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Colombia and East Asia
Trade relations and future prospects: an analysis using a CGE model*

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Abstract

This paper provides an empirical analysis of Colombian integration with East Asia using a Computable General Equilibrium (CGE) model, in which we assess the effects of several trade liberalization scenarios on trade flows and welfare. The results show that there is an important potential for the development of Colombian exports of other crops, chemical products, apparel and textiles to East Asian nations. This result is not derived from subscribing a Free Trade Agreement, but from unilaterally liberalizing tariffs in both regions.

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Key words: Computable General Equilibrium models, trade relations.

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I. Introduction

In the early nineties Colombia carried out a trade liberalization program within an economic openness program (*Apertura*), which resulted in considerable lower tariffs and the elimination of non-trade barriers. According to the World Trade Organization (*WTO*) the rates were lowered significantly from above 40% to a simple average of 11.5%, while non-tariff measures focused on few sectors subject to particular domestic or regional policy objectives and balance of payments measures were eliminated[1]. These actions accelerated Colombia's integration into the world economy. Total exports increased from US$6,700 million in 1990 to more than US$10,000 million in 1995. During the 1993-1995 period exports grew at an annual rate of 15% despite of the currency appreciation. On the other hand, trade liberalization increased total imports. In fact, in 1990 imports were US$5,600 million while in 1995 they reached a peak value of US$14,000 million. Between 1993 and 1995 imports grew at an annual average rate of 30%.

In relation with the East Asian region[2], trade flows with these countries improved during the nineties, although trade relationships still remain at low levels. Colombian exports to that region increased from US$300 million in 1990 to almost US$500 million in 1995. More important, imports from that region raised from US$680 million in 1990 to US$1,700 million in 1995, indicating that the openness process favored the trade balance of East Asia with Colombia. After 1995, exports and imports to/from that region declined in nominal values, explained by the 1997 Asian crisis that hit Colombia's exports. In addition, Colombia's economic slowdown during the last four years deteriorated import demand, which reflected a 30% decreased of East Asian imports in 1999.

Economic integration with East Asia is still a pending task. It is necessary to strengthen trade relationships with these nations given their technological leadership, their level of

[1] See, World Trade Organization (1996).

[2] East Asian countries include Australia, Brunei, Cambodia, China, the Philippines, Indonesia, Japan, South Korea, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam, countries that belong to the Forum for East Asia – Latin America Cooperation (FEALAC).

human capital, and their market size. The new international trade system that followed the creation of *WTO* has facilitated trade integration among regions[3].

Colombia has made some advances in the institutional front that search for a deeper economic relation with that region. In 1994, Colombia was accepted as a member of the Pacific Basin Economic Council (PBEC), of the Pacific Economic Cooperation Council (PECC), and recently of the Forum for East Asian and Latin American Cooperation (FEALAC). Since 1995 Colombia has been applying to the membership in the Asia-Pacific Economic Cooperation (APEC); to date the country has been partially accepted as a member of the Energetic and Telecommunication Cooperation Group and recently, in May 2000, Colombia was admitted as an observer of the APEC's Trade Promotion Working Group[4]. In addition, Colombia has sent high rank official missions, including presidents of the Nation, to East Asia to improve trade relationships[5].

East Asian countries have also made significant advances in liberalizing trade by promoting market access through the reduction of tariff and non-tariff barriers. As Kuwayama *et al* (2000) pointed out, since the mid-1980's tariffs have been reduced considerably as a result of unilateral liberalization, regional integration and commitments made during the Uruguay Round.

Few studies have addressed the issue of Colombia's integration with East Asia. This paper provides an empirical analysis using a Computable General Equilibrium (CGE) model, in which we assess the effects of several trade liberalization scenarios on trade flows and welfare.

This paper is organized as follows. Section 2 presents the evolution of trade relations between Colombia and East Asian countries during the nineties, and contrasts this

[3] See, Kuwayama *et al* (2000).

[4] For details see Ramírez D. A. (1999) and www.mincomex.gov.co

[5] Mayobre, E. and Noto, G. (1999) enumerate in detail the Colombian official missions to East Asia. For instance, President Barco went to Korea, the Philippines and China in 1987 and to Japan in 1989; President Gaviria visited Japan in 1994, President Samper went to China, Korea and Indonesia in 1996, and President Pastrana visited several East Asian countries during 1998-2002.

evolution with the behavior of other Latin American countries. Section 3 describes the recent Colombian trade policy towards East Asian countries. Section 4 presents the results of the empirical analysis and section 5 offers some concluding remarks.

II. Recent trade trends between Colombia and East Asia

Trade relations between Colombia and the East Asian countries have been insignificant, even after the openness processes that took place in Colombia and East Asia at the beginning of the nineties. The share of Colombian exports to East Asia within total Colombian exports was only 2.2% and the imports share was 12% in 2001. The trade balance has been favorable to the East Asian countries. Colombian imports from East Asia reached in that year more than US$1,500 million while exports to those countries were less than US$300 million. During the last ten years the share of Colombian exports to East Asia has diminished from 4.5% in 1990 to 2.2% of total exports in 2001. In absolute values, Colombian exports to these nations were very similar in both years (Graph 1). On the other hand, although the share of Colombian imports from East Asia in total imports remains almost the same in 1990 and 2001 (12%), in absolute values Colombian imports from that region duplicated (Graph 2).

The evolution of Colombian exports to East Asia has followed the same pattern of Colombian exports to the entire world, although the former present deeper fluctuations. For instance, during the period of high economic growth, 1993-1995, Colombian exports to East Asia increased almost 30%, on average, while Colombian exports to the entire world raised 14%. With the slowdown of the economic activity, exports to East Asia declined 25% in 1998 and 21% in 2000 while total exports dropped 6% in both years (Graph 1). The reduction of Colombian exports to East Asia is also explained by the Asian crisis that considerably affected all Latin American exports to that region, indicating that the income elasticity for Latin American exports to those countries is significantly high. In contrast to exports, imports from East Asia grew at a rate of 20% during 2000 and 2001, despite the economic recession and the high level of unemployment that Colombia has been experiencing since 1999. However, unlike exports, after the recession of 1999, in which

Colombian imports from East Asia fell more than 35%, imports from that region have augmented at an annual rate of around 20% in 2000 and 2001 (Graph 2).

Colombia's trade balance with East Asia depends greatly on Japan, given the relative weight that this economy has in Colombia's trade flows[6]. However, its relative importance declined in the last decade (Graph 3). For instance, in 1990, 87% of Colombian exports to East Asia went to Japan while in 2001, Japan received 61% of Colombian exports to that region. Such decrease has been offset by a steady growth in foreign sales to South Korea and China, which absorbed in 2001, 16% and 7.4% of Colombian exports to East Asia, respectively (Graph 4). Imports have been greater than exports diversification. In 1990, Japan provided nearly 85% of Colombian imports from East Asian countries. In 2001, this share decreased to 37%; again this decline was compensated by a significant increase in Chinas' share raising from 0.8% of Colombian imports in 1990 to 30% in 2001. South Korea has also gained participation, accounting in 2001 for more than 17% of Colombian imports from the East Asian nations (Graph 4).

It is worth highlighting the importance of China in Colombia's trade. In particular, Colombia has set up a strategic campaign to strengthen commercial relations with China by means of official missions, including the visit of high rank functionaries such as the president and vice-president of the Nation, ministers and congressmen, among others, to tighten the relations between both countries. The agenda has included the diversification of Colombian exports to China, the signing of scientific and technological collaboration agreements and foreign investment accords, among others[7]. Recently, in July 2002, the Minister of Foreign Trade opened a *Proexport* branch in Beijing, which is very important given the market size of US$1.100 billion that is still not being fully exploited[8] (Appendix 1). A Cooperation Agreement between China and Colombia to promote bilateral trade, investment and the cooperation in the developing of the Colombia's Especial Economic

[6] Japan is ranked among the ten top destinations of Colombia's exports.

[7] See, *Revista China Hoy*, 2000.

[8] For details see, Boletín de Prensa # 107, 08 July 2002, Ministerio de Comercio Exterior de Colombia, download from www.mincomex.gov.co

Export Zones (*Zonas Especiales Económicas de Exportación de Colombia, ZEEE*) was also signed[9].

The composition of Colombian exports to East Asia also changed during the last decade. Graph 5 shows that although coffee remains as the main product exported to that region other commodities have increased participation. For instance, the share of ferronickel increased from 3.3% in 1990 to more than 12% in 2001. Among non-traditional exports, the industrial sector presented the largest gain, increasing its share from 18% in 1990 to 26% in 2001. Food and beverage, coffee essence, leather, chemical goods and basic metals are the main industrial exports. Similarly, emeralds have gained importance in accounting for more than 8% of total exports. On the other hand, Colombian imports from East Asia are less diversified. Graph 6 shows that imports are concentrated mainly on basic metals, machinery and equipment, which accounted for 47% in 2001.

The above figures show the trade structure that prevails in both regions; East Asia has comparative advantage in manufactured goods that involve a higher technical component while Colombia has advantage in food items and manufactured goods with a lesser technical component. These comparative advantages show the potential that both regions have for strengthening their trade relations in the future. However, Colombia still has a small share within Latin America's trade flows to East Asia.

Table 1 shows that trade flows from Colombia to East Asia are smaller than the Latin American average, especially in the case of exports. In the year 2000, the share of Colombian exports was only 2% and Colombia only received 4% of Latin American imports from that region. The major partners of East Asia are concentrated in few countries: Brazil, Chile, Mexico and Argentina. For instance, in that year, East Asia received almost 60% of Latin American exports from Brazil (33%) and Chile (26%) whereas Mexico and Brazil absorbed 70% of Latin American imports from those nations (Graphs 7 and 8).

[9] The *ZEEE* comprises the municipalities of Buenaventura, Cúcuta, Ipiales and Valledupar.

Similarly, Colombia is one of the countries in Latin America with a small share of exports to East Asia over its total exports. Colombia has even decreased this share from 5.7% in 1995 to 2.7% in 2000, and is well below the Latin American average share, 9.2% in 1995 and 7.6% in 2000 (Graph 9). In the case of imports, the share of Colombia was 11.5% in 2000, slightly greater than the Latin American average of 11% (Graph 10). Paraguay is the most dependent economy from East Asian imports while Bolivia and Venezuela are the least dependent.

Japan is the major trading partner for Latin America within East Asia. In 2000, Japan received more than 43% of all Latin American exports, followed by China (21%) and South Korea (13%) (Graph 11). However, Latin American imports from East Asia have diversified recently. In 1995, Japan provided almost 50% of all Latin American imports while in 2000 this percentage reduced to 36%. Countries like China and South Korea have increased their supply of commodities within the Latin American market. In fact, those countries provided more than 40% of East Asian imports to Latin America (Graph 12). Other countries such as Indonesia, Malaysia, the Philippines and Thailand have been very dynamic despite their lower share (Graph 13).

The trade balance has always favored East Asia. In 2000, Latin America's trade deficit was almost US$20,000 million; more important this deficit quadruplicated in the period 1995-2000. East Asian exports (imports) to (from) Latin America are very small and have decreased recently. In fact, they account for only 3% of its total exports whereas East Asian imports from Latin America were about 1.5% of its total imports (Graphs 14 and 15).

Latin American exports to East Asia were greatly affected by the 1997 crisis. They fell at an annual rate of 9% between 1995 and 1998. In addition, during this period, the annual rate of growth of Latin American exports to all the East Asian countries was negative (Graph 13). On the other hand, Latin American imports from East Asia increased more than 10% annually in spite of the decline of the Latin American economic activity (Table 2).

In a recent paper, Kuwayama *et al* (2000) analyze the composition of the main products imported by East Asia from Latin America. Interestingly, although imports from Latin America only represent 1.5% of East Asia's total imports, there are some products whose share is very important. According to the authors, Chile provides almost 50% of total Asian and Pacific imports of unwrought copper alloys, Peru and Chile offer near 70% of the meat or fish meal fodder imported by Asia, and Brazil and Argentina supply 50% of oilcake and other residues.

In the next section we describe the recent Colombian trade policy towards East Asian countries.

III. Colombian Trade policy towards East Asian nations

Colombian trade policy in the past decade can be characterized by an increasing degree of openness towards the rest of the world. However, specific trade policy towards East Asian nations had a protectionist bias due to the dynamism that some flows of trade had during the first years of the *Apertura*.

Colombia used mainly the figure of safeguards as barriers to these very dynamic imports coming from some East Asian countries, in particular, China and Korea. These safeguard measures were introduced in the Colombian trade legislation in 1994. This legislation allowed Colombian authorities to impose specific duties or tariffs (or safeguards) on imports of products that caused damage to domestic producers directly competing with these goods (Table 3).

The figure of general safeguard can be applied to any trading partner, with the specific compromise of giving the opportunity to this country to present evidence contradicting the damage the domestic producer claims. In case the partner is not a member of the *WTO*, the country does not have the right to contradict the national producer's evidence and the duty is imposed unilaterally. It has some similarities with antidumping duties; the main feature being that it is a specific tariff on a certain good coming from a country and it is not applied

generally to all imports of these goods, irrespective of its origin. Its main difference is that antidumping duties are imposed by calculating the difference between the normal cost of production of a good and the cost of the country that incurs in this practice. In the case of the safeguard measure, the duty is calculated as the difference between the price of the good coming from a specific country and the average price of the rest of the world. As with the antidumping legislation, it requires a full investigation conducted by the trade authorities and notification to all parties involved. These safeguard measures have not been objected by any Colombian trading partner in the *WTO*.

The first safeguard measure imposed on an East Asian country dates from February 1995. An investigation by petition of domestic textile, apparel and footwear producers was conducted by the INCOMEX (Colombian Institute of Trade). It was recommended a specific duty of 40% on 244 items and of 100% on 8 items coming from China. The investigation revealed that between 1991 and 1994 imports of textiles from China increased their participation in total imports from 0.24% to 1.64%, imports of apparel increased from 0.93% to 9.15% and imports of footwear from 1.87 to 23.21%, showing outstanding dynamism.

In March 18 of 1996 a new safeguard measure was imposed on footwear imports coming from China, North Korea, Taiwan and Vietnam. Domestic producers presented the petition as a result of a huge increase in imports of these goods. The investigation showed that prices of the product coming from China and Taiwan were 93% below the domestically produced ones. Specific duties ranging from 70 to 130% were imposed on these flows.

In February 1997 trade authorities again studied the petition, this time supported by the most important textile companies, of establishing a permanent safeguard measure on textile imports coming from some East Asian countries. This time, apart from China and Taiwan that were included in the first investigation, new countries were included, like India, Indonesia and Panama. The reason why Panama was included is because many goods coming from East Asia are re-exported from this nation. Trade authorities not only approved the imposition of a permanent duty for more than 200 items, but also decided to

change the import regime of some textiles from China and Taiwan and imposed non-tariff barriers (*licencia previa*). Among the textile products upon which duties were levied were denims, cotton and polyester based fabrics. In October 1998 safeguard duties on polyester textiles were extended to Korea, Thailand and USA. Finally a safeguard measure was imposed in August 2001 to imports of metal chains (used in machines) coming from China.

From all safeguard measures imposed by Colombia since the *Apertura*, 90% have been applied to East Asian countries reflecting the clear protectionist bias of trade policy towards these nations. This has had an effect on the evolution of trade flows between Colombia and that region impeding the development of a more fluid trade relationship. It is clear that the great protectionism that Colombian authorities have exhibited has been drawn by particular interests of domestic producers, which fear great competition from manufactured products from this part of the world at very low prices. However, in none of these occasions the interests of consumers have been taken into account. Consumers could benefit greatly from more openness towards East-Asian nations as consumers in the rest of the world have. In this sense, it is clear that authorities and the society as a whole have not evaluated the whole range of benefits that more trade liberalization between Colombia and this area of the world could potentially have not only for consumers but for the generation of new opportunities of investment and exports.

The opportunities of trade creation for Colombia are considerable as long as many of these East-Asian countries are the most efficient producers of a wide range of goods. The country also needs desperately new markets for its exports, reducing extreme dependence on the US market, and the development of new flows of foreign direct investment and external financing that can support more growth. The way in which trade policy with these nations has been conducted, that certainly can be characterized as protectionist, has closed opportunities and has prevented a more efficient insertion in international trade with the most dynamic region of the world.

The best way to conduct an orderly opening of trade flows between Colombia and this diverse group of countries is negotiating a free trade agreement (FTA). This sort of array

has the advantage that offers a stable framework in which the countries involved are certain on what to expect from their trade relationship. But even if at the end of the negotiating process the interests of some industries considered strategic prevail and Colombia chooses not to open its market for some of these goods, it is still better to define a certain group of rules under which trade within these nations can develop.

Recent literature has concentrated on the analysis of economic integration between Latin America and East Asia[10]. However, few studies have addressed empirically this issue for the Colombian case. In the next section we present a CGE model which simulates the potential benefits of having a greater integration through trade.

IV. Empirical Analysis

1. Model description

In this section a CGE model is used to analyze trade liberalization between Colombia and East Asia[11]. The model is static and consists of seven regions, each one with a demand and production structures. The regions are linked through trade. Each region has twelve industries, each of which produces a single output. There are two factors of production (namely labor and capital) which are used as primary inputs. There is a representative consumer in each region and, for simplicity, intermediate production is not considered.

