The Future of Income Distribution in the Global Economy: Alternative Scenarios in a Computable General Equilibrium Framework

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I. Introduction

As we approach the close of the twentieth century, the globalization of trade and investments flows relative to global output has recently surpassed previous historical records.[1] Many developing countries have participated in these growing trade and investment flows, with greater benefits accruing to relatively higher wage and higher skilled workers.[2] Enhanced global trade and investment liberalization, as well as higher rates of growth in relatively poorer countries, has led to projections of even higher levels of global trade and financial flows. A growing share of these flows will likely be between many low and middle income countries competing to trade with high income countries, raising concerns about the income effects on the large mass of lower skilled workers worldwide. Indeed, about 99 percent of the 1 billion or so workers projected to join the world's labor force over the next thirty years will live in what are today's low-

[1] See Maddison, 1991.
[2] See Robbins, 1996 and Woods, 1996.

and middle-income countries.[3] More recently, some observers are wondering if Asia's current crisis and the specter of competitive devaluations has not already begun to accelerate the seemingly inevitable process of global adjustment to Asia's growing export capacity.[4]

This paper presents a dynamic computable general equilibrium (CGE) framework for analyzing the impact of alternative scenarios on production, real wages, the structure of employment, and wage income inequality within and between countries. The "IDB World CGE model" presented here was designed to simulate various policy measures, exogenous shocks, and economic interactions among nine "country clusters" or key regions of the world. Of particular interest will be the impact on employment and income distribution among skilled and unskilled workers due to enhanced trade and investment competition between Latin America, OECD, former Soviet Bloc, Asia, and other low and middle income regions. The CGE model simulates the dynamic evolution of patterns of trade, total output, factor mobility, and income distribution in each cluster of countries for each production factor. In addition, the model generates dynamic pathways of the behavior of the global system over a 28 year time framework (1992-2020), under alternative assumptions regarding macroeconomic variables, policy decision on education, research and development (R&D), and trade policies. We pay particular attention to both growth and inequality implications of all scenarios, searching for ways to improve growth without worsening income inequality, and to explore if increased growth with improved income distribution is possible on a global scale.

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[3] See World Bank WDR, 1995.
[4] See Lui, et al., 1998.

The IDB-World CGE model is also used to analyze the potential impacts of a series of policy interventions that can change the pattern of trade and investment, as well as the productivity path of different factors of production, and thus the pattern of income and employment adjustments. We specifically focus on the policies and investments that could substantially affect these alternative outcomes. In particular, the model will simulate alternative flows of investment resources for physical capital, human capital, and R&D improvements. First, the comparative statics impacts of trade and liberalization policies are modeled, both through liberalization within particular regional arrangements as well as through global and multilateral approaches. Second, the productivity enhancing externality impacts of trade liberalizations are analyzed. Finally, we analyze the relative dimensions of investment and policy interventions in human capital and R&D enhancements that would be required to redirect the adverse income distribution and employment adjustment trends implicit in current trends of global growth and integration.

The IDB-World CGE model can thus allow one to evaluate within a single framework, the long run relative impacts of different factor supplies (tangibles such as labor and capital), polices designed to increase the efficiency of factor allocation (trade liberalization), as well as improvements in different factor productivities (through investments in human capital and R&D).[5]

We illustrate the future through two major scenarios concerning global growth, integration, and income distribution: a Status Quo/Divergence Scenario and an Integration/Convergence Scenario. The major difference between these two scenarios is the level of investment in human capital improvement, which we find to be a key

[5] This is useful in addressing the long run implications of the current debate on the sources of growth in the so-called “Asian Miracle”. See Kim and Lau (1992), World Bank (1993), Krugman (1994),

significant determinate of the pattern of global growth and income distribution. The Status Quo/Divergence Scenario projects out current regional levels of educational expenditures, paths of skill improvements, and income widening. The Integration/Convergence Scenario simulates the levels of skill improvements and educational expenditures in each region that would be required to close the growth of income inequality for that region. Using each major scenario as a "base," we also run two identical series of alternative "sub-scenarios" dealing with trade liberation and protectionism, resource price shocks, and several others designed to simulate a range of possible policies and investments and their possible impacts on the pattern of global growth and income inequality.

The two major scenarios and their variations tell us much about the possible futures paths of the world economy and income distribution, as well as the relative efficacy of different policy and investment initiatives. The Status Quo and Divergence Scenario is a pessimistic, but probably realistic, scenario in which slow progress is made on the growth in investments in education. This scenario produces moderate growth with widening income inequality in most regions of the world. The effects of other policy measures such as trade liberalization and investment and productivity enhancing R&D improvements does not fundamentally change the basic course of this scenario. Nor are the results much affected by natural resource shocks or a turn to trade protectionism. Only the longer run enhanced productivity effects of trade liberalization are shown to have a much more significant impact on growth. Yet even in this higher growth variation of the Status Quo and Divergence Scenario, income inequality continues to widen significantly.

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and Young (1994).

The Integration and Convergence Scenario, on the other hand, is an optimistic, yet still realistic, scenario in which the vigorous and sustained pursuit of policies and investments which enhance educational levels of workers, particularly in both low and moderate income countries, produces higher rates of growth as well as substantial declines in relative, and in most regions, absolute levels of wage inequality. Within this context, trade liberalization and investment and productivity enhancing R&D improvements has the effect of further enhancing the closing of income gaps. This is still not a scenario of bliss: workers have to continue to work hard for their living, and poverty is not eradicated. But it shows the potential for all groups of workers to share in the benefits of globalization and for an increase in the labor incomes of the poorest segments of the populations of even the lowest income countries, leading to a large reduction in global poverty.

Part two of the paper proceeds with a detailed exposition of the global database on trade and financial flows between differently constituted clusters of countries throughout the world economy that is used in the CGE model. Part three will elaborate on the assumptions and the specifications of the model, while part four will focus on the interpretation of the result of the experiments simulating the different scenarios. Part five offers some conclusions and policy recommendations.

II. Data Base of a Changing World Economy

The construction of the database used in the IDB-World CGE model represents a major collection and aggregation undertaking. Table 1 presents the data components of the model which includes 9 "country clusters" or regional aggregations, 11 sectors of production, 6 factors, 2 types of labor mobility, and 3 institutions for the distribution of factor income.

Tables 2 to 6 present a summary of some of the components for the base data. Table 2 presents general economic indicators in the base data, revealing some important issues in the position of Latin American countries (LAC) in comparison to other world regions. The LAC region is the second largest of our groupings in terms of GDP and fifth in population, yet still ranks third in per-capita income behind the OECD by nearly 9 to 1 and behind ANICs by more than 2 to 1. One often cited explanation for this difference deals with relative educational performance between these regions[6]. It is interesting to note that while table 2 shows that the LAC region actually displays a slightly higher share of educational expenditures as a percentage of GNP relative to ANICs, table 3 shows that ANICs have been able to produce a better educated workforce. Table 4b, meanwhile, shows that LAC region has the highest percentage of workers in the urban unskilled category (42%) among developing regions (non-OECD and Transitional), while the LAC region also has the lowest share of agricultural labor (25%) among developing regions. ANICs have relatively more workers in agriculture (40%) while relatively less urban unskilled workers (32%). Thus as a share of non-agricultural labor, the LAC region displays a much higher concentration of unskilled workers compared to the ANIC region with a comparatively higher share of workers in the urban skilled and professionals.

Relative involvement in trade is another commonly noted difference between LAC and LNICs. Table 2 shows that LAC regions ranks sixth in its trade share of GDP, performing at only about a quarter of the ANICs level. Table 5 shows that ANICs exports are also the most diversified of the developing regions, while LACs are very highly concentrated with the OECD. The ANIC region is also a large net exporter to the OECD while the LAC region is a net importer. The tariff data in table 6 tells part of the story. ANICs have higher tariff levels than LACs with all regions of the world. Yet they also face higher tariffs than the LACs do in every region of the world.

Finally, differences in investments rates and quality of investments are also cited to explain relative recent economic performance. Table 2 shows that the ANICs have the highest rates of investment share of GDP than any other region, with the LACs trailing, yet both are ahead of the OECD. Yet with respect to expenditures on R&D relative to GDP, the OECD ranks highest with ANICs gaining and LACs lagging behind.

Appendix 1 presents information on the sources for this base data as well as information on the data used for future population and education projections.

III. The Construction of a Global Dynamic CGE Model

The Need for a General Equilibrium Approach

Missing in many discussions on income effects of globalization is a balanced analysis that clarifies both the significant benefits that global trade liberalization could have on developing countries, but also the increased risks for greater labor market adjustment problems and income distribution challenges. At the same time, we need a framework that places the costs and benefits of liberalization within a context in which we can compare the relative impacts of other policy interventions and investments in education and technology that directly affect the productivity of different factors of production.

[6] World Bank, 1993.

Computable general equilibrium (CGE) analysis is arguably the most advanced tool available to model and understand these linkages between sectors, countries and factors on a global scale. In CGE analysis, the impact of trade liberalization, market reforms and pro-competitive investments are seen in terms of connections throughout the economy on the cost of goods and services used by all producers and consumers of goods and services. The impact of reducing trade barriers and eliminating subsidies can thus be analyzed simultaneously through the reduction in production in protected and subsidized sectors, the increase in overall efficiency and production in previously unprotected sectors, as well as the possible general equilibrium taxes considerations. The impact of an increase in investments in education and technology can be seen in terms of growth, income distribution, and cost effectiveness. We compare the rates of return to capital (endogenously generated in the model from factor supplies, demands, and technology), with the rate of return to education, by region and level, and the return to R&D spending, to see where societies scarce resource bring the highest returns. We also look at the income distribution consequences of each policy, and attempt to evaluate these alternatives by their overall desirability.

