5	0	95	10	2	88	5	0	95
TOXWAT	10	3	87	5	0	95	11	3	86	5	0	95
TOXSOL	11	2	86	6	0	94	12	2	85	6	0	94
BIOAIR	13	0	87	28	0	72	12	0	87	28	0	72
BIOWAT	4	1	95	29	0	71	4	1	95	28	0	72
BIOSOL	13	0	87	24	0	76	12	0	88	25	0	75
SO2	12	3	85	6	0	94	13	3	83	6	0	94
NO2	12	3	85	6	0	94	13	3	83	6	0	94
CO	12	3	85	6	0	94	13	3	83	6	0	94
VOC	7	2	90	5	0	95	8	3	89	5	0	95
PART	12	3	85	6	0	94	13	3	83	6	0	94
BOD	-3	0	103	-19	0	119	-6	0	106	-19	0	119
TSS	12	0	88	-19	0	119	12	0	88	-19	0	119

5. Environmental Policy Scenarios

This section examines the interactions between environmental policy and the economy. It does so by contrasting the “NATFA diversion” and “Trdae Integration” scenarios against the ‘business as usual’ (BaU) reference scenario (defined at the start of section 4 to be the “slow improvement” trade scenario under *status quo* “command and control” environmental policies). In most cases, we find the links between the environment and economic activity to be significant. We discover that policies aimed at a direct reduction in emissions may obtain quite positive environmental results but lead either to damaging and unintended or to beneficial effects on economic growth. Thus, the complex interaction of policy on the economy should discourage policy makers from adopting corrective measures based on a heuristic approach or partial analyses.

The environmental policies

Pollution taxes directly targeted to affect polluting agents’ behavior are usually quite efficient in reducing environmental damage[39], but they may have some costs in terms of economic growth. In this section, the El Salvador environment model has been used to determine the effects of these environmental taxes.

This takes the form, for each of the 13-emission type, of a uniform tax levied on producers and consumers so that an exogenously assigned emission reduction with respect to the benchmark level is achieved within the period considered. For an exogenous reduction rate in emission volumes the model endogenously calculates the tax rate. The result is analogous to the implementation of tradable pollution rights where the equilibrium price of these rights is equal to the applied tax.

The current simulations consider a progressive reduction of pollution by separately conducting 13 different experiments, one for each emission type. For each experiment, a target in terms of emissions abatement is exogenously fixed as follows. Emission levels for the emission type are reduced with respect to the reference scenario by 2 per cent in 2000, 8 per cent in 2004, 17 per cent in 2007 and 25 per cent in the end of the period. The instrument used to reach this

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[39] Technical progress is considered even more efficient (see Carraro (1996)). However emission proportional taxes are more efficient than other indirect tax instruments (such as fuel taxes).

target is a uniform tax per unit of emission paid by the agent causing the pollution and is endogenously determined by the model.[40]

In order to render more legible our results presented in the following tables, emissions are aggregated into five groups. Toxic pollutants or "Tox" combine TOXAIR, TOXWAT, and TOXSOL. Bio-accumulative metals or "Bio" combines BIOAIR, BIOWAT, and BIOSOL. Oxide emissions or "NOX" includes SO_2, NO_2, CO. Other air pollutants or "Air" includes VOC and PART. Finally, other water pollutants or "Wat" includes BOD and SS. These aggregations are consistent in physical terms and do not hide relative variations of opposite sign. In fact, emissions show a high correlation degree within each group.[41]

The results

Table 5.1 summarizes the main results in terms of emission elasticities. The figures in this table correspond to a percentage change in group emissions with respect to a 1-percent change in total production or consumption. The first column (BaU) shows for each emission group the elasticities of the BaU reference scenario. For instance, average yearly growth rates for bio-accumulative metals (Bio) in the period 1996–2010 in the reference case are estimated to be equal to 1.23 times the average growth rate for production.

In Table 5.1, the 13 columns to the right of the BaU scenario (column) correspond to the hypothetical implementation of a uniform, emission tax on each of the 13 emission types. For instance, if a uniform tax were levied on water pollutants (TOXAIR) so that 25 per cent abatement with respect to the benchmark were the target for the year 2010, average yearly growth rates for toxic emissions ("Tox") would be equal to 0.64 times the average growth rate for production. Or, considering consumption-originated emissions, 0.72 times the corresponding growth rate for final demand. Comparing these two figures to the associated figures of 1.24 and 1.08 under the BaU column reveals, for example, that the TOXAIR instrument causes economic agents to change their emissions behavior. Emissions, which were growing at a rate *higher* than that of production and consumption, now grow with the TOXAIR instrument at a *lower* rate.

From the figures of Table 5.1 it is clear that targeted emission taxes have considerable complementary reduction effects. For each simulation and across emission groups, emissions

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[40] See Bussolo (1998) for more details of the general modeling approach.

