

# COLOMBIAN INTERNATIONAL TRADE FROM A PHYSICAL PERSPECTIVE: TOWARDS AN ECOLOGICAL “PREBISCH THESIS”

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## **Abstract**

Prebisch's approach to economic development was based on the notion that there is an international historical division of labour. *Peripheral* countries are specialized in exporting primary goods while *Centre* countries export industrial goods. The *Terms of Trade* for peripheral countries tend to deteriorate. This approach can be extended to ecological issues. The international *Centre-Periphery* division does not only involve the monetary exchange of goods and capital, but also the physical exchange in which Southern countries provide materials and energy so that Northern countries can develop their socioeconomic metabolism. This metabolic process is guaranteed through cheap prices for primary goods. This paper aims to apply and extend Prebisch's thought on unequal exchange, both monetary and ecological, in relation to Colombian trade in the period 1970-2002, using Material Flow Analysis.

## **Key words**

Ecological Economics; Ecologically Unequal Exchange; Colombia; Material Flow Analysis; International Trade and Environment; Prebisch.

## **1. INTRODUCTION**

At the beginning of the 21<sup>st</sup> century, Latin America and other developing countries still specialise in exporting primary, natural resource-intensive goods, and secondary goods intensive in unqualified labour. This development pattern is complemented with the import of capital goods rich in technology and knowledge from industrialized countries. Despite the export emphasis on industrial products over the past thirty years, in many developing countries import-export patterns are similar to those that existed two centuries ago, based on primary goods. The volumes exported have increased greatly. This specialisation model has been the object of concern and study by possibly the most respected and influential economist to come out of Latin America, in both the academic world and the field of international development institutions such as ECLAC and UNCTAD. Raúl Prebisch (1901-1986) had a notable influence on the management of the Latin American economy between 1950 and 1975. Prebisch's influence derives from the study he made for ECLAC (Economic Commission for Latin America and the Caribbean) in 1949, later published as an article, *The Economic Development of Latin*

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*America and Its Principal Problems* (Prebisch, 1949). ECLAC (CEPAL in Spanish), a United Nations institution, was created in 1948, and Prebisch held the post of director between 1950 and 1963. The influence of ECLAC and Prebisch was felt when Latin American structuralist ideas arose, the time of post war crisis and reconstruction, the high point of Keynesian interventionism, the beginning of the new international economic order and the Bretton Woods institutions (IMF, World Bank); the ‘empirical’ implementation of the import substitution strategy as a response to the collapse of the international economy in the 1930s, and the protectionist attitudes of many countries around the world.

In this context, one of Prebisch’s main concerns was the relationship between international trade and development and within this, the deterioration of terms of trade for export products from the *peripheral* countries, or from the *South*. These products are characterised as using natural resources, and are produced by unqualified labour, whereas those from the centre (*North*), are characterised as capital and knowledge-intensive. The deterioration of terms of trade for exports means that an ever increasing quantity of exports is needed to obtain the same amount of imported goods. This phenomenon gave rise to the concept of economically unequal exchange, which was made popular in the 1960s. However, few have looked at Prebisch’s theory with environmental lenses. In the new field of Ecological Economics (EE) there have been some attempts to introduce the notion of trade-related environmental cost-shifting between countries, particularly from the North to the South (Muradian and Martínez-Alier, 2001a; Muradian *et al*, 2002; Machado *et al*, 2001; Giljum, 2003; Giljum and Eisenmenger, 2004).

Prebisch’s concept of an international division of labour between the *Centre* and the *Periphery*<sup>1</sup> can be extended to the issues related to the metabolism of economic systems. In the global system, many Southern countries play a role as suppliers of the material and energy needs required by Northern countries for their activities. This role is much more important today than in the 16<sup>th</sup>-18<sup>th</sup> centuries, when trade was in “preciosities”. The low prices of primary commodities and the deterioration of terms of trade are the mechanisms through which the *North* can acquire the material and energy resources to fulfil its metabolic processes (Hornborg, 1998; Naredo and Valero, 1999).

In this article, Colombian foreign trade from the 19<sup>th</sup> century until today is described, with emphasis on unequal trends between 1970 and 2002, both in monetary and ecological terms. The first part of the article will discuss Prebisch’s concerns about trade and development. The relevance of his ideas for Ecological Economics (EE) will be shown. Once this theoretical framework has been presented, the methodology used to estimate the foreign trade balance in biophysical terms for Colombia will be summarised, and the research results in both monetary and ecological terms will be analysed. Ecologically unequal exchange is expressed in terms of the Colombian foreign trade biophysical deficit and the deterioration of ecological terms of trade throughout the period analysed. The article ends with the conclusions.

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<sup>1</sup> This concept cannot be exclusively attributed to Prebisch. The unequal exchange hypothesis is shared with Hans Singer (1950). Marxist thought brought additional aspects associated with the different value of human work between the North and the South (Emmanuel, 1973). Immanuel Wallerstein (1974) also complements this vision, particularly with his distinction between trade in “preciosities” and trade in “bulk commodities”.

## 2. PREBISCH'S THESIS

Prebisch was an economist, and his central concern was to establish specific policy guidelines to drive economic development in Latin America. This was understood as a process aimed at improving the population's quality of life through the systematic increase of productivity. However, any initiative with this aim came into collision with the structural economic imbalances that existed as much in the foreign sector as domestically. Prebisch suggested that a development strategy will not be successful if economic activity concentrates on production and export of primary commodities to industrial centres. For this reason, encouraging industrialisation is essential (Gurrieri, 2001).

### 2.1 Deterioration of terms of trade

The theory of the deterioration in terms of trade in developing countries was formulated in parallel by Prebisch (1949, 1951, 1952) and Singer (1950). This theory combines two different but complementary hypotheses (Ocampo and Parra, 2003). First, the negative effects of the *low income-elasticity of demand* for raw materials on the terms of trade in developing countries. Given that a large part of the technological change in manufactured goods is associated with reducing the cost of raw materials, the surplus of primary commodities will tend to put pressure on the relative prices in the international sphere to bring them down. From another point of view, the productivity increases in the primary commodity sector will tend to lower prices of exports from the periphery. Today we may confirm that since Prebisch wrote, although demand for primary goods has increased very much (the world economy is certainly not "dematerializing"), there has often been an oversupply of primary goods, and decreasing relative prices.