A CGE model, like the one used here, can be used to estimate such overall impacts. Starting from a mapping of the flow of goods and services (including trade flows), factors of production, and payments in an economy (called a social accounting matrix, or SAM), the impact of alternative policies on equilibrium prices and on elements of the SAM can be traced. The CGE model ensures that the estimated outcomes are all consistent with each other. In other words, policies that favor one sector increase demand for intermediate goods (including imports) used in the sector and generate additional demand for all factors of production used intensively in that sector's production, bidding up their cost. The resulting increase in output is either consumed domestically or exported, depending on demand, which in turn depends on relative incomes and prices. A brief description of the workings of the base model will be given in Appendix 1.

The IDB World CGE model developed for this report is a member of a growing family of trade-focused, multi-country CGE models. Designed to analyze the impact of trading interactions between countries, the model focuses on the trade relations between developed and developing countries. Particular emphasis is placed on the demand for different categories of labor as we use the model to explore the impact of trade liberalization, skill accumulation, and economic growth on wage distributions--both across regions and skill levels. The model includes eight regions (Latin America, Sub-Saharan Africa, Southern Asia, China, Asian NICs, Other Low-Middle Income Countries, Transitional Countries (Former USSR Bloc) and Rich OECD Countries), with the rest of the world treated residually with simple import and export demand functions. For each region, the model includes ten sectors (four primary, five manufacturing, and services) and six factors of production (capital, land, and four skill categories: agricultural, unskilled, skilled, and professional). Each regional economy has a separate CGE model which determines: sectoral supply, demand, exports, imports and market clearing prices; factor supply, demand, and market clearing wages; and the real exchange rate. The regions are linked by trade flows. World prices of all goods are determined within the model, equilibrating sectoral export supply and import demand on world markets. Domestically produced and traded goods are specified as imperfect substitutes, which provides for a realistic continuum of "tradability" and two-way intra-sectoral trade, rather than assuming that all goods are either perfect substitutes in world markets or are not traded as all.

The model is dynamic, generating solutions for six periods stretching from the base year of 1992 until the terminal year of 2020. It includes rural-urban migration linking agricultural and urban unskilled labor markets within each region. The model captures the links between changes in endowments, including demographics and changes in education and skill levels, protection, and relative wages as specified in neo-classical trade theory. It provides a simulation laboratory for exploring the empirical importance of changes in trade on relative wages, and for comparing the magnitude of these effects to the effects of capital accumulation, productivity growth, skill upgrading, capital flows, and migration patterns.

The model was constructed in such a manner to take into consideration the huge differences in resource allocation among different regions, as well as differences in skills within the labor force. The model will also allow for the consideration of the trade patterns over long periods of time (28 years), and for the assessment of the potential impact of various patterns of integration on factor returns and the distribution of factor income.

Global and regional trade arrangements can be simulated and analyzed as components of the international trend towards increased liberalization among countries and integration within regional blocs. Regarding future perspectives, the model considers alternative new integration initiatives, such as trade agreements between Latin America and OECD, ANICs and OECD, and a trade agreement between all non OECD and Transitional countries.

Appendix 2 presents a detailed description of the full model which is programmed in GAMS.

III. Basic Questions and Scenarios:

The IDB-World CGE model is designed to address the potential impacts on income distribution in different parts of the world over time due to alternative scenarios of the liberalization and incorporation of various groups of countries and types of workers into the world economy. We also simulate policies and investments that could substantially affect these alternative outcomes. In particular, the model will simulate alternative flows of investment resources for human capital improvements as well as R&D expenditures linked to total factor productivity growth.

This paper organizes our CGE modeling results around two major scenarios: a Status Quo/Divergence Scenario and an Integration/Convergence Scenario (See Table 7). The major difference between these two scenarios is the level of investment in human capital improvement, which we find to be a key determinate of the pattern of global growth and income distribution. The Status Quo/Divergence Scenario projects out current regional levels of educational expenditures, paths of skill improvements, and income widening. The Integration/Convergence Scenario simulates the levels of skill improvements and educational expenditures in each region that would be required to close the growth of income inequality for that region.

Using each major scenario as a "base," we also run an identical set of five alternative trade scenarios, a resource price shock scenario, and three others designed to simulate a range of possible policies and investments and their possible impacts on the pattern of global growth and income inequality:

(1) Alternative strategies for regional and global trade policy, including:

(a) full implementation of the recent GATT/WTO agreements;

(b) a further round for the complete global elimination of all tariff barriers;

(c) a Latin American-OECD regional trade accord;

(d) an Asian NICs-OECD trade regional accord;

(e) a developing country only (non-OECD and Transitional economies) trade accord;

(2) The above trade policy sub-scenarios with the addition of "dynamic externality" effects.

(3) Additional investments in R&D that enhance total factor productivity (TFP) growth through the lifting of Latin American investments to Asian NIC levels.

(4) Raising levels of investment rates from GDP in LAC to ANIC levels.

(5) The simulation of a natural resource shock through the impact on Latin America of the doubling of mining/mineral exports by the rest of the world producers.

(6) Additional investments in education that close the skill gap between Latin America and Asian NICs by 100.

Before proceeding to an analysis of the CGE model results, we first consider the assumptions used in each of these alternative scenarios and subscenarios.

Investments in Human Capital

The dynamic CGE model developed here can allow for the analysis of alternative scenarios of increased global integration, their impact on income differences within and between regions, and the impact that particular policy interventions may have on these trends in growth and inequality. In the absence of a concerted effort to promote education and improve the human capital of developing country workers, the gap between rich and poorer workers can be shown to widen. However, the model can also show that specific interventions directed at improving the human capital condition of workers, particularly in developing countries, can both enhance global growth and improve within and between region income distributions.

A key reason for using a dynamic global CGE model is to be able to track developments in trade and investments related to the emergence of low wage economies like China and South Asia as regional and global economic powers. The model traces the interdependence among growth of production and incomes in China and South Asia, and the pattern of production and growth in other low and middle income countries in Latin America, as well as the rich countries of the OECD (Japan, the EU and the United States). A dynamic perspective allows differential investment rates, demographic change, and other inter-temporal phenomena to impact these economic variables. As the majority of the cohorts that will be joining the labor force before 2020 have already been born, the key question is how to model the role of government spending for education and its impact on the skill composition of the labor force.

Using estimated coefficients between government spending and enrollments in primary, secondary and tertiary education, we model the impacts of increased investment in education on growth, trade and income distribution. This process involves three steps. First, the money to be spent must either be raised through borrowing, raising taxes, or diverting other government spending. This generates costs and distributional implications that must be netted out of the gross gains to yield net gains. Alternatively, one can abstract from these "general equilibrium taxation" concerns by either assuming non-distortionary lump-sum taxes or that funds for the expansion of education are available through foreign borrowing. Secondly, education must be translated into labor market skills and labor productivity. We have estimated conversion factors that translate increased education attainment into skills and productivity, thus we can directly estimate how increases in education results in additional skilled and professional workers. Lastly, there must be sufficient investment to generate employment opportunities in the non-agricultural economy to keep wages and productivity higher and thus provide a strong positive return to education.

Thus several potential impacts on economies of increased spending on education exist, with a general equilibrium model necessary to sort out their relative strengths and net effects within and across countries. First, higher educational levels will result in higher productivity and higher incomes. Moving workers from agriculture to unskilled industrial employment by improving and enhancing basic literacy will no doubt improve income distribution, while a focus on tertiary education to train professionals is likely to be regressive. Secondly, increasing the number of workers at a higher skill level will directly reduce the average wage at that level, but indirectly increase the rate of return to capital in sectors that use such labor intensive in production, increasing investment output and offsetting the wage decline. Thirdly, countries without a comparative advantage in agricultural goods will see an increase in trade as the inflow of workers to manufacturing sectors generates an exportable surplus, while outflows of workers from agriculture encourages imports of lower cost foreign products. The net result is likely to be a slight rise in agricultural prices and thus an improvement in agricultural sector wages rates and return to land. Countries with a comparative advantage in agriculture will find that increased mechanization will take place in those sectors, as the outflow of workers in those sectors raises wages, encouraging greater use of machinery. Increases in manufacturing sector labor may allow effective import substitution in some areas and overall trade volumes may fall.

Trade Liberalization

Computable general equilibrium models have been used to analyze a wide variety of economic issues and there is a long tradition and literature in the use of CGE models to estimate the economic impacts of trade liberalization at the national, regional and global level (See Dervis, de Melo, and Robinson (1982); and Devarajan, Lewis, and Robinson (1993)). In the context of regional integration, particularly dealing with the North American Free Trade Area, CGE models have also been widely used, with the work reviewed by Brown (1992) and Hinojosa-Ojeda and Robinson (1992). The CGE model we use here reflects the experience gained through many years of analyzing a variety of regional and global trading arrangements.

The model and scenarios presented in this paper are designed to evaluate the impact of alternative paths of trade and financial liberalization among clusters of countries around the world. The scenario results display the static and dynamic general equilibrium effects of changing the structure of trade protection in the region. By systematically altering only the trade policy variables of the countries in the region, we can evaluate the effects of different patterns of protection on the structure of production and income distribution for each country-cluster or sub-region, the regional structure of trade, the pattern of trade with the rest of the world.