[41] Even though the model is run with 36 sectors, for the sake of clarity only global or very aggregated results are shown. Detailed results, averaging more than 3000 values per period are available.

elasticities with respect to production are smaller than in the benchmark. It is also worthwhile to notice that a specific abatement policy not only reduces its targeted toxic emissions type but also those of other pollutants. To illustrate this complementarity, we return to the TOXAIR example under the "slow improvement" scenario. We observe that the TOXAIR instrument has also succeeded, in the case of El Salvador, to reduce to significantly below unity the elasticities for *all* other emission groups. Interestingly, the Tox group is not even the most strongly affected; NOX, with the highest production elasticity under BaU (1.30) falls to the lowest (0.56). This result stems to from the fact that substitution effects among different emission types are not induced in the production processes. This may be explained by two related facts. First, specific intermediates (for example, oil) are used in the production of most goods and generate emissions of most types. Second, given the Leontief structure of intermediate consumption, no substitution is possible among them. Thus, targeting a specific effluent has the connected beneficial effects of reducing other pollutants.

Finally, note that the environmental policy economic instruments applied to the "NAFTA diversion" and "Trade integration" scenarios do not lead to substantially different elasticities. The percentage differences are mostly small. In fact, the elasticities are in general all smaller (negative percentage differences) than the "slow improvement" case, with the exception of production under the "NAFTA diversion" scenario, which are slightly larger, and air pollution under "Trade integration", which at times are up to 60 percent larger. In no case are the percentage differences greater than unity, however, so that the conclusions above still hold. This result is consistent with the diversion assumptions of the scenarios in which polluting primary goods and polluting manufactures expand and contract, respectively, to differing degrees relative to the BaU scenario, as illustrated in the bottom halves of Table 5.2(b) and Table 5.2(c).

Table 5.1: Production and consumption emission elasticities with respect to "Slow Improvement" scenario for the year 2010

	BAU	*TOXAIR*	*TOXWAT*	*TOXSOL*	*BIOAIR*	*BIOWAT*	*BIOSOL*	*SO2*	*NO2*	*CO*	*VOC*	*PART*	*BOD*	*TSS*
“Slow Improvement” scenario														
Elasticities wrt Production (Growth rate of Emissions/Growth rate of XP)														
Tox	1.24	0.64	0.70	0.76	1.05	1.21	1.06	0.82	0.82	0.81	0.63	0.82	1.13	1.08
Bio	1.23	0.75	0.84	0.78	0.78	1.16	0.82	0.94	0.94	0.91	0.76	0.94	0.98	0.87
NOX	1.30	0.56	0.61	0.72	1.15	1.27	1.15	0.76	0.76	0.76	0.54	0.76	1.22	1.17
Air	1.23	0.63	0.67	0.75	1.09	1.21	1.10	0.79	0.79	0.79	0.60	0.79	1.15	1.11
Wat	1.22	0.68	0.78	0.72	0.73	1.15	0.77	0.89	0.89	0.86	0.69	0.89	0.92	0.82
Elasticities wrt Consumption (Growth rate of Emissions/Growth rate of Consumption)														
Tox	1.09	0.72	0.76	0.81	0.95	1.08	0.96	0.86	0.86	0.85	0.69	0.86	1.00	0.97
Bio	1.58	1.61	1.61	1.56	1.36	1.40	1.47	1.60	1.60	1.59	1.63	1.60	1.56	1.54
NOX	1.09	0.64	0.68	0.72	0.91	1.07	0.92	0.77	0.77	0.76	0.63	0.77	0.97	0.94
Air	1.08	0.72	0.76	0.80	0.95	1.07	0.96	0.86	0.86	0.85	0.68	0.86	1.00	0.97
Wat	0.79	0.66	0.75	0.60	0.41	0.75	0.43	0.79	0.80	0.75	0.70	0.80	0.54	0.47
“NAFTA diversion” scenario for exports (percent difference with respect to "Slow Improvement" scenario)														
Elasticities wrt Production														
Tox		0.14	0.12	0.01	0.14	0.32	0.15	0.10	0.11	0.07	0.18	0.10	0.24	0.17
Bio		0.31	0.34	0.11	-0.18	0.46	-0.07	0.33	0.34	0.27	0.37	0.33	0.26	0.06
NOX		0.23	0.17	0.07	0.25	0.36	0.24	0.11	0.11	0.08	0.30	0.11	0.30	0.25
Air		0.10	0.08	0.02	0.19	0.30	0.18	0.06	0.06	0.04	0.15	0.06	0.24	0.19
Wat		0.21	0.27	-0.02	-0.32	0.43	-0.20	0.28	0.29	0.20	0.28	0.28	0.18	-0.06
Elasticities wrt Consumption (Growth rate of Emissions/Growth rate of Consumption)														
Tox		-0.18	-0.21	-0.21	-0.07	0.09	-0.04	-0.16	-0.16	-0.17	-0.20	-0.16	0.03	-0.01
Bio		0.13	0.13	0.11	-0.05	0.10	0.05	0.13	0.13	0.12	0.13	0.13	0.13	0.11
NOX		-0.27	-0.33	-0.35	-0.12	0.09	-0.09	-0.30	-0.30	-0.32	-0.27	-0.30	0.02	-0.05
Air		-0.19	-0.22	-0.22	-0.07	0.08	-0.04	-0.16	-0.16	-0.17	-0.22	-0.16	0.03	-0.02
Wat		-0.05	0.03	-0.21	-0.73	0.07	-0.59	0.08	0.09	0.01	-0.01	0.09	-0.18	-0.43
“Trade Integration” scenario (percent difference with respect to "Slow Improvement" scenario)														
Elasticities wrt Production														
Tox		-0.28	0.63	-15.78	-27.48	-10.39	17.43	33.97	0.06	0.47	29.09	-22.18	-27.73	8.48
Bio		-4.52	-3.34	-8.00	-4.26	-33.17	41.03	-13.27	-3.19	0.20	14.96	-21.73	-6.64	13.50
NOX		2.98	3.42	-19.29	-35.11	-5.76	15.37	59.14	2.14	1.35	42.58	-24.92	-36.59	9.11
Air		0.72	1.17	-16.12	-30.09	-6.54	13.69	43.41	0.55	0.14	32.02	-22.50	-31.17	7.58
Wat		-4.94	-3.45	-9.76	-6.31	-36.54	49.53	-14.23	-3.32	0.65	19.63	-25.44	-6.49	15.21
Elasticities wrt Consumption (Growth rate of Emissions/Growth rate of Consumption)														
Tox		-2.10	-1.75	-11.97	-16.04	-11.56	12.27	11.93	-1.85	-1.39	21.31	-20.90	-15.85	3.85
Bio		0.92	0.91	3.93	15.55	-1.54	-3.67	-7.02	0.90	1.25	-1.59	3.00	3.50	2.10
NOX		-3.61	-3.21	-13.45	-23.18	-15.57	16.45	19.44	-3.69	-3.07	16.27	-20.12	-24.08	4.76
Air		-2.09	-1.81	-11.78	-16.42	-11.04	11.85	12.01	-1.82	-1.39	23.80	-22.56	-15.73	3.78
Wat		-1.32	-0.48	7.72	44.41	-44.76	73.76	-44.97	-0.78	6.66	6.54	-13.26	47.66	19.29

