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Documento de Trabajo FLACSO Ecuador 2016\_05

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## Abstract

The existence of unequal exchange between rich and poor countries is being demonstrated in the literature for some time, explained by differences in labour costs that reflected in the prices of traded goods. In recent years, research has also demonstrated that the lack of inclusion of the environmental impacts in prices of traded goods reflected an ecologically unequal exchange. This paper contributes to the discussion with the new coined concept of caloric unequal exchange that reflects the deterioration of terms of trade for food in terms of calories. Using last FAO data available, exports and imports from and to Latin America and the Caribbean are analysed for the period 1961 through 2011 in volume, value and calories and for different groups of products. The conclusion is reached that although calories exported by the region to the rest of the world are more expensive than those imported, the ratio is deteriorating over time. This trend is found to be different depending on the partner involved. In all cases, the region is helping the rest of the world in improving their diets at a lower cost. This result confirms the loss of natural funds such as soil and nutrients, which can be seen as a de-capitalisation of exporting countries. A side result is that globalisation is homogenising diets over time, concentrating most of food consumption in a reduced number of products, and therefore increasing interdependency among countries and affecting food security. This new debate is found to be useful for designing trade and development policies in the countries analysed.

## Keywords

Caloric unequal exchange, Latin America, terms of trade, food

## JEL Code

F14, F18, N56, Q57

## 1. Introduction

Latin America and the Caribbean, as shall be seen later in the paper, is feeding the world historically. As it happens with other commodities, the terms of trade in the case of food products have been deteriorating over time. This result, and the dependency the region has in exports to obtain foreign currency, induces countries to engage in a race-to-the-bottom as they compete each other selling the same products, driving export prices even lower. This is known as unequal exchange, which translates in the need for exporting more volume over time for being able to import the same volume.

This deterioration of the terms of trade, as discussed later, was advanced by economists in the region such as Prebisch (Prebisch, 1959, 1950) or Furtado (Furtado, 1970, 1964), and gained the attention of authors such as Emmanuel (Emmanuel, 1972) or Amin (Amin, 1976). Soon the concept evolved and incorporated environmental concerns, giving birth to the concept of ecologically unequal exchange, according to which exports of natural resources were not accounting for environmental externalities produced in exporting countries.

The same relationship of deterioration of terms of trade occurs with raw materials exported. The result is a boom in exports that drives down international prices, except for the recent boom in commodities that is over since mid-2015. This overexploitation of natural endowments can be seen as a de-capitalisation of exporting countries (Samaniego et al., 2014; UNEP, 2013), as these exports are eroding the natural capital base for future development, which is not compensated even in monetary terms.

The outcome is that these economies, once the commodity boom is over, return to trade deficits even in monetary terms, which puts more pressure on their natural ecosystems.

Following and contributing to this discussion for years in Latin America (Eisenmenger et al., 2007; Falconí and Vallejo, 2012; Giljum, 2004; Machado et al., 2001; Muradian and Giljum, 2007; Pérez-Rincón, 2006; Samaniego et al., 2014; Vallejo, 2010), and being aware of studies measuring also the loss of nutrients involved in food exports (Pengue, 2005), we decided to explore the unequal exchange of food trade.

It is in this regard that the article introduces the concept of caloric unequal exchange, which could be defined in two ways. On the one hand it reflects the unbalance found between exports and imports of food products in terms of calories. On the other hand it expresses the deterioration in the terms of trade of food traded when considering the cost of calories exported and imported. If unequal exchange allowed to discuss of power relationships in international trade, and ecologically unequal exchange allowed to incorporate to the debate environmental externalities derived from trade, it is our belief that caloric unequal exchange will allow for discussing nutritional issues and quality of the diet when analysing food trade.

The paper explores this concept in the case of Latin America and the Caribbean with respect to the rest of the world, for the period 1961-2011, using the latest available data published by FAO.

The paper has four specific objectives:

- 1) To test the existence of caloric unequal exchange as defined above both in volume terms but also considering the cost of exported vs imported calories and their evolution over time.

- 2) To examine the loss in regional food self-sufficiency or the increase in external dependency. This would imply economic vulnerability for the region as well as increasing environmental costs (loss of soils and nutrients, more energy use and CO<sub>2</sub> emitted) and a loss of genetic diversity implied by increased homogenisation of traded goods and diets;
- 3) To test if changes in observed consumption reflect supply side effects. That is, the move towards oils and fats may be a response to these products increasing their share in international trade of food products.
- 4) To test if increased trade in food products resulted in a diversification of diets in the region.

The rest of the paper is structured in the following way. Section 2 presents the concept of caloric unequal exchange within a more general context of unequal exchange. Section 3 presents the data and methods used. Results are presented in Section 4, while a discussion of them, intended to answer the specific objectives pointed here, is carried out in Section 5. The last section summarises the main conclusions.

## 2. Unequal exchange, ecologically unequal exchange and caloric unequal exchange

The concept of ecologically unequal exchange builds on the concept of ‘unequal exchange’ developed by Emmanuel (Emmanuel, 1972) and Amin (Amin, 1976) or earlier by the work of structuralists Raúl Prebisch and Celso Furtado (Furtado, 1970, 1964; Prebisch, 1959, 1950). At that time, the concept focused on the unequal relationship found between traded goods between countries in terms of embodied labour time, that reflected in prices being different and therefore developing countries showing deteriorating terms of trade. Ecologically unequal exchange put the focus on embodied land, natural resources and pollution (Bunker, 2007, 1985, 1984; Dorninger and Hornborg, 2015; Hornborg, 2014, 2009, 1998; Hornborg et al., 2007; Muradian and Giljum, 2007; Röpke, 2001). Exports of developing countries would be intensive in natural resources. However, they would not account in their prices the value of the environmental externalities involved, implying a *de facto* transfer of wealth from poor to rich countries. Externalities would not be seen then as market failures, but rather as ‘cost-shifting-successes’ (Muradian and Martinez-Alier, 2001).

In fact, Hornborg sees unequal exchange as emerging from an inverse relationship between productive potential and economic value. In his own words, “‘*production*’ (i.e. *the dissipation of resources*) will continuously be rewarded with ever more resources to dissipate, generating ecological destruction and global, core/periphery inequalities as two sides of the same coin” (Hornborg, 1998).

The interested reader can have full reviews of the concepts in the literature mentioned above. We are aware of current debates on the origins of the term, as the one between Foster and Hornborg (Foster and Holleman, 2014; Hornborg, 2014), or even on the existence of ecologically unequal exchange itself (Dorninger and Hornborg, 2015; Moran et al., 2013), but this is not the scope of this document.

The work of Bunker helped understanding how natural resource extraction shaped the underdevelopment of the Amazon in earlier decades (Bunker, 1985, 1984), paving the way for new studies in the years coming, falling in the realm of what is called political ecology, which deals with ecological distribution conflicts (Martinez-Alier and O’Connor, 1996).

Much work has been conducted on the issue showing evidence of the imbalances in international trade and the burden of the exploitation of natural resources, particularly in Latin America. In the case of Brazil there is work showing that exports of non-energy goods had more embedded energy than imports (Machado et al., 2001). Embodied pollution in exports was also analysed (Muradian et al., 2002). The authors presented environmental load displacement from rich to poor countries. They estimated embodied pollution from 18 industrialized countries versus the rest of the world, with the result of more air emissions embodied in imports than in local exports by rich countries. A study using material flow accounting in Chile showed how the burden of the exploitation of natural resources was unequally distributed and remained in the exporter (Giljum, 2004).

Jorgenson conducted a series of tests on the existence of ecologically unequal exchange worth mentioning. He first tested the hypothesis for 66 lower-income countries, finding that those countries with high levels of primary exports to high-income countries, showed, at the same time, lower consumption-based environmental demand, measured by their ecological footprint (Jorgenson, 2009). Later he extended the analysis to deforestation (Jorgenson et al., 2010) and CO<sub>2</sub> emissions (Jorgenson, 2012).