For each alternative scenario, the model generates results concerning the impact on real GDP, output, trade, value added, the real wages paid to each labor category, as well as the rental rate of capital and land. Trade diversion and trade creation impacts will be evaluated through data on total, intra-regional, and extra-regional trade. For each alternative scenario we can therefore evaluate the impacts of a different path of integration on the whole regional pattern of trade and financial interdependence.

These scenarios should be seen as model experiments rather than predictions of the actual pattern of growth that may accompany each of these alternative paths of integration. The actual growth pattern will be the result of many more factors than just trade policy, especially macro-economic and incomes policies. The CGE modeling framework allows for controlled experimentation to determine the size of the impact that could be strictly attributed to changes in a select set of policy variables, specifically tariff and non-tariff barriers in this paper. Both the comparative statics and dynamic experiments are meant to describe, therefore, the impact of different patterns of trade liberalization Ain the medium to long run≅. Dynamics here does not imply the actual path of the transition, but rather the a period to period cumulative effect over time of positive productivity externalities that could potentially result from regional integration.

The CGE model presented here, like other multi-country CGE models, has a medium to long-run focus. We assume, for example, that factor markets adjust. While sectoral employment changes, aggregate employment is assumed to remain unchanged (except for the migration flows discussed above). Later in this paper, we report the results of comparative static experiments in which we Ashock≅ the model by changing some exogenous variables and then compute the changed equilibrium solution.

The results of each scenario are presented relative to a base calibrated with the pre-liberalization structure of trade and financial protection throughout the region. For each set of sub-scenarios, sub-scenarios (1) represents the comparative statics effects while sub-scenarios (2) additionally measures the potential dynamics effects of the same scenario.

The general gains from trade liberalization fall into two main categories: (1) the "comparative statics" effects which result from one-time enhanced efficiency of resource allocation through increased specialization according to comparative advantage; and (2) the potential "dynamic" effects that positive externalities to the process of trade liberalization and integration may have on each country and on the region as a whole.

The "dynamic" effects of trade liberalization are model through three mechanisms which are empirically important in export-led development: (i) increased productivity from exploiting economies of scale in production for the larger market; (ii) increased efficiency in production and marketing due to competition in domestic markets; and (iii) technological advances affecting production technologies and factor usage, linked to foreign capital goods inflows.

Additional gains relate to regional trade agreements, of which only a few will be further discussed below.[7] Regional integration can create a positive feedback loop. Trade

[7] For more details, see McCleery 1998.

preferences to neighboring economies can increase economic activity, incomes, trade, and economic growth in a mutually reinforcing way, given strong ties among the countries. These factors could certainly work for many country clusters, which already have strong trade and financial linkages among member countries.

R&D Expenditures and Factor Productivity

Numerous studies have linked R&D to total factor productivity (TFP) growth. [Kim and Lau 1992, Young 1994] We present a scenario of increased R&D expenditures as a share of GDP compared to the base R&D shares of GNP. The scenario simulates additional investments in R&D that double such investments as a share of GDP in every region.

Natural Resource Shocks

The simulation of different natural resource shocks poses a few problems in this context. Ordinarily, one might simulate a price shock and national or regional responses. However in the global CGE context, such a price shock would have to be traced to its origins in a demand increase in some large region. Rather than play with demand parameters in this way, we simulate the impact of a positive productivity shock in the mining sector. This productivity shock results in increased exports and export revenues, which feed back to imports of capital goods, intermediate goods, and consumption goods. We test for the possibility of a "Dutch disease" effect, where additional resources are pulled out of industry into the growing sector. We would thus the latter shock to productivity in the mining and minerals sector to worsen income distribution, which it does.

Education Expenditures, Labor Productivity, and Income Distribution

The primary education scenario is the across the board increase in educational expenditure in all regions that constitutes the difference between Status Quo/Divergence and Integration/Convergence. On the one hand, moving from this low to high education scenario would require massive new investments in education. On the other hand, as we show in the next section, such investment would pay off handsomely in terms of both income growth and poverty alleviation. We also run an additional scenario of increased investments in education in specific regions. The first simulates investments that entirely close the skill gap between Latin America and Asian NICs by 50%. Again, the additional expenditure required to close the gap is considerable, but as we shall show, the payoff is large as well.

V. Scenario Results

The two major scenarios and their variations tell us much about the possible future paths of the world economy and income distribution, as well as the relative efficacy of different policy and investment initiatives.

Tables 8 through 10 present the results of the two major Divergence and Convergence Scenarios, as well as the series of 6 sub-scenarios which we run on top of the two major scenarios. Table 8 presents real GDP results by region and scenario. Table 9 presents the results of factor wages and Table 10 presents the results of exports and imports. All results are represented in annual average percent change terms from the base year (1992) data.

Divergence and Convergence Base Scenarios

As was stated before, the principal difference between the two major scenarios is the level of investment in human capital improvements, which we find to be a key determinate of the pattern of global growth and income distribution. The Status Quo/Divergence Scenario was projected out from current regional levels of educational expenditures and paths of skill improvements. Using UNESCO data discussed in Appendix 1, we projected the rate of improvement in educational attainment and labor skill category mobility seen over the last 15 years into the next 28 years. In the Integration/Convergence Scenario, we simulated the levels of improvements in educational attainment and expenditures as well as labor skill category mobility in each region that would be required to reduce or eliminate the growth of income inequality in every region. This exercise yielded the result that educational attainment would have to improve by about 50% from current trends in all regions in order to generate a trend of relative or absolute convergence in factor wages. We also calculated the rate of return of investment to education which, as expected will vary across regions. (See Table 13).

The differences between the Convergence and Divergence Scenarios indicate that movement towards a world wide closing of the gaps in wages between lower and higher skill labor categories also produces increasing growth rates of GDP and trade. As can been seen from Table 8 and Table 11, increasing spending on education as a share of GNP by 50% increases GDP average annual growth in all regions by a range of under .1% in most poorer regions and more than .3% in China, LACs and the Transitional

Table 11: Differences in GDP Growth Rates

SSA	***LOW***	***CHN***	***LMID***	***ANIC***	***LAC***	***TRAN***	***OECD***
0.102	0.062	0.314	0.089	0.262	0.320	0.506	0.238

region. These differential positive rates of growth thus reflect different returns to investment of education by region (Table 13). The highest rates of return are in China, LAC and TRANS, while the lowest are SSA and LOW. It is important to note that some of the countries with the lowest rates of return to education also have the highest education expenditures as a share of GDP (Table 2), indicating serious problems in efficiency of their educational systems. China is interesting since it is the country with the lowest share of educational expenditures (2%) but with the highest rate of return. LACs and Transitional represent good investments.

It is interesting to note that these relatively small improvements in GDP growth rates combined with, and related to, relatively small educational investments as a share of GDP are enough to substantially improve the incomes of poorer people and to close the relative, if not absolute, levels of wage inequality in all regions around the world. Table 9 shows the impact of these increases on educational investments and GDP growth on the average annual growth rates of factor wages by skill labor categories in each region. Note that the Divergence Scenario, which represents current educational investment trends, produces widening and substantial gaps in wage inequality in every region on the globe. The Convergence Scenario, on the other hand, substantially increases the growth of income among poorer workers and produces an absolute decline in inequality in regions that contain the majority of the world's population, as well as a significant relative decline in inequality in all other regions. Notable for absolute declines in inequality are

LAC, China, SSA and OECD. Regions showing relative declines in equality are LOW, LMID, TRANS, and ANICS.

Table 12 shows the difference in the Convergence Scenario wage growth rates compared to the Divergence Scenario. Notice that a decline or reversal in inequality trends is achieved primarily though significant increases in the growth rates of relatively less lower wage agricultural and unskilled ranging from 1.7% in LMID (representing an increase in .5% over the divergence scenario) to 3.3% in LAC (representing an increase of 1.4%). AGLAB and USKLAB wages grow at the same rate due to rural to urban migration which is modeled as equalizing relative wage differentials among these two types of workers. Higher wage workers are still gaining in the Convergence Scenario,

Table 12: Differences in Growth of Wages

	SSA	LOW	CHN	LMID	ANIC	LAC	TRAN	OECD
AGLAB	0.396	0.439	0.559	0.55	0.714	1.453	0.854	1.096
USKLAB	0.396	0.439	0.559	0.55	0.714	1.453	0.854	1.096
SKLAB	-0.713	-0.667	-0.808	-0.371	-0.386	-0.631	-0.767	-0.364
PROFES	-0.423	-0.866	-0.793	-0.799	-0.74	-1.541	-0.51	-0.5

although at slightly lower rates than in the Divergence Scenario. This is most notably the case in LAC and China, where there are absolute reductions in inequality, but also in LOW and TRAN, which display only relative declines in inequality.

Trade Scenarios (1 and 2)

Trade liberalization has the effect of more efficiently allocating resources based on the elimination of distortionary tariff barriers and the opening of wider markets. This can have an impact on both an initial reallocation of resources and thus raise GDP (the so-called comparative statics effect), and it can have a more lasting impact by raising the productivity growth of an economy (the so-called dynamic externality effects).

As was stated previously, both effects are modeled here. As is typical in other large CGE modeling exercises of trade liberalization, the comparative static effects show either a very small increase in GDP, such as for the OECD in Table 8, or they show slight net negative results due to negative terms of trade effects as is known to be common in many CGE models of developed-developing country trade.[8] The results of the dynamic externality scenarios are much more powerful and positive, as is common in most CGE trade models. Table 8 shows the dynamic externality effects of each trade liberalization sub-scenario, operating through increase rates of TFP growth related to increased trade resulting from each pattern of trade liberalization in both the Divergence and Convergence Scenarios. In the Divergence Scenario, the long term impacts of dynamic externality effects result in increasing average annual GDP growth rates from 0.3% in LMID to greater than 0.8% in LAC, the region that displays the highest potential gains.