Table 5.2(a): “Slow Improvement” scenario under an economic instruments-based environmental policy

	BaU	*TOXAIR*	*TOX WAT*	*TOXSOL*	*BIOAIR*	*BIOWAT*	*BIOSOL*	*SO2*	*NO2*	*CO*	*VOC*	*PART*	*BOD*	*TSS*	*min*	*max*	*Average*
Yearly Average Growth Rates																	
RGDP	0.0411	0.0431	0.043	0.042	0.040	0.037	0.041	0.042	0.042	0.042	0.044	0.042	0.041	0.041	0.037	0.044	0.042
PollPrimary	0.039	0.039	0.038	0.038	0.040	0.037	0.039	0.038	0.038	0.038	0.038	0.038	0.040	0.039	0.037	0.040	0.038
NPollPrimary	0.037	0.040	0.039	0.039	0.038	0.036	0.038	0.039	0.039	0.039	0.040	0.039	0.037	0.038	0.036	0.040	0.038
AgriFood	0.032	0.036	0.035	0.034	0.033	0.032	0.033	0.034	0.034	0.034	0.036	0.034	0.026	0.033	0.026	0.036	0.033
LightMan	0.041	0.042	0.043	0.043	0.043	0.040	0.043	0.042	0.042	0.042	0.042	0.042	0.043	0.043	0.040	0.043	0.042
PollMan	0.061	0.043	0.046	0.047	0.047	0.054	0.049	0.052	0.052	0.052	0.041	0.052	0.053	0.050	0.041	0.054	0.049
OthMan	0.074	0.076	0.075	0.076	0.071	0.070	0.074	0.075	0.075	0.075	0.077	0.075	0.074	0.076	0.070	0.077	0.075
PollServ	0.059	0.060	0.062	0.060	0.057	0.053	0.057	0.061	0.061	0.061	0.062	0.061	0.059	0.058	0.053	0.062	0.059
NPollServ	0.054	0.055	0.055	0.055	0.054	0.052	0.054	0.055	0.055	0.055	0.055	0.055	0.054	0.054	0.052	0.055	0.054
Percent variation Final year Simulation wrt Final year BAU																	
PollPrimary		0.6	-1.2	-0.8	1.1	-2.6	0.7	-1.7	-1.7	-1.5	-0.5	-1.7	2.0	0.5	-2.6	2.0	-0.5
NPollPrimary		4.3	3.4	2.8	1.2	-1.5	1.1	2.3	2.3	2.4	4.1	2.3	0.0	1.1	-1.5	4.3	2.0
AgriFood		4.7	3.6	2.9	1.5	-1.0	1.4	2.2	2.2	2.3	4.9	2.2	-8.1	1.2	-8.1	4.9	1.5
LightMan		1.1	1.8	2.3	2.7	-1.8	2.5	1.3	1.3	1.5	1.6	1.3	2.2	2.2	-1.8	2.7	1.5
PollMan		-20.7	-17.3	-17.1	-16.2	-7.9	-14.9	-10.4	-10.5	-11.4	-23.4	-10.4	-9.5	-13.1	-23.4	-7.9	-14.1
OthMan		3.5	1.5	2.4	-4.0	-4.6	0.5	1.7	1.7	1.9	4.3	1.7	-0.2	2.9	-4.6	4.3	1.0
PollServ		1.4	3.2	0.6	-3.1	-8.4	-2.5	2.0	2.0	1.7	3.4	2.0	-1.0	-2.0	-8.4	3.4	-0.1
NPollServ		1.4	0.8	0.6	-0.9	-3.4	-0.2	0.5	0.5	0.5	1.3	0.5	0.0	0.2	-3.4	1.4	0.1