Most of the analyses, though, focus on traditional extractive sectors such as mining and oil, with minor exceptions such as Austin, who showed how developed economies transferred the environmental costs of their beef consumption to developing nations, the origin of their imports (Austin, 2010).

Our work contributes to the expansion of the concept to new realms, this is why we coin the term 'caloric unequal exchange'. We mean by that the deterioration of the terms of trade when calories of foodstuff instead of quantities are used. Our hypothesis is that developing countries, and for our case Latin America and the Caribbean, are increasingly exporting food products to the rest of the world at a lower cost to the calorie, expressing a new form of unequal exchange.

Analysing caloric unequal exchange is important as it brings together other issues regarding trade and food production globally, such as dietary diversity and malnutrition, food security and environmental concerns.

A human diet requires at least 51 nutrients in consistently adequate amounts continuously (Graham et al., 2007). According to these authors, the global crisis in malnutrition is the result of dysfunctional food systems that cannot deliver enough essential nutrients to meet the requirements of all. They argue that one of the reasons is that current food systems put too much attention to cereals, which allowed combating hunger, and away from more varied cropping systems including pulses, fruits and vegetables.

Rising incomes and wealth worldwide are driving changes in food consumption patterns that are also changing international trade. Food trade is shifting towards commodities that are more land intensive (Alexander et al., 2015). According to these authors, the production of animal products is responsible for 65% of land use change in recent years. There is a shift from staples such as potatoes and pulses to commodities such as meat, milk and sugar. In fact, between 1961 and 2011, the authors report how meat consumption per capita has risen 83%, while starchy roots has decreased 17% and pulses 28%. Animal-based protein has surged between 1961 and 2011 from 61g per person per day to 80g, driven by economic development and urbanisation, with relative convergence from emerging economies (Sans

and Combris, 2015). These changes have environmental implications. What we choose to eat and drink not only affects our health but also has environmental impact on ecosystems and affects monetary resources (Duchin, 2005). Animal origin food production causes greater environmental impacts than fruit and vegetable production (De Marco et al., 2014).

In developed countries the income determinant works differently, as it forces lower-income population to opt for calorie-rich but nutrient-poor foodstuff based on the cost of calories. The recent world economic crisis has implied the relative abandonment of the Mediterranean diet in some developed countries like southern European countries (Bonaccio et al., 2016). Affordability, income distribution and cost related to food products are, therefore, important determinants influencing food choices (Donati et al., 2016).

This change in the diet is not exclusive to developed countries. Trade liberalisation has allowed the entrance of foreign investment in food distribution in developing countries, shifting consumption to processed, calorie rich and nutrient-poor food, with 29% increase per year in developing countries (Blouin et al., 2009). Trade liberalisation and yield improvements helped in making more food available for humankind, however, this came at the expenses of reduced diversity in traded food (Remans et al., 2014).

These trends may pose threats to future food security, as globally national food supplies have become more similar in composition, based on a set of global crop plants. The increasing interdependency between countries calls for a new interpretation of food security in terms of nutrition development (Khoury et al., 2014). This is one of the reasons that drove our interest in looking at international food trade from a caloric point of view.

### 3. Material and Methods

The study focuses in the region of Latin America and the Caribbean (LAC). The time window considered depends on the availability of data. For data on consumption, sufficiency and variety of consumption we use the period of 1961-2011. In regard with terms of trade, the period of 1986-2011 is used instead. This is due to the lack of information in the trade data for earlier periods.

The main source of data is FAOSTAT (FAO, 2016). We have used both data on food trade as well as food balances. We present data in terms of volume, monetary values (in constant USD of 2005) and calories (kcal). Analysing LAC as a region means deducting intra-regional trade from trade statistics, as we are only interested in the relationship of the region as a block with the rest of the world.

Several steps were followed that are described below.

First, a match between trade data and food balances product categories was needed. This study does not cover all the products individuated in the food balances, but focuses in the most relevant product groups according to consumption by the region. Trade data considers more than 400 products, while food balance sheets considers 74 products, grouped by FAO in 14 major food groups: cereals – excluding beer, sugar crops, sugars and syrups, pulses, tree nuts, oil crops, vegetable oils, vegetables, fruit – excluding wine, roots and tubers, stimulants, spices, alcoholic beverages, miscellaneous. According to an FAO official<sup>1</sup>, data in these two databases (trade and food balances) does not match as they have different domains,

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<sup>1</sup> Nicola Graziani, personal communication, 21/02/2016

reason why the data on the food balance are standardized<sup>2</sup>. With the aim of isolating intra-regional trade within LAC and calculate extra-regional trade with the rest of partners, we matched the two tables with the FAOSTAT food balance product classification table<sup>3</sup>.

The study disaggregates the analysis for six major food products groups, according to their relative importance in terms of consumption: cereals – excluding beer, sugar and syrups, roots and tubers, pulses, vegetable oils and fruits – excluding wine.

Second, using data from the food balances, we calculated coefficients for kcal / kg for each product.

In this way, trade indicators for ALC can be expressed as:

$$Z_{s,r,t,j \in LAC} = \sum p_{it,j \notin LAC} \quad (1)$$

Where  $Z$  denotes the indicator  $s$  (exports or imports),  $r$  the unit (volume, monetary, calories),  $t$  the year,  $j$  the country ( $j=1 \dots n$ ),  $i$  the product ( $i=1 \dots n$ ), and LAC countries from Latin America and the Caribbean.

Third, we isolated intra- from inter-regional trade for LAC. The calculations on trade are done considering LAC as a block and in relation to its trade partners, the rest of the world, the US, China and Europe.

Fourth, using the coefficients described above, we converted trade data (exports and imports) in volume into calories. In order to analyse the Prebish-Singer hypothesis (Prebish, 1959, 1950) of the deterioration of the terms of trade in terms of calories, the average calorie content per kilogram reported in the food balances was used as proxy for expressing exports and imports in terms of calories, for product  $i$  and country  $j$  in the year  $t$ .

Fifth, using USD prices for 2005, that is, adjusted to FAO's value added deflator by country for agriculture, silviculture and fishing, the value of exported and imported calories were used for calculating the unit cost of calories exported and imported, which allowed us to compute the terms of trade in this way

$$ToT_{t,j \in LAC} = \frac{\sum X \text{ kcal (US\$ 2005)}_{t,j \notin LAC}}{\sum M \text{ kcal (US\$ 2005)}_{t,j \in LAC}} \quad (2)$$

Where ToT stands for terms of trade,  $X$  denotes exports,  $M$  denotes imports,  $t$  the year,  $j$  the country and LAC denotes countries from Latin America and the Caribbean.

Sixth, an indicator for self-sufficiency in food products for the region was also calculated as one minus the share of imported calories over domestic consumption in terms of calories:

$$Self - sufficiency = 1 - \frac{\sum M \text{ kcal}_{t,j \in ALC}}{\sum C \text{ kcal}_{t,j \in ALC}} \quad (3)$$

Where  $C$  denotes domestic consumption.

<sup>2</sup> [http://www.fao.org/docrep/003/X9892E/X9892e04.htm#P3309\\_98127](http://www.fao.org/docrep/003/X9892E/X9892e04.htm#P3309_98127)

<sup>3</sup> Available at <http://faostat.fao.org/site/655/default.aspx> as of 16th of February, 2016



Seventh, we calculated the level of concentration of products in consumption, measured in kcal, by a cumulative distribution of the relative share in consumption of each of the 74 products reported in the food balances.

#### 4. Results

Table 1 presents the food trade balance (for the selected product groups) between LAC and the rest of the world for the period 1986 through 2011. Data is presented in volume, monetary value and its conversion into calories. Exports in volume rise 4.5 times in the period, almost the same as in calories (4.0), whereas its monetary value is multiplied only by a factor of 3.1. In the case of imports, they are increased in 2.5 times in terms of value and 2.3 in calories, while they are multiplied by a factor of almost 4.1 in monetary terms. This result already indicates the existence of caloric unequal exchange that will be detailed later on.