Each of these regional dynamic GDP gains resulting from trade liberalization sub-scenarios are all slightly augmented in the Convergence Scenario. In virtually all cases, the dynamic externality effects of trade liberalization are greater than the gains in GDP observed in the shift from the Divergence to the Convergence Scenarios. Yet the effect of closing the gaps in wage inequality are much greater in the Convergence Scenario compared to the Divergence Scenario. Thus the Convergence Scenario with dynamic externality effects of trade liberalization produces the highest overall rates of GDP

[8] See Brown (1987), de Melo and Robinson (1989), and Burniaux (1990) for a discussion on terms of trade effects in trade based CGE models

growth as well as the greatest closing of income gaps in all regions of the world economy.

Table 9 presents the wages effects of different trade liberalization scenarios. As is to be expected in the comparative statics versions of the scenarios in this and other world CGE trade models, global trade liberalization should produce the factor returns expected within a Stolper-Samuleson framework and it does. In both the Convergence and Divergence Scenarios, sub-scenarios 1a (GATT) and 1b (full world liberalization), income inequality widens within OECD as the wages of skill workers rise and the wages of the less skilled fall. In the developing regions, however the opposite is true and the wages of the less skilled rise and the higher skilled fall. It is interesting to note that while the comparative statics versions of these sub-scenarios reduce income inequalities in the developing countries, they do so at only a fraction of the effect that educational investments have between the Convergence and Divergence Scenarios. In addition, the Convergence Scenarios reduces income inequality in the OECD, while trade liberalization does not.

With respect to the inter-regional liberalization scenarios 1c, 1d, and 1e, the benefits to wages earners in the developing regions either are diminished compared to more global trade liberalization scenarios or disappear altogether. This is clearly the case for LAC in sub-scenarios 1c and for ANIC in sub-scenarios 1d, as well as for virtually all developing regions in sub-scenarios 1e. The appeal of this inter-regional arrangements also has less appeal to the OECD who either see their growth to high wage workers disappear with continued losses to low wage workers (as is the case with an OECD-LAC arrangement in 1c), or else they see the high wage workers loose income as they face targeted competition from ANIC (in the OECD-ANIC arrangement in 1d) or are shut out from markets in 1e.

R&D Investment Scenarios (3)

These scenarios are based on additional investments in R&D that enhance total factor productivity (TFP) growth, including (a) a doubling of investments in every region, (b) the lifting of Latin American investments to Asian NIC levels.

Table 8 shows that scenario 3a clearly has a positive impact on GDP growth in all regions and in both Scenarios. Interestingly, the effect of the same increase in R&D expenditures produces a slightly better expansion of growth in the Convergence than in the Divergence Scenario, indicating a complementarity between R&D and human capital investment. More significant is that with roughly equivalent increases in R&D and education as a share of GDP, the Convergence Scenario produces much higher rates of growth than the R&D scenario in all regions, but especially the high and middle income regions.

What increase R&D investments does not provide compared to the Convergence Scenario, however, is improvements in income distribution. Income inequality actually increases in all regions due to much more rapid increases in the wages of high skilled workers relative to low skilled workers in both the Convergence and Divergence Scenarios. It should be pointed out, however, that lower skilled workers do also gain in the R&D scenarios, but not as much as they do from human capital improvements.

Physical Capital Investment Scenarios (4)

In this scenario, we raise the rates of investment in LAC to 10% above those of ANIC levels. Relative growth rates of LAC obviously increases in both scenarios. Yet as we saw in the R&D scenario, growth is further enhanced in the Convergence due to a complementarity with physical and human capital investments. It is also important to note that while the level of physical capital investment in this scenario is roughly equivalent to the increase in human capital investment in the Convergence Scenario, the latter produces a higher rate of growth than the former. The physical capital investment scenario also produces less growth than the R&D scenario for a similar increase in outlays.

With respect to income inequality, it is not surprising that skilled workers in LAC enjoy much faster receive income growth than the lower skilled, although they also enjoy some growth. What is interesting is that the physical capital scenario produces a higher rate of inequality than the R&D scenario, due to both a much higher rate of growth of the more skilled as compared to the less skilled.

Natural Resource Shock Scenarios (5)

This scenario similes a major natural resource shocks, particularly the impact on Latin America of the doubling of mining/mineral exports by the rest of the world producers. While this would create rapid rates of growth in regions around the world, it also does produce growth in LAC. Yet LAC would be falling behind at a much more rapid rate than in any other scenario.

This scenario also has the effect of increasing the wages of skilled workers at a much higher rate than either the R&D or the physical capital investment scenario. At the same time, this scenario reduces the wages of the unskilled at roughly the same rate as the physical capital investment scenario.

Additional Human Capital Investment Scenarios (6)

Finally, we run a series of sub-scenarios which simulate additional investments in education. The first (6a) closes the educational and skill gap between Latin America and Asian NICs by 50%. The second (6b) raises educational spending in all regions except OECD by 50%.

The first sub-scenario (6a), not surprisingly, has a bigger impact on GDP growth within the Divergence compared to the Convergence Scenario. In fact, given that educational and skill levels tend to become more similar in the Convergence Scenario, there is virtually no Aggregate GDP effect here.

In both the Convergence and Divergence Scenarios, however, sub-scenario (6a) does have the effect of reducing income inequality within LAC, but more so in the Convergence Scenario. Within the Convergence Scenario, wages of the lower skilled rise much faster while wages of the more skilled do not fall as much as in the Divergence Scenario.

The second sub-scenario (6b) is interesting because it shows us the impact on the rich OECD region of additional educational expenditures in the rest of the world outside of the OECD. Global growth is further enhanced and within region income inequality is further reduced. The effect on the OECD is positive, but not only in terms of GDP growth. The OECD own income inequality if benefited from a complementary improvement in the developing regions towards higher skilled workers, which generate higher growth, but also a relieving of pressure on lower skilled workers both world-wild and at home.

VI. Conclusions and Policy Recommendations

This paper presented a dynamic computable general equilibrium (CGE) framework for analyzing the impact of alternative scenarios on production, real wages, the structure of employment, and inequality within and between countries. The "IDB World CGE model" presented here was designed to simulate various policy measures, exogenous shocks, and economic interactions among nine "country clusters" or key regions of the world. Of particular interest will be the impact on employment and income distribution among skilled and unskilled workers due to enhanced trade and investment competition between Latin America, OECD, former Soviet Bloc, Asia, and other low and middle income regions. We pay particular attention to both growth and inequality implications of all scenarios, searching for ways to improve growth without worsening income inequality, or alternatively improving income distribution without reducing growth.

The IDB-World CGE model is also used to analyze the potential impacts of a series of policy interventions that can change the pattern of trade and investment, as well as the productivity path of different factors of production, and thus the pattern of income and employment adjustments. We specifically focus on the policies and investments that could substantially affect these alternative outcomes. In particular, the model simulates alternative flows of investment resources for physical capital, human capital, and R&D improvements. The IDB-World CGE model can thus allow one to evaluate within a single framework, the long run relative impacts of different factor supplies (tangibles such as labor and capital), polices designed to increase the efficiency of factor allocation (trade liberalization), as well as improvements in different factor productivities (through investments in human capital and R&D).

Our results shown that growth can clearly be augmented by trade liberalization, as well as additional investments in any of several area, but that each has different consequences for income inequality.

The dynamic externality effects of trade liberalization are shown to be powerful and positive in all regions in the world economy, a result that is common in most CGE trade models. The dynamic externality effects operate through increased rates of TFP growth related to increased trade resulting from each sub-scenario of trade liberalization within both the Divergence and Convergence Scenarios. In the Divergence Scenario, the long term impacts of dynamic externality effects result in increasing average annual GDP growth rates from 0.3% in LMID to greater than 0.8% in LAC, the region that displays the highest potential gains. In every region, dynamic GDP gains resulting from trade liberalization sub-scenarios are slightly augmented in the Convergence Scenario.

In virtually all cases, the dynamic externality effects of trade liberalization are greater than the gains in GDP observed in the shift from the Divergence to the Convergence Scenarios. Yet the effect of closing the gaps in wage inequality are much greater in the Convergence Scenario compared to the Divergence Scenario. Thus the Convergence Scenario with dynamic externality effects of trade liberalization produces the highest overall rates of GDP growth as well as the greatest closing of income gaps in all regions of the world economy.

In addition to the effects of trade liberalization, we focus on three major areas of investments that have received considerable attention in the development literature, namely investments in physical capital (structures, plant and equipment), education, and research and development. Except for the case of R&D, for which we do not directly calculate rates of return, the first thing to notice from Table 13 is that rates of return vary considerably across regions, especially in education. This variance leads to different orderings, implying different policy recommendations. For instance, it appears that OECD countries should be spending relatively more on R&D, given its high return (20% by assumption) relative to returns on investments in education and physical capital in the range of 11-12%. But for middle income countries in Asia, Latin America, and Eastern Europe alike, the big returns are in investments in education. In Latin America and the transitional economies, investments in education yield rates of return more than 50% higher than investments in R&D, and about twice the return of investments in physical capital.

It is troubling to note that the rate of return to education lags behind both the returns to R&D and to physical capital in the poorest regions. With the exception of China, which more closely resembles its transitional cousins in Europe in terms of high returns to education and relatively low returns to physical capital, rates of return on educational investments lag under 10% in Sub-Saharan Africa, South Asia, and North Africa/Middle East.