Table 5.2(b): "NAFTA Diversion" scenario under an economic instruments-based environmental policy

	BAU	*TOXAIR*	*TOX WAT*	*TOXSOL*	*BIOAIR*	*BIOWAT*	*BIOSOL*	*SO2*	*NO2*	*CO*	*VOC*	*PART*	*BOD*	*TSS*	*min*	*max*	*Average*
Yearly Average Growth Rates																	
RGDP	0.0411	0.0432	0.043	0.042	0.040	0.037	0.041	0.042	0.042	0.042	0.044	0.042	0.041	0.041	0.037	0.044	0.042
PollPrimary	0.039	0.038	0.036	0.037	0.038	0.035	0.038	0.036	0.036	0.036	0.037	0.036	0.039	0.037	0.035	0.039	0.037
NPollPrimary	0.037	0.040	0.039	0.039	0.037	0.035	0.037	0.038	0.038	0.038	0.040	0.038	0.037	0.037	0.035	0.040	0.038
AgriFood	0.032	0.036	0.035	0.034	0.033	0.032	0.033	0.034	0.034	0.034	0.036	0.034	0.026	0.033	0.026	0.036	0.033
LightMan	0.041	0.042	0.043	0.043	0.043	0.040	0.043	0.042	0.042	0.042	0.042	0.042	0.043	0.043	0.040	0.043	0.042
PollMan	0.061	0.043	0.046	0.046	0.047	0.055	0.048	0.052	0.052	0.052	0.041	0.052	0.053	0.050	0.041	0.055	0.049
OthMan	0.074	0.077	0.076	0.076	0.071	0.071	0.075	0.076	0.076	0.076	0.078	0.076	0.074	0.077	0.071	0.078	0.075
PollServ	0.059	0.061	0.062	0.060	0.057	0.053	0.058	0.061	0.061	0.061	0.062	0.061	0.059	0.058	0.053	0.062	0.059
NPollServ	0.054	0.055	0.055	0.055	0.054	0.052	0.054	0.055	0.055	0.055	0.055	0.055	0.054	0.055	0.052	0.055	0.054
Percent variation Final year Simulation wrt Final year BAU																	
PollPrimary		-1.6	-3.3	-3.0	-1.3	-4.7	-1.7	-3.8	-3.8	-3.7	-2.7	-3.8	-0.4	-1.9	-4.7	-0.4	-2.7
NPollPrimary		4.0	3.1	2.6	0.9	-1.8	0.9	2.1	2.1	2.1	3.8	2.1	-0.3	0.8	-1.8	4.0	1.7
AgriFood		4.6	3.6	2.9	1.5	-1.0	1.3	2.1	2.1	2.2	4.9	2.1	-8.3	1.2	-8.3	4.9	1.5
LightMan		0.9	1.6	2.2	2.6	-1.9	2.3	1.2	1.1	1.3	1.4	1.1	2.0	2.1	-1.9	2.6	1.4
PollMan		-20.7	-17.3	-17.2	-16.3	-7.8	-14.9	-10.3	-10.5	-11.4	-23.5	-10.3	-9.4	-13.2	-23.5	-7.8	-14.1
OthMan		4.5	2.5	3.4	-3.1	-3.7	1.4	2.6	2.6	2.9	5.3	2.6	0.8	3.9	-3.7	5.3	2.0
PollServ		1.6	3.4	0.8	-2.9	-8.2	-2.3	2.2	2.2	1.9	3.6	2.3	-0.7	-1.7	-8.2	3.6	0.2
NPollServ		1.5	0.9	0.7	-0.8	-3.3	-0.1	0.6	0.6	0.6	1.5	0.6	0.1	0.3	-3.3	1.5	0.3

Table 5.2(c): "Trade Integration" scenario under an economic instruments-based environmental policy