**Table 1.** Food trade balance for LAC with the rest of the World, volume, value and calories, 1986-2011

Year <sup>1</sup>	Exports (10 <sup>3</sup> Tn)	Imports (10 <sup>3</sup> Tn)	Exports (10 <sup>6</sup> US\$ 2005)*	Imports (10 <sup>6</sup> US\$ 2005)*	Exports (10 <sup>12</sup> kcal)	Imports (10 <sup>12</sup> kcal)
1986	34,578.9	17,478.3	20,490.5	4,143.3	83.2	45.1
1991	37,769.0	19,781.1	14,613.4	4,453.1	62.3	43.5
1996	40,721.1	15,831.1	17,188.5	4,976.9	87.9	41.7
2001	89,809.0	42,009.2	32,846.8	10,288.6	206.7	89.4
2006	117,750.4	44,578.3	48,738.2	12,962.7	279.8	101.4
2011	155,756.1	43,549.2	62,759.4	17,182.7	335.0	105.0

\* Adjusted to the value added deflator by country for Agriculture, silviculture and fishing (value US\$, 2005 prices)

<sup>1</sup> Data is obtained by combining the trade matrix and the food balance matrix as explained in Methods

Note: Mexico is absent for 1996 due to lack of data in all tables and figures

**Source:** (FAO, 2016)

Food consumption for the selected product groups in LAC is presented in Table 2, in absolute calories content, its share within total consumption and calories per capita. The main result observed here is the notable increase in the consumption of vegetable oil, which, in per capita terms, is 3 times higher at the end of the period, at the expenses of a reduction in pulses and roots and tubers. Sugars also increase over time, representing around 20% of the calorie intake, well above the WHO *strong recommendation* of reducing the intake of free sugars to less than 10% of total energy intake (World Health Organization, 2015). Both results indicate a likely worsening of the diet in the region that will be further analysed in future research.

**Table 2.** Food consumption by product group for LAC, measured in kcal, 1961-2011

Product groups	10 <sup>12</sup> kcal/year						Share of total consumption (%)						Per capita consumption of kcal					
	1961	1971	1981	1991	2001	2011	1961	1971	1981	1991	2001	2011	1961	1971	1981	1991	2001	2011
Cereals - Exc beer	75.5	102.2	138.6	167.0	198.7	228.6	48.8	46.7	46.3	46.2	45.7	44.8	924.8	961.9	1032	1020	1029	1048
Sugar and Syrups	28.7	40.1	59.6	71.2	80.2	91.2	18.6	18.3	19.9	19.7	18.5	17.9	352.2	377.1	443.9	434.9	415.6	418
Roots and tubers	12.8	19.4	18.6	18.8	22.1	26.0	8.3	8.8	6.2	5.2	5.1	5.1	157.1	182.2	138.3	115.1	114.3	119.4
Pulses	10.7	14.9	17.5	17.4	20.2	22.1	6.9	6.8	5.8	4.8	4.7	4.3	130.9	140.6	130.1	106	104.8	101.5
Vegetable oils	9.1	15.5	32.0	46.5	58.1	72.7	5.9	7.1	10.7	12.9	13.4	14.3	111.7	146.3	238.1	283.8	301.3	333.5
Fruits - Exc wine	8.9	13.8	15.5	18.7	23.7	28.9	5.8	6.3	5.2	5.2	5.4	5.7	109.0	129.4	115.6	114.5	122.7	132.4
Alcoholic beverages	4.2	6.1	9.1	11.5	13.8	16.9	2.7	2.8	3.1	3.2	3.2	3.3	51.8	57.7	68.12	70.49	71.42	77.58
Vegetables	2.0	2.7	3.7	4.8	7.1	8.8	1.3	1.2	1.2	1.3	1.6	1.7	24.2	25.4	27.37	29.06	36.96	40.34
Oil crops	1.8	3.0	2.8	3.4	7.0	9.3	1.2	1.4	0.9	0.9	1.6	1.8	22.3	28.4	20.54	20.76	36.33	42.65
Other*	0.8	1.3	1.8	2.1	3.7	5.4	0.5	0.6	0.6	0.6	0.8	1.1	9.8	12.4	13.1	12.63	19.11	24.92

\* Includes: stimulants, nuts, sugar crops, spices and miscellaneous

**Source:** (FAO, 2016)

The relative share of exports and imports in terms of calories is presented in Table 3. The region has reduced its exports of sugar and syrups, which went from representing 52.6% in 1986 to 31.1% in 2011. Cereals still represent over 26% of total exports. On the other hand, vegetable oil has increased its share slightly, although the biggest rise is on oil crops, which went up from 1.9% to 18.3%. The region does not only consume more vegetable oil as we saw above, but it exports increasing quantities of oil seeds. With regard to imports, the region is very dependent on cereals, representing more than two thirds of total imports in all the period. The share of sugars and syrups is also increasing over time.

**Table 3.** Evolution of exports and imports measured in kcal by product group, 1986-2011

Grupos de productos	1986		1991		1996		2001		2006		2011	
	% X	% M	% X	% M	% X	% M	% X	% M	% X	% M	% X	% M
Sugar and syrups	52.6	1.6	20.2	6.6	29.7	0.9	29.7	3.0	31.2	4.0	31.1	7.4
Cereals - exc. Beer	24.0	80.2	22.1	76.2	19.7	87.5	27.6	82.1	17.6	83.8	26.7	74.3
Vegetable oils	15.4	13.1	34.5	13.0	32.1	3.8	23.8	8.4	28.4	6.1	18.0	12.2
Fruits - exc. Wine	3.3	0.1	10.3	0.2	7.8	0.3	2.8	0.4	4.0	0.3	3.3	0.4
Oil crops	1.9	1.6	7.2	0.9	7.9	3.9	13.6	1.9	16.4	2.3	18.3	1.7
Stimulates	1.1	0.0	2.8	0.2	1.6	0.1	0.8	0.3	0.8	0.3	0.8	0.3
Pulses	0.5	2.4	0.9	1.8	0.3	2.1	0.5	2.7	0.4	1.9	0.5	2.1
Vegetables	0.4	0.1	0.7	0.1	0.1	0.1	0.4	0.2	0.4	0.2	0.5	0.2
Alcoholic beverages	0.4	0.4	0.7	0.6	0.4	0.8	0.7	0.5	0.6	0.5	0.6	0.6
Other*	0.4	0.6	0.6	0.5	0.4	0.6	0.2	0.7	0.3	0.7	0.3	0.8