One explanation for these low rates of return can be found in the relatively poor current state of education in these regions. With poor human resources, institutions, and traditions in the educational systems, rates of return are bound to be lower. A second factor could be gender bias in education, and the inefficiencies this promotes. A comprehensive discussion of the reasons for these differences across regions is beyond the scope of this paper, however.

Thus further education investments can serve as an engine of growth primarily for China and the middle income countries in Latin America, Europe and Asia. We can further conclude that higher overall rates of return to investments of all types in these regions may account for their preeminence in attracting private capital inflows.

This policy recommendation to promote education investment in Latin America and selected other developing regions rests not only on growth, but on income distribution considerations as well. Our simulations show that education (combined with job creation in appropriate sectors of the economy) is the key to convergence in incomes across skill levels in the population, and to lifting the poorest workers out of absolute poverty. While growth based on R&D or increase capital accumulation does raise the wages of agricultural and unskilled urban workers, the majority of the benefits from such growth accrue to skilled and professional workers, who are at the forefront of mechanization, product and process development, etc.

Globalization will clearly be a boon primarily to those best prepared to receive it. Yet we have shown that trade liberalization alone is clearly not a sufficient answer to the joint challenges of faster growth and better income distribution in the developing world. More research remains to be done before the claims made here regarding investments in education in middle income countries can be fully substantiated. But at this point, trade liberalization combined with investments in education seem to be the best hope for generating rapid growth with substantial improvements in the distribution of income in

Latin America, in the face of rapid labor force growth, strong competition from other regions, and other challenges that will emerge before the year 2020.

Appendix 1: Education and R&D Expenditure and Projection Data

Classification of Data by Regions:

Education expenditure and R&D expenditure structure are categorized into 8 regions:

OECD: Australia, New Zealand, Canada, US, Japan, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Spain, Sweden, United Kingdom;
ANIC: Korea, Singapore, Malaysia, Thailand, Taiwan
LNIC: Argentina, Brazil, Mexico, Chile, Colombia, Venezuela
TRAN: Albania, Belarus, Bosnia, Bulgaria, Croatia, Czeh Republic, Estonia, Hungrary, Latvia, Lithuania, Poland, Republic of Moldavia, Romania, Russian Federation, Slovakia, Slovenia, The FYR of Macedonian, Ukraine, Yugoslavia
LMID: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Tunisia, Iran , Iraq, Jordan, Kuwait, Saudi Arabia, Syrian Arab Republic, Turkey
CHN: China, Hong Kong
LOW: Indonesia, Philippines, India, Pakistan, Bangladesh
SSA: Anglola, Benin, Botswana, Bulkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad Comoros, Comoros, Congo, Cote divoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gobon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, Togo, Uganda, Tanzania, Zaire, Zambia, Zimbabwe.

Base Education Data Sources:

All data on education indicators, including enrollment and expenditures, were obtained from *UNESCO*'s *Word Education Report,* which is published one quarter ahead of the correponding statistics in *UNESCO*'s Statistical Yearbook. In the few cases where there is a difference between particular figures given in the two publications, the yearbook's figure should be regarded as superseding the report's figure. Date refers to the latest year for which data is available. For educational indicators, the year indicated is that within which the school year begins: e.g. 1992 refers to the school year 1992/93. Expenditure indicators refer to the financial year.

Enrollment data classification:

Total enrollment structure for each region is calculated from the aggregated average of net enrollment of students for each education category from each countries within a region. If net enrolment ratios are not available for both years (1980 and 1992), then we use a calculation method to estimate net enrollment ratios. If only one year of the net enrollment data is available (e.g. 1992), the other (e.g. 1980) will be calculated by using the growth rates of the Gross enrollment data between 1980-92. In cases where both net enrollment data is unavailable, (Singapore, Malaysia, Thailand and Pakistan), gross enrollment ratios are used. No schooling refers to those who did not attend the first-level education on that particular year.

Projected Educational structure

The files containing the projected educational structure data for the Divergence Scenario were constructed from estimates from UN, UNESCO, and other sources, for the base and final years (1992, 2020). The data files corresponding to the divergence scenarios use the actual projections as "targets" for the year 2020. The data files for the Convergence Scenario are from on our own estimates, which are based on sizable improvements in the level of education which are currently projected. This improvement corresponds to an increase of 50% for the higher levels (secondary and higher education), and the reduction of the "no schooling" category of about 60-70%. The values for the intermediate years (1995,2000,2005,2010 and 2015) are computed as the linear interpolation between the extreme points.

This improvement in education is introduced into the model through the specification of a "map" that indicates the composition of each labor category in terms of their share of workers with a specific level of education. Then, the composition intervenes in the determination of the initial factor supply for each labor category and for each country/region.

Returns to education.

Returns to education are computed as the rate of return based on an additional level of investment in education needed to improve by half the structure of skills in the labor force (equivalent to a 50% increase in the expenditure in education as share of GDP in each region), compared to the simulated GDP growth which is generated with the higher skill structures in each region. This increase in GDP is the increase from the "divergence" level to the "convergence" level.

R&D Expenditure data classification:

R&D Expenditure data were obtained from UNESCO statistical Yearbook 1997 (UNESCO). The measurement of R&D expenditure is calculated on the basis of intramural current expenditure, includes overheads, and intramural capital expenditure. The sum of the intramural expenditures incurred by the national institutions provides the total domestic expenditure which is the information presented at the international level. The total expenditure for R&D comprises current expenditure, including overheads and capital expenditure.

Note:

We have expanded our appendix which describe in greater detail all the steps that were used in (1) the use of UNESCO data to project to the year 2020 the current trends in education and skill structural achievement across regions used in the base "Divergence" scenario; (2) the method used to construct the higher education and skill target and the associated higher levels of educational investments in the "Convergence" that would result in narrowing or closing the income gaps between skill catagories; and (3) the method used to calculate the returns to education in the "Divergence" and "Convergence" scenarios.

It is important to note that our model results simulate closely what many global empirical studies have shown, namely that Latin American lags in educational and skill achievement while having slightly higher returns to education than in Asia. (See, for example, Psacharopourlos, George (1994)."Returns to Investment in Education: A Global Update" World Development, Vol. 22, No. 9: 1325-1343.) This seeming paradox is less puzzling when one notes that the empirical studies also confirm the fact that there are declining returns to education with improvements in educational structures.

(b) We have spent a great deal of time improving our method for simulating the "externality" effects of trade liberalization. We have reworked the model to tie regional TFP (total factor productivity) growth directly to the regional level of trade expansion in each scenario. This much more direct method allows us to generate results in the dynamic (multi-period model) setting that are much more in line with our previously higher GDP results that we had gotten with our single period models. Our reworked GDP growth results of trade liberalization with "externality" effects are also very much in line with other standard multi-period CGE model results of the impact of trade liberalization. (See, for example, Hertel, Thomas, Christian F. Bach, Betina Dimaranan, and Will Martin (1996). "Growth, Globalization and Gains from the Uruguay Round," Policy Research Working Paper 1614, International Trade Division, World Bank: Washington, D.C. (May).) (c) You will notice that the new externality results show much more important changes in the factors returns, which are also in ling with our previous models and the above cited model.

(d) We continue to use rural and urban wage levels across labor maket (skill) groups, as well as their relative growth rates across scenarios, as the best way to present changes in inequality. In this context, per-capita income figures would not be that meaningful.

Appendix 2 : Description of the IDB CGE Model

Solving the CGE Model

The CGE model presented here has been developed and solved using a package called the General Algebraic Modeling System (or GAMS). GAMS embodies two related developments of the last several years. First, the increasing power and availability of personal computers allows every modeler to have desktop access to computational resources that were once available only on mainframe computers. Second, the development of packaged software to solve complex mathematical or statistical problems such as that posed by our CGE model has permitted modelers to return their attention to economics.

Several syntax rules and presentation conventions are worth noting before continuing with a description of the model. 1/ The main virtue of GAMS is it allows modelers to specify models in (nearly) standard algebraic notation, while leaving the actual solution to GAMS. For the most part, these rules and conventions correspond to standard algebraic practice, so that the modeler need not learn an entire new software "language" to use GAMS. Most of the departures from standard algebra are straightforward as well. "SUM" represents the summation operator, S; SUM(i,... means sum over the index i, while SUM((i,j),... means some over both i and j. "PROD" represents the product operator, P, and "LOG" is the natural logarithm operator. The "$" introduces a conditional "if" statement in an algebraic statement. 2/ Parameters are treated as constants in the model; variables are free to vary endogenously, although some of them may be set exogenously as part of the model closure specification. 3/

The following is a list of the tables included in this appendix:

Table 1	Regional, Sectoral and Factor Classification.
Table 2	Parameters used in the model.
Table 3	Variables used in the model.
Table 4	Quantity Equations.
Table 5	Price Equations.
Table 6	Income and Expenditure Equations.
Table 7	Export and Externality Equations.
Table 8	AIDS (almost ideal demand system) Demand Equations.
Table 9	Migrations Equations.
Table 10	Market Clearing Equations.
Table 11	Other Files used in the model (data and processing modules).

[9] GAMS is designed to make complex mathematical models easier to construct and understand. In our case, we are using it to solve a large, fully-determined, non-linear CGE model (where the number of equations and number of variables are equal), although GAMS is suitable for solving linear, non-linear, or mixed integer programming problems as well. For a thorough introduction to model-building in GAMS, see Brooke, Kendrick, and Meeraus (1988).

[10] For example, PM(i,k,cty1)$imi(i,k,cty1) = xxx will carry out the expression shown for all PM(i,k,cty1) that belong to the set imi(i,k,cty1); in other words, calculate an import price for all sectors in which there are imports.