	BAU	*TOXAIR*	*TOX WAT*	*TOXSOL*	*BIOAIR*	*BIOWAT*	*BIOSOL*	*SO2*	*NO2*	*CO*	*VOC*	*PART*	*BOD*	*TSS*	*min*	*max*	*Average*
Yearly Average Growth Rates																	
RGDP	0.0411	0.0437	0.044	0.044	0.043	0.041	0.038	0.041	0.043	0.043	0.043	0.044	0.043	0.042	0.038	0.044	0.042
PollPrimary	0.039	0.051	0.049	0.050	0.052	0.048	0.051	0.049	0.049	0.049	0.050	0.049	0.052	0.051	0.048	0.052	0.050
NPollPrimary	0.037	0.041	0.041	0.040	0.039	0.037	0.039	0.040	0.040	0.040	0.041	0.040	0.038	0.039	0.037	0.041	0.040
AgriFood	0.032	0.035	0.034	0.033	0.032	0.030	0.032	0.033	0.033	0.033	0.035	0.033	0.025	0.032	0.025	0.035	0.032
LightMan	0.041	0.044	0.045	0.046	0.046	0.042	0.046	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.042	0.046	0.045
PollMan	0.061	0.038	0.041	0.041	0.042	0.050	0.044	0.047	0.047	0.046	0.035	0.047	0.049	0.045	0.035	0.050	0.044
OthMan	0.074	0.068	0.067	0.067	0.061	0.061	0.065	0.067	0.067	0.067	0.068	0.067	0.065	0.067	0.061	0.068	0.066
PollServ	0.059	0.061	0.063	0.061	0.058	0.054	0.059	0.062	0.062	0.062	0.063	0.062	0.060	0.059	0.054	0.063	0.061
NPollServ	0.054	0.055	0.054	0.054	0.053	0.051	0.053	0.054	0.054	0.054	0.055	0.054	0.054	0.054	0.051	0.055	0.054
Percent variation Final year Simulation wrt Final year BaU																	
PollPrimary		18.2	15.1	16.0	18.7	13.2	18.3	14.6	14.6	14.8	16.2	14.6	19.2	17.9	13.2	19.2	16.3
NPollPrimary		6.4	5.4	4.8	3.0	0.3	3.0	4.4	4.4	4.4	6.0	4.4	1.9	3.0	0.3	6.4	3.9
AgriFood		3.3	2.1	1.4	-0.2	-2.5	-0.3	0.7	0.7	0.8	3.4	0.7	-9.1	-0.4	-9.1	3.4	0.1
LightMan		3.6	5.1	5.8	6.1	1.6	6.0	4.8	4.8	5.0	4.6	4.7	5.6	5.7	1.6	6.1	4.9
PollMan		-26.4	-23.0	-23.2	-21.7	-13.1	-20.3	-16.4	-16.5	-17.5	-28.7	-16.3	-14.4	-18.6	-28.7	-13.1	-19.7
OthMan		-7.5	-9.1	-8.6	-15.0	-15.1	-11.0	-9.1	-9.1	-8.9	-6.8	-9.0	-11.1	-8.7	-15.1	-6.8	-9.9
PollServ		2.8	4.9	2.2	-1.3	-6.6	-0.7	3.7	3.7	3.4	5.0	3.7	1.0	-0.1	-6.6	5.0	1.7
NPollServ		0.6	-0.1	-0.3	-1.9	-4.3	-1.2	-0.4	-0.4	-0.4	0.5	-0.4	-1.0	-0.8	-4.3	0.6	-0.8

The aggregate reduction in the emission volumes is primarily the result of the decrease in production-generated emissions. This is due to a shift of production towards less polluting activities as well as, within each activity, to the implementation of cleaner technologies. As an example, Table 5.2 provides a detailed analysis decomposing the various reduction effects and shows a lower output for those sectors producing highly polluting goods with respect to the reference scenario in the year 2010 (*composition effect*). Thus under the "NAFTA diversion" scenario, for example, we find across-the-board lower growth (negative figures in the rows) for polluting primary and polluting manufactures sectors, compared to the BaU scenario. The table also illustrates that emissions abatement in the other industries is obtained through (strongly) diminished pollution intensities (*technology effect*) as the result of substitution of toxic intermediates with more labor and capital and cleaner energy sources.

Having shown the efficiency of the emission taxes, the next important question concerns its cost in terms of reduced economic growth. Here we have some big surprises. Overall, judging from the results of the RGDP row in Table 5.2, the different progressive abatement policies examined have quite low costs in terms of output foregone. The average yearly GDP growth rate across all trade scenario simulations is found in the range of 3.7 to 4.4 percent, very close to the benchmark rate of 4.11 percent. Under the "slow integration", ("NAFTA diversion" and "Trade integration") scenarios, the tax on BIOWAT (BIOWAT and BIOSOL) yielded the lowest growth at 3.7 percent (3.7 and 3.8). Of course, what stands out here is the 4.4-percent growth figure: for most of the experiments on "Tox" and air emission types we have an *increase* in RGDP growth, relative to the BaU case.

This low (indeed often *negative*) cost may be explained by several related reasons. First, as explained above, the *composition effect* plays an important role and, even if certain sectors reduce considerably their output and consequently their factor demands, other industries expand and take advantage of the non-polluting resources released by the contracting sectors. Moreover, these expanding activities benefit as well from the assumed substitution possibilities between different inputs and factors, shifting their technologies towards cleaner input combinations, thus avoiding rising costs due to the emission taxes.[42]

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[42] Annex A and Annex B show the initial pollution coefficients for both production and consumption (the α's and β's of equation on page 10). It is clear that, in the El Salvador case, these coefficients are concentrated in a few sectors. In fact, targeted emission taxes considerably affect only that small number of industries that are making an intense use of the polluting inputs. This, jointly with the other reasons exposed in the main text, explains why additional

Second, the redistribution scheme of the emission tax revenue often almost cancels out the distortionary effect of these same taxes. We notice that in the simulations with abatement policies, the savings are higher, even in the current model with myopic agents who do not anticipate future emission taxes. This is due to the tax redistribution scheme. Revenues from emission taxes are redistributed to the households as a function of their income tax rates[43]. Hence, a large part of the increased government transfers they receive is saved. This results in larger investment possibilities and faster capital accumulation, a sort of "double-dividend" effect.[44] Finally, new capital vintages enjoy larger production substitution elasticities, helping the economy to adjust more quickly without compromising aggregate growth rates.

Tax-based abatement policies seem to be less effective on the emission volumes generated through final consumption. One reason for this is likely the more limited set of substitution opportunities facing households for many of the pollutant streams. The exception here, of course, are the BIOWAT and BIOSOL experiments and their effects on "Wat"-type emissions. Here we see households can and do respond significantly. For example, under the "Trade integration" scenario with a tax on BIOSOL, the consumption elasticity is 74 percent bigger than under the "slow improvement" scenario.