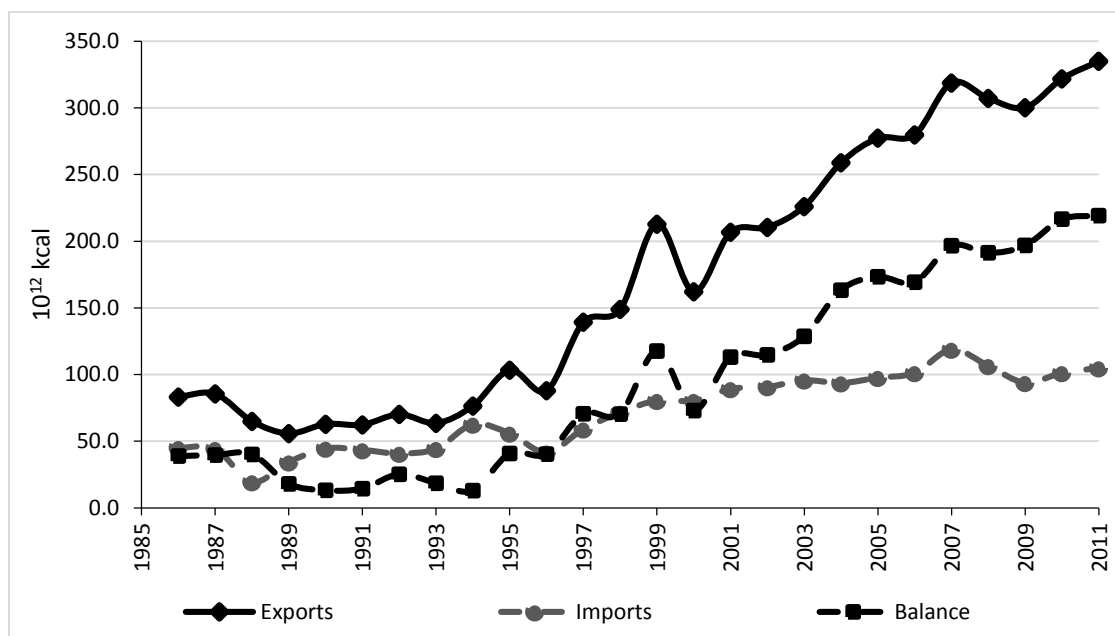
\*Includes: spices, nuts, roots and tubers and miscellaneous

**Source:** (FAO, 2016)

Figure 1 represents exports, imports and the trade balance in terms of calories, data found in Table 1. The surplus has increased fivefold in the period of 26 years analysed. The result

here is that the region is increasingly feeding the rest of the world. As we will discuss, one should not only look at this result from a pure economic perspective, but keeping in mind that this huge increase in exports implies a de-capitalisation of the region in terms of soil erosion, loss of arable land and nutrients embodied in food exported, as Pengue reported in the case of Argentina and soy exports (Pengue, 2005).

**Figure 1.** LAC exports, imports and balance for food products ( $10^{12}$  kcal), 1986-2011

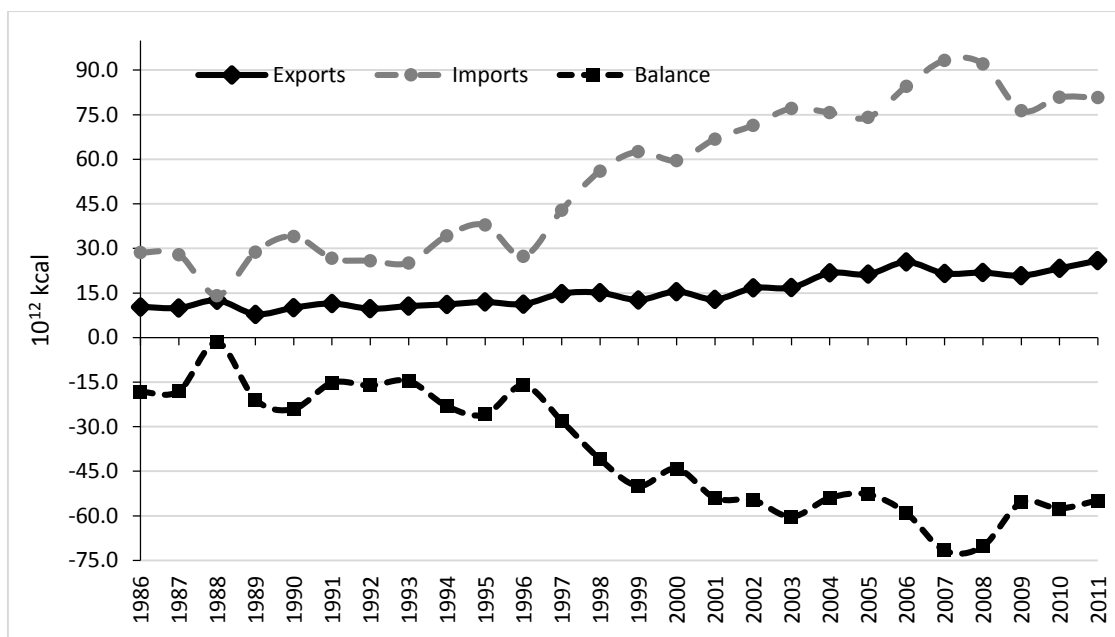


**Source:** (FAO, 2016)

This overall result hides differential behaviours depending on the trade partner analysed. In year 2011 the main trade partners for LAC countries were China, Europe and the USA. Market share for LAC exports was 17.4%, 17% and 7.7% respectively, that is, 42.1% between the three of them. Imports from LAC countries are far more concentrated, with the USA representing 76.9% in the same year. Based in this, we decided to analyse these cases individually.

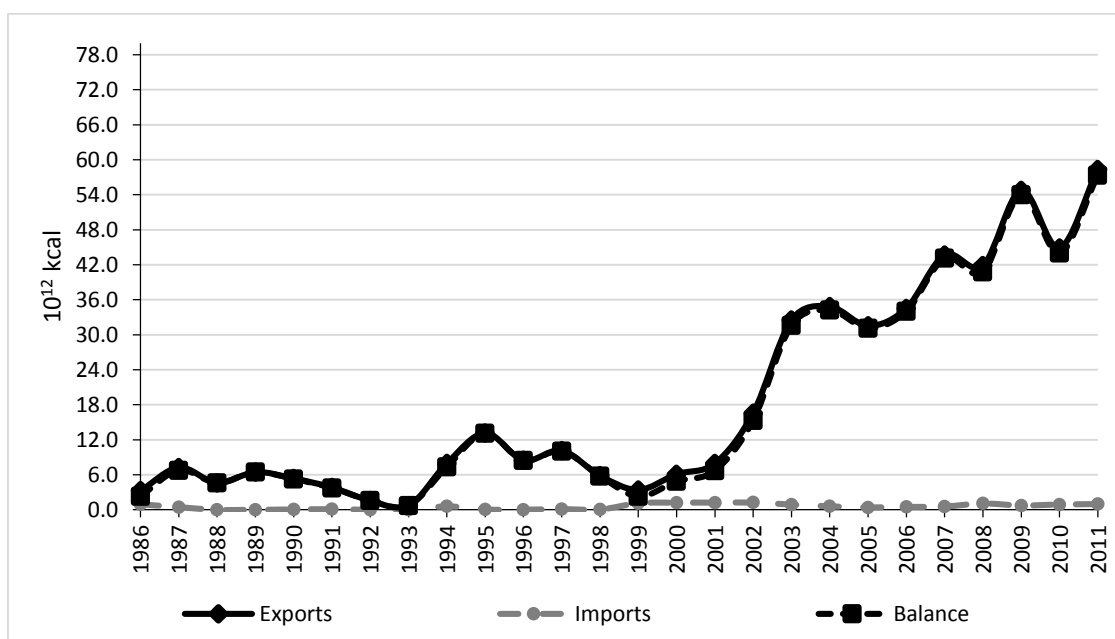
Thus, in Figure 2 we can see how the region maintains a negative balance with the USA, which has more than doubled in the period and corresponds, in its larger part, to cereals, with a maximum in year 2007. However, as we can see in Figure 3, the region maintains a positive and growing balance with China, which reached in 2011 a similar value to the deficit shown with the USA. The relationship with China seems not to have suffered the boom and crash of commodities in recent years. In the case of the trade with Europe, Figure 4 shows how the region maintained a positive balance during all the period, reaching a maximum in 2007, falling abruptly until 2009 when values similar to those of year 2000 were attained, rising again afterwards. In the cases of both China and Europe, it is noticeable that the balance goes hand in hand with exports, as there are basically no imports to LAC countries from this two regions.