[11] For example, the exchange rate (EXR) and net foreign borrowing (FBAL) both are listed as variables; in practice, one will be set exogenously, while the other will be determined by the model.

Table 1. Regional, Sectoral and Factor Classification

Countries and regions

CTY1, CTY2	Universe	OECD	Australia, New Zealand, Canada, US, Japan, EU12
		ANIC	Taiwan, Korea, Singapore, Malaysia, Thailand, Taiwan
		LAC	Latin America
		TRAN	East Europe, Former Soviet Union
		LMID	Middle East, North Africa
		CHN	China, Hong Kong
		LOW	Indonesia, Phillippines, South Asia
		SSA	Sub-Saharan Africa
		ROW	REST OF THE WORLD
K(CTY1)	Countries	OECD	Australia, New Zealand, Canada, US, Japan, EU12
		ANIC	Taiwan, Korea, Singapore, Malaysia, Thailand
		LAC	Latin America
		TRAN	East Europe, Former Soviet Union
		LMID	Middle East, North Africa
		CHN	China, Hong Kong
		LOW	Indonesia, Phillippines, South Asia
		SSA	Sub-Saharan Africa

Sectors and groupings

I,J Sectors of production

GRAIN GRAINS INCLUDING PROCESSED RICE
OTHAG OTHER AGRICULTURE
FANDF FORESTS AND FISHING
MINES ENERGY AND MINERALS
FOOD FOOD PROCESSING
TEXT TEXTILE APPAREL
WOOD WOOD AND PAPER
INTER BASIC INTERMEDITE
CAPGD CAPITAL GOODS
SERV SERVICES

im(i,k)	Import sectors
imn(i,k)	Non-import sectors
ie(i,k)	Export sectors
ien(i,k)	Non-export sectors
imi(i,k,cty1)	Bilateral imports in base data
iei(i,k,cty1)	Bilateral exports in base data
ie1(i,k)	Aggregate CET export sectors
ied(i,k)	Downward sloping export demand from rest of world
iedn(i,k)	flat export demand from rest of world
iedw(i,k)	across country aggregate downward sloping export demand from RoW
iec(i,k)	Sectors with second level export CET
iecn(i,k)	Sectors with second-level competitive exports
ik(i)	Capital and intermediates goods sectors
iag(i)	Agricultural sectors
iagn(i)	Non-agricultural sectors
iserv(i)	Service sector (for GDP accounts) (SERV)

Factors and groupings

iff,f	Factors of production	CAPITAL	Capital stock
		LAND	Agricultural land
		AGLAB	Rural labor
		USKILAB	Urban unskilled labor
		SKLAB	Urban skilled labor
		PROFES	Professionals

Households and institutions

hh	Households	hhall	Single household category
ins	Institutions	labr	Labor
		ent	Enterprises
		prop	Property income

Table 2 Basic Model Parameters

CLES(i,hh,k)	Household consumption shares
E0(i,cty1,cty2)	Exports, base data
EK0(i,k)	Total sectoral exports, all destinations, base data
EKPTL0(k)	Aggregate exports, all destinations, base data
ENTR(k)	Enterprise income tax rate
ETAE2(i,k)	Externality elasticity for aggregate exports
ETAK2(k)	Externality elasticity for capital goods imports
ETAM2(k)	Externality elasticity intermediate inputs
FS0(iff,k)	Aggregate factor supply, base data
GLES(i,k)	Government expenditure shares
HHTR(hh,k)	Household income tax rate
IO(i,j,k)	Input-output coefficients
MKPTL0(k)	Imports of capital goods, base data
PIE(i,k)	Ag. program producer incentive equivalent per unit
PVAB0(i,k)	Base-year value added price
PWE0(i,cty1,cty2)	World price of exports, base data
PWEFX0(i)	Benchmark world export price
PWM0(i,cty1,cty2)	World market price of imports, base data
PWTC(i,k)	Consumer price index weights (PQ)
RHSH(hh,k)	Household shares of remittance income
SINTYH(hh,ins,k)	Household distribution of value added income
SPREM(i,k)	Share of premium revenue to the government
SSTR(iff,k)	factor payment tax rates (version 1: active)
TE(i,k)	Tax rates on exports
THSH(hh,k)	Household transfer income shares
TM(i,k,cty1)	Tariff rates on imports
ITAX(i,k)	Indirect tax rates
VATR(i,k)	Value added tax rate
ZSHR(i,k)	Investment demand shares
	Production and trade function parameters
AC(i,k)	Armington function shift parameter
AD2(i,k)	CES production function shift parameter
AE(i,k)	CET export composition function shift parameter
ALPHA2(i,iff,k)	CES factor share parameter
AT(i,k)	CET function shift parameter
DELTA(i,k,cty1)	Armington function share parameter
ETAE(i,k)	Export demand elasticities for rest of world
ETAW(i)	Aggregate export demand elasticities for rest of world
GAMMA(i,k,cty1)	CET export composition function share parameters
GAMMAK(i,k)	CET function share parameter
RHOE(i,k)	CET export composition function exponent
RHOP(i,k)	CES production function exponent
RHOC(i,k)	Armington function exponent
RHOT(i,k)	CET function exponent
	Parameters for AIDS import demand functions
SMQ0(i,k,cty1)	Base year import value share
AQS(i,k)	Constant in Stone price index
AMQ(i,k,cty1)	Share parameter in AIDS function
AQ(i,k)	Constant in translog price index
BETAQ(i,k,cty1)	Coefficient in AIDS function
GAMMAQ(i,k,cty1,cty2)	Price parameter in AIDS function

Table 3. Variables

Price block

EXR(k)	Exchange rate
PQ(i,k)	Consumption price of composite good
PD(i,k)	Domestic prices
PDA(i,k)	Processors actual domestic sales price including subsidy
PE(i,k,cty1)	Domestic price of exports
PEK(i,k)	Average domestic price of exports
PINDCON(k)	Consumer price index
PM(i,k,cty1)	Domestic price of imports
PQ(i,k)	Price of composite goods
PREM(i,k)	Premium income from import rationing
PVA(i,k)	Value added price including subsidies
PVAB(i,k)	Value added price net of subsidies
PWE(i,cty1,cty2)	World price of exports
PWM(i,cty1,cty2)	World price of imports
PWERAT(i,k)	Ratio of world export prices
PWEFX(i)	benchmark world export price
PX(i,k)	Average output price
TM2(i,k,cty1)	Import premium rates

Production block

D(i,k)	Domestic sales of domestic output
E(i,cty1,cty2)	Bilateral exports
EK(i,k)	Aggregate sectoral exports
INT(i,k)	Intermediate demand
M(i,cty1,cty2)	Bilateral imports
Q(i,k)	Composite goods supply
SMQ(i,k,cty1)	Import value share in total sectoral demand
X(i,k)	Domestic output

Factor block

AVWF(iff,k)	Average wage with current weights
FDSC(i,iff,k)	Factor demand by sector
FPE(k)	Total farm program expenditures
FS(iff,k)	Factor supply
FT(k)	Factor tax rate (version 2 fixed=0)
WF(iff,k)	Average factor price
WFDIST(i,iff,k)	Factor differential
YFCTR(iff,k)	Factor income

Migration block

WGDFL(la,k,lb,l)	Wage differentials
MIGL(la,k)	Labor migration flows (within category)
MIGRU(la,k)	Labor migration flows (across category)
MIGK(k)	Capital migration flows

Income and expenditure block

CDD(i,k)	Private consumption demand
CONTAX(k)	Consumption taxes
ENTSAV(k)	Enterprise savings
ENTAX(k)	Enterprise taxes
ENTT(k)	Government transfers to enterprises
ESR(k)	Enterprise savings rate
EXPTAX(k)	Export tax revenue
FBAL(k)	Overall current account balance
FBOR(k)	Foreign borrowing by government
FKAP(k)	Foreign capital flow to enterprises
FSAV(k,cty1)	Bilateral net foreign savings
FSAVE(k)	Foreign savings
FTAX(k)	Factor taxes
GD(i,k)	Government demand by sector
GDPVA(k)	Nominal expenditure GDP
GDTOT(k)	Government real consumption
GOVSAV(k)	Government saving
GOVREV(k)	Government revenue
HHT(k)	Government transfers to households
HSAV(k)	Aggregate household savings
HTAX(k)	Household taxes
ID(i,k)	Investment demand (by sector of origin)
INDTAX(k)	Indirect tax revenue
MPS(hh,k)	Savings propensities by households
REMIT(k)	Remittance income to households
TARIFF(k,cty1)	Tariff revenue
VATAX(k)	Value added taxes
YH(hh,k)	Household income
YINST(ins,k)	Institutional income
ZFIX(k)	Fixed aggregate real investment
ZTOT(k)	Aggregate nominal investment

Externality effects

SAD(i,k)	Aggregate exports externality parameter
SAD2(i,k)	Intermediate inputs externality parameter
SAC(iff,k)	Capital goods externality parameter
EKPTL(k)	Aggregate exports
MKPTL(k)	Capital goods imports

Table 1 lists the regional, sectoral, and factor classifications used in the model, as well as identifying the sectoral subsets that are needed in the equations of the model. Table 2 contains the parameter definitions used in the CGE model equations. Table 3 contains the variables that appear in the model.