Commodities are considered to be qualitatively different from similar commodities produced abroad. This is the Armington assumption (Armington, 1969), widely used in international trade applied general equilibrium analysis, to account for the presence of cross hauling in international trade data. The use of this assumption also rules out complete specialization.

[10] For instance see Bender and Li (2002), Kuwayama *et al* (2000), Kuwayama *et al* (1998), Kuwayama (1997) and Sprout (1995).

[11] The model follows closely Iregui A. M (2001).

Production in the model exhibits constant returns to scale and firms are perfectly competitive, so that prices equal marginal costs of output. In each region and each industry labor (L) and capital (K) are combined to produce value added according to a constant elasticity of substitution (CES) production function. Each industry in each region produces a commodity that can be transformed either into a commodity sold on the domestic market, or into an export using a constant elasticity of transformation (CET) function. In a second stage, exports are allocated across regions according to a CET function. The production structure in each industry is summarized in Figure 1 and the formal equations and notation used in the model are presented in Appendix 2.

Factors are non-produced commodities in fixed supply in each region. It is assumed that both factors are mobile across industries within the region, but are internationally immobile.

Turning to the demand side of the model, consumers within a region are assumed to have identical homothetic preferences. This assumption allows us to consider a representative consumer, endowed with all the labor and capital in the region. At the top level, consumers decide how much to spend on goods from each sector given the regional budget constraint. Consumers demand a composite of similar imported and domestically produced goods. At the second level, the consumer determines domestic and aggregate import expenditure in each sector according to a CES function. At the third level, purchases of imports from each region are selected in each sector, according to a CES function. The nesting structure used for each sector in each region in the CES final demand function is summarized in Figure 2, and the complete set of equations and notation that defines the demand side of the model is presented in Appendix 2.

The budget constraint in each region is given by income equal expenditure, where income is derived from factor ownership, government transfers and the region's trade surplus (or deficit). On the other hand, the region's expenditure includes the amount spent on goods.

The model also incorporates factor taxes and import tariffs that may have regional effects. Factor taxes affect the cost structure of domestic output. Since part of this output is exported, these domestic taxes can affect the region's competitivity. Factor taxes are modeled as ad valorem taxes on the use of both labor and capital, and so will affect the price paid by producers. Import tariffs are modeled as ad valorem taxes on imports, with rates varying across commodities. Import tariffs are used to alter the terms of trade of a country with respect to its trading partners. Finally, all tax revenues raised are assumed to be transferred back to consumers.

Once the model has been specified, it can be solved for an equilibrium solution. A general equilibrium in the model can be interpreted in the usual Walrasian sense as a set of goods and factor prices for which all markets clear. That is demand-supply equalities hold in each goods and factors markets; zero profit conditions hold for each industry in each region; and each region is in external-sector balance. Appendix 2 formally presents the full set of equilibrium conditions of the model.

2. Benchmark data set

The model consists of seven regions, each of which engages in both domestic and foreign trade activities. No internal trade among the countries of any region is included. These regions are Colombia (COL), China, Japan (JAP), Korea, other countries from East Asia (OTHEREA), Rest of America (RA) and Rest of the World (ROW). Table 4 presents the grouping of individual countries.

In the model, each region is assumed to have twelve production sectors, each of which produces a single output. The sectors are: agriculture, forestry, fishing and hunting (ACSP); apparel, beverages and tobacco (Bevtab), chemical products (chemicals), leather, manufactures, metals, mining, other crops, processed products (Procprod), textiles and services. Table 5 presents the grouping of individual sectors.

The benchmark data set involves data on value added by component by industry, factor taxes, foreign trade and import tariffs. Given that the model considers a representative

consumer in each region, the final demand for domestic products is equal to gross output minus exports, whereas the final demand for imported products equals imports.

The size of the seven regions is given by their respective GDP, in 1997 US million dollars, as taken from the Global Trade Analysis Project (GTAP). The benchmark data set satisfies the equilibrium conditions of the model in the presence of the existing policies[12].

Tax rates are calculated by dividing tax revenues (as taken from the benchmark data set) by the model tax base, obtaining an average effective tax rate. For simplicity, in applied general equilibrium models it is assumed that marginal tax rates equal the observed average tax rates.

Because of the CES/CET functional forms used in the model, some values for the elasticities of substitution and the elasticities of transformation need to be specified. The elasticities used here are based on Dimaraman et al (2000) and Iregui (2001). Next, we calculate the parameters of the model that are consistent with the benchmark data set, following the procedure described in Mansur and Whalley (1984). These parameters allow us to reproduce the data set as an equilibrium solution of the model. Then, we compare counterfactual equilibria with the benchmark equilibrium generated by the data. The model was solved using a routine we wrote in GAMS.

3. Model Results

A set of simulations is performed to investigate the effects that trade liberalization, between Colombia and East Asia, have on welfare and trade flows. Counterfactual experiments are carried out in which existing import tariffs are eliminated. After each change is introduced, a new equilibrium is calculated and the results are compared with the benchmark equilibrium. The welfare effects of the policy changes are measured by the Hicksian Equivalent Variation (EV) for each region, where a positive EV refers to a welfare improving change and vice versa. The EV is the minimum amount that someone who gains

[12] The data set is not included in the paper, but is available from the authors upon request.

from a particular change would be willing to accept to forego the change. In the case of an individual who loses from the change, the EV is the maximum he would be willing to pay to prevent that change. The measure of EV can be written as:

$$EV = E\left(U^N, P^0\right) - E\left(U^0, P^0\right) \tag{1}$$

As can be seen, the EV compares the utility levels achieved before and after the change (U^0 and U^N, respectively) at the initial equilibrium prices (P^0). Following Shoven and Whalley (1992, p.125), when preferences are linear homogeneous the EV can be written as:

$$EV = \left(\frac{U^N - U^0}{U^0}\right) I^0 \tag{2}$$

where I^0 denotes the initial disposable income.

A positive EV could be the result of the removal of domestic distortions that affect producer and/or consumer decisions. Distortions to producer decisions are caused by the effects of taxes on producer prices whereas distortions to consumer decisions are caused by the effect that differential factor taxation can have on output prices.

The main effect of an import tariff is to increase the cost of shipping goods to a country. According to the theory, the tariff drives a wedge between the prices in the importing (raises the price) and exporting countries (lowers the price). As a result, consumers lose in the importing country, producers gain in the importing country and the government imposing the tariff gains the tax revenues. In addition, as the tariff distorts the incentives to both consumers and producers, there is an efficiency loss. There is also a terms of trade gain since the tariff lowers foreign export prices; however, the gain depends on the ability of the tariff-imposing country to drive down foreign export prices (Krugman and Obstfeld, 1994). In the case of a small country, like Colombia, the imposition of a tariff has very little effect on world prices, since its share of the world market is usually minor. All this can be illustrated in Figure 3.

In this figure, the tariff raises the domestic price from PW to PT. The area a+b+c+d shows the consumer loss. Other groups of this society gain when comparing the initial and final situations. Producers gain the area "a" due to higher prices and the Government also gains the area "c+e" as a result of collecting tariff revenue. On the other hand, "b" and "d" represent efficiency losses from increasing tariffs for the society as a whole. If we consider the case in which this country is big and can affect world prices, a higher tariff could lead to terms of trade improvement, represented by area "e".

The experiments carried out can be divided into two groups. The first one involves the elimination of import tariffs on exports from certain regions whereas the second group involves the unilateral elimination of imports tariffs. In the first group we considered three scenarios: (i) elimination of import tariffs applied to Colombia by Japan, Korea, China and Other Asian nations, (ii) elimination of import tariffs applied to East Asia by Colombia and (iii) reciprocal elimination of import tariffs. The second group of experiments also comprises three scenarios: (i) unilateral elimination of tariffs by East Asian nations; (ii) unilateral elimination of import tariffs by Colombia; and (iii) elimination of tariffs by East Asia and Colombia.

The goods taken into account are: apparel, beverages and tobacco, chemical products, mining, other crops and textiles and correspond to the main traded items between Colombia and East Asia (see section 2). In both groups of experiments, the first and second scenarios were carried out for each good individually while the third scenario is almost equivalent to a free trade agreement (FTA) between these regions.

Table 6 presents the welfare effects (EV) for the first group of counterfactual experiments. It is important to mention that the results of the EV in all three scenarios are small, since trade between Colombia and East Asia is almost non existent.

In the first scenario, Colombia's welfare decreases in all cases but other crops varying from -0.0005% of GDP (apparel, beverages and tobacco, chemicals, mining and textiles) to 0.015% of GDP in the case of other crops. These losses show that a reduction in tariffs in

East Asia will not represent gains to Colombia except in the case of other crops, and reveals the low competitiveness that our country has with respect to those nations.

In the same manner, the second scenario in which Colombia lowers its tariffs to East Asian products does not represent any significant gains to them, and implies some welfare losses to Colombia. The last scenario, in which a FTA is represented, implies small gains to East Asian nations but not to Colombia. This reveals that an arrangement of this type is not very attractive to Colombia, although it may represent some benefits to East Asian nations. The main reason for this result is that at the current situation, Colombian exports are not very competitive in these markets.

The benefits of trade liberalization or a FTA should not be looked only in terms of its effect on welfare. The development of exports is also a very important criterion. The inter-temporal process in which new exports are generated as a consequence of lower import prices cannot be predicted by a static model like the one used in this analysis. However, at least part of the effect of the increase in exports is shown as we concentrate on the percentage increase (decrease) in the volume of exports and imports generated by the FTAs considered in this analysis.

Table 7 shows how Colombian exports of apparel, beverage and tobacco, chemical products, mining, other crops and textiles are affected when East Asian countries eliminated imports tariffs on these products. As a result, Colombia could expect to increase its exports of agricultural products, included in Other Crops, mainly to Korea and Japan.

On the other hand, if Colombia eliminated its tariffs on Chinese, Japanese, Korean and OTHEREA exports apparel, chemical products, manufactures, metals, mining and textiles, imports of textiles, apparel, chemical products and manufactures are expected to expand. The most dynamic imports being apparel and manufactures from Korea and textiles from OTHEREA (Table 8).

If we look at the effect on total exports by sectors of the elimination of import tariffs by East Asian nations or by Colombia (first two scenarios in Table 9), we can observe that the aggregate effects are very small as a result of the insignificant trade between these two regions. Next, two possibilities of FTA were considered. The first one involved apparel, leather and textiles. In this case, the benefits of the agreement are tiny; for instance, Colombian exports of apparel increase 0.01% whereas Korean exports raise 0.05%. The second one comprised chemical products, manufactures, metals and mining. The results show that Colombia could expect some expansion of its exports of these products, but the East Asian nations would not expand their exports significantly. Their gains, as it was shown in Table 8, will be in textiles and apparel, but they will not represent much of their actual exports.

Although the opening of these markets may be attractive to Colombia, the resulting very small increase in its exports leads us to the conclusion that a FTA with these nations is not a priority for Colombian trade policy.

In which way can trade between the two regions be enhanced? How can Colombia look for a more close trade relationship with one of the most dynamic regions of the world? To answer these questions the second group of experiments was performed.

As it is shown in Table 10, a unilateral liberalization of tariffs in East Asian countries will increase Colombian welfare by more than it would if the liberalization covered only Colombia. In the new situation these countries will also benefit more from eliminating the barriers between themselves. For the regions eliminating the tariffs, the OTHEREA's welfare deteriorates in all cases but mining (from 0.03% of GDP in the case of apparel to 0.13% of GDP in the case of chemical products). As expected, a unilateral liberalization of trade among these nations represents more benefits for their interregional trade than to Colombia.

The unilateral liberalization of tariffs in Colombia will represent welfare losses to the country that are greater than if the liberalization covered only East Asian products. If

Colombia eliminates import tariffs on apparel, chemical products, manufacturing, metals and textiles there will be some important welfare losses. The losses vary between 0.02% of GDP in textiles and 0.66% of GDP in manufactures. However, in the case of mining, Colombia obtains welfare gains of 0.09% of GDP as a result of increasing imports at lower prices. For the other regions, the effects on welfare are negligible since Colombia's share in world trade of these products is very small and cannot affect world prices. This result indicates that Colombia gains little from unilaterally liberalizing trade with these nations.

If all these countries decided to reduce their tariffs, Colombia will still lose, and this loss will be greater than the expected under a FTA. When Colombia, China, Japan, Korea and OTHEREA eliminate imports tariffs on apparel, leather and textiles all regions but Japan and Korea suffer welfare losses, since the tariffs on these products constitute an important source of revenue for the governments of these countries, hence contributing to the reduction in consumption.

From the point of view of the society as a whole, according to these results, there is only one reason why a FTA between the two regions could be desirable: if unilateral liberalization is going to occur anyhow and it is going to represent welfare losses to the countries involved, specially to Colombia, but, on the other hand it will allow exports to expand, a gradual way of achieving the final result is through this type of arrangement.

In Table 11 it is shown how Colombian exports of the different goods are expected to perform if tariffs are unilaterally eliminated in East Asian nations. In the case of apparel, East Asian countries increase trade among them; and this implies a reduction of Colombian exports of these goods to the region. This substitution of Colombia as provider of these goods is pure "trade creation", since these Asian nations are substituting a less efficient producer for a more efficient one in the provision of these goods.

On the contrary, for chemical products and other crops we find that Colombia increases its exports of these products but substitutes its destination markets towards Japan and OTHEREA. Under the new conditions, the relative prices of Colombian exports of these

goods are lower in Japan and OTHEREA than in the previous destinations. This happens because tariff reductions are greater in Japan and OTHEREA than in the other countries due to more initial protection of these goods.

Finally, in the case of textiles, Colombia increases its sales to OTHEREA while maintaining its share with the remaining countries in East Asia. Again, when tariffs are eliminated, the existence of higher initial tariffs in OTHEREA than in other destinations explain the results obtained.

Table 12 shows how the unilateral elimination of import tariffs on manufactures, chemical products, metals, textiles and apparel affects Colombian imports of these goods. As expected, there is an increase in imports because now some of these goods can be purchased at lower prices. However, in the case of metals and textiles we find a substitution of one market for another. For example, Colombia reduces its purchases of metals from China, Korea and other East Asian countries and increases its imports from Japan. Under the new conditions, relative prices of Japanese metals are lower than Colombian prices of these goods, as a result of greater initial tariffs applied to Japan.

In the case of textiles, Colombia reduces its imports from Japan and instead increases its purchases from China, Korea and OTHEREA. This is directly related to the referred protectionist bias in some products that Colombian trade policy has had towards China, Korea and other East Asian nations. Because tariffs applied to these countries are higher than the applied to Japan, when eliminated, imports increase by more.

Table 13 presents the percentage change in total exports by sectors for all the countries considered once import tariffs have been unilaterally eliminated. In the first scenario, trade among East Asian nations is strengthened as barriers come down. This reflects the importance of the barriers that prevail today within these nations. In the case of Colombia, exports increase in all sectors but apparel and beverage and tobacco. The reason why this might be the case is that under the new conditions, these countries become even more competitive with regard to Colombia in these two types of goods.

In the second scenario, in which Colombia unilaterally eliminates import tariffs to all countries, exports of apparel and textiles reduce since the domestic production is now replaced by inexpensive imports coming from East Asia. However, the effect on manufactures is positive because the whole sector has access to cheaper inputs, increasing its competitiveness. However, for the other countries, the effects on exports are very small with the exception of apparel in Korea, whose exports increase 1.1%. This reflects the fact that these nations are already competitive even with the existence of tariffs in the Colombian market.

Finally, when Colombia, China, Japan, Korea and OTHEREA eliminate import tariffs on apparel, leather and textiles simultaneously, Colombian exports of apparel and textiles increase whereas those of leather reduce. For the countries in East Asia the trade among them increases. Again, this result reflects the importance of prevailing barriers to trade within East Asian nations. On the other hand, when tariffs are reduced in all these nations, Colombia will gain competitiveness in apparel and lose in its leather exports.

V. Concluding Remarks

It is desirable to strengthen trade relations between Colombia and the East Asian countries, which have shown poor performance during the past decade. For Colombia, the development of new markets for exports is necessary to achieve more growth and reduce excessive dependence on US and Latin American markets. On the other hand, East Asia is one of the most dynamic regions of the world and offers good opportunities for these exports.

The results obtained from this analysis show that there will be small welfare losses to Colombia from a FTA with East Asia and that gains from opening export markets will not be big. However, Colombia could continue developing a more fluid trade relationship with these countries.

With the limitations of the instrument used in this analysis, one encouraging result is that it shows that there is an important potential for the development of Colombian exports of other crops, chemical products, apparel and textiles to East Asian nations. This result is not derived from subscribing a FTA, but from unilaterally liberalizing tariffs in both regions. This is a process that is already underway because many East Asian nations are liberalizing their trade through regional agreements. China recently joined the *WTO*, and Colombia and other countries in America will soon take an important step in this direction with the application of the Free Trade Agreement of the Americas.