6. Summary and Conclusions

There is large literature about whether environmental regulations reduce a country's economic competitiveness. We take as given, however, that *poor* environmental regulation restricts sustainable growth and inadequate environmental policy *reduces* the benefits of trade-driven growth. As such, we consider the issue and challenge to be *how* to design an environmental regulatory regime and policies that *support* trade-driven growth by enhancing sustainable competitiveness. This need is all-the-more real given the trend toward regional trade agreements on the way toward regional integration. These may contain "side" agreements on environmental issues that need to be prepared and negotiated carefully.

Using a computable general equilibrium approach for the case of El Salvador we first examine the likely long-term effects of *status quo* (command and control) environmental policy

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relative price distortions caused by emission taxes are not spread to too many sectors and why aggregate growth is not affected in a remarkable way.

[43] These are calculated from the base year SAM.

[44] See Goulder (1995) for a survey of this important environmental taxation debate.

in the face of strong growth emanating from a "peace dividend" and alternative scenarios for hemispheric trade integration. These scenarios include (i) a "slow improvement" in trade volumes essentially under the existing trade relationships and patterns, (ii) a "NAFTA diversion" scenario in which Mexico's entry into NAFTA diverts El Salvador's trade from the United States and to Mexico, and (iii) a "Trade integration" scenario in which El Salvador gains preferential access to North American markets. These scenarios imply very different patterns of sectoral emissions since Mexico and Central America import mostly manufactures from El Salvador while the United States and ROW import mostly primary goods. We take as our indicators 13 types of air, water, and soil discharge streams.

We simulate *status quo* and economic instruments-based environmental policies under the three trade scenarios and then compare results for the period 1996-2010.[45] In the case of the economic instruments-based policies, an emission charge is implemented so that in the final year (2010) a 25-percent reduction of the relevant emission is achieved with respect to the scenario without the charge. Under *status quo* policies, over the period 1996-2010 we find that resources are excessively drawn into the dirtier sectors. For example, under the lowest growth (most conservative) case, biologically accumulative metals and NOX increase at a rate of 23 percent and 30 percent, respectively, over and above the average annual production growth rates and 9 percent and 58 percent faster than aggregate consumption average annual growth rates. We then propose and analyze several alternative policies to mitigate these negative growth effects, including product charges, consumption taxes, tariffs, subsidies on international transactions. We find that these policies actually reduce emissions growth to rates *below* that of production and consumption (emission-to-production and emission-to-consumption elasticities less than unity). While no major differences are noticed under green taxes between the "slow improvement" and "NAFTA diversion" scenarios, the tax effects were most pronounced under the "Trade integration" case.

We also show that the cost in terms of output foregone of these pro-environment policies is rather negligible with the worst cases yielding a ten-percent loss in the annual *rate* of growth (from 4.1 percent to 3.7 percent). We decompose these effects into scale, composition, and technology effects. While scale effects are the strongest, composition effects are large and play a

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[45] The total number of simulations was 3 (trade scenarios) x 13 (the pollutant-related taxes) x 14 (number of forecast periods) or 546.

significant role (described below). More surprisingly, in a significant number of experiments the pro-environment policies actually *promoted* GDP growth itself (in some cases up to 4.4 percent, a 7.5 percent rate increase). While one should be careful to draw conclusions, there are two main reasons for this positive effect. First, the tax revenues are recycled back in the economy through lump-sum transfers to households who then save more and more savings are transformed into more investment and more growth. This effect is reinforced by the fact that investment occurs using new technologies and because production and consumption *composition* effects may be attenuated or changed. Second, and this applies differentially across different type of emission taxes, we are in a “second-best world” context; the environmental tax is an additional distortion that may correct initial distortions, moving the economy towards a better equilibrium.

In addition to the surprising growth effects, strong complementary was observed across emission streams. For example, a charge on BOD discharges also reduced the rate of air and soil emissions, as production scale, composition, and technology effects made their way through the economy. Moreover, we find that, in a general equilibrium context, recycled environmental tax revenues may be used to stimulate investment, increasing competitiveness *and* cleaner production (though clearly future research is needed here). For these and other reasons, we find that the CGE-based approach to be an especially appropriate policy analysis tool.

There are several unresolved issues that should be included in any agenda for future research. First and foremost is a deeper analysis of the negative output costs (gains) from some of the environmental taxes implemented here. Also missing is a richer analysis of the environmental benefits side. We look at 25-percent emission reductions but this is only for expository purposes; ideally, taxes should be set at the level of marginal benefits. Finally, setting a tax and achieving full compliance with its payment are very different. Investment demand depends on the probability of paying the charge. This in turn depends on the quality of environmental enforcement, which in turn depends on the level of resources allocated to the enforcement agencies. The issues of enforcement and its financing, therefore, needs to be included in the analysis.

Under any of the stylized trade scenarios investigated here (but especially under “NAFTA diversion” and “Trade integration”), El Salvador can expect trade-led growth to lead to ever higher emissions growth. By showing how these are distributed throughout the economy and by underscoring the minimal cost in terms of output foregone (and sometimes even gained) of corrective policies, this paper should provide policy makers in El Salvador the confidence to pursue the sustainable growth environmental policies in the future. Clearly, with the trend toward regional trade agreements, environmental charges should be a critical part of the country's policy agenda for the 21st Century.