Table 4. Quantity Equations

(1)	X(i,k)	=	SAD(i,k)*SAD2(i,k)*AD2(i,k)*(SUM(iff,ALPHA2(i,iff,k)*FDSC(i,iff,k)**(-RHOP(i,k)))) **(-1/RHOP(i,k)) ;
(2)	(1-ft(k))*WF(iff,k)*WFDIST(i,iff,k)	=	1 - vatr(i,k))*pva(i,k)*SAD(i,k)*SAD2(i,k)*AD2(i,k) *
			(SUM(f, ALPHA2(i,f,k) *FDSC(i,f,k) **(-RHOP(i,k))))**((-1/RHOP(i,k))-1)
			*ALPHA2(i,iff,k)*FDSC(i,iff,k)**(-RHOP(i,k)-1) ;
(3)	INT(i,k)	=	SUM(j, IO(i,j,k)*X(j,k));

Model Specification

In addition to eleven sectors for each country model, the model has six factors of production (four labor types, land, and capital), as identified in Table 1. The output-supply and input-demand equations are shown in Table 4. Output is produced according to a CES production function of the primary factors (equation 1), with intermediate inputs demanded in fixed proportions (equation 3). Producers are assumed to maximize profits, implying that each factor is demanded so that marginal product equals marginal cost (equation 2). In each economy, factors are not assumed to receive a uniform wage or "rental" (in the case of capital) across sectors; "factor market distortion" parameters (the WFDIST that appears in equation 2) are imposed that fix the ratio of the sectoral return to a factor relative to the economywide average return for that factor.

Table 5. Price Equations

(4)	PM(imi,k,cty1)	=	PWM(imi,k,cty1)*EXR(k) * (1 + TM(imi,k,cty1) + tm2(imi,k,cty1)) ;
(5)	PE(iei,k,cty1)	=	PWE(iei,k,cty1) * (1 - te(iei,k))*EXR(k) ;
(6)	PEK(ie,k)	=	SUM(cty1$pt(k,cty1), PE(i,k,cty1) * E(i,k,cty1)) / EK(i,k) ;
(7)	PDA(i,k)	=	(1 - ITAX(i,k)) * PD(i,k) ;
(8)	PQ(i,k)*Q(i,k)	=	PD(i,k)*D(i,k) + SUM(cty1$imi(i,k,cty1), (PM(i,k,cty1)*M(i,k,cty1))) ;
(9)	PX(i,k)*X(i,k)	=	PDA(i,k)*D(i,k) + SUM(cty1$iei(i,k,cty1), (PE(i,k,cty1)*E(i,k,cty))) ;
(10)	PINDCON(k)	=	PROD(i, PQ(i,k)**pwtc(i,k)) ;
(11)	PVA(i,k)	=	PX(i,k) - SUM(j,IO(j,i,k)*PQ(j,k)) + PIE(i,k);
(12)	PVAB(i,k)	=	(1 - ITAX(i,k))*PD(i,k)*D(i,k)/X(i,k) + (SUM(cty1, PE(i,k,cty1)*E(i,k,cty1)))/X(i,k)
			- SUM(j, IO(j,i,k)*PQ(j,k)) ;
(13)	PWE(i,cty1,cty2)	=	PWM(i,cty2,cty1) ;

The price equations are shown in Table 5. In equations 4 and 5, world prices are converted into domestic currency, including any tax or tariff components. Equation 13 guarantees cross-trade price consistency, so that the world price of country A's exports to country B are the same as the world price of country B's imports from country A. Equation 6 defines the aggregate export price as the weighted sum of the export price to each destination. Equation 7 calculates the domestic price, net of indirect tax. Equations 8 and 9 describe the prices for the composite commodities Q and X. Q represents the aggregation of sectoral imports (M) and domestic goods supplied to the domestic market (D). X is total sectoral output, which is a CET aggregation of total supply to export markets (E) and goods sold on the domestic market (D). Equation 11 defines the sectoral price of value added, or "net" price (PVA), as the output price minus the unit cost of intermediate inputs (from the input-output coefficients), plus production incentives from exogenous agricultural producer subsidy schemes (PIE). Equation 12 defines the sectoral price of value added net of subsidies and incentives.

In the IDB CGE model, the aggregate consumer price index in each region is set exogenously (PINDCON in equation 10), defining the *numeraire*. The advantage of this choice is that solution wages and incomes are in real terms; moreover, since our Cobb-Douglas price index is consistent with the underlying Cobb-Douglas utility function, the changes in consumption levels generated by the model are exactly equal to the *equivalent variation*. The solution exchange rates in the sub-regions are also in real terms, and can be seen as equilibrium price-level-deflated (PLD) exchange rates, using the country consumer price indices as deflators.

Table 6. Income and Expenditure Equations

```
(14)  YFCTR(iff,k)      =  SUM(i, (1-ft(k))*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));
(15)  TARIFF(k,cty1)    =  SUM(i$imi(i,k,cty1), TM(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k) ;
(16)  PREM(i,k)         =  SUM(cty1$imi(i,k,cty1), TM2(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k) ;
(17)  INDTAX(k)         =  SUM(i, TX(i,k)*PD(i,k)*D(i,k)) ;
(18)  EXPTAX(k)         =  SUM((i,cty1), te(i,k)*PWE(i,k,cty1)*E(i,k,cty1)*EXR(k)) ;
(19)  YINST("labr",k)   =  SUM(la, YFCTR(la,k)) ;
(20)  YINST("ent",k)    =  YFCTR("capital",k) + EXR(k)*FKAP(k) - ENTSAV(k) - ENTAX(k) + ENTT(k) +
          SUM(i,(1-sprem(i,k))*PREM(i,k)) ;
(21)  YINST("prop",k)   =  YFCTR("land",k) ;
(22)  YH(hh,k)          =  SUM(ins, sintyh(hh,ins,k)*YINST(ins,k)) + rhsh(hh,k)*EXR(k)*REMIT(k) + HHT(k)*thsh(hh,k) ;
(23)  ENTAX(k)          =  ENTR(k)*(YFCTR("capital",k) + ENTT(k)) ;
(24)  FTAX(k)           =  SUM((iff,i), ft(k)*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));   (note: if sstr(k)>0 then ft(k)=0)
(25)  HTAX(k)           =  SUM(hh, hhtr(hh,k)*YH(hh,k)) ;
(26)  VATAX(k)          =  SUM(i, vatr(i,k)*PVA(i,k)*X(i,k)) ;
(27)  SSTAX(k)          =  SUM(iff, sstr(iff,k)*YFCTR(iff,k)) ;                (note: if ft(k)>0 then sstr(k)=0)
(28)  FPE(k)    =       SUM(i, pie(i,k)*X(i,k) )  ;
(29)  GOVREV(k)         =  SUM(cty1, TARIFF(k,cty1)) + INDTAX(k) + EXPTAX(k) + FTAX(k) + HTAX(k) + SSTAX(k) +
          SUM(i,sprem(i,k)*PREM(i,k)) + ENTAX(k) + VATAX(k) + FBOR(k)*EXR(k);
(30)  GOVSAV(k)         =  GOVREV(k) - SUM(i, GD(i,k)*PQ(i,k)) - HHT(k) - ENTT(k) - FPE(k) ;
(31)  HSAV(k)           =  SUM(hh, MPS(hh,k)* ((1.0-hhtr(hh,k))*YH(hh,k)));
(32)  ENTSAV(k)         =  esr(k)*YFCTR("capital",k) ;
(33)  ZTOT(k) =         GOVSAV(k) + HSAV(k) + ENTSAV(k) + EXR(k) * FSAVE(k);
(34)  FSAVE(k)          =  FBAL(k)-FKAP(k)-FBOR(k)-REMIT(k) ;
(35) CDD(i,k)  =        SUM(hh, CLES(i,hh,k)*YH(hh,k)*(1.0-hhtr(hh,k))*(1.0-mps(hh,k))) / PQ(i,k) ;
(36)  GD(i,k)           =  gles(i,k)*GDTOT(k) ;
(37)  ID(i,k)           =  zshr(i,k)*ZFIX(k) ;
(38)  ZTOT(k) =         SUM(i, PQ(i,k)*ID(i,k))  ;
(39)  GDPVA(k)          =  SUM(i, PQ(i,k)* (CDD(i,k)+GD(i,k)+ID(i,k)))  + SUM((i,cty1), PWE(i,k,cty1) * E(i,k,cty1))*EXR(k)  -
          SUM((i,cty1), PWM(i,k,cty1) * M(i,k,cty1))*EXR(k) ;
```

The circular flow of income from producers, through factor payments, to households, government, and investors, and finally back to demand for goods in product markets is shown in the equations in Table 6. The country models incorporate official tariff revenue (TARIFF in equation 15) which flows to the government, and the tariff equivalent of non-tariff barriers (PREM in equation 16) which accrues as rents to the private sector. Each economy is modelled as having a number of domestic market distortions, including sectorally differentiated indirect, consumption, and value-added taxes as well as factor, household, and corporate income taxes (equations 17-18 and 23-27). The single household category in each economy has a Cobb-Douglas expenditure functions (equation 35). Real investment and government consumption are set in equations 36 and 37.