The second hypothesis is related to the *asymmetries in the functioning of the labour markets* in the centre and the periphery of the global economy. In this explanation, the deterioration of terms of trade is generated through the factors market: while in the case of manufactured goods, the fruits of technical progress and increased productivity benefit both entrepreneurs and workers through higher profits and wages, in the case of primary products, technical progress translates into lower prices and lower wages. In other words, exporting primary commodities from poor countries in exchange for industrial products or services from rich countries implies trading many badly-paid hours of work for a few hours of well-paid work.

This asymmetry is a result of the workings not only of the goods markets (greater market power to fix prices of manufactured goods) but also of labour markets (better organisation of unionized industrial workers). This has dynamic effects on employment levels. The relative labour surpluses displaced from primary activity tend to be concentrated in developing countries, which also have greater difficulties in employing these surpluses in new production sectors. In this way, labour surpluses again give rise to the lowering of wages and the deterioration of terms of trade<sup>2</sup>.

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<sup>2</sup> In the case of tropical agricultural products (such as sugar and coffee), according to Lewis (1955), the high *elasticity of supply* is a third factor contributing to lowering the terms of trade. Given the abundance of land and labour and the facility for transferring this type of crop between tropical countries, frequent oversupplies are generated in the international market.

In relation to this discussion, Prebisch highlighted the subsidies that the Centre gives to agricultural activities in comparison with industrial work within its own borders. “There, the production rhythm tends to exceed growth in demand, and in response, defence mechanisms are established (subsidies) for the price relations in favour of agricultural products. Although this accentuates the effect of low growth in demand of agricultural exports in the Periphery, it has the virtue of demonstrating the importance that the centres have given to the deterioration of primary prices, and at the same time, signals a possible means of solving the problem on the international level” (Prebisch, 1963).

A historical controversy has raged around the evolution of terms of trade in developing countries. The neoclassical and Keynesian literature from 1950s and 1960s concentrated on the first hypothesis (Johnson, 1954), i.e. the effects of low income elasticity of demand for primary goods. The analysis of unequal exchange, for its part, was centred on the asymmetries in labour markets (Findlay, 1980 and Taylor, 1983). For a wide-ranging analysis of both streams of empirical literature, see Ocampo (1986), who remarked upon the existence of more reliable data and new statistical methodologies for time series analysis. Ocampo, an economist from Colombia (and Oxford) was himself secretary-general of ECLAC around 2000. It is important to note his recent research (Ocampo and Parra, 2003). From data on the prices of 24 basic products throughout the 20<sup>th</sup> century, it can be shown that the terms of trade, with the exception of oil, have decreased by two-thirds since 1920. This means an annual decrease of -1.5% in the past 80 years, obviously a very significant deterioration.

However, it was found that the fall was not manifested as a continuous reduction in prices, but rather it was associated with the two great structural crashes that occurred in 1921 and 1979. These crashes are related to strong slowdowns in the international economy after the First World War and the first oil crisis in the 1970s. This deterioration of terms of trade has been corroborated by several different authors (Cuddington, 1992; Bleaney and Greenaway, 1993; Cashin, and McDermott, 2002). The latter found a persistent negative trend -without crashes- leading to an accumulated reduction of 75% throughout the period analysed (Ocampo and Parra, 2003). These results tend to corroborate the Prebisch-Singer hypothesis. The vast recent literature on international ‘divergence’ of salaries and income per capita helps to demonstrate the hypothesis related to the trend in factorial terms of trade (ECLAC, 2002).

## **2.2 Hierarchy in the global economic system**

Prebisch’s theory in this field is focused on the notion that the process of technical progress propagation since the Industrial Revolution generated a periphery on the global level. Under this system, the periphery is linked to the centre in terms of its ability to satisfy the centre’s food supply or raw material requirements. In this way, the income generated by the whole system from increases in productivity tends to be concentrated in the centre, because the price relationship between industrial and primary products has historically favoured the former (Prebisch, 1951, 1952).

This selectivity in the ‘penetration’ of technical progress explains the differences in development between one country and another, creating structural heterogeneity. If a peripheral country’s production is of more interest to a central country, it will have better technology for these sectors of interest, but this technology will only lead to

improvement for a limited part of the population, because of the lack of complementariness between sectors.

The outward directed development of the periphery is historically contingent, the result of a fortuitous history. It gives them the chance to occupy a place within the whole but it causes slow penetration of technical progress, and produces distortions in the internal production apparatus that result in heterogeneity in productivity, as well as in income in economic sectors and regions within Southern countries. A centre and a periphery can also be identified within these countries. This interpretation destroys the doctrine that states that the fruit of technical progress will tend to be equally shared out through international trade, either through lowered prices or an equivalent rise in income.

### **3. ECOLOGICAL IMPLICATIONS OF THE UNEQUAL EXCHANGE THEORY**

The concept of a dualist international division of labour developed by Prebisch and other authors (Singer and Wallerstein) can be easily extended to international ecological issues by using the analytical structure of EE and in particular, the social metabolism approach. For EE, society is not just a series of economic, social and cultural relationships between individuals and groups, but also a subsystem embedded in a wider physical system. Energy comes into the economy, and leaves it as dissipated heat. Raw materials are extracted, enter the economy, and become waste. The economy transforms raw materials to provide material goods and services for itself, and rejects the waste (Schandl and Weisz, 2002).

Within this analytical framework, the international division between the centre and the periphery relates not only to the monetary trade of goods and capital, but also to the physical trade in which many Southern countries provide the material and energy requirements for Northern countries to develop their socioeconomic metabolism. This trade is ecologically and economically unequal, as apart from not recognising environmental costs and natural heritage exhaustion, monetary terms of trade are unfavourable for the Southern exporting countries.