The implementation of a FTA with East Asian nations may not seem to be a priority of Colombian trade policy; however it should not be discarded in the future. Taking into account possible sensitive sectors, the signature of such an agreement could lead to a more fluid and mutually beneficial trade relationship.

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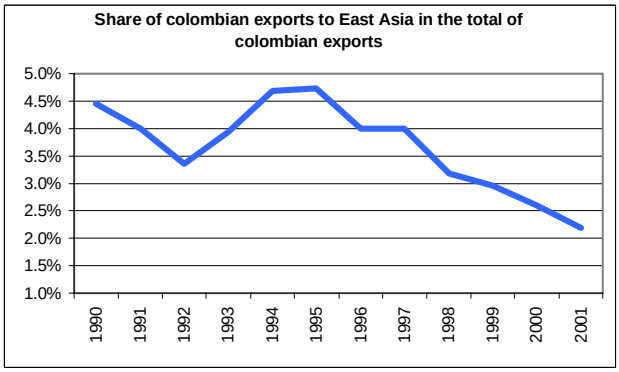
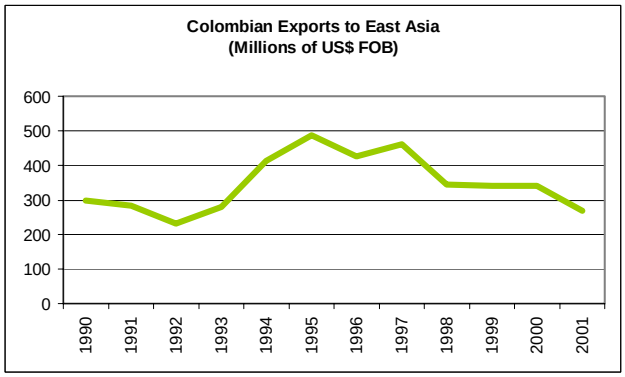
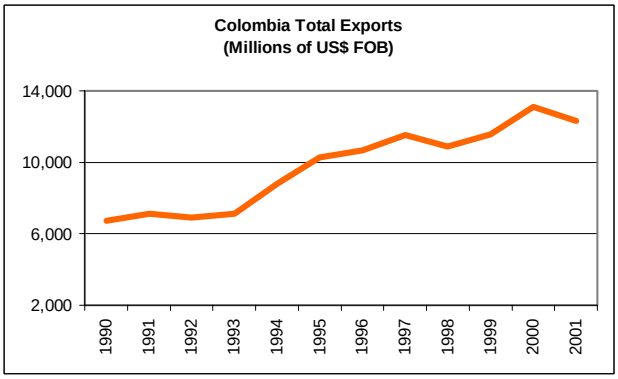
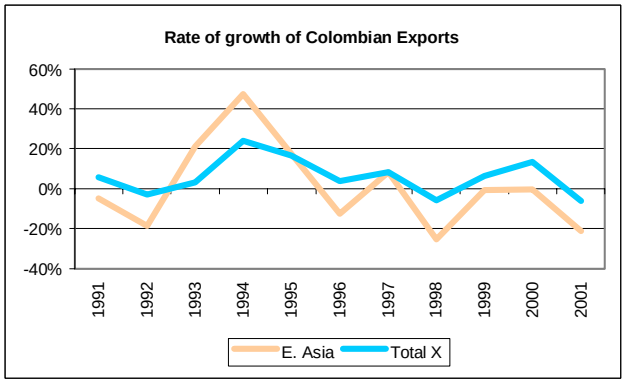
Graph 1









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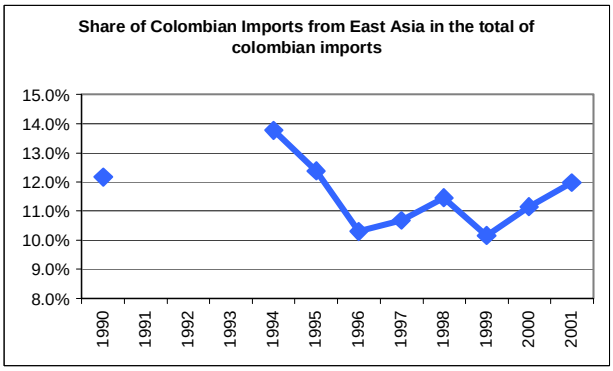

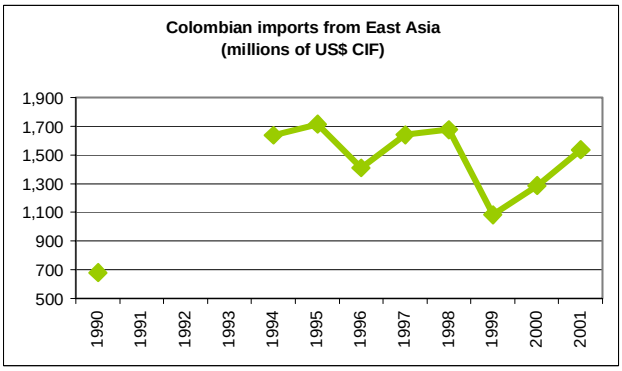

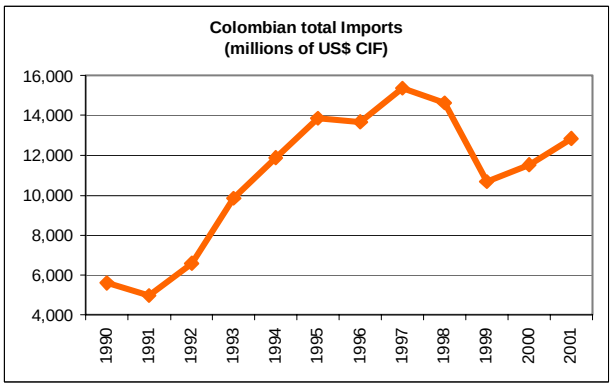

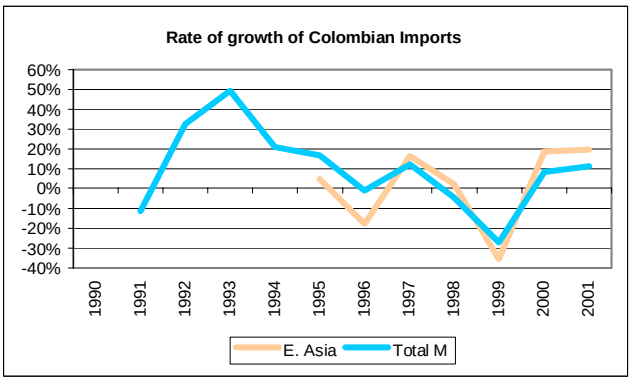

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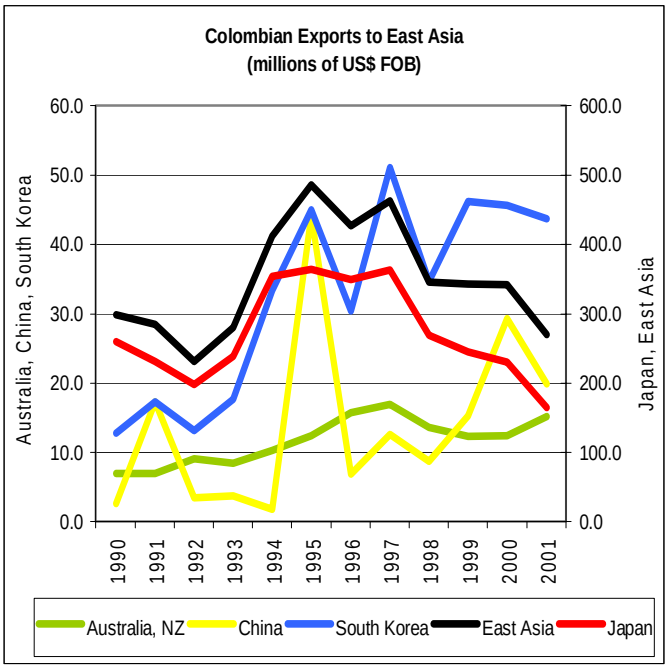

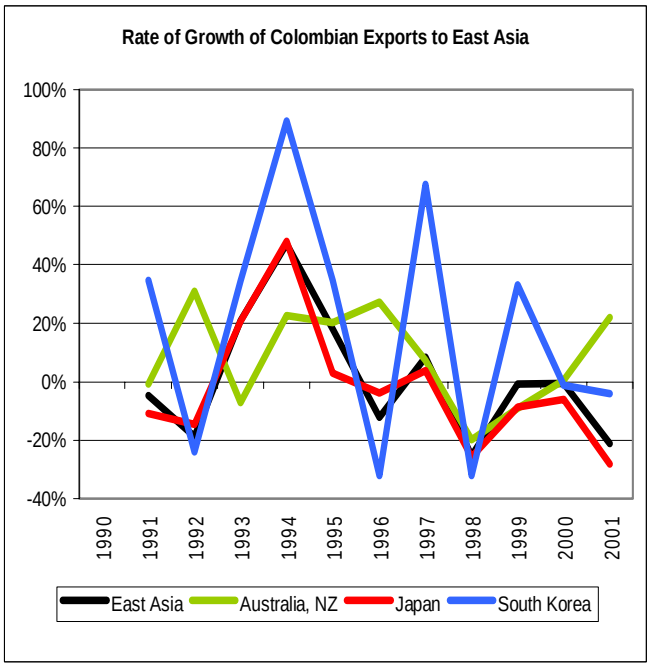

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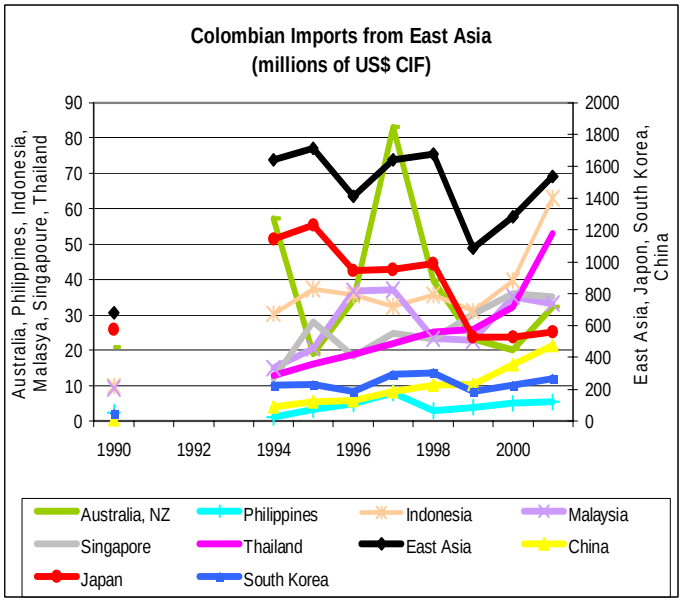

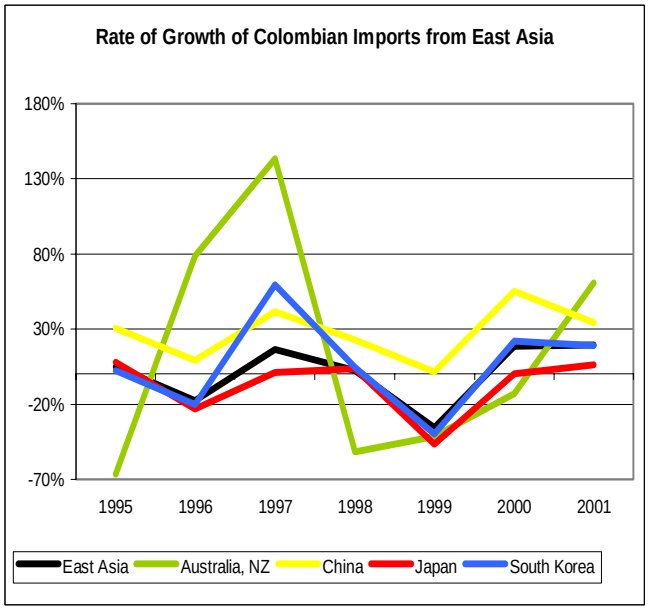

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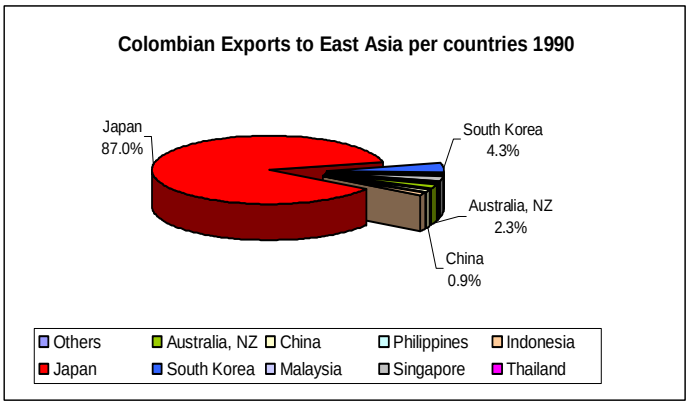

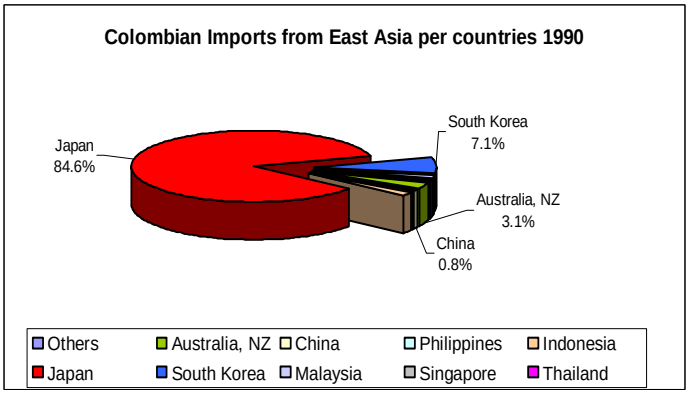

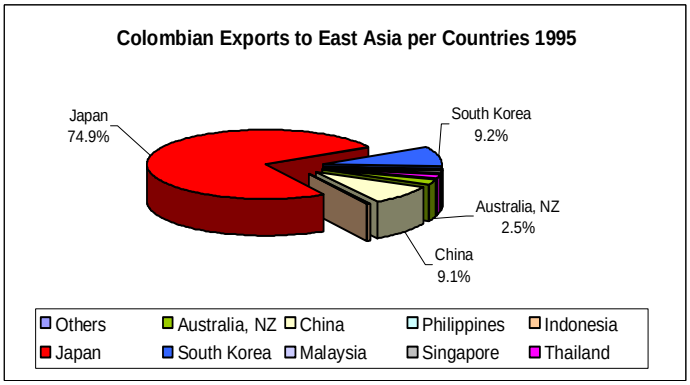

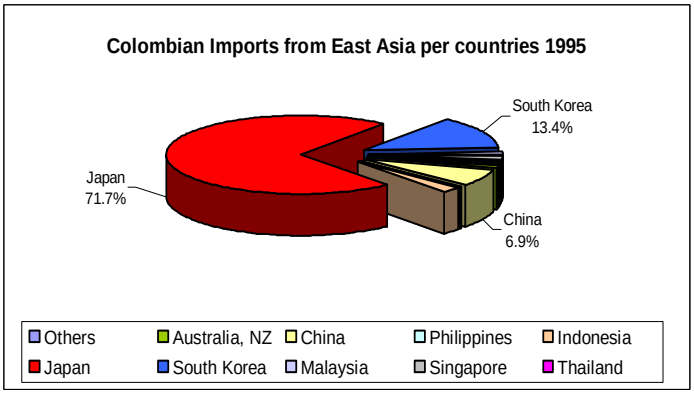

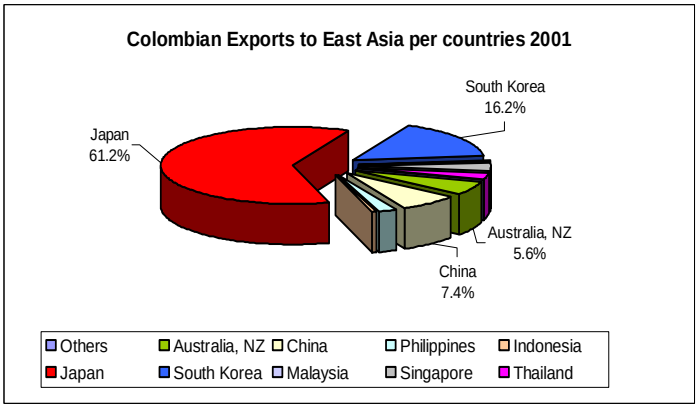

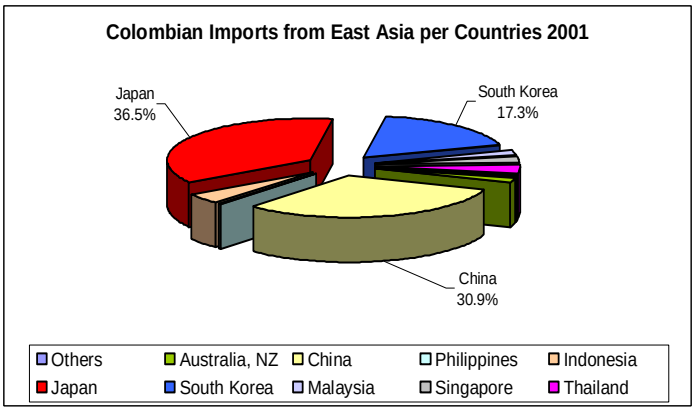

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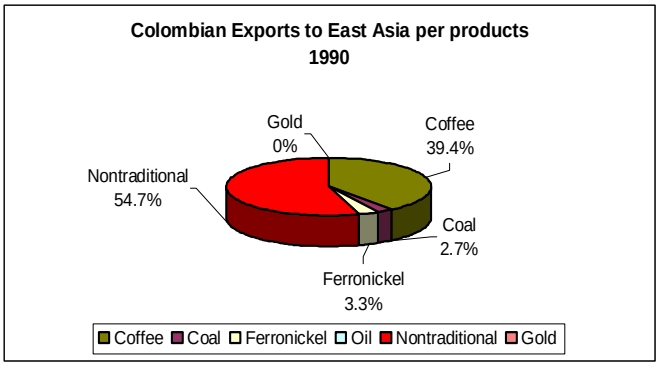