Table 7. Export and Externality Equations

(40)	X(ie1,k)	=	AT(ie1,k)*(GAMMAK(ie1,k)*EK(ie1,k)**(-RHOT(ie1,k)) + (1 - GAMMAK(ie1,k))*D(ie1,k) **(-RHOT(ie1,k)))**(-1/RHOT(ie1,k)) ;
(41)	X(ien,k)	=	D(ien,k) ;
(42)	EK(ie1,k)	=	D(ie1,k)*(PDA(ie1,k)/PEK(ie1,k)*GAMMAK(ie1,k)/(1-GAMMAK(ie1,k))) **(1/(1+RHOT(ie1,k)));
(43)	E(iec,k,cty1)	=	EK(iec,k) * (((gamma(iec,k,cty1)*PEK(iec,k)) / (ae(iec,k)**rhoe(iec,k) * pe(iec,k,cty1))) **(1/(1+rhoe(iec,k)))) ; (note: at the moment iec=no -->top level turned off)
(44)	PE(iecn,k,cty1)	=	PEK(iecn,k) ;
(45)	EK(i,k,"row")	=	EK0(i,k,"row")* (PWE(i,k,"row")/PWE0(i,k,"row"))**(-etae(i,k)) ;
(46)	SUM(k, E(i,k,"row"))	=	SUM(l. E0(i,l,"row")) * (PWEFX(i)/PWEFX0(i))**(-etaw(i)) ;
(47)	PWE(i,k,"row")	=	PWERAT(i,k)*PWEFX(i) ;
(48)	M(i,cty1,cty2)	=	E(i,cty2,cty1) ;
(49)	SAD2(i,k)	=	(mkptl(k)/mkptl0(k))**etam2(k))*(1 - pvab0(i,k)) + pvab0(i,k) ;
(50)	SAD(ie1,k)	=	(EK(ie1,k)/EK0(ie1,k))**(etae2(ie1,k)) ;
(51)	SAC("capital",k)	=	(EKPTL(k)/EKPTL0(k))**etak2(k) ;
(52)	EKPTL(k)	=	SUM((cty1,i), PWE(i,k,cty1)*E(i,k,cty1)) ;
(53)	MKPTL(k)	=	SUM((cty1,ik), PWM0(ik,k,cty1)*M(ik,k,cty1)) ;

Export-related functions are shown in Table 7. Exports are supplied according to a CET function between domestic sales and total exports (equation 40), and allocation between export and domestic markets occurs in order to maximize revenue from total sales (equation 42). The rest of the world is modeled as a large supplier of imports to each model region at fixed world prices. Rest of world demand for regional exports can either be modelled as occurring at fixed world prices, or with two alternative mechanisms to capture possible terms of trade effects. First, each region can be characterized as facing its own downward-sloping demand curve based on its total exports (equation 45), where the price it faces is a function of the amount it exports relative to the base. Second, one can characterize the export price for each region as determined by aggregated changes in the export market, so that the average world price is set in equation 46, and each region's export price linked to that in equation 47 by requiring that PWERAT equal 1. The final equations in Table 7 specify how trade-related externalities are incorporated into the model. There are three different kinds of trade-productivity links. Equation 49 relates productivity in production to imports of intermediate and capital goods. The extent of productivity increase depends on the share of intermediates in production. The productivity parameter, SAD2, appears in the production function and profit maximization equations (1 and 2). Equation 50 quantifies the externality associated with export performance C higher export growth relative to the base value at the sectoral level (EK/EK0) translates into a larger value of the productivity parameter SAD, which also directly affects domestic productivity (equations 1 and 2). Equation 51 represents the externality associated with aggregate exports. Increased aggregate exports yields a higher value of SAC, which is "embodied" in the capital stock input into the production process.

Table 8. AIDS Demand Equations

(54)	PM(i,k,k)	=	PD(i,k) ;
(55)	LOG(PQ(i,k))	=	AQ(i,k) + SUM(cty2, AMQ(i,k,cty2)*LOG(PM(i,k,cty2))) + (1/2)*SUM((cty1,cty2), GAMMAQ(i,k,cty1,cty2)*LOG(PM(i,k,cty1)) * LOG(PM(i,k,cty2))) ;
(56)	SMQ(imi,k,cty1)	=	AMQ(imi,k,cty1) + BETAQ(imi,k,cty1)*LOG(Q(imi,k)) + SUM(cty2,GAMMAQ(imi,k,cty1,cty2)*LOG(PM(imi,k,cty2))) ;
(57)	SMQ(i,k,k)	=	1 - SUM(cty1, SMQ(i,k,cty1)) ;
(58)	M(i,k,cty1)	=	smq(i,k,cty1)*PQ(i,k)*Q(i,k) / PM(i,k,cty1) ;
(59)	PD(i,k) * D(i,k)	=	SMQ(i,k,k) * Q(i,k)*PQ(i,k) ;

The specification of the almost ideal demand system (or AIDS) for imports is shown in Table 8. The expenditure shares SMQ are given by equation 56, where subscript *imi* refers to sectors, subscript *k* refers to the importing country, and subscript *cty1* refers to the source of the imports (another region or the rest of the world). We adopt the notation convention that when *k* = *cty1*, we are describing the domestic component of composite demand (D). Hence in equation 54, the "own" price of imports is simply the domestic price, and in equation 59, D is determined by the $SMQ_{i,k,k}$ share, while the import demands are determined in equation 58. The composite price index, PQ, is defined in equation 55 as a translog price index [Deaton and Muellbauer (1980)].[12]

Table 9. Migration Equation

(60)	(AVWF(la,k)/EXR(k))	=	wgdfl(la,k,la,l)*(AVWF(la,l)/EXR(l)) ;
(61)	(AVWF("capital",k)/EXR(k))	=	wgdfk(la,k,la,l)*(AVWF("capital",l)/EXR(l)) ;
(62)	FS(la,k)	=	FS0(la,k) + MIGL(la,k) + MIGRU(la,k) ;
(63)	FS("capital",k)	=	FS0("capital",k) + MIGK(k) ;
(64)	SUM(k, MIGL(la,k))	=	0 ;
(65)	SUM(la, MIGRU(la,k))	=	0 ;
(66)	SUM(k, MIGK(k))	=	0 ;

Table 9 outlines the labor and capital migration relations in the model , equilibrium international migration levels are determined which maintain a specified ratio of real wages in the four labor categories in the countries, measured in a common currency. According to equation n 60, the international migration equilibrium requires that real average wages (AVWF) remain in a fixed ratio (WGDFL) for each migrating labor category in the two countries, measured in a common currency. Similarly, internal migration in each country maintains a specified ratio of average real wages between the rural and unskilled urban markets (the EXR terms become irrelevant). Domestic labor supply in each skill category in each country is then adjusted by the migrant labor flow (equation 61), while equations 64 and 65 insure that workers do not "disappear" or get "created" in the migration process. Equation 62 describes capital migration by imposing a fixed ratio (WGDFK) in the average wage for capital, while equation 66 states that capital is neither created nor destroyed in the migration process.

[12] Robinson, Soule, and Weyerbrock (1991) analyze the empirical properties of different import aggregation functions in a three-country model of the U.S., European Community, and rest of world that is broadly similar to our IDB CGE model. Green and Alston (1990) discuss the computation of various elasticities in the AIDS system when using the Stone or translog price indices.

Table 10. Market Clearing Equations

(67)	Q(i,k)	=	INT(i,k) + CDD(i,k) + GD(i,k) + ID(i,k) ;
(68)	FS(iff,k)	=	SUM(i, FDSC(i,iff,k)) / SAC(iff,k) ;
(69)	AVWF(iff,k)	=	SUM(i, (1-ft(k))*wfdist(i,iff,k)*wf(iff,k)*fdsc(i,iff,k))/SUM(j, fdsc(j,iff,k)) ;
(70)	FSAV(k,cty1)	=	SUM(i, PWM(i,k,cty1)*M(i,k,cty1)) - SUM(i, PWE(i,k,cty1)*E(i,k,cty1)) ;
(71)	FBAL(k)	=	SUM(cty1, FSAV(k,cty1)) ;

To complete the model, there are a number of additional "market-clearing" or equilibrium conditions that must be satisfied, as shown in Table 10. Equation 67 is the material balance equation for each sector, requiring that total composite supply (Q) equal the sum of composite demands. Equation 68 provides equilibrium in each factor market; the SAC parameter provides the means to incorporate the externality associated foreign capital goods imports. Equation 70 is the balance condition in the foreign exchange market, requiring that import expenditures equal the sum of export earnings and net foreign capital inflows; equation 71 is the overall trade balance equation, summing up the bilateral trade balances.

Model Closure

The IDB model permits a number of different "closure" choices that affect the macroeconomic relationships in the model. In the present closure, we have assumed that the aggregate trade balance (FBAL) is fixed for each country, and that the exchange rate (EXR) varies to achieve external balance. Real investment (ZFIX) and government real consumption (GDTOT) are both fixed at the base year level. To satisfy the government budget constraint in equation 30, we permit lump-sum government saving (GOVSAV) to be determined as a residual (government transfers to households and enterprises are both fixed). On the foreign market, borrowing by the government (FBOR), net foreign savings (FSAV), and foreign cpital flows to enterprises (FKAP) are all fixed.

Table 11: File Structure

Data Files	**Content**
OECD8.DAT	Data for OECD economies
ANIC8.DAT	Data for ANIC economies
LNIC8.DAT	Data for Latin America economies
LMID8.DAT	Data for Low and Median Income economies
LOW8R.DAT	Data for low income economies
CHN8R.DAT	Data for China and Hong Kong
TRAN8R.DAT	Data for Transition economies (Former Soviet Union, East Europe)
SSA8.DAT	Data for sub-Saharan Africa
EXTERNAL.DAT	Data on export and import externality elasticities
SIGMA5.DAT	Elasticities and other inputs for AIDS calibration
AIDSCAM4.DAT	AIDS calibration parameters (generated by AIDSPAR1.INC)
AIDSPAR1.INC	Program segment for calibrating and writing out AIDS parameters
SAMMAKE2.INC	Program to load data in country SAMS
LOADSOLV.INC	Program segment to load model results into matrices and print
LOADGDP6.INC	Program segment to calculate GDP matrices and print
LOADPERC.INC	Program segment to calculate percentage change results

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