This schema allows the North to acquire materials and energy for its metabolism, with prices, direct foreign investment and external credit as the mechanisms that facilitate such acquisitions. It is important to understand that these unbalanced trade relations are associated with the asymmetry that exists between the physical cost of natural resources and their monetary value. These relations become accentuated as the processes advance towards the final sale of a product, given that to produce goods, more work, energy and materials have been spent or dissipated<sup>3</sup> (Hornborg, 1998, and Naredo and Valero, 1999). This asymmetry benefits the countries, businesses and people who work on the final phases of management and trade, meaning that the growing specialisation accentuates the North-South, city-country or rich-poor imbalance at all levels. Furthermore, this asymmetry is reinforced by the workings of an international financial and institutional system that strengthens the economic and political power of rich countries and their economic agents beyond what would be allowed through simple trade balances (Carpintero, 2003).

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<sup>3</sup> A product does not incorporate the energy spent to produce it, on the contrary, the energy is dissipated. There is more potential energy (and materials) in raw materials than in the final product.



The contribution made by EE means that Prebisch's theories now have clear environmental implications. According to Prebisch's theories, while in the North, the continuous increases in industrial productivity are translated into increases in salaries and income, in the South, any increases in primary sector productivity are translated not only into a fall in salaries, given the labour surplus, but also into a fall in terms of trade. In addition, with the purpose of maintaining export income flow, the rhythm of natural resource extraction is intensified<sup>4</sup>. If this is the case, these asymmetries do not only generate a dynamic that follows Prebisch's thesis, but they also widen out its effects to ecological issues in the long term. The intensification of natural resource exploitation and the subsequent environmental impacts certainly generate environmental liabilities but such costs are not included in the prices of export products. The South does not only export its productivity increases, but also physically exhausts its natural resources by sending them abroad. As Röpke (1994) indicated, many developing countries fall into a kind of underdevelopment and ecological deterioration 'trap' associated with trade and the deterioration of terms of trade.

For EE, international trade generates environmental effects on natural resources and the environment in Southern countries through different mechanisms: i) Free trade provides an incentive to externalise environmental costs with the aim of gaining competitiveness in the global market. This could result in a 'lowering effect' of environmental and social standards in both the South and the North (Daly, 1993); ii) Free trade stimulates moving environmental burdens towards Southern countries, while the North maintains high levels of environmental quality within its own borders (Muradian and Martínez-Alier, 2001a). There is a displacement of environmental burdens to the South (pollution, natural resource depletion, expansion of the agricultural border, or other land use changes such as mangrove destruction in favour of shrimp exports). This is promoted by the consumption of importing countries, and the effects are suffered in the exporting countries; iii) The growing distances between places of extraction and transformation and use, are leading to a great expansion in sea transport, and the creation of huge rail and port infrastructures which are highly intensive in raw material use and soils and atmospheric pollution (Bunker, 1996); iv) International trade also increases the physical and social 'distance' between those who take decisions and those who are affected by them, making it difficult for northern consumers to see the consequences of their actions. This increase in trade and in geographical expansion of economic activity affects local institutions and regulations, limiting their role in environmental conservation (Costanza *et al.*, 1997). Simultaneously, indigenous groups at the "commodity frontiers" must deal with Transnational Corporations with whom no common cultural language is possible. As Ostrom (1990) notes, maintaining and strengthening short communication lines and local control on resources are aspects that can be effective for natural resource preservation.

Empirical evidence of unequal ecological exchange has been found in different studies. For instance, Muradian and Martínez-Alier (2001b) found that the relative

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<sup>4</sup> Any country that specializes in basic goods exporting tends to fall into a trap. If prices are low, the exploitation of natural resources by resource unit is intensified (intensive effect), and if the prices are high or have a growth trend, the exploitation of natural resources is extended to other areas of territory (extensive effect). Equally, as the change in relative export prices is not homogenous between all exportable goods, there is also a specialization effect linked to the product with the greatest comparative advantage, thus intensifying natural resource exploitation through production specialization.

‘dematerialisation’ of some industrial countries can be explained to a great extent by the increase in natural resource exploitation in many Southern countries. Poor countries attract ‘polluting’ activities and material intensive production (because they are relatively poor) while rich countries specialise in clean and material extensive production, without changing their consumption patterns. The same authors found that in the past 30 years, the consumption of non-renewable resources exported from the South has increased, while there has been a significant fall in their international prices, generating a loss in terms of trade compared with imports (Muradian and Martínez-Alier, 2001a). Other research demonstrates that international trade has allowed pollution sources to be transferred from the North to the South (Muradian *et al*, 2002, Machado *et al*, 2001). This displacement of pollution-intensive activities from the centre to the periphery should be related not so much to lack of environmental awareness in the periphery as to local lack of power and low incomes (Martinez-Alier, 2002).

Similar results appear in studies conducted specifically for some Southern countries. For example, in the case of Chile, it was found that the physical trade balance (PTB) of the total direct and indirect flows included in imports and exports between 1973 and 2000 reflected an important deficit due to the high material requirements needed for copper production and other products associated to biomass export, such as fruit, wine, paper pulp, wood and fish products (Giljum, 2004). In similar studies on Brazil and Venezuela, there were significant deficits in the PTB (Machado, 2001 and Castellano, 2001, respectively).

#### 4. METHODOLOGY AND DATA

To measure physical material movements between the economy and the environment, the methodology known as Material Flow Analysis (MFA), which accounts for the use of natural resources in production processes and consumption in terms of tonnes, is used. Raw materials, water and air are extracted from the natural system as inputs, transformed into products and finally retransferred to the natural system as outputs (waste and emissions). This has similarities with the natural metabolism process, as characterised by Ayres (1989) and Fisher-Kowalski (1998) by the respective terms of ‘industrial metabolism’ and ‘social metabolism’. According to the law of mass conservation, the total inputs should by definition be equal to the total outputs plus the net accumulation of materials in the system. This material balance principle should be true for the economy as a whole, as well as for each one of its subsystems: an economic sector, a company, a home.

MFA has already reached a reasonable level of standardisation, to which different European institutions and governments have contributed. Two institutions stand out as pioneers of international research: the Wuppertal Institut in Germany and the Institut für Interdisziplinäre Forschung und Fortbildung (IFF) at the University of Klagenfurt, Austria. The publication of the methodological guide “Economy-wide material flow accounts and derived indicators” by the European Statistics Office (EUROSTAT, 2001), meant that a more harmonised and universal standard has been achieved (Schandl and Weisz, 2002).