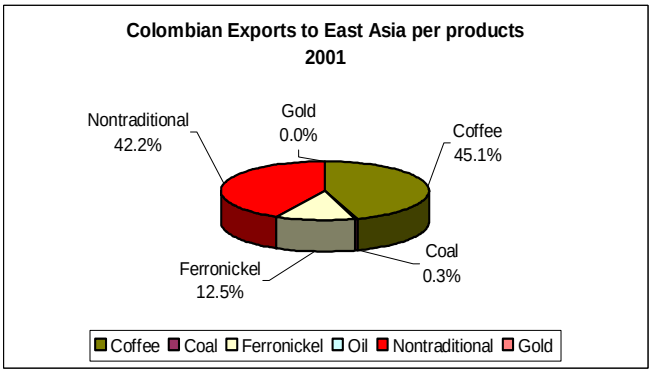

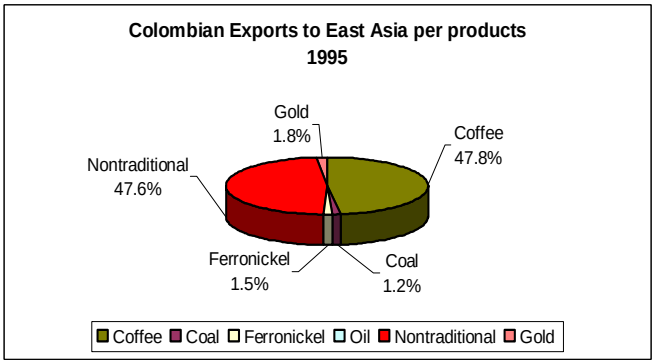

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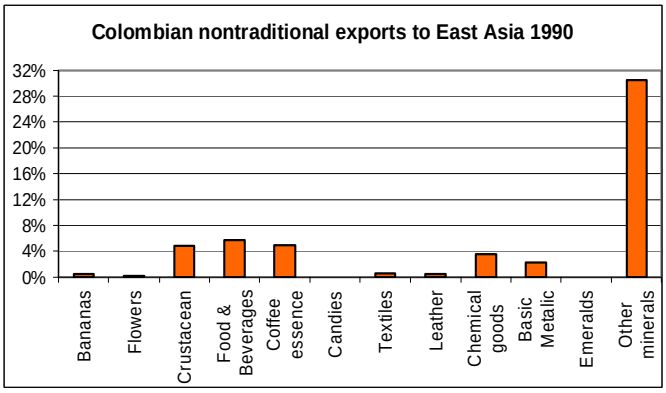

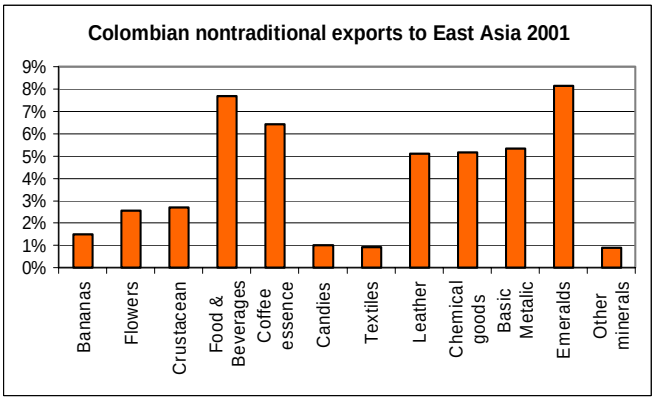

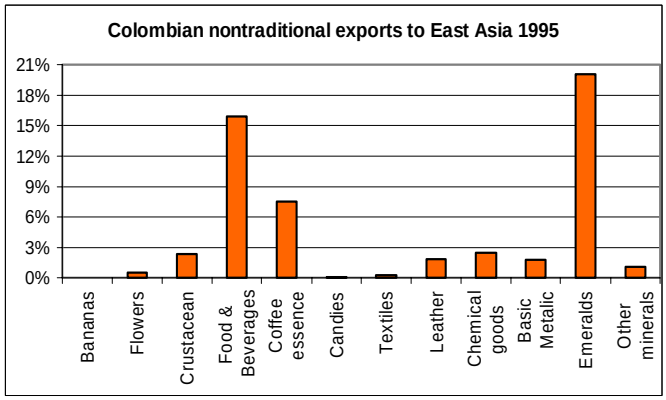

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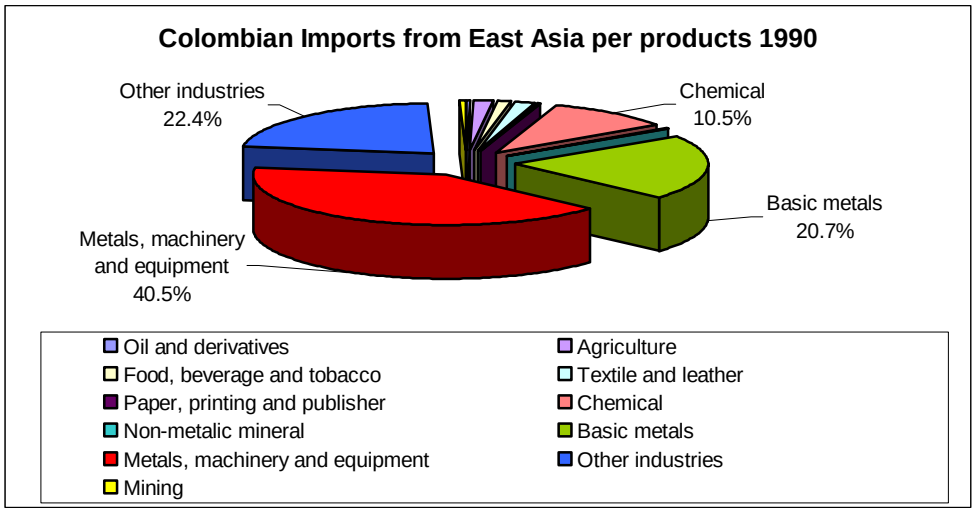

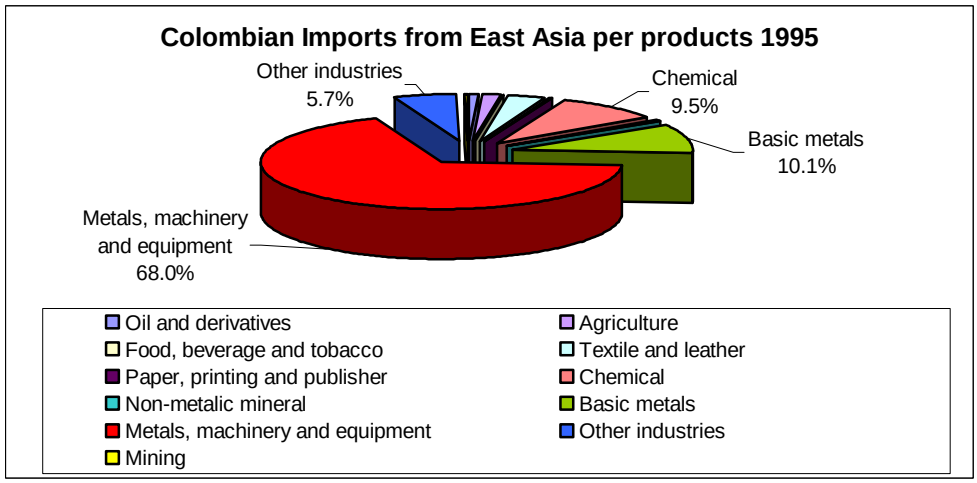

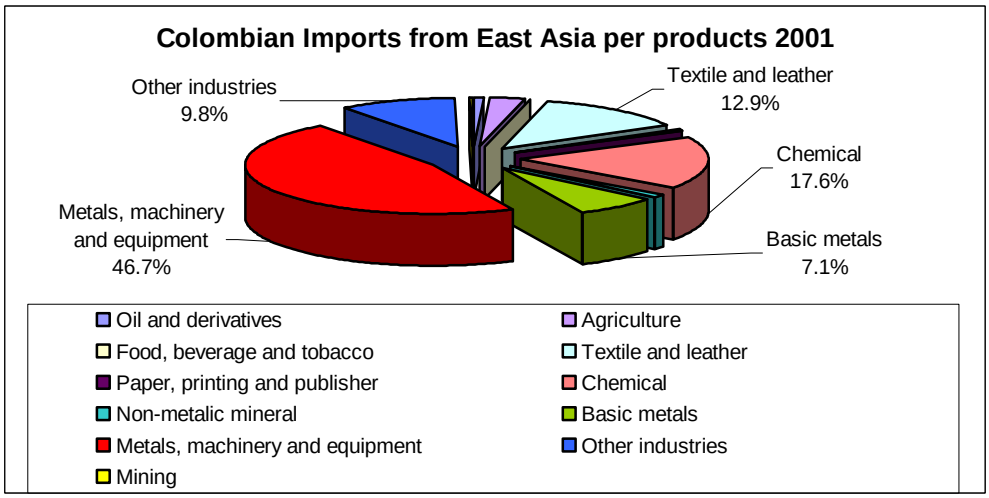

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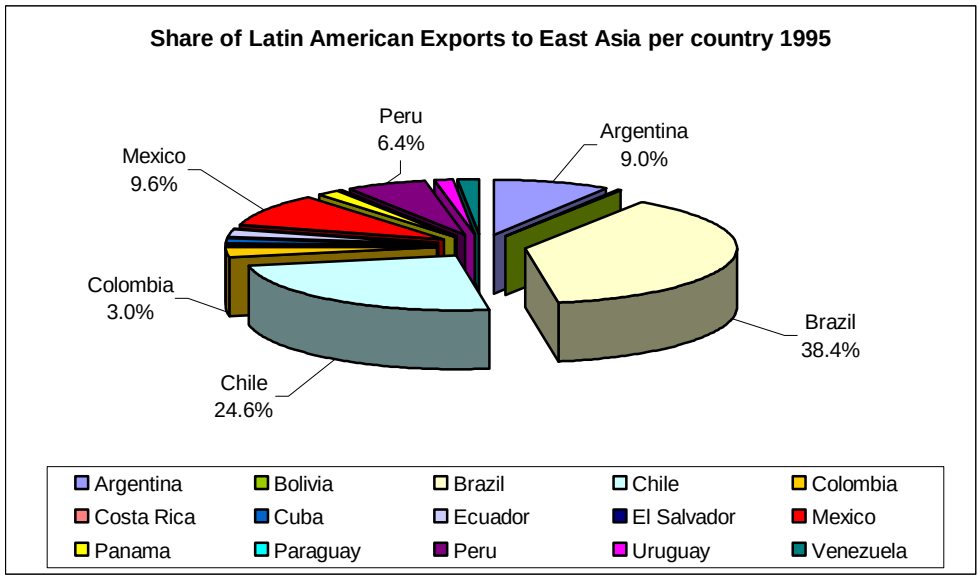
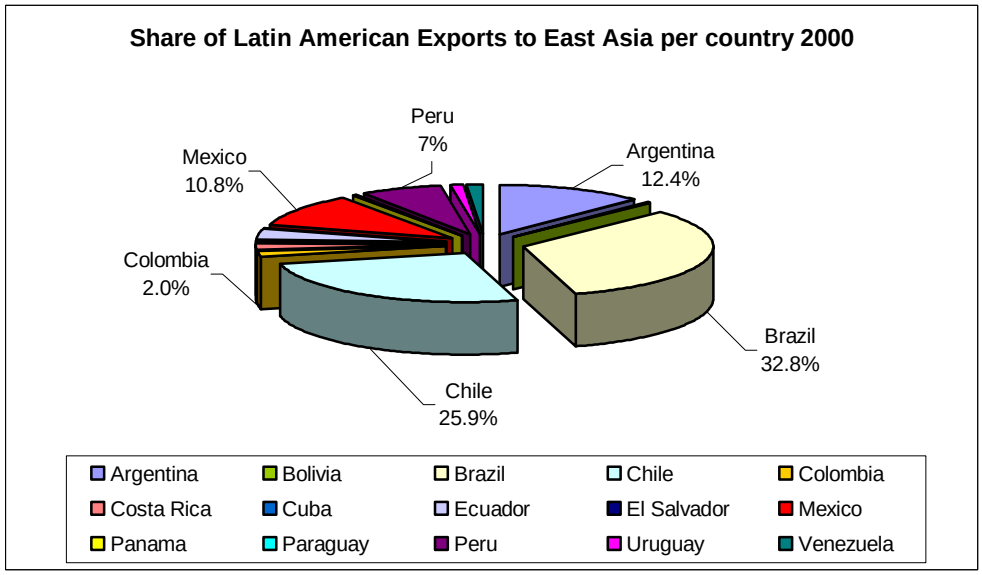
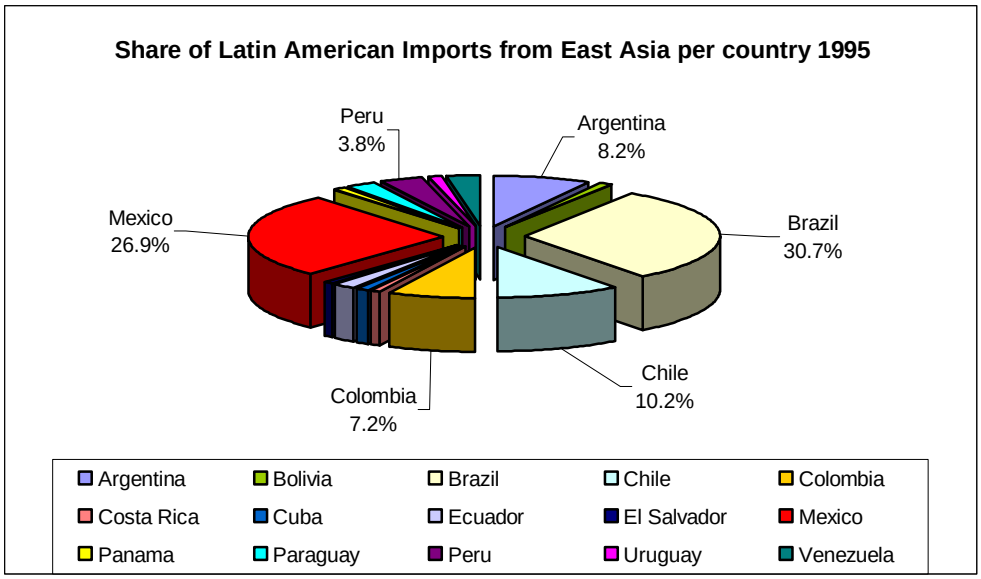
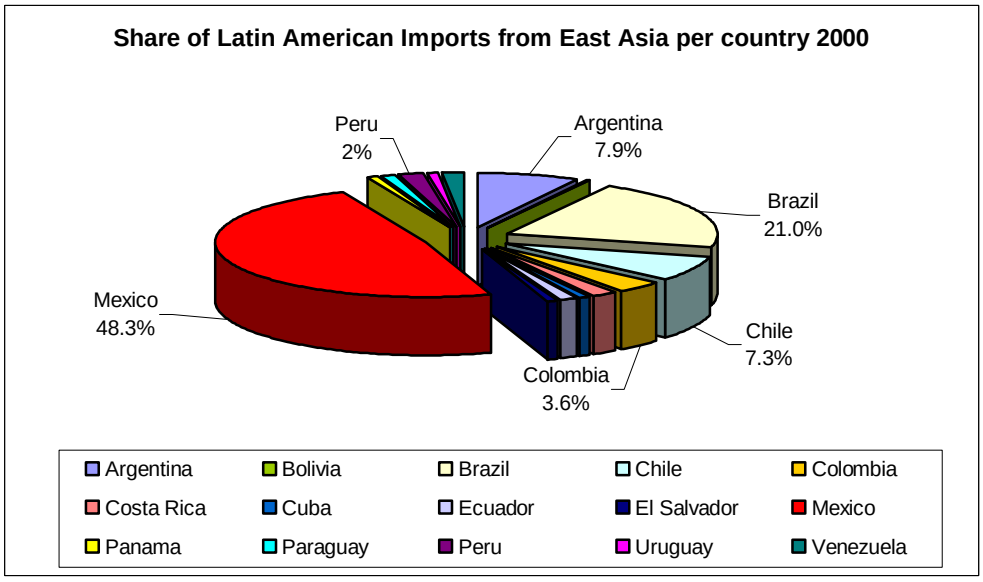