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Annex A: Consumption emission coefficients (pounds per million colones)

	TOXAIR	TOXWAT	TOXSOL	BIOAIR	BIOWAT	BIOSOL	SO2	NO2	CO	VOC	PART	BOD	TSS
CofOthExAg	0	0	0	0	0	0	0	0	0	0	0	0	0
Grains	0	0	0	0	0	0	0	0	0	0	0	0	0
SugarCane	0	0	0	0	0	0	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	0	0	0	0	0	0	0	0	0	0	0
Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining	663.5	818.1	4,827.6	12.6	0.7	270.3	681.1	296.5	1,081.0	596.2	95.1	473.0	26,045.1
MeatFish	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy	0	0	0	0	0	0	0	0	0	0	0	0	0
Milling	0	0	0	0	0	0	0	0	0	0	0	0	0
SugarRef	0	0	0	0	0	0	0	0	0	0	0	0	0
OthFood	0	0	0	0	0	0	0	0	0	0	0	0	0
Beverages	0	0	0	0	0	0	0	0	0	0	0	0	0
Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothing	0	0	0	0	0	0	0	0	0	0	0	0	0
Leather	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood	0	0	0	0	0	0	0	0	0	0	0	0	0
Paper	77.6	372.3	0	0	0	0	0	0	0	0	0	0	0
Printing	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals	462.2	1,254.2	827.0	0	0	0	0	0	0	1,070.3	0	0	0
OilRef	1,570.4	4,866.8	6,115.2	0	0	0	14,307.6	8,778.2	5,192.0	1,915.8	2,410.9	0	0
RubberPlst	1,117.0	0	0	0	0	0	0	0	0	0	0	0	0
MinProd	0	0	0	0	0	0	0	0	0	0	0	0	0
MetProd	0	0	275.3	3.9	0	32.1	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0
TrspEq_Mfg	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricit	0	0	0	0	0	0	0	0	0	0	0	0	0
Water	0	0	0	0	0	0	0	0	0	0	0	0	0
Construct	0	0	0	0	6.6	0	0	0	0	0	0	0	0
Commerce	0	0	0	0	0	0	0	0	0	0	0	0	0
Rest_Hotel	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	0	0	0	0	0	0	0	0	0	0	0	0	0
Communic	0	0	0	0	0	0	0	0	0	0	0	0	0
FinInsRE	0	0	0	0	0	0	0	0	0	0	0	0	0
Gov_OthSv	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex B: Production dummies - emission coefficients (pounds per million colones)

	TOXAIR	TOXWAT	TOXSOL	BIOAIR	BIOWAT	BIOSOL	SO2	NO2	CO	VOC	PART	BOD	TSS
CofOthExAg	0	0	0	0	0	0	0	0	0	0	0	0	0
Grains	0	0	0	0	0	0	0	0	0	0	0	0	0
SugarCane	0	0	0	0	0	0	0	0	0	0	0	0	0
Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	0	0	0	0	0	0	0	0	0	0	0
Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0	0	0	0
MeatFish	0	0	0	0	0	0	0	0	0	0	0	0	0
Dairy	0	0	0	0	0	0	0	0	0	0	0	545.9	0
Milling	0	0	0	0	0	0	0	0	0	0	0	0	0
SugarRef	0	0	0	0	0	0	0	0	0	0	0	0	0
OthFood	0	0	0	0	0	0	0	0	0	0	0	0	0
Beverages	0	0	0	0	0	0	0	0	0	237.5	0	0	0
Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles	0	0	0	0	0	0	0	0	0	0	0	0	0
Clothing	721.1	0	0	0	0	0	0	0	0	0	0	0	0
Leather	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood	0	0	0	0	0	0	0	0	104.0	47.1	31.6	0	0
Paper	16.0	273.1	43.7	0	0	0	115.6	51.2	42.5	0	14.7	102.3	107.9
Printing	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	19.2
OilRef	0	0	0	0	0	0	0	0	0	0	0	0	0
RubberPlst	0	0	0	0	0	0	0	0	0	0	0	0	0
MinProd	0	0	0	0	0	0	105.8	263.0	0	0	22.2	0	0
MetProd	0	0	0	0.03	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	9.2	0	0	0
TrspEq_Mfg	0	0	0	0.02	0	0	0	0	0	0	0	0	0
Electricit	0	0	0	0	0	0	0	0	0	0	0	0	0
Water	0	0	0	0	0	0	0	0	0	0	0	0	0
Construct	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce	0	0	0	0	0	0	0	0	0	0	0	0	0
Rest_Hotel	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	0	0	0	0	0	0	0	0	0	0	0	0	0
Communic	0	0	0	0	0	0	0	0	0	0	0	0	0
FinInsRE	0	0	0	0	0	0	0	0	0	0	0	0	0
Gov_OthSv	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex C(1): Summary of export growth and composition assumptions under "Slow Improvement" scenario, 1996-2010