MFA differentiates between three main groups of material inputs: water, air and all the other materials, which consist of raw and semi-manufactured materials, as well as final goods. Raw materials can also be divided into biomass, mineral resources and fossil fuels. This differentiation is a little more complex in semi-manufactured and final goods as they appear as mixed materials, and therefore a significant part of unclassified materials are included. In general, air and water are excluded because of their great weight and the difficulties in calculation.

With relation to foreign trade, the Physical Trade Balance (PTB) is the most important indicator. A PTB expresses if the imported resources from the rest of the world exceed the resources exported from a country or region, and also how much of the domestic material consumption is based on imports and how much on local resource extraction. The PTB calculation is the result of subtracting exports (X) from imports (M), the opposite of what is done for monetary trade balances. The deficit in this context (M-X) refers to the quantity of net biophysical resources that leave a territory (EUROSTAT, 2001).

As with a general MFA balance, a PTB also includes direct flows and indirect or hidden flows. Indirect flows are not physically exported or imported, but they are materials clearly required and used throughout the production chain to deliver the final product on the other side of the border. In MFA literature, these indirect flows have been called an 'incorporated material requirement' or 'ecological rucksack' (Giljum and Hubacek, 2001). In this research only directly used material flows were accounted for.

Information collection, management and processing in physical as well as monetary aspects was carried out essentially from national official sources and secondary sources on Colombian economic history (Banco de la República, Departamento Nacional de Estadística –DANE- and Departamento Nacional de Planeación -DNP). It should also be noted that the series constructed for the aggregated analysis corresponded to the period 1970-2002; however there were some gaps in the information sources for disaggregated analysis, therefore only the period 1975-2002 was considered.

## **5. COLOMBIAN FOREIGN TRADE PATTERNS DURING THE 19th AND 20th CENTURY**

Both the structure of foreign trade in force at the end of the 19<sup>th</sup> century and its evolution throughout the 20<sup>th</sup> century have to a great extent been subject to comparative advantage (GRECO, 2002). In other words, Colombian foreign trade (FT) has been characterized in the main by the export of goods intensive in unqualified labour and natural resources, and by importing goods which correspond to resources scarce in the country (qualified labour and capital and knowledge intensive goods). In addition, the production and FT structure also reflect the natural barriers associated with the settling of considerable population groups in mountain areas, a fact which has imposed high transport costs.

There are also other social and political factors that have contributed to modelling Colombia's production and FT patterns. In particular, the international economic order that promotes primary goods specialisation for Southern countries could be mentioned,



along with the import substitution policy that allowed Colombia after the 1930s to consolidate an industry of consumer and intermediate goods.

During the 19th century, export products were associated with the primary sector, with the principal products being precious metals (silver and gold), tobacco, indigo, quinine and coffee. While precious metal production had been a constant since the 18<sup>th</sup> century, the other products, with the exception of coffee, had relatively short export cycles which limited their impact in terms of capital accumulation (Safford, 1977). The sharp falls in quinine, indigo and tobacco exports are not strange at all. They are associated with different phenomena that separately affect raw material and primary good exports, the appearance of substitutes and alternative sources of supply, as well as international oversupply that generated price reductions and made production unprofitable in some areas.

In the last 25 years of the 19th century coffee cultivation gained significance, becoming a motor for economic development. At the end of the 19<sup>th</sup> century, it generated around 50% of export revenue. This was accompanied by one of the most serious periods of deforestation in the Colombian Andes, the process known as the 'coffee colonisation', which made possible a significant extension of the agricultural frontier which continued to increase until the 1930s. Simultaneously, there was a decisive turning point during this century that marked the destiny of Colombian international trade; trade relations moved from orbiting around Europe to the United States, a relation which still exists.

One hundred years ago, trade was not very important for the Colombian economy. In 1913, Colombia's share of exports in GNP was 4.2%, a level lower than that of the main Latin American countries. However, at the end of the 20<sup>th</sup> century, the Colombian economy had stopped being an example of isolation, with its export share reaching 12% of GNP (GRECO, 2002). Likewise, the Colombian economy's exporting dynamic grew throughout this century, multiplying its value by 985 times in (constant 1990) US\$, going from 11.8 million in 1905 to 11.664 million in 1999. Significant phases of acceleration can also be observed, principally associated with the improvement of terms of trade in exportable products, in particular, coffee, and relevant falls related to deterioration in terms of trade. The great peak of Colombian foreign trade has arrived with the outward development model which was put into place at the end of the 1960s and increasing demand for raw materials.

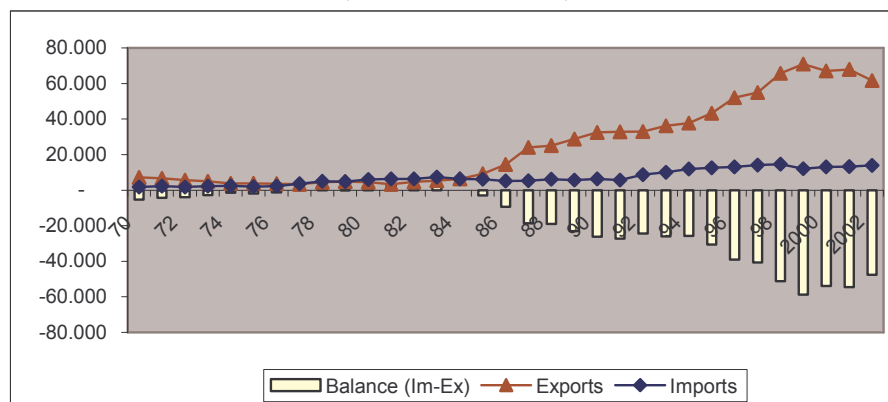
Just as in the 19<sup>th</sup> century, nowadays the main exports are directly related to the primary sector, headed by coffee, gold, bananas and fossil fuels. Within these, the coffee economy has been the basic sustenance of Colombian exports throughout almost the whole century, only losing relevance in the last 20 years. From the 1970s onwards, the category 'other exports', associated with export promotion policy, has been gaining growing importance. In the final years of the 20<sup>th</sup> century, this area of the economy represented 55% of Colombian exports in monetary terms. Nevertheless, these newly-promoted exports maintain a high level of primary goods such as flowers, cotton, beef, seafood, emeralds, nickel and coal. Although there are also products linked to the industrial sector, a good proportion of these are not only labour-intensive, but also demand significant components of natural resources, such as clothing, printing, and the chemical industry related to oil refining.