Source: IMF (2001), Direction of Trade Statistics Yearbook 2001

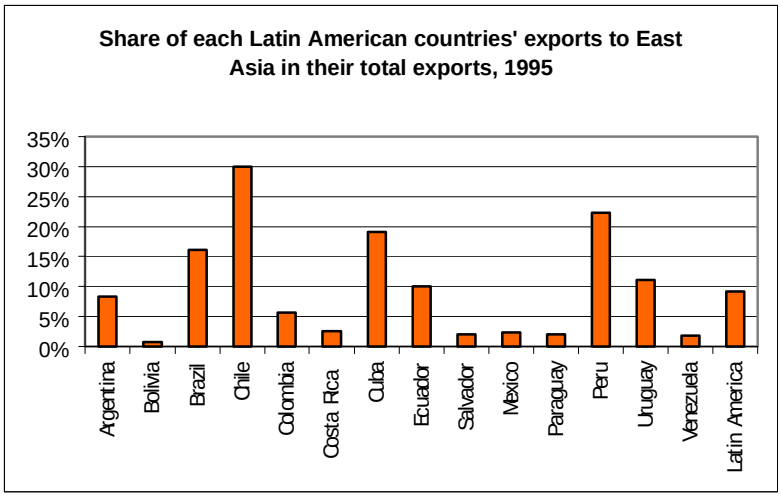
Graph 8

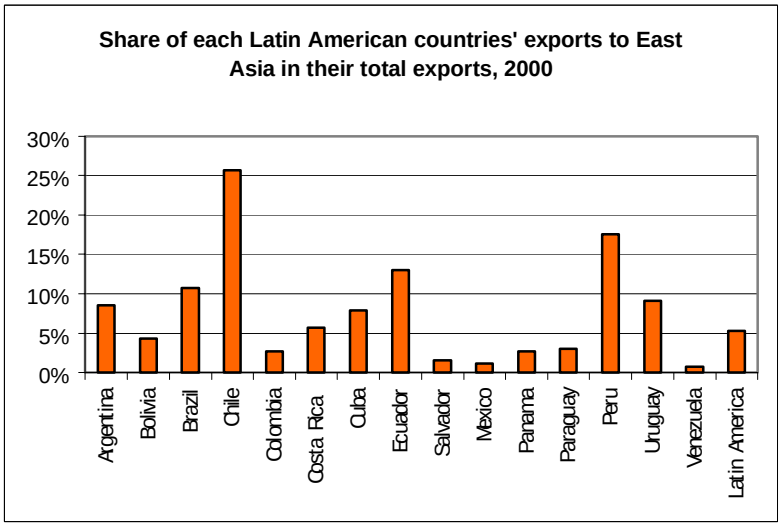




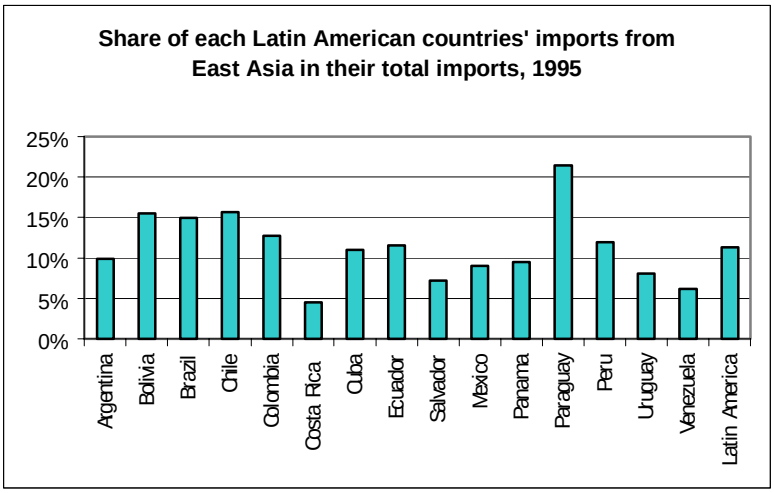
Source: IMF (2001), Direction of Trade Statistics Yearbook 2001

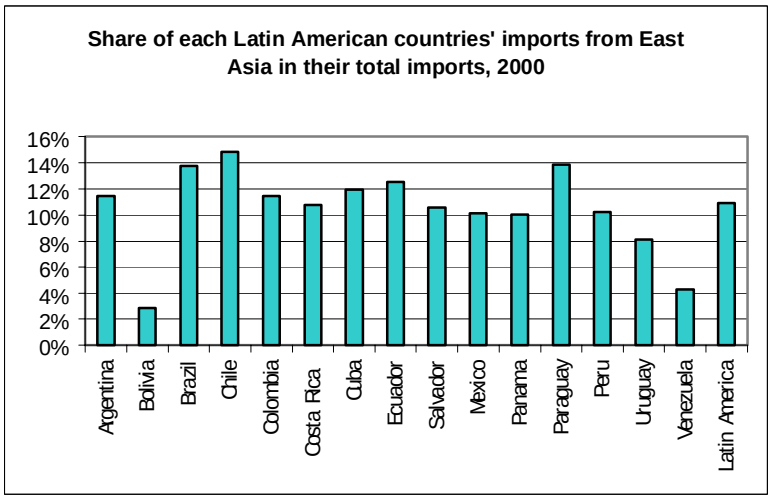
Graph 9


Share of each Latin American countries' exports to East Asia in their total exports, 1995
35%
30%
25%
20%
15%
10%
5%
0%
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
Salvador
Mexico
Paraguay
Peru
Uruguay
Venezuela
Latin America

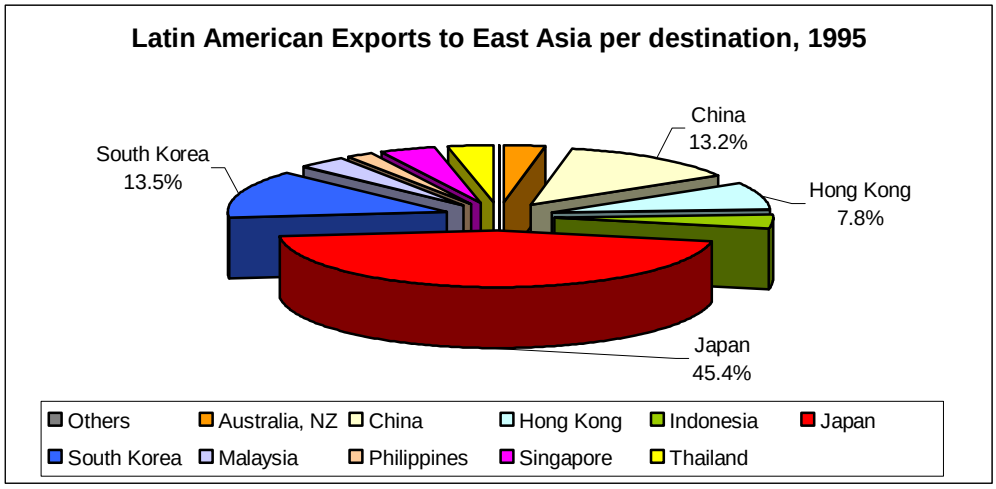

Share of each Latin American countries' exports to East Asia in their total exports, 2000
30%
25%
20%
15%
10%
5%
0%
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
Salvador
Mexico
Panama
Paraguay
Peru
Uruguay
Venezuela
Latin America

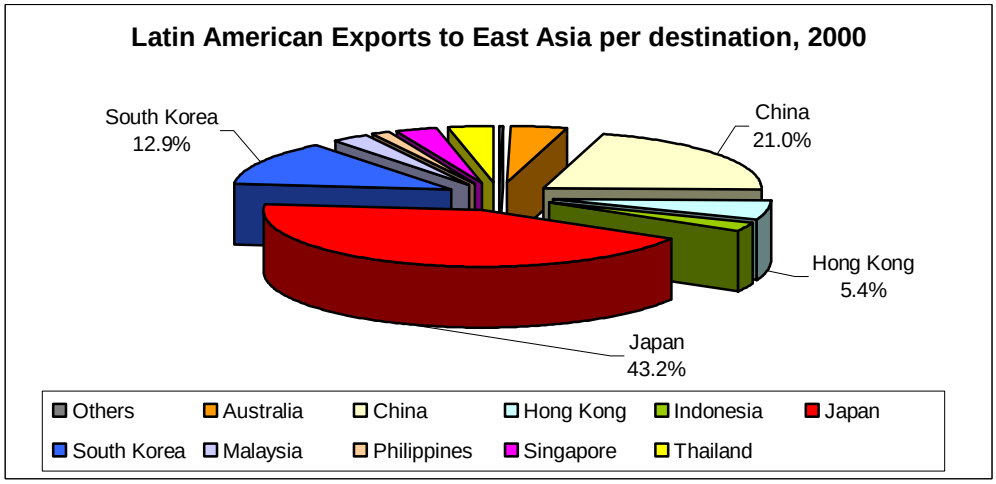
Graph 10


Share of each Latin American countries' imports from East Asia in their total imports, 1995
25%
20%
15%
10%
5%
0%
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
Salvador
Mexico
Panama
Paraguay
Peru
Uruguay
Venezuela
Latin America


Share of each Latin American countries' imports from East Asia in their total imports, 2000
16%
14%
12%
10%
8%
6%
4%
2%
0%
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
Salvador
Mexico
Panama
Paraguay
Peru
Uruguay
Venezuela
Latin America