**Figure 2.** LAC exports, imports and balance for food products with the USA ( $10^{12}$  kcal), 1986-2011



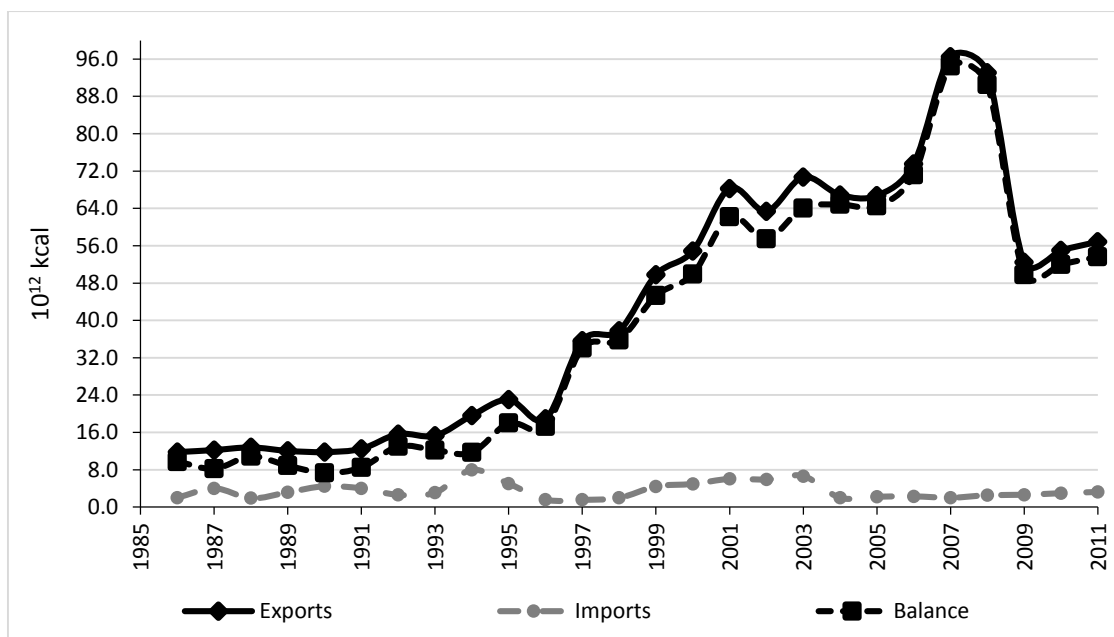
Source: (FAO, 2016)

**Figure 3.** LAC exports, imports and balance for food products with China ( $10^{12}$  kcal), 1986-2011



Source: (FAO, 2016)

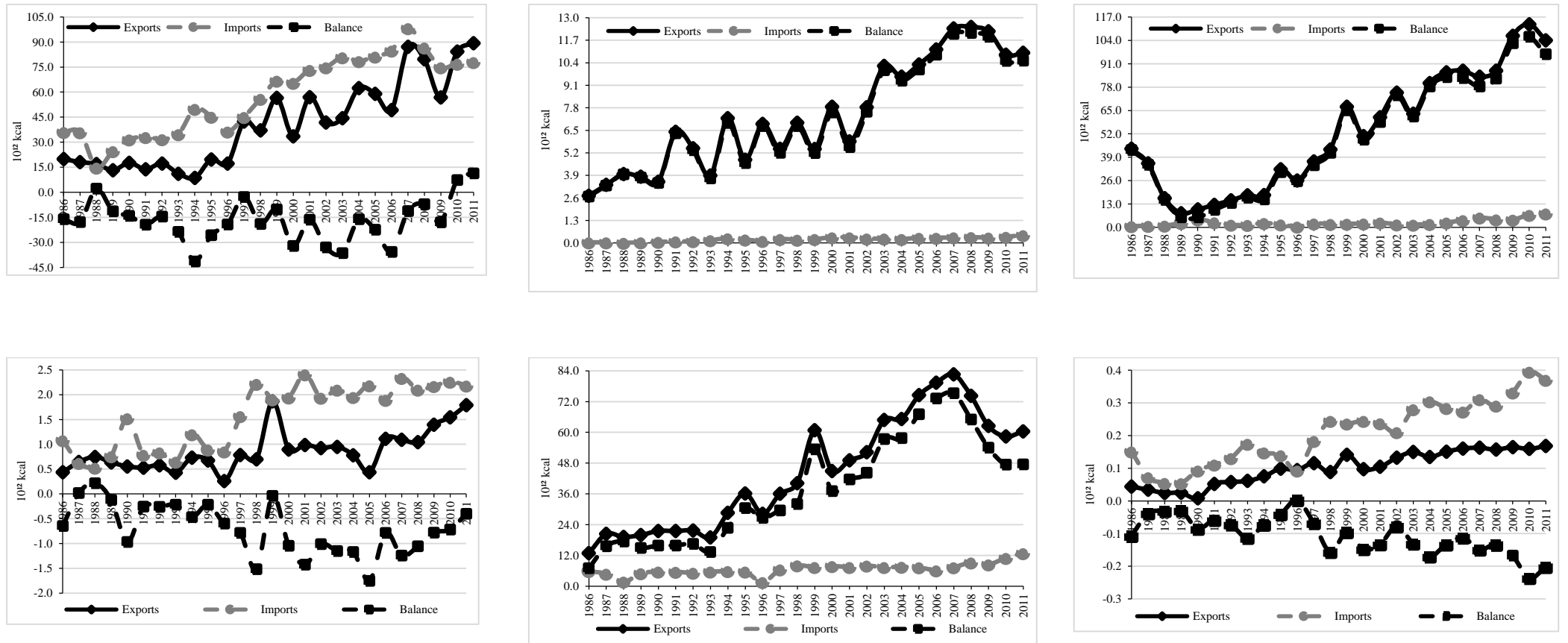
**Figure 4.** LAC exports, imports and balance for food products with Europe ( $10^{12}$  kcal), 1986-2011



**Source:** (FAO, 2016)

Figures 5a to 5f show the caloric trade balances for six selected product groups. The region has become in recent years net exporter of cereals, while is net importer of roots and tubers and pulses (although with low levels). The region has been largely dependent on cereals for most of the time and is dependent on pulses while exports increasing quantities of fruits. This is a result that, in terms of food self-sufficiency, may justify shifting production patterns to accommodate to domestic consumption patterns.

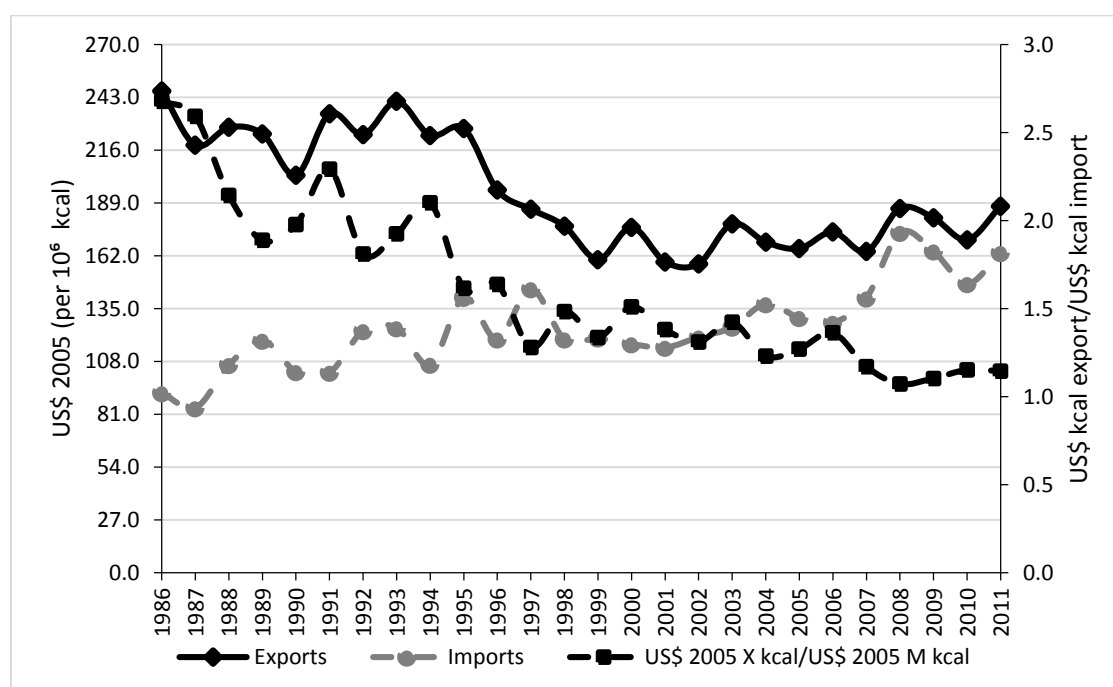
**Figure 5.** LAC exports, imports and balance for food products (a= cereals – exc. beer; b= fruits – exc. wine; c= sugar and syrups; d= pulses; e= vegetable oils; f= roots and tubers),  $10^{12}$  kcal, 1986-2011