Imports have both complementary and substitution relationships with local production. Notable is the growing importance of industrial imports associated with intermediate goods and capital. In money terms, these two categories currently represent an average of 80% of all imports, with half of these being capital goods. During the first 70 years of the 20<sup>th</sup> century, the same pattern from the 19<sup>th</sup> century was repeated: imports were financed almost exclusively by exports, following the same cycles and trends of the latter. It can therefore be stated that until the end of the 1970s, monetary trade deficits were compensated by the surplus from the nearest following periods. However, after the 1980s, more long-lasting monetary trade deficits, which were financed by overseas resources, appeared. This has meant a growing need to finance investment and consumption in Colombia through external loans, which has in turn led to the need to increase exports to service this debt (GRECO, 2002).

## 6. COLOMBIAN FOREIGN TRADE BIOPHYSICAL BALANCE: 1970-2002

The direct flow of materials exported by Colombia increased significantly during the period under analysis, with a special dynamic from 1985 onwards (Figure 1). After an important decrease until 1977, going from 7.2 million tons in 1970 to 3.3 million in this year, the figure increased once more until it reached levels of 71 million tons in 1999. The total fell to 62 million in 2002.

**Figure 1. Physical Balance of Trade in the Colombian economy: 1970-2002**  
(In thousands of tons)



Source: DANE, Departamento Administrativo Nacional de Estadísticas-ACE, Anuario de Comercio Exterior. Calculations by the author.

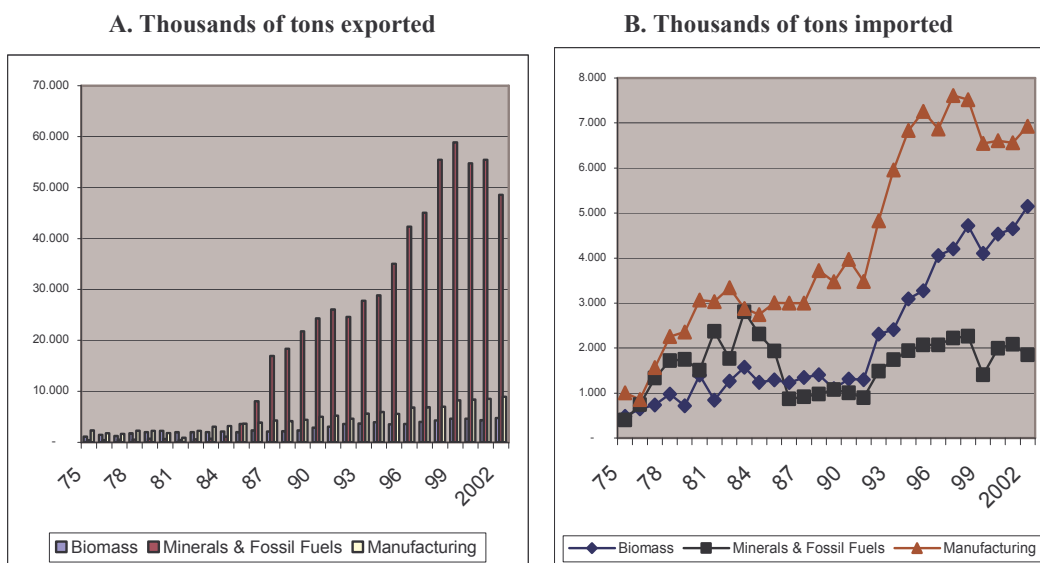
Both the downward as well as the upward cycle can be explained by the changes that occurred in the material structure of exports. The first cycle is associated with the fall in oil exports that started at the beginning of the 1970s, which disappeared from 1973 to 1986, and also with the significant increase in industrial exports which have less relative weight. The upward cycle is related to mining goods, in particular, the reappearance of oil with production from the Caño Limón and Cusiana wells in East Colombia and new coal and ferronickel exports from the Cerrejón and Cerromatoso large open cast mines on the Colombian Atlantic coast. As can be observed in Figure 2-A, the export dynamic in physical terms is driven by mineral and energy exports from 1986 onwards. This dynamic is the cause of the deficit in the Colombian physical foreign trade balance.

Physical imports remained relatively constant until 1976, with an average close to 2 million tons. After this point, they underwent continuous but slow growth in the rest of the period until reaching the figure of 14 million tons in 2002. There was a small initial physical deficit until 1976, and later a slight surplus in the period 1977-83. From this moment onwards, driven by mining and energy exports already mentioned, there were continuously growing deficits for the rest of the period, representing significant net amounts of material resources leaving the country. The total balance during the 33 years analysed shows a net deficit of 591 million tons of materials that have left Colombia on their way to other parts of the world. It could be said that this quantity is the tip of the iceberg of the ecological debt accumulated during these 33 years that the rest of the world owes Colombia due to foreign trade. The hidden part of the iceberg are the 'ecological rucksacks', related to the hidden flows and the environmental impacts.

This balance throws light on the ecologically unequal exchange. 'Environmental load displacement' can be clearly observed: the environmental costs caused in one region are paid for by another (Muradian *et al*, 2002). While Colombia exports material requirements that the rest of the world demands for its activities, the country takes on the costs of pollution and natural resource exhaustion.

On the other hand, considering the structure of imports in physical terms, it may be seen that the majority is made up of manufactured goods of all kinds, with its share stabilising at around 50% in the 1990s (Figure 2-B). The growing importance of imported biomass can also be observed, as it has been increasing since the 1990s, with current levels reaching around 35%. This last dynamic can be explained by the economic aperture policy which was strongly promoted during these years, which facilitated the entry of soybeans, sorghum, corn and other cereals.