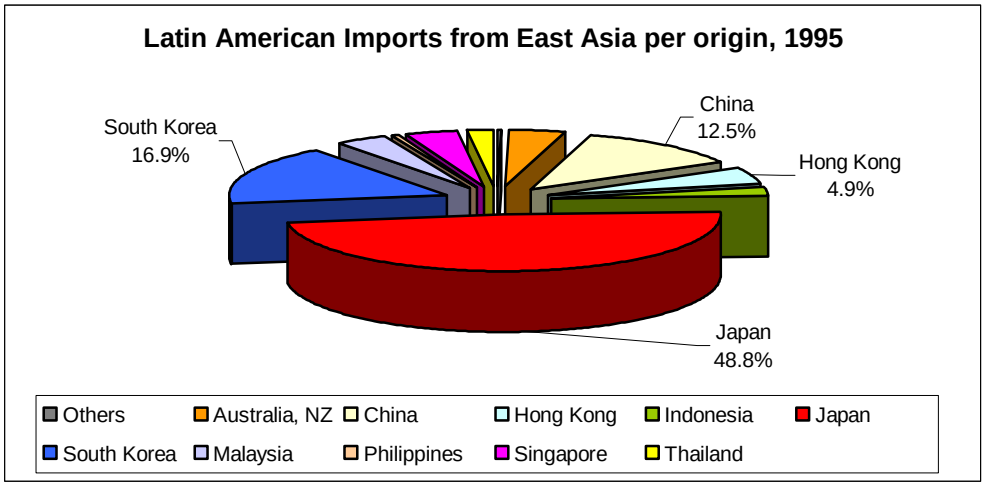
Graph 11

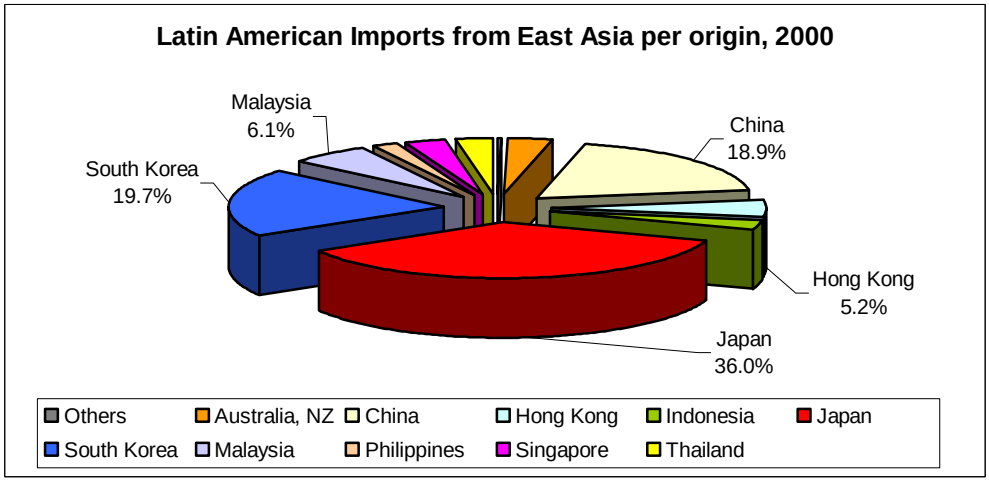




Source: IMF (2001), Direction of Trade Statistics Yearbook 2001

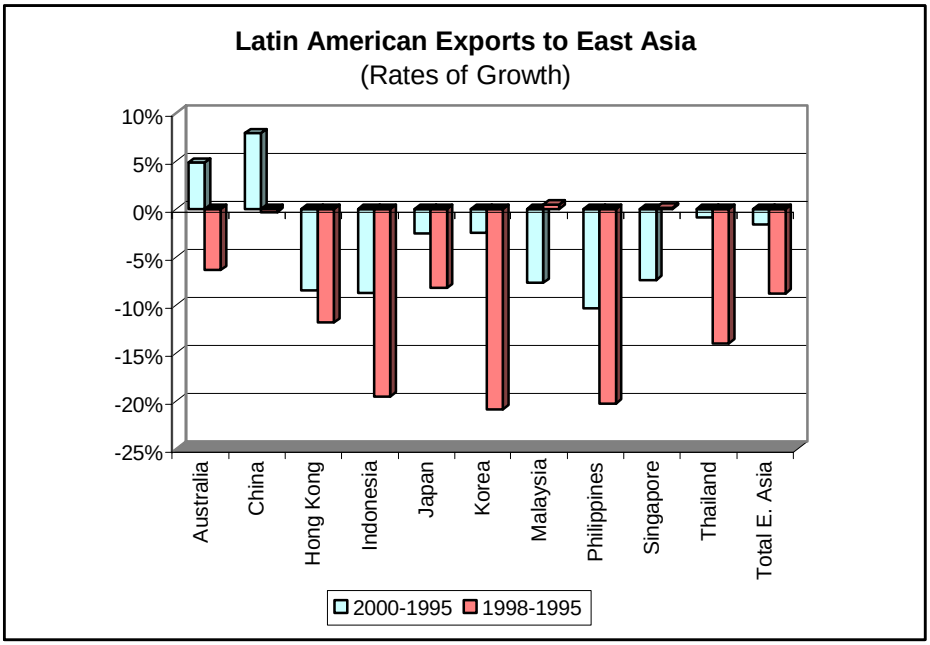
Graph 12

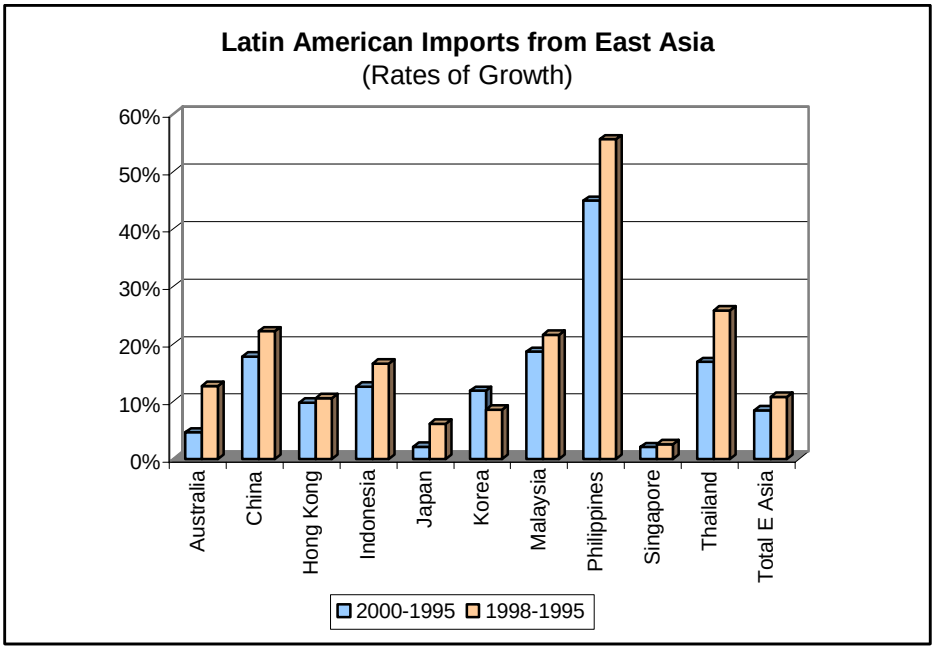




Source: IMF (2001), Direction of Trade Statistics Yearbook 2001

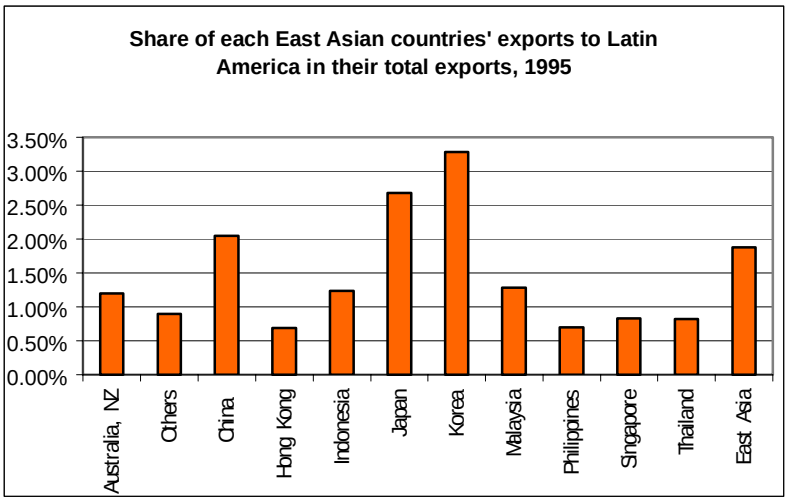
Graph 13

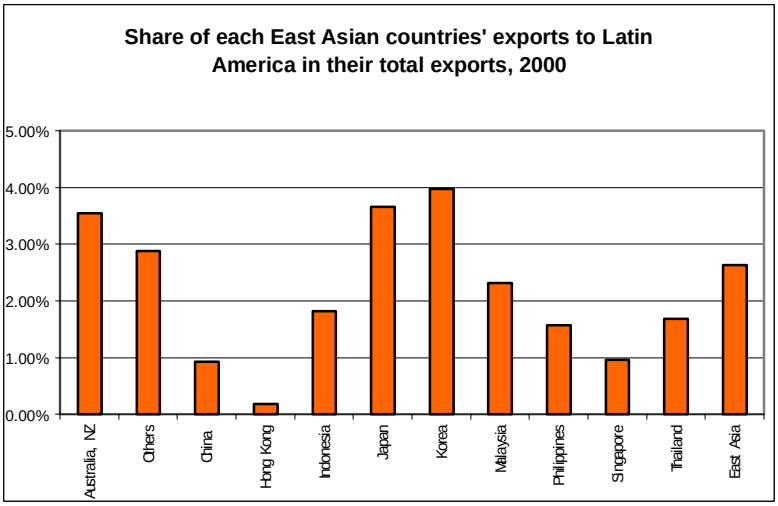




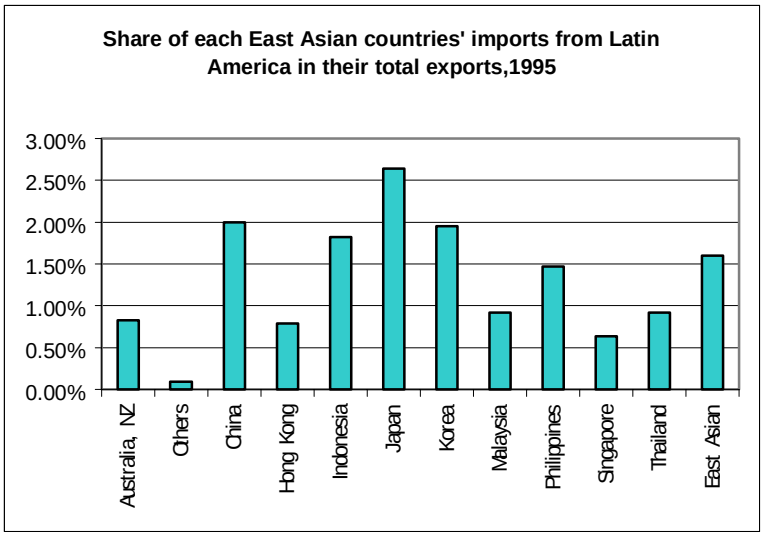
Source: IMF (2001), Direction of Trade Statistics Yearbook, 2001

Graph 14


Share of each East Asian countries' exports to Latin America in their total exports, 1995
3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
Australia, NZ
Others
China
Hong Kong
Indonesia
Japan
Korea
Malaysia
Philippines
Singapore
Thailand
East Asia


Share of each East Asian countries' exports to Latin America in their total exports, 2000
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
Australia, NZ
Others
China
Hong Kong
Indonesia
Japan
Korea
Malaysia
Philippines
Singapore
Thailand
East Asia

Graph 15


Share of each East Asian countries' imports from Latin America in their total exports,1995
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
Australia, NZ
Others
China
Hong Kong
Indonesia
Japan
Korea
Malaysia
Philippines
Singapore
Thailand
East Asian

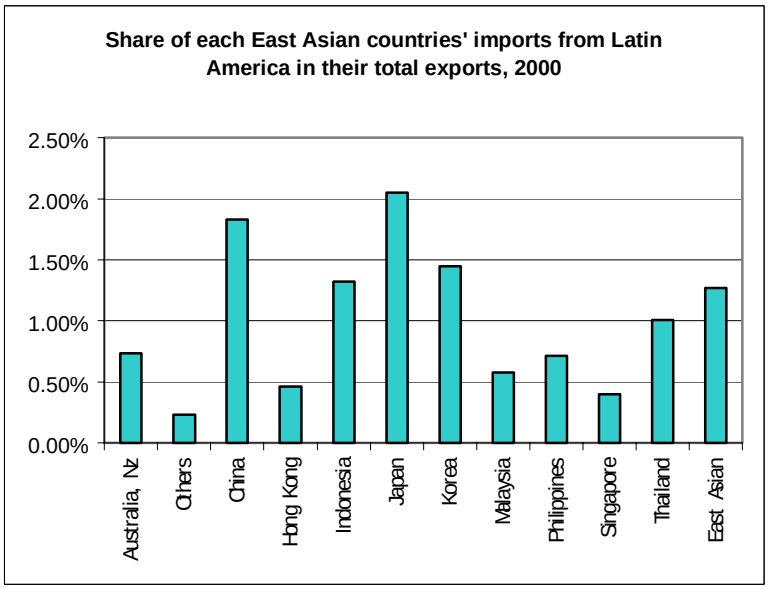

Share of each East Asian countries' imports from Latin America in their total exports, 2000
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
Australia, NZ
Others
China
Hong Kong
Indonesia
Japan
Korea
Malaysia
Philippines
Singapore
Thailand
East Asian

Figure 1

Production structure in each sector

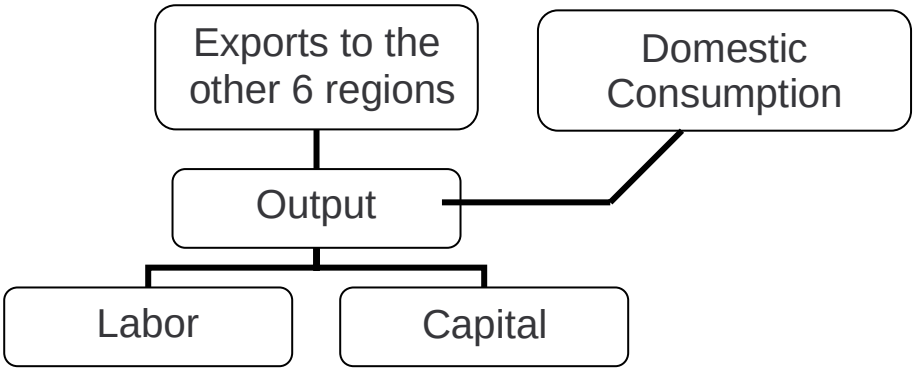


Figure 2

Nested utility structure in each region and sector

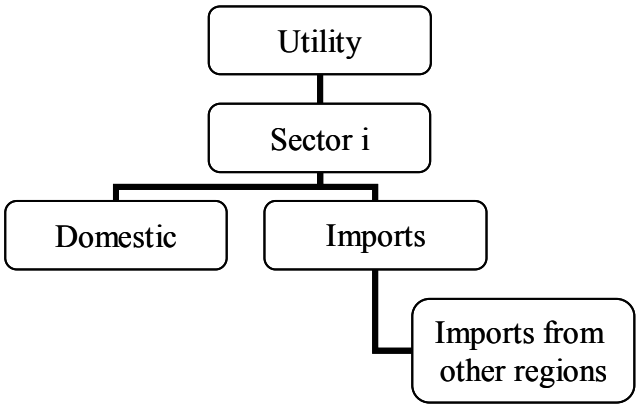
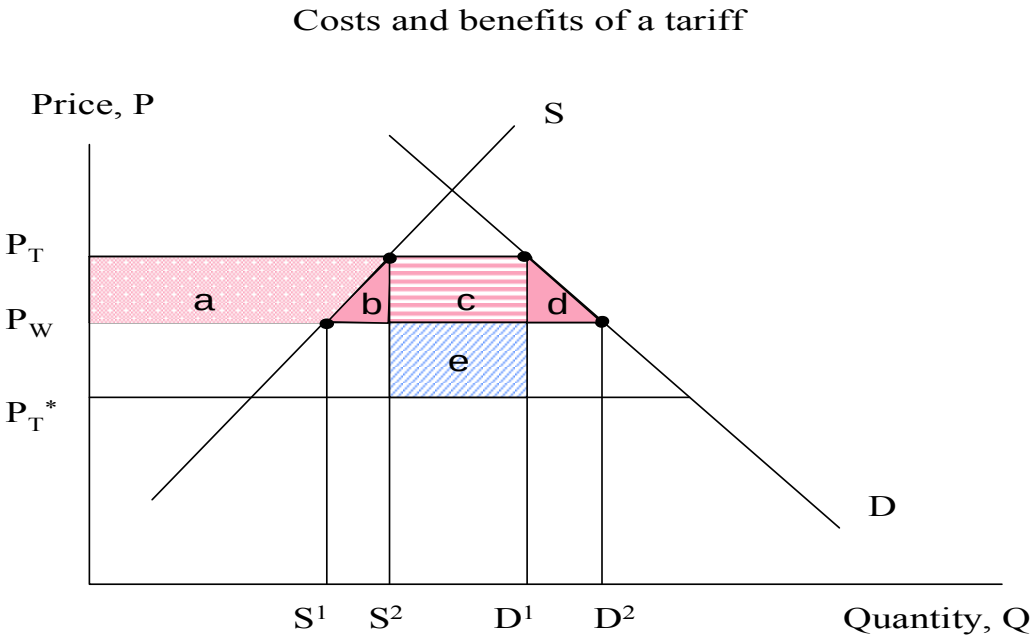


Figure 3



Source: Krugman, P. and Obstfeld, M. (1994)

Table 1

Colombian trade with East Asia: A comparison with Latin American
(millions of US$)

Year	Total Latin American Exports to East Asia	Average Latin American Exports to East Asia	Colombian Exports to East Asia
1995	19,511	1,301	585
1998	14,792	986	352
2000	18,016	1,201	355
Year	Total Latin American Imports from East Asia	Average Latin American Imports from East Asia	Colombian Imports from East Asia
1995	24,341	1,623	1,764
1998	33,071	2,205	1,713
2000	36,549	2,437	1,323

Source: DANE and IMF (2001), Direction of Trade Statstics Yearbook

Table 2

Latin American trade with East Asia
(Annual Rate of Growth)

Period	Exports	Imports
1995-98	-8.82%	10.76%
1998-00	10.36%	5.13%
1995-00	-1.58%	8.47%

Source: IMF (2001)

Table 3

Summary of safeguard measures imposed by Colombia to East Asian Products, 1994-2001

Dates	Products	Countries involved	Tariffs imposed
February 1995	Apparel, footwear	China	91,2%, 1,64% and 23,21%
March 1996	Footwear	China, Korea, Taiwan, Vietnam	40% and 93%
June 1996	Textiles and apparel	China	100%
October 1996	Textiles	China	*Licencia previa* (non tariff barrier)
December 1996	Textiles	China	85% and *licencia previa*
February 1997	Textiles	China, India, Korea, Panama, Taiwan	254%, 87%
July 1998	Polyester fibres	Thailand, Indonesia, Taiwan, China	*Licencia previa* (non tariff barrier)
October 1998	Polyester fibres	Korea, Thailand, Malaysia	*Licencia previa* (non tariff barrier)
August 2001	Metal chains	China	*Licencia previa* (non tariff barrier)

Source: Ministerio de Comercio Exterior

Table 4: Regional Classification

Region 1: Col	Colombia			
Region 2: China	China			
Region 3: Jap	Japan			
Region 4: Korea	Korea			
Region 5: OTHEREA	Australia	Indonesia	Malaysia	New Zealand
	Philippines	Singapore	Thailand	Vietnam
Region 6: RA	Anguila	Antigua & Barbuda	Argentina	Aruba
	Bahamas	Barbados	Belize	Bolivia
	Brazil	Canada	Cayman Islands	Chile
	Costa Rica	Cuba	Dominica	Dominican republic
	Ecuador	El Salvador	Grenada	Guatemala
	Guyana	Haiti	Honduras	Jamaica
	Mexico	Netherlands Antilles	Nicaragua	Panama
	Paraguay	Peru	Saint Kits and Nevis	Saint Lucia
	Saint Vincent and the Grenadines		Suriname	Trinidad & Tobago
	United States	Uruguay	Venezuela	Virgin Islands (UK)
Region 7: ROW	Afghanistan	Albania	Algeria	Andorra
	Angola	Austria	Armenia	Azerbaijan
	Bahrain	Bangladesh	Belarus	Belgium
	Benin	Bermuda	Bhutan	Bosnia & Herzegovina
	Botswana	Brunei	Bulgaria	Burkina Faso
	Burundi	Cambodia	Cameroon	Cape Verde
	Central Africa Rep.	Chad	Comoros	Congo
	Cote d'Ivoire	Croatia	Cyprus	Czech Republic
	Denmark	Djibouti	Egypt	Equatorial Guinea
	Eritrea	Estonia	Ethiopia	Faroe Islands
	Fiji	Finland	France	French Polynesia
	Gabon	Gambia	Ghana	Germany
	Georgia	Gibraltar	Greenland	Greece
	Guadeloupe	Guinea	Guinea-Bissau	Hong Kong
	Hungary	Iceland	India	Iran
	Iraq	Ireland	Israel	Italy
	Jordan	Kazakhstan	Kenya	Kiribati
	Kuwait	Kyrgyzstan	Laos	Latvia
	Lebanon	Lesotho	Libya	Liberia
	Lithuania	Liechtenstein	Luxemburg	Macau
	Macedonia	Madagascar	Malawi	Mali
	Malta	Marshall Islands	Mauritania	Mayotte
	Maldives	Mauritius	Micronesia	Moldova
	Monaco	Mongolia	Morocco	Mozambique
	Myanmar	Namibia	Nauru	Nepal
	Netherlands	New Caledonia	Niger	Nigeria
	North Korea	Norway	Oman	Pakistan
	Poland	Papua New Guinea	Portugal	Qatar
	Romania	Russian federation	Rwanda	Saudi Arabia
	San Marino	Sao Tome & Principe	Senegal	Seychelles
	Sierra Leona	Slovakia	Slovenia	Solomon Islands
	Somalia	South Africa	Spain	Sri Lanka
	Sudan	Swaziland	Sweden	Switzerland
	Syria	Tajikistan	Taiwan	Tanzania
	Togo	Tonga	Tunisia	Turkmenistan
	Turkey	Tuvalu	Uganda	Ukraine
	United Arab Emirates	United Kingdom	Uzbekistan	Vanuatu
	Western Samoa	Yemen	Yugoslavia	Zaire
	Zambia	Zimbabwe		

Table 5: Classification by sectors

Sector 1: ACSP	Barley	Bovine cattle, sheep and goats, horses, asses, mules and hinnies, live
	Bovine semen	Edible products of animal origin, n.e.c.
	Eggs, in shell, fresh, preserved or cooked	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
	Forestry, logging and related service activities	Fruits and nuts
	Hides, skins and furskins, raw	Hunting, trapping and game propagation including related service activities
	Insect waxes and spermaceti, whether or not refined or colored	Maize (corn)
	Natural honey	Oil seeds and oleaginous fruit
	Other cereals	Paddy rice
	Plant-based fibers	Raw animal materials used in textile
	Raw milk	Rye, oats
	Snails, live, fresh, chilled, frozen, dried, salted or in brine, except sea snails; frogs' legs, fresh, chilled or frozen	Sugar beet
	Sugar cane	Swine, poultry and other animals, live
	Vegetables	Wheat and meslin
Sector 2: Other Crops	Beverage and spice crops	Cut flowers
	Live plants	Cereal straw and husks, unprepared, whether or not chopped, ground, pressed or in the form of pellets
	Flower buds	Flower seeds
	Fruit seeds	Plants and parts of plants used primarily in perfumery, in pharmacy, or for insecticidal, fungicidal or similar purposes
	Other raw vegetable material	Sugar beet seed and seeds of forage plants
	Swedes, mangolds, fodder roots, hay, Lucerne (alfalfa), clover, sainfoin, forage kale, lupines, vetches and similar forage products, whether or not in the form of pellets	Unmanufactured tobacco
	Vegetable seeds	
Sector 3: Mining	Extraction of crude petroleum and natural gas	Manufacture of coke oven products
	Manufacture of refined petroleum products	Mining and agglomeration of hard coal
	Mining and agglomeration of hard lignite	Mining and agglomeration of peat
	Mining of metal ores	Mining of uranium and thorium ores
	Other mining and quarrying	Processing of nuclear fuel
	Service activities incidental to oil and gas extraction excluding surveying	