	Assumptions	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Growth in merchandise exports																
TOTAL			8.16	8.34	8.53	8.72	8.91	9.09	9.28	9.47	9.65	9.83	10.01	10.18	10.35	10.51
US	5	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Central America	15	100	115	130	145	160	175	190	205	220	235	250	265	280	295	310
Mexico	15	100	115	130	145	160	175	190	205	220	235	250	265	280	295	310
ROW	5	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Partner's share of merchandise. exports																
		100.00	100	100	100	100	100	100	100	100	100	100	100	100	100	100
US		30.42	29.34	28.23	27.11	25.99	24.86	23.73	22.60	21.48	20.38	19.30	18.23	17.20	16.19	15.21
Central America		37.82	39.94	42.10	44.28	46.49	48.70	50.91	53.11	55.30	57.45	59.58	61.66	63.68	65.66	67.57
Mexico		1.04	1.10	1.16	1.22	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.75	1.81	1.86
ROW		30.72	29.63	28.51	27.38	26.25	25.11	23.96	22.83	21.70	20.58	19.49	18.42	17.37	16.35	15.36
Manufactures share, partner goods exports																
All together		0.657	0.671	0.685	0.699	0.713	0.727	0.741	0.754	0.768	0.781	0.793	0.805	0.817	0.828	0.839
US	0.005	0.507	0.512	0.517	0.522	0.527	0.532	0.537	0.542	0.547	0.552	0.557	0.562	0.567	0.572	0.577
Central America	0	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
Mexico	0	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971
ROW	0.003	0.386	0.389	0.392	0.395	0.398	0.401	0.404	0.407	0.410	0.413	0.416	0.419	0.422	0.425	0.428

Annex C(2): Summary of export growth and composition assumptions under "NAFTA Diversion" scenario, 1996-2010

	Assumptions	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Growth in merchandise exports																
TOTAL			7.82	8.10	8.40	8.71	9.04	9.38	9.74	10.11	10.51	10.93	11.38	11.85	12.35	12.87
US	3	100	103	106	109	112	115	118	121	124	127	130	133	136	139	142
Central America	15	100	115	130	145	160	175	190	205	220	235	250	265	280	295	310
Mexico	35	100	135	170	205	240	275	310	345	380	415	450	485	520	555	590
ROW	5	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Partner's share of merchandise. exports																
		100.00	100	100	100	100	100	100	100	100	100	100	100	100	100	100
US		30.42	28.88	27.34	25.79	24.25	22.72	21.21	19.72	18.26	16.83	15.44	14.09	12.79	11.55	10.37
Central America		37.82	40.09	42.36	44.63	46.85	49.01	51.07	53.02	54.80	56.40	57.77	58.88	59.69	60.16	60.28
Mexico		1.04	1.29	1.61	1.99	2.45	3.00	3.68	4.48	5.44	6.57	7.90	9.45	11.24	13.30	15.65
ROW		30.72	29.74	28.69	27.60	26.45	25.27	24.04	22.79	21.50	20.21	18.90	17.59	16.28	14.98	13.70
Manufactures share, partner goods exports																
All together		0.657	0.672	0.688	0.704	0.720	0.736	0.751	0.767	0.782	0.797	0.812	0.826	0.840	0.853	0.866
US	0.005	0.507	0.512	0.517	0.522	0.527	0.532	0.537	0.542	0.547	0.552	0.557	0.562	0.567	0.572	0.577
Central America	0	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
Mexico	0	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971
ROW	0.003	0.386	0.389	0.392	0.395	0.398	0.401	0.404	0.407	0.410	0.413	0.416	0.419	0.422	0.425	0.428

Annex C(3): Summary of export growth and composition assumptions under “Trade Integration” scenario, 1996-2010

	Assumptions	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Growth in merchandise exports																
TOTAL			10.44	10.71	10.99	11.26	11.54	11.82	12.09	12.36	12.63	12.89	13.15	13.40	13.63	13.87
US	20	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Central America	10	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
Mexico	25	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450
ROW	5	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Partner's share of merchandise. exports																
	100.000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
US	30.421	32.69	35.03	37.42	39.84	42.29	44.75	47.21	49.65	52.05	54.41	56.71	58.94	61.08	63.13	
Central America	37.816	37.25	36.59	35.82	34.97	34.03	33.01	31.92	30.77	29.57	28.33	27.07	25.79	24.50	23.21	
Mexico	1.040	1.16	1.30	1.45	1.60	1.77	1.95	2.15	2.35	2.57	2.80	3.04	3.29	3.55	3.82	
ROW	30.724	28.89	27.09	25.31	23.59	21.91	20.29	18.72	17.23	15.81	14.46	13.18	11.99	10.87	9.83	
Manufactures share, partner goods exports																
	Assumptions															
All together		0.657	0.661	0.665	0.669	0.673	0.676	0.680	0.684	0.688	0.692	0.696	0.701	0.705	0.710	0.714
US	0.01	0.507	0.517	0.527	0.537	0.547	0.557	0.567	0.577	0.587	0.597	0.607	0.617	0.627	0.637	0.647
Central America	0	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
Mexico	-0.005	0.971	0.966	0.961	0.956	0.951	0.946	0.941	0.936	0.931	0.926	0.921	0.916	0.911	0.906	0.901
ROW	0.003	0.386	0.389	0.392	0.395	0.398	0.401	0.404	0.407	0.410	0.413	0.416	0.419	0.422	0.425	0.428