**Figure 2. Colombian exports and imports by material type: 1975-2002**



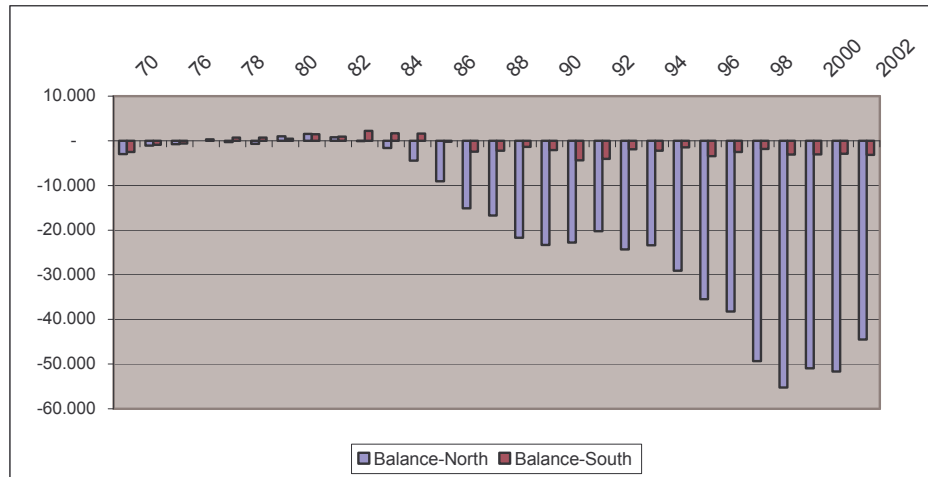
Source: DANE-ACE. Calculations by the author.

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Comparing the accounts for the Colombian physical trade balance (PTB) with the group of high income countries (North) and with the low and middle income countries

(South)<sup>5</sup>, a similar cycle can be found for both regions, although with great differences in the magnitude. At the beginning of the 1970s, there was a small deficit with both groups of countries, which then became a small physical surplus in the next five years of this decade. From approximately 1985, a permanent deficit in Colombian trade begins to appear for both groups of countries, with higher results for the North (Figure 3). Ecologically unequal exchange, through which more material resources leave the country than enter it, is related essentially with trade between Colombia and the North.

**Figure 3. The Colombian Economy's Physical Trade Balance with the North and South: 1970-2002 (thousands of tons)**



Source: DANE-ACE. Calculations by the author.

For Northern (industrialised) countries, the natural resources that can be extracted in their own territory are not enough to maintain their current metabolism. Their production and consumption need to import large quantities of energy and materials from Southern countries, such as Colombia. These material and energy needs can only be obtained, and the difference in quality of life maintained, if the prices of the imports that come from the North (manufactured) are higher than the prices of exports that come from the South (raw materials). As Hornborg (1998) states, prices are the mechanism through which the North obtains the exergy (available energy) surplus that it uses, sometimes helped by military power. Therefore the asymmetry between the high physical value of natural resources and their low economic value is what allows the metabolism of the world system in its current organisation to function. International trade plays a leading role in importing materials and energy to develop production and consumption processes in the North. Unequal ecological and economic exchanges are the consequences. The direction of the net flow of energy and materials is therefore a suitable means of identifying unequal exchange. [A comparative analysis of the type of material exported and imported by the Colombian economy during the study period corroborates Prebisch's thesis. Colombia exports natural resource intensive goods with a low monetary value per ton and, in parallel, imports capital intensive goods with a higher value per ton (see Figure 2). This reflects the asymmetry described between the physical and monetary values of merchandise traded internationally, where the

<sup>5</sup> The North is defined as the countries that, according to the World Bank's classification, have high incomes (above \$9,206 US per capita). The South is made up of the countries that have income per capita lower than this amount (World Bank, 2001).

monetary value increases as more work, energy and materials are used and dissipated to produce a good]<sup>6</sup>.

## 7. TRADE RELATIONS AND ECOLOGICAL EFFECTS (1970-2002)

As has been stated throughout this article, one of the principal concerns of Prebisch's theory is related to the role of deterioration and instability of international prices of exports from regions wealthy in natural resources, as an element that explains these regions' economic backwardness. The effect of this long-term instability and fall in prices of primary goods exported is a loss of the purchasing power of national exports. EE contributes an additional element: to the economic loss implied by the low monetary value of merchandise exported from Southern countries in relation to the high monetary value of products imported from the North, it adds the deterioration and despoiling of natural resources in ecological terms. This leads to the paradox that impoverished countries not only specialise in the export of those goods that generate the lowest monetary added value, but that it is precisely this merchandise that also supposes the highest physical cost of replacement or damage repair, and incorporates more energy and materials (Carpintero *et al*, 1999).

To define the 'terms of trade' in this case, work was carried out with a proxy of international prices of the goods traded by Colombia, using the average value per ton exported and imported. Based on this definition, Figure 4 shows the results for the period analysed, finding significant differences in the price trends per ton. While the value per ton imported showed a rising trend during the whole period in current dollars, this value for exports had a boom until 1982, and then later continually decreased until 2002. The rising value per ton of Colombian exports until 1982 is associated with the high international coffee price and a change in the export structure composition.

During this coffee boom, below zero temperatures in some Brazilian coffee zones reduced their bean supply greatly, while significant stocks gathered by Colombia in previous years, as well as the solidity of the International Coffee Pact, meant that sales abroad exceeded 12 million sacks annually (before this Colombia traditionally exported 7-8 million sacks) at the highest international prices in the history of coffee-growing in the country. The prices exceeded \$2.30 US per pound in 1977, in comparison with 2004, when the price has been around \$0.81 US per pound (FNCC).

The other important change was an increase in the share of industrial exports in the 1970s, which have a higher value per ton, therefore contributing to improving the terms of trade. The newly promoted exports, coal and ferronickel, as well as the reappearance of oil, which gained force above all in the second half of the 1980s, led to a decrease in the value per ton of exports<sup>7</sup>. In Fig. 4, the linear trends for each category can be observed; showing the loss in terms of trade against Colombian exports.