Table 5(Continued): Classification by sectors

Sector 4: Processed Products	Animal oils and fats, crude or refined, except fats of bovine animals, sheep, goats, pigs and poultry.	Animal or vegetable fats and oils and their fractions, partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared.
	Bakery products	Cereal flours other than of wheat or meslin.
	Cereal groats, meal and pellets n.e.c.	Cocoa, chocolate and sugar confectionery.
	Cotton linters.	Dairy products.
	Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules or hinnies, fresh, chilled or frozen	Fats of bovine animals, sheep, goats, pigs and poultry, raw or rendered; wool grease
	Flours, meals and pellets of meat or meat offal, inedible; greaves	Food products n.e.c.
	Fruit juices and vegetable juices	Groats, meal and pellets of wheat
	Macaroni, noodles, couscous and similar farinaceous products	Maize (corn) oil and its fractions, not chemically modified
	Margarine or similar preparations	Meat of bovine animals, fresh or chilled
	Meat of bovine animals, frozen	Meat of goats, fresh, chilled or frozen
	Meat of horses, asses, mules or hinnies, fresh, chilled or frozen	Meat of sheep, fresh or chilled
	Meat of sheep, frozen	Meet of swine, fresh or chilled Meet of swine frozen
	Meet of swine, frozen	Meat and edible offal, fresh, chilled or frozen, n.e.c.
	Mixes and doughs for the preparation of bakers' wares	Oil-cake and other solid residues resulting from the extraction of vegetable fats or oils; flours and meals of oil seeds or oleaginous fruits, except those of mustard; vegetable waxes, except triglycerides; degras; residues resulting from the treatment of fatty substances or animals or vegetable waxes
	Palm, coconut, palm kernel, babassu and linseed oil and their fractions, refined but not chemically modified; castor, tung and jojoba oil and fixed vegetable fats and oils (except maize oil) and their fractions n.e.c., whether or not refined, but not chemically modified	Palm, coconut, palm kernel, babassu and linseed oil, crude
	Other cereal grain products (including corn flakes)	Other vegetable flours and meals
	Preparations used in animal feeding	Prepared and preserved fish
	Prepared and preserved vegetables	Prepared and preserved fruit and nuts
	Preserves and preparations of meat, meat offal or blood	Rice, semi- or wholly milled
	Soya-bean, ground nut, olive, sunflower seed, safflower, cotton-seed, rape, colza and mustard oil, crude	Soya-bean, ground nut, olive, sunflower seed, safflower, cotton-seed, rape, colza and mustard oil and their fractions, refined but not chemically modified; other oils obtained solely from olives and sesame oil, and their fractions, whether or not refined, but not chemically modified
	Starches and starch products; sugars and sugar syrups n.e.c.	Sugar
	Wheat or meslin flour	
Sector 5: Bevtab	Beverages and tobacco products	
Sector 6: Textiles	Manufactures of textiles	Manufacture of man-made fibres
Sector 7: Apparel	Manufacturing of wearing apparel; dressing and dyeing of fur	
Sector 8: Leather	Tanning and dressing of leather ; manufacture of luggage, handbags, saddlery, harness and footwear	

Table 5 (Continued): Classification by sectors

Sector 9: Manufactures	Manufacture of electrical machinery and apparatus n.e.c.	Manufacturing nec
	Manufacture of machinery and equipment n.e.c.	Manufacture of medical precision and optical instruments, watches and clocks
	Manufacture of motor vehicles, trailers and semi-trailers	Manufacture of office, accounting and computing machinery
	Manufacture of other transport equipment	Manufacture of paper and paper products
	Manufacture of radio, television and communication equipment and apparatus	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	Other publishing (photos, engravings, postcards, timetables, forms, posters, art reproductions, etc.)	Printing and service activities related to printing
	Publishing of books, brochures, musical books and other publications	Publishing of newspapers, journals and periodicals
	Publishing of recorded media	Recycling
	Reproduction of recorded media	
Sector 10: metals	Casting of iron and steel	Casting of non-ferrous metals
	Manufacture of basic iron and steel	Manufacture of basic precious and non-ferrous metals
	Manufacture of fabricated metal products, except machinery and equipment	Manufacture of other non-metallic mineral products
Sector 11:Chemical Products	Manufacture of basic chemicals	Manufacture of other chemical products
	Manufacture of rubber and plastics products	
Sector 12: Services	Activities of membership organizations n.e.c.	Activities auxiliary to financial intermediation
	Air transport	Collection, purification and distribution of water
	Construction	Computer and related activities
	Dwellings	Education
	Extra-territorial organizations and bodies	Financial intermediation, except insurance and pension funding
	Health and social work	Hotels and restaurants
	Insurance and pension funding, except compulsory social security	Land transport; transport via pipelines
	Manufacture of gas; distribution of gaseous fuels through mains	Non-specialized retail trade in stores
	Other business activities	Other retail trade of new goods in specialized stores
	Other service activities	Post and telecommunications
	Private households with employed persons	Production, collection and distribution of electricity
	Public administration and defense; compulsory social security	Real state activities
	Recreational, cultural and sporting activities	Renting of other machinery and equipment
	Renting of personal and household goods n.e.c.	Renting of transport equipment Repair of personal and household goods
	Research and development	Retail sale of food, beverages and tobacco in specialized stores
	Retail sale of second-hand goods in stores	Retail trade not in stores
	Sales, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	Sewage and refuse disposal, sanitation and similar activities
	Supporting and auxiliary transport activities; activities of travel agencies	Steam and hot water supply
	Water transport	

Table 6
Equivalent variation as a percentage of GDP
(%)

Experiment	COL	CHINA	JAP	KOREA	OTHER EA
1. Elimination of import tariffs by China, Japan, Korea and Other EA on Colombian exports of:					
Apparel	-0.0005	0.0000	0.0000	0.0000	0.0000
Beverage and tobacco	-0.0005	0.0000	0.0000	0.0000	0.0000
Chemical products	-0.0005	0.0000	0.0000	0.0000	0.0000
Mining	-0.0005	0.0000	0.0000	0.0000	0.0000
Other crops	0.0148	-0.0001	-0.0010	-0.0035	-0.0002
Textiles	-0.0005	0.0000	0.0000	0.0000	0.0000
2. Elimination of import tariffs by Colombia on Chinese, Japanese, Korean and OTHEREA exports of:					
Apparel	-0.0010	0.0000	0.0000	0.0004	0.0000
Chemical products	-0.0023	0.0000	0.0001	0.0008	0.0001
Manufactures	-0.0605	0.0003	0.0010	0.0068	0.0002
Metals	-0.0021	-0.0001	0.0001	0.0000	0.0001
Mining	-0.0005	0.0000	0.0000	0.0000	0.0000
Textiles	-0.0017	0.0000	0.0000	0.0006	0.0001
3. Elimination of import tariffs by Colombia, China, Japan, Korea and Other EA on their trade of:					
All products	-0.0352	0.0003	0.0000	0.0046	0.0004
Apparel, leather and textiles	-0.0031	0.0000	0.0000	0.0007	0.0001
Chemical products, manufactures, metals, and mining	-0.0363	0.0003	0.0012	0.0121	0.0003

Table 7

Elimination of import tariffs by China, Japan, Korea and OTHEREA on Colombian exports: Effects on Colombian exports Percentage change (%)

	Exports to:			
Exports of:	CHINA	JAPAN	KOREA	OTHER EA
Apparel	0.00	-100.00*	0.00	0.00
Beverage and tobacco	0.00	0.00	0.00	0.00
Chemical products	-100.00	0.00**	-100.00	0.00**
Mining	-100.00	0.00**	0.00**	0.00**
Other crops	0.00	11.30	35.04	0.44
Textiles	0.00	0.00	0.00	0.02

* A reduction of 100% may seem very large. However, the trade flows between Colombia and the East Asian countries are very small, so that the reduction in exports is not considerable. Colombia is substituting one market for its exports for another.
** Less than 0.001% but different from zero

Table 8

Elimination of Colombian import tariffs on Chinese, Japanese, Korean and OTHEREA exports: Effects on Colombian imports Percentage change (%)

	Imports from:			
Imports of:	CHINA	JAPAN	KOREA	OTHER EA
Apparel	0.05	0.00	13.46	0.05
Chemical products	0.00**	3.55	5.28	2.52
Manufactures	5.42	6.78	10.90	0.00**
Metals	0.00**	4.25	0.00**	0.00**
Mining	-100.00*	0.00	0.00	0.00**
Textiles	-100.00*	-100.00*	8.35	10.29

* A reduction of 100% may seem very large. However, the trade flows between Colombia and the East Asian countries are very small, so that the reduction in imports is not considerable. Colombia is substituting one source of imports for another.
** Less than 0.001% but different from zero.

Table 9
Percentage change in total exports by sectors
(%)

	COL	CHINA	JAP	KOREA	OTHER EA
1. Elimination of import tariffs by China, Japan, Korea and OTHEREA on Colombian exports of:					
Apparel	0.00**	0.00**	0.00**	0.00**	0.00**
Beverage and tobacco	0.00**	0.00**	-0.01	0.00**	-0.02
Chemical products	0.00**	0.00**	0.00**	0.00**	0.00**
Mining	0.00**	0.00**	-0.02	-0.01	0.00**
Other crops	1.82	-0.01	0.03	0.02	0.00**
Textiles	-0.02	0.00**	0.01	0.00**	0.00**
2. Elimination of import tariffs by Colombia on Chinese, Japanese, Korean and OTHEREA exports of:					
Apparel	0.00**	0.00**	0.00**	0.05	0.00**
Chemical products	0.02	0.00**	0.01	0.01	0.00**
Manufactures	0.38	0.00**	0.01	0.03	0.00**
Metals	0.02	0.00**	0.01	0.00**	0.00**
Mining	0.00**	0.00**	-0.02	-0.01	0.00**
Textiles	-0.06	0.00**	0.01	0.03	0.02
3. Elimination of import tariffs by Colombia, China, Japan, Korea and OTHEREA on their trade of:					
a. Apparel, leather and textiles					
Apparel	0.01	0.00**	0.00**	0.05	0.00**
Leather	0.01	0.00**	0.00**	0.00**	0.00**
Textiles	0.00**	0.00**	0.00**	0.01	0.01
b. Chemical products, manufactures, metals, and mining					
Chemical products	0.43	0.00**	0.00**	-0.02	0.00**
Manufactures	0.66	0.00**	0.01	0.01	0.00**
Metals	0.39	0.00**	0.00**	-0.03	0.00**
Mining	0.52	0.00**	-0.03	-0.04	0.01

** Less than 0.001% but different from zero

Table 10
Equivalent variation as a percentage of GDP
(%)

Experiment	COL	CHINA	JAP	KOREA	OTHER EA	RA	ROW
1. Unilateral elimination of import tariffs by China, Japan, Korea and Other EA on:							
Apparel	0.15	0.02	-0.02	0.02	-0.03	0.01	0.00
Beverage and tobacco	0.19	0.02	-0.02	0.01	-0.05	0.00	0.00
Chemical products	0.11	-0.42	0.06	0.36	-0.13	-0.01	-0.02
Mining	0.00	0.01	0.00	-0.08	0.02	0.00	0.00
Other crops	0.20	0.07	-0.01	0.00	-0.04	0.00	0.00
Textiles	0.04	-0.32	0.06	0.18	-0.11	-0.02	-0.01
2. Unilateral elimination of import tariffs by Colombia on:							
Apparel	-0.05	0.00	0.00	0.01	0.00	0.00	0.00
Chemical products	-0.20	0.01	0.00	0.02	0.00	0.00	0.00
Manufactures	-0.66	0.01	0.00	0.05	0.01	0.00	0.00
Metals	-0.13	0.01	0.00	0.00	0.00	0.00	0.00
Mining	0.09	0.01	0.00	0.00	0.00	0.00	0.00
Textiles	-0.02	0.01	0.00	0.01	0.00	0.00	0.00
3. Unilateral elimination of import tariffs by Colombia, China, Japan, Korea and Other EA on:							
Apparel, leather and textiles	-1.30	-0.50	0.00	0.74	-0.09	-0.01	-0.02

Table 11
Unilateral elimination of import tariff by China, Japan, Korea and Other East Asian Countries: Effects on Colombian exports
Percentage change (%)

Exports of:	Exports to:					
	CHINA	JAPAN	KOREA	OTHER EA	RA	ROW
Apparel	0.00	-100.00*	0.00	0.00	-0.68	-1.78
Beverage and tobacco	0.00	0.00	0.00	0.00	0.78	-100.00*
Chemical products	-100.00*	8.48	-100.00*	0.15	-0.55	54.30
Mining	-100.00*	0.00**	-6.32	0.92	0.02	0.04
Other crops	0.00	10.88	-7.25	10.04	1.49	1.72
Textiles	0.00	0.00	0.00	6.14	-1.90	13.27

* A reduction of 100% may seem very large. However, the trade flows between Colombia and the East Asian countries are very small, so that the reduction in exports is not considerable. Colombia is substituting one market for its exports for another.
** Less than 0.001% but different from zero.

Table 12
Unilateral elimination of Colombian import tariffs: Effects on Colombian imports
Percentage change (%)

Imports of:	Imports from:					
	CHINA	JAPAN	KOREA	OTHER EA	RA	ROW
Apparel	10.77	0.00	11.73	10.77	10.78	10.77
Chemical products	3.28	3.30	3.25	3.30	3.30	3.31
Manufactures	1.71	1.70	1.68	1.71	1.69	1.71
Metals	-100.00*	5.03	-100.00*	-100.00*	5.02	5.04
Mining	7.65	0.00	0.00	0.02	5.55	0.00
Textiles	0.05	-100.00*	13.07	13.12	13.04	-0.35

* A reduction of 100% may seem very large. However, the trade flows between Colombia and the East Asian countries are very small, so that the reduction in imports is not considerable. Colombia is substituting one source of imports for another.

Table 13
Percentage change in total exports by sectors (%)

	COL	CHINA	JAP	KOREA	OTHER EA	RA	ROW
1. Unilateral elimination of import tariffs by China, Japan, Korea and Other EA on:							
Apparel	-0.80	2.43	5.95	2.89	0.74	2.38	3.08
Beverage and tobacco	-5.13	1.58	1.54	4.76	-1.97	2.84	5.10
Chemical products	4.55	1.26	1.12	1.12	1.31	1.19	1.91
Mining	0.01	0.34	0.41	0.94	0.52	0.27	0.57
Other crops	2.39	-4.03	3.81	4.45	1.03	3.60	5.78
Textiles	0.38	2.84	6.34	4.15	2.04	2.62	6.95
2. Unilateral elimination of import tariffs by Colombia on:							
Apparel	-0.15	0.00	0.00	1.09	0.00	0.33	0.02
Chemical products	0.62	0.01	0.01	-0.06	0.01	0.10	0.03
Manufactures	2.69	0.01	0.01	-0.02	0.01	0.01	0.03
Metals	0.45	-0.12	0.01	-0.02	0.00	0.10	0.03
Mining	0.26	-0.10	0.01	0.02	0.02	0.06	-0.00
Textiles	-0.34	-0.03	-0.08	-0.08	-0.04	0.75	-0.05
3. Unilateral elimination of import tariffs by Colombia, China, Japan, Korea and Other EA on:							
a. Apparel, leather and textiles							
Apparel	4.46	5.44	5.48	-1.39	0.65	2.36	3.08
Leather	-2.01	4.04	7.25	0.73	1.43	2.48	3.33
Textiles	8.53	2.49	6.92	1.79	2.48	2.84	6.35