Source: (FAO, 2016)

Deepening the analysis of data shown in Table 1, Figure 6 presents the cost of one million kcal exported and imported (left axis) in real terms and the ratio between the cost of the exported calorie and the imported calorie (right axis), that is, an approximation to the terms of trade measured in calories. The trend observed in the figure is towards a reduction in the cost of exported calories and a slight increase in the cost of imported calories over time, which implies a deterioration of the terms of trade measured in calories, with a decrease of more than 100% in the period analysed. Thus, the region is not only increasingly feeding the rest of the world (Figure 1), but it does so at a lower cost over time, despite the recent boom in commodity prices experienced worldwide.

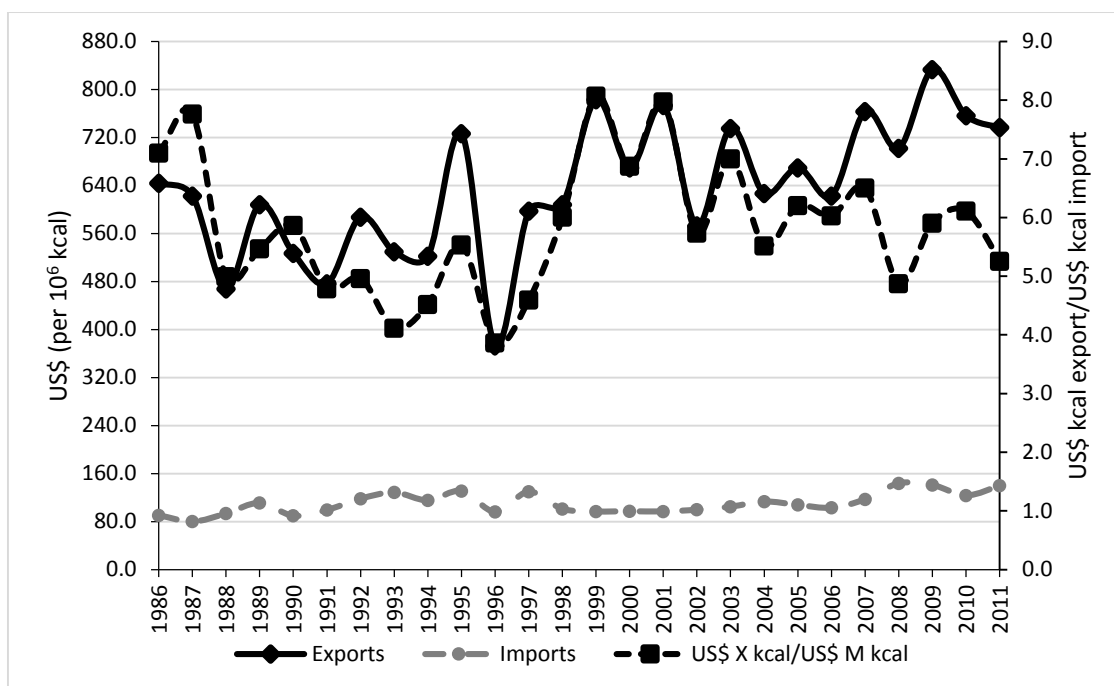
**Figure 6.** LAC exports, imports and terms of trade, 1986-2011



**Source:** (FAO, 2016)

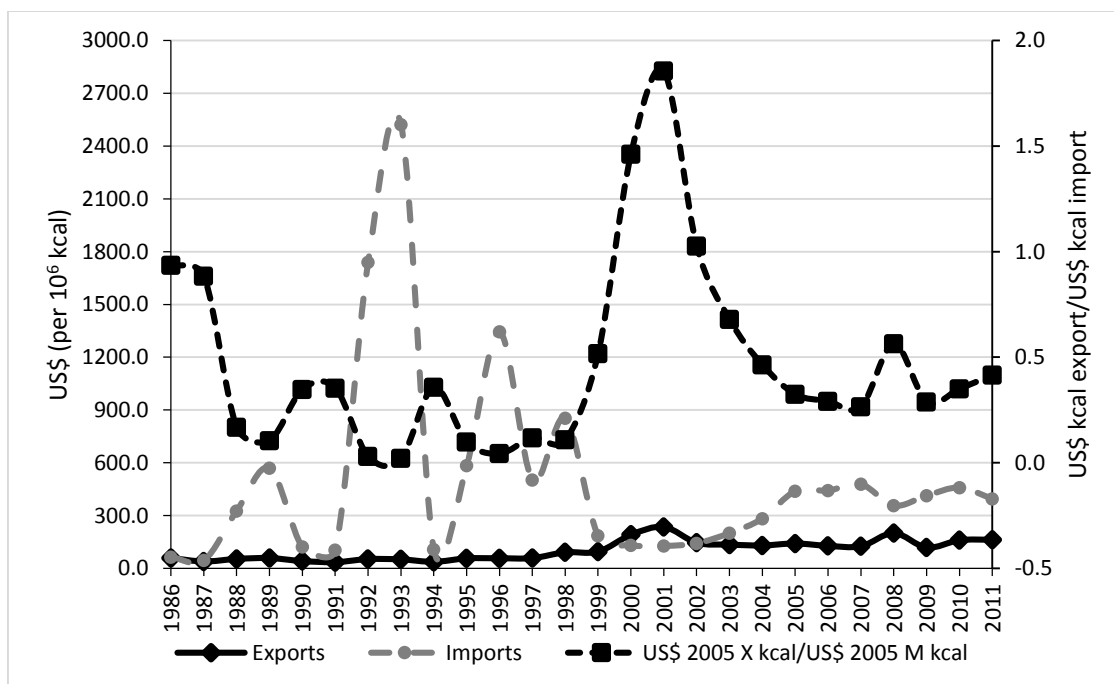
Again, this result is different depending on the trading partner. Terms of trade are very favourable to LAC with respect to the USA, as seen in Figure 7, exporting expensive calories and importing cheap ones (cereals). Nevertheless, since year 1999 they tend to worsen over time. In the case of China, Figure 8 shows how imported calories are more expensive than exported ones for almost all years in the period, showing also a deterioration of terms of trade over time. Finally, Figure 9 shows how the terms of trade experienced a drastic change with Europe in 1996. Before that year, calories exported by LAC countries to Europe were more expensive than those imported. However, after that year the trend reversed and calories imported became increasingly more expensive and those calories exported became cheaper, deepening the worsening of terms of trade, which deteriorated in more than 400% in the period.