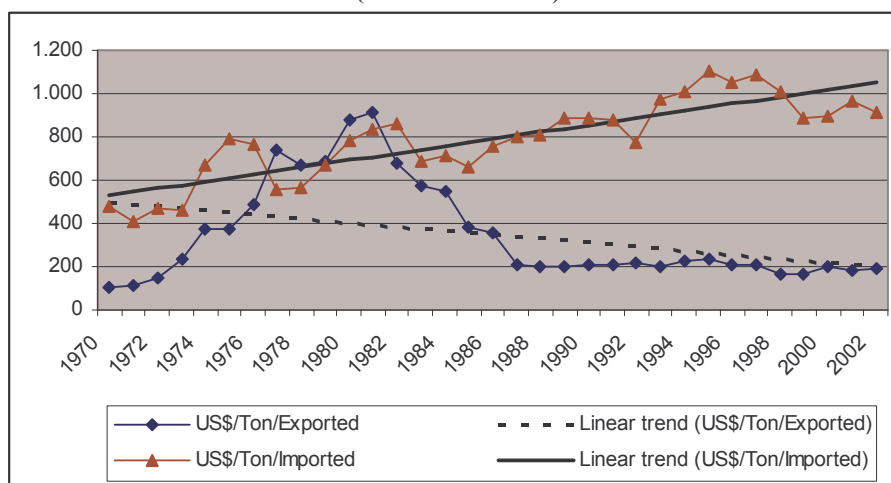
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<sup>6</sup> Some industrialised countries such as the USA, Canada, Australia, New Zealand and Norway are raw material exporters, and may be affected by deterioration in terms of trade. However, the effects on their economies are different for three reasons: i) They have greater complementarity between these sectors and their industrial activity; ii) They depend less on this type of exports; and iii) They have more political and economic power at the international level, which is translated into greater governance over local policy. This allows them to offset the negative effects of free trade policy on their local economies.

<sup>7</sup> In 2004, coal and oil prices are increasing, but the period analyzed ends in 2002. This could cause some changes in the conclusions obtained. However, these are minor, as both imports and the external debt



**Figure 4. Terms of Trade of Colombia: 1970-2002**  
(US\$ Current/Ton)

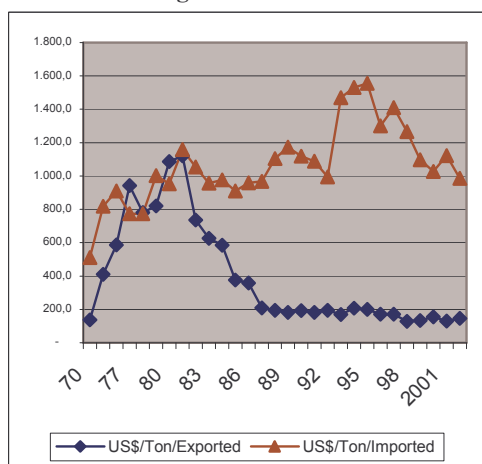


Source: DANE-ACE. Calculations by the author.

The previous analysis is complemented with an analysis by group of countries. On examining Figure 5-A, a considerable difference can be found between the value per ton of Colombian exports to rich countries and the value per ton of the imports from these same countries. Between 1977 and 1983, the high coffee prices mentioned above meant a reduction in this difference, but it has risen consistently from 1983 until the end of the period studied, 2002. The value per ton imported from the North has increased relative to the value per ton exported by Colombia.

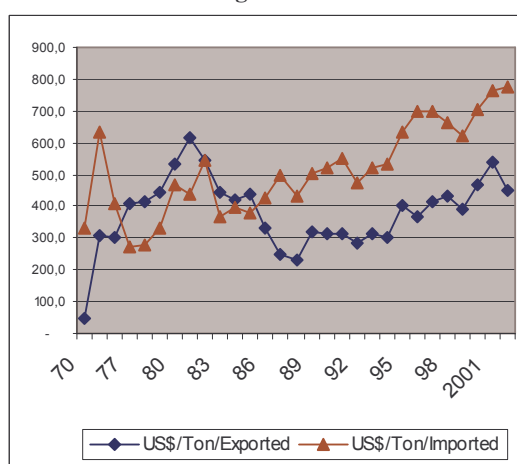
**Figure 5. Terms of Trade of Colombia by groups of countries by income:**  
1970-2002 (US\$ Current/Ton)

**A. Value of average ton of FT with the North**



Source: DANE-ACE. Calculations by the author.

**B. Value of average a ton of FT with the South**



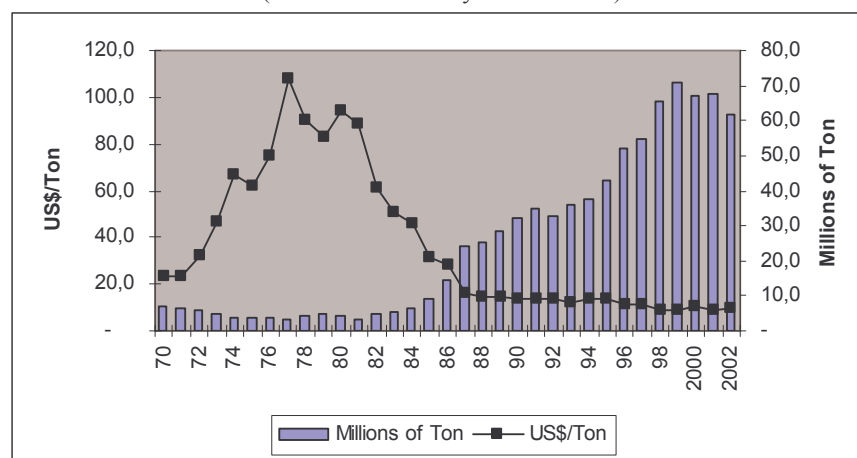
Source: DANE-ACE. Calculations by the author.

It is a different matter for trade with the South. Although import prices increased slightly, relative to export prices, the difference is much smaller than for trade with the North (see Figure 5-B).

have both increased over these two years; therefore the pressure to intensify the exploitation on natural resources has been maintained.

Figure 6 presents the results of the analysis of the relation between the real average value per ton exported<sup>8</sup> and the export volume in tons. The fall in real prices per ton exported is accompanied by the continuous growth of the volume of material exported by the country.

**Figure 6. Relation between the real price per ton and volume of material exported by the Colombian economy (1970-2002)**  
(Dollars corrected by the USA CPI)



Source: DANE-ACE. Calculations by the author. CPI, USA: Mitchell (1993) and IMF.