Appendix 1
Main indicators of East Asian countries: 2000

Indicators	AUS	BRU	CAMB	CHN	HKG	IND	JPN	KOR	LAO	MYS	BUR	NZL	PHL	SGP	THA	VIET
People																
Population, total (millions)	19.2	0.338	12	1,300	6.8	210.4	126.9	47.3	5.3	23.3	47.7	3.8	75.6	4	60.7	78.5
Population growth (annual %)	1.1	2.4	2.2	0.9	1.1	1.6	0.2	0.9	2.3	2.4	1.2	0.5	1.8	1.7	0.8	1.3
Life expectancy at birth (years)	78.9	76.2	53.8	70.3	79.8	66	80.7	73.2	53.7	72.5	56.1	78.2	69.3	77.7	68.8	69.1
Net primary enrollment (% of relevant age group)[1]/	100	..	100	100	91	99	100	100	73	100	99	100	100	91	88	100
Net secondary enrollment (% of relevant age group)[1]/	96	..	39	70	69	56	100	100	63	64	54	93	78	76	48	55
Economy																
GDP (current US$ billions)	390.1	..	3.2	1,100	162.6	153.3	4,800	457.2	1.7	89.7	..	49.9	74.7	92.3	122.2	31.3
GDP growth (annual %)	1.9	..	5	7.9	10.5	4.8	2.4	8.8	5.7	8.3	..	2.5	4	9.9	4.3	5.5
GDP per capita (current US$)	20,318	..	267	846	23,912	729	37,825	9,666	321	3,850	..	13,132	988	23,075	2,013	399
Inflation, GDP deflator (annual %)	4.5	..	1.5	0.9	-6.6	11	-0.6	-1.6	23.8	4.7	..	3.5	6.7	1.8	1.8	5.3
Agriculture, value added (% of GDP)	..	..	37.1	15.9	..	16.9	..	4.6	52.9	11.1	..	..	15.9	0.1	10.5	24.3
Industry, value added (% of GDP)	..	..	20.5	50.9	..	47.3	..	42.7	22.8	45.4	..	..	31.1	34.3	40.1	36.6
Services, etc., value added (% of GDP)	..	..	42.4	33.2	..	35.8	..	52.7	24.3	43.6	..	..	52.9	65.6	49.5	39.1
Exports of goods and services (% of GDP)	..	..	40.1	25.9	150	38.5	..	45	..	125.5	..	..	56.3	179.9	67	..
Imports of goods and services (% of GDP)	..	..	46.9	23.2	145.3	30.7	..	42.2	..	104.4	..	..	50.2	161.4	59	..
Gross capital formation (% of GDP)	..	..	15	37.3	27.6	17.9	..	28.7	20.4	25.6	..	..	17.8	31.3	22.7	27.4
Current revenue, excluding grants (% of GDP)	..	..	..	..	..	..	..	..	..	..	..	31.1	15.4	26.2	16	17.7
Overall budget balance, including grants (% of GDP)	..	..	..	..	..	..	..	..	..	..	..	-0.4	-4.1	10.1	-3.1	-2.5
Technology and infrastructure																
Fixed lines and mobile telephones (per 1,000 people)	971.5	534.5	12.3	177.6	1,392.30	48.7	1,111.90	1,030.50	9.8	412.3	5.8	1,063.10	124.4	1,168.20	142.6	41.7
Personal computers (per 1,000 people)	464.6	70.1	1.1	15.9	350.6	9.9	315.2	237.9	2.6	103.1	1.1	360.2	19.3	483.1	24.3	8.8
Internet users (millions)	6.6	0.03	0.01	22.5	2.6	2	47.1	19	0.01	3.7	0.01	0.83	2	1.2	2.3	0.2
Trade and finance																
Trade in goods as a share of GDP (%)	34.7	..	40.2	43.9	256.2	62.4	17.7	72.8	52.7	201.3	..	54.5	98.5	295.3	107.2	96
Trade in goods as a share of goods GDP (%)	..	..	..	65.8	..	97.2	..	153.8	..	356.5	..	..	..	858	211.4	..
High-technology exports (% of manufactured exports)	15.2	..	..	18.6	23.3	16.2	28.3	34.8	..	..	..	10.2	..	63	..	..
Foreign direct investment, net inflows in reporting country (current billions US$)	11.5	..	0.1257	38.4	..	-4.55	8.2	9.3	0.072	1.7	0.2548	3.2	2	6.4	3.4	1.3

Source: World Bank, World Develompent Indicators Database,April 2002

[1] /: data of 1997

Appendix 1 (Continued)
Main indicators of Latin American Countries: 2000

INDICATORS	ARG	BOL	BRA	CHL	COL	CRI	CUB	ECU	SLV	MEX	PAN	PRY	PER	URY	VEN
People															
Population, total (millions)	37	8.3	170.4	15.2	42.3	3.8	11.2	12.6	6.3	98	2.9	5.5	25.7	3.3	24.2
Population growth (annual %)	1.2	2.3	1.3	1.3	1.8	2.1	0.3	1.9	2	1.4	1.6	2.5	1.7	0.7	1.9
Life expectancy at birth (years)	73.9	62.6	68.1	75.6	71.6	77.5	76.5	69.6	70.1	73	74.6	70.4	69.3	74.4	73.3
Net primary enrollment (% of relevant age group)[1]/	100	97	97	90	89	89	..	100	89	100	90	96	94	94	83
Net secondary enrollment (% of relevant age group)[1]/	77	40	66	85	76	40	..	51	36	66	71	61	84	84	49
Economy															
GDP (current US$ billions)	285	8.3	595.5	70.5	81.3	15.9		13.6	13.2	574.5	9.9	7.5	53.5	19.7	120.5
GDP growth (annual %)	-0.5	2.4	4.5	5.4	2.8	1.7	5.6	2.3	2	6.9	2.7	-0.3	3.1	-1.3	3.2
GDP per capita (current US$)	7,703	1,000	3,495	4,638	1,922	4,184	..	1,079	2,095	5,862	3,414	1,364	2,082	5,970	4,979
Inflation, GDP deflator (annual %)	1.1	3.7	8.5	4	10.7	7.1	2.6	105.9	3.9	10.9	0.8	8.9	3.6	3.6	26.8
Agriculture, value added (% of GDP)	4.8	22	7.4	10.5	13.8	9.4	6.7	10	10.1	4.4	6.7	20.6	7.9	6	5
Industry, value added (% of GDP)	27.6	15.3	28.6	33.5	30.5	31.2	46.4	40.2	30.2	28.4	17	27.4	27.2	27.3	36.4
Services, etc., value added (% of GDP)	67.7	62.7	64	56	55.7	59.4	46.9	49.8	59.6	67.3	76.3	52	64.9	66.7	58.6
Exports of goods and services (% of GDP)	10.8	17.6	10.9	31.8	21.9	48.3	15.7	42.4	27.6	31.4	33.1	20.3	16	19.3	29.4
Imports of goods and services (% of GDP)	11.4	25.1	12.1	30.8	20.4	46.1	18.2	30.8	42.7	33.2	38.9	35.4	17.9	20.7	17
Gross capital formation (% of GDP)	15.9	18.2	20.5	23.4	12.2	17.1	9.7	16.8	17	23.3	30.2	22.1	20.1	13.9	17.5
Current revenue, excluding grants (% of GDP)	14.1	17.6	..	23.7	..	20.9	..	..	15.8	..	..	..	16.4	28.1	19.8
Overall budget balance, including grants (% of GDP)	-2.3	-3.4	..	0.1	..	-1.3	..	..	1.7	..	..	..	-2	-3.4	-2.1
Technology and infrastructure															
Fixed lines and mobile telephones (per 1,000 people)	376.5	130.1	318	443.5	222.4	301.4	44.2	138.1	218.2	267.1	295.7	..	111.3	410.3	325.3
Personal computers (per 1,000 people)	51.3	16.8	44.1	82.3	35.4	149.1	10.7	21.7	19.1	50.6	37	12.7	40.9	104.9	45.5
Internet users (millions)	2.5	0.12	5	2.5	0.878	0.25	0.06	0.18	0.05	2.7	0.09	0.04	2.5	0.37	0.95
Trade and finance															
Trade in goods as a share of GDP (%)	18.1	35.9	19.1	51.4	30.2	77.2	..	61.1	59.2	60.8	42.9	40.5	29.5	29.2	39.7
Trade in goods as a share of goods GDP (%)	49.8	..	..	110.7	62.4	..	..	..	146.7	155.3	..	79.9	..	103.6	94
High-technology exports (% of manufactured exports)	9	..	18.6	3.4	7.3	..	..	5.6	6	22.4	..	3	..	2	3
Foreign direct investment, net inflows in reporting country (current billions US$)	11.7	0.733	32.8	3.7	2.4	0.409	..	0.71	0.185	13.3	0.603	0.0818	0.68	0.298	4.5

Source: World Bank, World Develompent Indicators database,April 2002

[1]/: data of 1997

Appendix 2

Model equations and notation

Production side of the model

Value-added function

(A.1) $$Q_i^r = \gamma_i^r \left[\delta_i^r L_i^{r\left(\sigma_i^r - 1\right)/\sigma_i^r} + \left(1-\delta_i^r\right) K_i^{r\left(\sigma_i^r - 1\right)/\sigma_i^r} \right]^{\sigma_i^r/(\sigma_i^r - 1)}$$

Domestic and foreign sales

(A.2) $$Q_i^r = \varphi_i^r \left[\beta_i^r DC_i^{r\left(\rho_i^r - 1\right)/\rho_i^r} + \left(1-\beta_i^r\right) EXP_i^{r\left(\rho_i^r - 1\right)/\rho_i^r} \right]^{\rho_i^r/\left(\rho_i^r - 1\right)}$$

Export allocation

(A.3) $$EXP_i^r = v_i^r \left(\sum_S \theta_i^r RX_i^{r,s\left(\varepsilon_i^r - 1\right)/\varepsilon_i^r} \right)^{\varepsilon_i^r/\left(\varepsilon_i^r - 1\right)}, S \neq r$$

Demand side of the model

Utility function

(A.4) $$U^r = \left(\sum_{i=1}^{12} \left(\alpha_i^r\right)^{1/\mu^r} \left(X_i^r\right)^{\left(\mu^r - 1\right)/\mu^r} \right)^{\mu^r/\left(\mu^r - 1\right)}$$

Domestic and import consumption

(A.5) $$CMP_i^r = \Omega_i^r \left(\omega_i^r IMP_i^{r\left(v_i^r - 1\right)/v_i^r} + \left(1-\omega_i^r\right) DOM_i^{r\left(v_i^r - 1\right)/v_i^r} \right)^{v_i^r/\left(v_i^r - 1\right)}$$

Import allocation

(A.6) $$IMP_i^r = \Psi_i^r \left(\sum_s \chi_i^r DIMP_i^{r,s\,\zeta_i^r - 1/\zeta_i^r} \right)^{\zeta_i^r/(\zeta_i^r - 1)}, s \neq r$$

Constraints

Consumer budget constraint $\left(I^r = E^r\right)$

(A.7) $$P_{L,r}\overline{L}_r + P_{K,r}\overline{K}_r + TAXREV^r + TB^r = \sum_{i=1}^{12} P_i^r X_i^r$$

Government budget constraint

(A.8) $$TAXREV^r = \sum_{i=1}^{12} \tau_i^r P_{M,i}^r IMP_i^r + t_{K,i}^r \sum_{i=1}^{12} P_{K,r} K_i^r + t_{L,i}^r \sum_{i=1}^{12} P_{L,i} L_i^r$$

Trade balance equation

(A.9) $$\sum_{i=1}^{12} P_{M,i}^{r^*} IMP_i^r + TB^r = \sum_{i=1}^{12} P_{X,i}^r EXP_i^r \,,$$

where $TB^r = TB_0^r \left(\sum_{i=1}^{12} P_{i,r} X_i^r \right) \left(\sum_{i=1}^{12} P_{i,r}^0 X_i^r \right)^{-1}$ and the term in parenthesis is a Paasche price index.

Zero profit conditions

In each region the value of domestic output in sector i must be equal to the capital and labor costs of producing good i. At the same time, the value of domestic output in sector i equals the value of commodities sold in the domestic market plus the value of commodities sold as exports. Combining these two zero profit conditions, the following expression is obtained:

(A.10) $$P_{DC,i}^r DC_{X,i}^r + P_{X,i}^r EXP_i^r = P_{K,i}^r K_i^r + P_{L,i}^r L_i^r$$

The value of commodities sold as exports must equal the value of the sum of exports to the other 6 regions:

(A.11) $$P_{X,i}^r EXP_i^r = \sum_S P_{RX,i}^{r,s} RX_i^{r,s} \,,\; s \neq r$$

The value of total imports must equal the value of the sum of imports from the other 6 regions:

(A.12) $P^r_{M,i} IMP^r_i = \sum_S P^{r,s}_{DIMP,i} DIMP^{r,s}_i, s \neq r$

The value of the composite commodity i demanded by consumers must equal the value of aggregate imports plus the value of domestically produced goods:

(A.13) $P_{i,r} CMP^r_i = P^{r^*}_{M,i} IMP^r_i + P^r_{DOM,i} DOM^r_i$

The value of goods sold for domestic consumption must be equal to the value of the demand for domestically produced goods; i.e.,

$$P^r_{DC,i} DC^r_i = P^r_{DOM,i} DOM^r_i .$$

Hence:

(A.14) $P^r_{DC,i} = P^r_{DOM,i}$

The value of exports from region r to region s must be equal to the value of imports of region s from region r; i.e.,

$$P^{r,s}_{RX,i} RX^{r,s}_i = P^{s,r}_{DIMP,i} DIMP^{s,r}_i .$$

Hence:

(A.15) $P^{r,s}_{RX,i} = P^{s,r}_{DIM,i}$

Market clearing conditions

- Goods markets

The supply of goods for domestic consumption must equal the demand for domestically produced goods:

(A.16) $DC^r_i = DOM^r_i$

Exports from region r to region s must equal imports of region s from region r because there are assumed to be no transfer (e.g. transport) costs in shipping goods from one region to another:

(1.17) $$RX_i^{r,s} = DIMP_i^{s,r}$$

Total supply of composite commodities, which consists of the composite of similar domestic products and aggregate imports, must equal consumer's demand in each region:

(A.18) $$CMP_i^r = X_i^r$$

Factor markets

For labor:

(A.19) $$\sum_{i=1}^{12} L_i^r = \bar{L}_r$$

For capital, assuming that it is internationally immobile, the market clearing condition is:

(A.20) $$\sum_{i=1}^{12} K_i^r = \bar{K}_r$$

Equations for price relationships

Import prices

(A.21) $$P_{M,i}^{r^*} = P_{M,i}^r \left(1 + \tau_i^r\right)$$

Factor prices

(A.22) $$P_{K,i}^r = P_{K,r} \left(1 + t_{K,i}^r\right)$$

(A.23) $$P_{L,i}^r = P_{L,r} \left(1 + t_{L,i}^r\right)$$

List of variables

Q_i^r	Value added good *i* region *r*.
L_i^r	Labor input good *i* region *r*.
K_i^r	Capital input good *i* region *r*.

DC_i^r Output for domestic consumption good *i* region *r*.

EXP_i^r Output for exports good *i* region *r*.

$RX_i^{r,s}$ Exports of good *i* from region *r* to region *s*.

U^r Consumer utility region *r*.

X_i^r Consumer demand good *i* region *r*.

CMP_i^r Total supply of good *i* region *r*.

IMP_i^r Total imports good *i* region *r*.

DOM_i^r Domestic output for domestic for consumption good *i* region *r*.

$DIMP_i^{r,s}$ Imports good *i* region r from to region *s*.

I^r Income region *r*.

E^r Expenditure region *r*

TAXREV^r Tax revenues region *r*.

TB^r Trade surplus or deficit region *r*.

$P_{L,r}$ Selling prices of labor region *r*.

P_L^r Producer price labor input good *i* region *r*.

$P_{K,r}$ Selling prices of capital region r.

P_K^r Producer price capital input good *i* region *r*.

$P_{i,r}$ Gross price of consumer good *i* region *r*.

P_i^r Price paid by consumers for good *i* region *r*.

$P_{M,i}^{r^*}$ Domestic price of imports good *i* region *r*.

$P_{M,i}^r$ Gross price of imports good *i* region *r*.

$P_{X,i}^r$ Price of exports good *i* region *r*.

$P_{DC,i}^r$ Price goods sold for domestic consumption good i region r.

$P_{RX,i}^{r,s}$ Price of good i exported from region r to region s.

$P_{DOM,i}^r$ Price good i for domestic consumption region r.

$P_{DIMP,i}^{r,s}$ Price of good i imported by region r from region s.

List of parameters

γ_i^r Scale parameter value added function, good i region r.

δ_i^r Share parameter value added function, good i region r.

σ_i^r Elasticity of substitution between labor and capital, good i region r.

φ_i^r Scale parameter exports and domestic sales function, good i region *r*.

β_i^r Share parameter exports and domestic sales function, good i region *r*.

ρ_i^r Elasticity of transformation between domestic output, good i region *r*.

v_i^r Scale parameter export allocation function, good i region r.

θ_i^r Share parameter export allocation function, good i region r.

ε_i^r Elasticity of transformation between regional exports, good i region *r*.

α_i^r Share parameter utility function, good *i* region r.

μ^r Elasticity of substitution in consumption region r.

Ω_i^r Scale parameter domestic and import consumption function, good i region *r*.

ω_i^r Share parameter domestic and import consumption function, good i region *r*.

ν_i^r Elasticity of substitution between domestic and imported consumption, good *i* region *r*.

ψ_i^r Scale parameter import allocation function, good i region r.

δ_i^r Share parameter import allocation function, good i region r.

ζ_i^r Elasticity of substitution between regional imports, good i region r.

$\overline{L}_r$ Endowment of labor region *r*.

$\overline{K}_r$ Endowment of capital region *r*.

τ_i^r Tax rate on imports good *i* region *r*.

$t_{K,i}^r$ Tax rate on capital region r.

$t_{L,i}^r$ Tax rate on labor region *r*.

TB_0^r Benchmark region's trade surplus or deficit region r.