**Figure 7.** LAC exports, imports and terms of trade with the USA, 1986-2011



Source: (FAO, 2016)

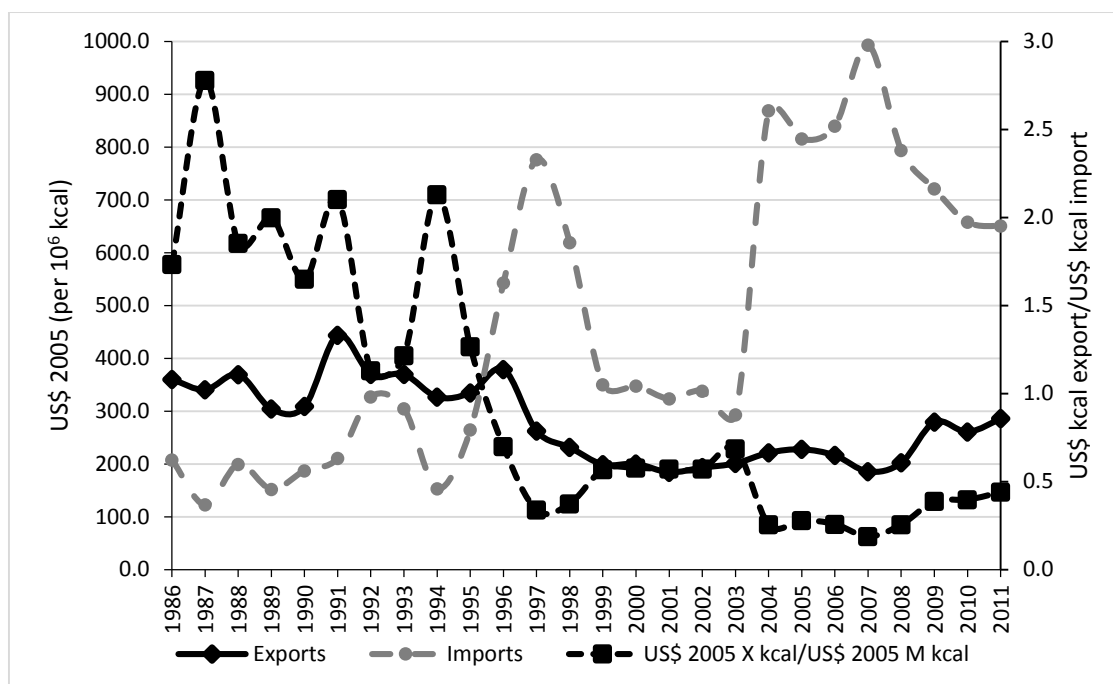
**Figure 8.** LAC exports, imports and terms of trade with China, 1986-2011



Source: (FAO, 2016)



**Figure 9.** LAC exports, imports and terms of trade with Europe, 1986-2011



**Source:** (FAO, 2016)

Table 4 presents data on self-sufficiency for the region. Despite being a net exporter region for most of the product groups, LAC also depends on imports from third countries. In aggregated terms, the region shows a loss of self-sufficiency, notably due to cereals. Paradoxically, many of the products that are imported are, at the same time, exported to the rest of the world, showing a lack of complementarity in regional food trade, a phenomenon that is further analysed by the authors elsewhere (Falconí et al., n.d.). In particular, Argentina exports cereals to the rest of the world, while most of the countries are importing cereals from the rest of the world. This is also the case for sugar and syrups.

**Table 4.** Food self-sufficiency index for LAC in kcal, 1- (*imports / consumption*), 1986-2011

Year	Agregate	Cereals- exc beer	Roots and tubers	Sugar and syrups	Pulses	Nuts	Oil crops	Vegetable oils	Vegetables	Fruits- exc wine	Stimulants	Spices	Alcoholic beverages	Miscellaneous
1986	84.3	74.4	99.0	98.7	92.3	89.1	63.9	82.1	99.3	99.6	96.8	81.8	98.1	7.4
1987	85.1	75.3	99.5	98.6	95.4	91.8	1.3	87.1	99.4	99.7	98.4	87.1	98.3	8.6
1988	93.5	89.8	99.6	98.3	96.0	96.9	45.7	95.6	99.8	99.9	98.5	92.7	98.9	-65.8
1989	88.5	82.9	99.6	95.9	93.7	90.9	86.4	87.5	99.4	99.7	94.7	92.4	89.5	28.2
1990	85.5	78.7	99.4	92.8	88.8	91.7	73.0	85.7	99.0	99.4	91.8	88.9	96.1	41.6
1991	86.8	79.0	99.3	95.4	95.2	90.0	87.1	87.1	98.9	99.3	91.1	88.1	97.5	43.0
1992	87.8	80.3	99.1	97.8	94.8	89.0	76.7	88.3	98.5	99.2	89.8	85.8	96.7	35.7
1993	86.8	78.4	98.9	98.0	96.0	83.1	71.5	87.1	98.2	98.8	90.9	87.2	96.6	51.6
1994	82.2	70.3	99.2	96.5	92.9	78.9	41.5	87.0	98.1	98.3	88.1	81.1	96.1	66.8
1995	84.1	72.6	99.3	97.7	94.4	87.6	61.6	87.1	98.5	98.8	91.0	83.5	97.4	48.4
1996	84.9	70.2	99.4	99.3	94.1	94.0	52.0	95.7	98.9	99.2	94.3	48.4	96.5	67.2
1997	84.0	73.9	99.0	96.9	91.2	87.7	48.8	86.1	97.8	98.8	91.0	81.4	96.5	71.8
1998	80.6	67.6	98.7	97.3	87.4	87.7	62.3	82.7	97.6	98.8	87.9	64.7	96.8	72.0
1999	79.3	63.5	98.9	97.1	89.7	83.1	83.7	85.6	97.9	98.8	84.6	85.2	97.8	67.1
2000	79.8	64.6	98.8	97.0	90.0	80.6	79.4	85.6	97.7	98.3	81.3	85.1	97.2	63.6
2001	78.3	62.1	98.8	96.2	87.7	81.5	75.5	86.6	97.6	98.4	85.2	81.8	96.7	64.0
2002	78.1	61.4	99.0	97.8	90.0	81.2	63.8	85.7	97.6	98.8	83.0	74.1	97.1	71.3
2003	77.8	60.5	98.6	98.0	90.0	81.3	71.8	87.0	97.9	98.9	81.5	83.9	97.5	69.8
2004	78.7	62.1	98.5	97.5	90.1	79.0	76.3	87.3	97.7	99.0	84.5	75.4	97.2	74.5
2005	78.1	61.5	98.7	96.6	89.0	83.5	74.1	87.8	97.4	98.7	74.8	85.3	96.9	72.7
2006	76.9	58.6	98.7	94.7	90.6	78.4	69.4	89.8	97.1	98.7	76.0	86.1	96.7	65.8
2007	74.1	53.8	98.7	93.2	89.0	81.1	63.5	88.4	97.4	98.6	72.3	85.9	96.3	74.9
2008	76.5	58.6	98.7	94.3	89.6	79.2	76.8	85.9	97.0	98.6	77.8	80.9	96.5	82.0
2009	79.4	64.6	98.5	94.7	89.5	83.5	73.9	86.9	97.3	98.7	78.2	77.4	96.3	78.7
2010	77.8	63.3	98.2	91.1	89.2	82.1	75.2	83.2	97.2	98.5	81.2	85.3	96.7	82.3
2011	77.4	63.3	98.4	90.2	89.1	80.5	79.9	81.1	97.3	98.2	78.1	79.9	96.2	81.4

Source: (FAO, 2016)