When there was recuperation of the value per ton of Colombian exports from 1979 onwards, related to the rise in international coffee prices, there was a small fall in export physical volume. Conversely, when export prices go down, a rapid rise in the physical volume of exports begins, attributable to a great extent to mining exports. Presumably the fall in export prices put pressure on to overexploit natural resources. However, the dynamic of this relationship will depend on the practice of each specific market for each exported good, including the demand characteristics (price and income elasticities) and the supply (type of good and production structure).

## 8. CONCLUSIONS

- Throughout the two centuries of Colombia's history as a republic, there has been a specialisation pattern in foreign trade associated with the comparative static advantages of the national economy. While in the 19<sup>th</sup> century, the main export categories were gold, coffee, quinine, indigo and tobacco, throughout the 20<sup>th</sup> century, they were coffee, oil, bananas and gold, with coal, nickel, emeralds, flowers and illegal crops entering the market with force in the last 30 years. In particular, until the beginning of the 1980s, coffee exports and the comings and goings of their price were determining factors in the national economy's development. In parallel, during these two centuries a pattern was also developed for imports, with emphasis on intermediate and capital goods.

<sup>8</sup> The value in current dollars was corrected with the USA Consumer Price Index throughout the period analysed. In this way, the quantity is expressed in real terms.

- This trade pattern has had important environmental implications: the extension of the agricultural coffee frontier with the destruction of a large native forest area in the Colombian Andes; water and soil pollution due to the intensification of agrochemical use for cash crops; a move away from traditional agricultural patterns, which were more environmentally sustainable; and high levels of localised atmospheric and soil pollution generated by mining activities and oil extraction.
- A growing deficit is evident in the Colombian economy's physical trade balance (PTB) during the period analysed (1970-2002), which can be explained by the reappearance of oil exports and new exports of coal and ferronickel. This deficit represents the net export of around 600 million tons in 33 years, the visible part of the ecological debt that the rest of the world has with Colombia. The actual material deficit as well as the environmental liabilities would be much greater if the hidden flows associated with the exports were included.
- While financial trade deficits can be solved in the short term by reducing imports or increasing indebtedness, foreign investment or remittances from Colombians abroad, the physical imbalance has no similar mechanisms. It results in irreversible deterioration and exhaustion of natural resources.
- On carrying out an analysis by groups of countries, the Colombian PTB can be explained in the main by trade with high income countries (North). 85% of the total tonnage exported by Colombia is directed at satisfying the material and energy requirements of these countries, in particular the USA and the EU.
- On analysing the terms of trade (prices per ton of exports vs. prices per ton of imports), a significant deterioration in Colombian exports' purchasing power is clearly shown. While the trend in the monetary value of a ton of exports fell throughout almost the whole period, with the exception of the peak in the late 1970s associated with the rise in coffee prices, the value per ton of imports underwent continuous growth.
- Such trends are related on the one hand with the fall in biotic raw materials (into which category coffee falls) and on the other, with the rise in values per ton of imported manufactured goods, which represent 52% of the physical and 83% of the monetary value of Colombian imports. Except for biotic raw materials, the average value of exports is lower than the average value of imports. This exception is due to the high value per ton of Colombian agricultural goods (coffee, bananas and flowers) compared with the low value of the commercial crops imported (soy, corn and other cereals).
- This research combines Prebisch's thesis with ecological economics. There is evidence that unequal ecological and economic exchange exists between Colombia and the rest of the world, in particular with Northern countries, which is manifested in two different ways: i) the direction of the net flow of energy and materials is clearly directed towards the rest of the world, leaving Colombia with a growing deficit of 'potential productivity' (materials and energy available) which leaves the country to feed into external production and consumption processes. This implies higher opportunity costs for Colombia; ii) the terms of trade are increasingly unfavourable for Colombian exports (rich in natural resources) when compared with imports (with a high economic value). Both aspects meet the views of Hornborg (1998) and Naredo and Valero (1999), in that the maintenance of the existing socio-metabolic world system is connected with the inverse relationship between physical value and economic value. While raw materials and energy are of low economic value, manufactured goods (which have already dissipated much energy and materials) have a high monetary value. This price differential is what allows the

North to obtain the available energy and materials for its social metabolism, and unequal exchange is its most obvious condition.

- Although trade relations between two countries or regions of the world can be balanced in monetary terms, they can be characterised at the same time by a clear inequality in terms of natural resource flow (Proops *et al*, 1999). In addition, some regions of the world can systematically drain the ecological capacity of others through the intensive importing of resources and exporting waste (Giljum, 2003). The studies of physical accounts of trade relations clarify that relative dematerialisation in some countries of the North is related to the increase in the inputs from the South.
- This research also gives reason to believe that the greater integration with the world market that began in Colombia in the 1970s with the promotion of exports, and which was intensified in the 1990s with economic aperture, has produced a significant increase in the pressure on natural resources in Colombia in terms of resource flows, but has altered little the specialisation patterns of Colombian foreign trade. In this respect, foreign transnational companies have played an important role with their strong presence in coal, oil and ferronickel.
- The results of this research put the *scale effect* of international trade on the table. An increase in foreign trade produces a rise in environmental impact through the increase in the amount of material resources mobilized. The quantities of materials, energy and territory incorporated into trade should also be taken into consideration. The harmonization of environmental standards and internalisation of ecological costs are necessary mechanisms, but are not enough.
- In terms of economic-environmental politics, all actions aimed at reversing the specialisation pattern of the Colombian economy are adequate to tackle the problem. In this context, the search for more complementarities between exports and national production, increases in added value and export diversification, as well as protection against the deterioration of terms of trade, are actions that will contribute to climbing out of this trap of underdevelopment and environmental degradation. However, this will not be sufficient if it is not understood at the global level that the FT dynamic driven by the raw material demand in industrialized countries intensifies natural resource exploitation in Southern countries, thus affecting the sustainability of the whole planet.
- Finally, while MFA is a useful methodology that has enriched the analysis of the relations between trade, economy and the environment for Colombia, one weakness found is the excessive emphasis placed on mining and fossil fuel exports, which limits the visibility of environmental effects of other exports (flowers, cocaine, prawns), with less physical weight, but which have an effect on a wide range of natural resources.

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