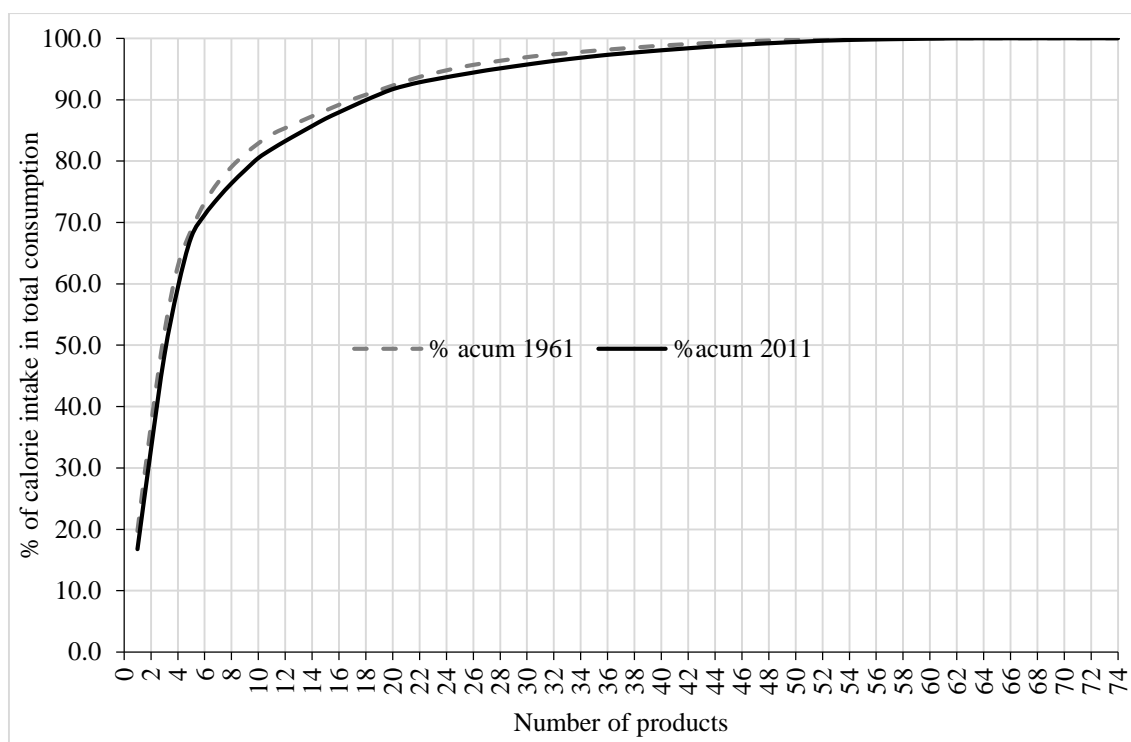
Finally, our research shows (see Table 5 and Figure 10) the degree of concentration of consumption in a few products, measured in kcal, comparing 1961 and 2011. This high concentration in a few products did not change much in the period. We have used here the product categories found in FAO food balances and not trade data, as was done in the rest of the paper. Thus, three products (corn, wheat and sugar) represented 52% of calorie intake in 1961, while the share only went down to 48.3% in 2011. When looking at the five most important products (corn, wheat, sugar, rice and beans) they represented 68.7% of consumption in 1961 while represented 67.6% in 2011 (with a change in composition, corn, wheat, sugar, rice and soy oil). Moreover, when looking at the ten main products, they represented 82.9% of consumption in 1961 and 80.5% in 2011. Therefore, apart from a change in the diet, with a noticeable increase in vegetable oils (soy and palm) and alcohol (beer) and a decrease in beans, cassava and potatoes, the striking result is that a large fraction of consumption still concentrates in a very low number of products, despite advances in production and in international trade.

**Table 5.** Cumulated share of products in consumption, in kcal, 1961 and 2011

Number of product	Main products in 1961	% cumulated 1961	% cumulated 2011	Main products in 2011
1	Corn and products	19.7	16.8	Corn and products
2	Wheat and products	36.9	33.0	Wheat and products
3	Sugar (Raw Equivalent)	52.0	48.3	Sugar (Raw Equivalent)
4	Rice (Milled Equivalent)	62.8	59.3	Rice (Milled Equivalent)
5	Beans	68.7	67.6	Soybean Oil
6	Cassava and products	73.2	71.2	Beans
7	Sugar non-centrifugal	76.5	74.0	Palm Oil
8	Potatoes and products	79.0	76.4	Cassava and products
9	Bananas	81.1	78.5	Beer
10	Cottonseed Oil	82.9	80.5	Potatoes and products

**Source:** (FAO, 2016)

**Figure 10.** Share of cumulated calorie intake in total consumption per number of products, 1961 and 2011



**Source:** (FAO, 2016)

## 5. Discussion

As shown by Figures 6-9, the region as a whole has experienced favourable terms of trade during the period analysed, with the calorie exported being more expensive than the calorie imported. However, this result, apart from being different depending on the trading partner, is deteriorating over time, leading us to conclude there is a worsening of the terms of trade in caloric terms.

If we put together the fact that trade balance is increasingly positive in volume terms with the deterioration of terms of trade, we can say that LAC countries are exporting ever cheaper food products to the rest of the world, making the diet elsewhere more affordable. This is also due to the fact that the environmental consequences of this exporting boom of food products are not accounted for in prices. First, the products most exported, sugar and syrups, cereals and vegetable oils, correspond largely to monocultures. These three categories alone accounted for 80% of the calories exported by the region in 2011 (see Table 3), showing how trading patterns affect production, by pushing monocultures, which have environmental impacts attached and do use large amounts of inputs (Arizpe et al., 2014, 2011). Second, loss of soil and nutrients that go away along with volumes exported are not accounted for, exactly what Pengue analysed for Argentina and soy exports (Pengue, 2005). These are two reasons why optimism in exporting countries should be tamed down until full and deep analyses are conducted measuring this de-capitalisation of the region. This is a pending task for research in the future.

We have also observed that the region faces a loss in food self-sufficiency, as was shown in Table 4. This is to say that at the same time the region is increasingly feeding the world, it loses sufficiency in certain products (e.g. cereals, sugar), which makes it more vulnerable. The loss in self-sufficiency in cereals may obey to pressures from the external market. As we saw in Table 3, cereals represented 34% of exports from the region in 2011, at the same time that the region is increasingly importing cereals from elsewhere. This mismatch has been analysed by the authors elsewhere (Falconí et al., n.d.), introducing some policy options to correct it. Moreover, this change in the productive pattern implies a de-capitalisation of the region with the loss of soil and nutrients, and with the increased use in fertilizers and exosomatic energy, leading to higher environmental impacts.

The change in the consumption pattern observed in Table 2 has implied a drastic increase in fats, precisely one of the products the region has started to export increasingly. Our hypothesis is that this change in consumption has been preceded by a change in the productive pattern, itself a reaction to food trade patterns. We leave for further research an examination of the validity of this hypothesis.

Finally, we interpret that both the loss in the quality of the diet and the high concentration of caloric intake in a few products put into question globalisation and the green revolution, as the resulting outcome is an increase in vulnerability of the food chain worldwide. Products increasing its share in global demand, such as oils and fats, are displacing higher quality products such as tubers and pulses. A deep analysis on the evolution of consumption patterns in the region is badly needed so that new trade policies can be offered that counterbalance existing policies based on increasing food exports regardless of the quality of the products.

## **6. Conclusions**

This research has contributed to the debate on unequal exchanges, by enlarging the family with the new coined term of caloric unequal exchange.

We have found there is a deterioration of the terms of trade of traded food in terms of calories for the region, of more than 100% between 1986 and 2011. This goes along with an increased volume (and value) of exports, which were multiplied by 4.5 (and 3.1) times. This boom in commodities exports results in increasing environmental costs in terms of soil deterioration, export of nutrients, and more energy consumed and CO<sub>2</sub> emitted for those exports, which fall under the category of ecologically unequal exchange.

A side result we have found is that of the homogenisation of diets, concentrating consumption in just a few products, which are, effectively, the most traded around the world. In fact, in year 2011 only 3 products (corn, wheat and sugar) accounted for almost 50% of calorie consumption, while 10 products accounted for more than 80%. This entails an ever greater interdependency among countries that increases economic vulnerability and entails a threat for the region's food self-sufficiency. From a nutritional point of view this result also has implications, as we observed how consumption of oils and fats grew faster than that of other products, at the expenses of cereals, pulses and roots and tubers. Isolating demographic factors (as different demographic structure of population reflects in different food requirements) and income issues (food intake composition also changes with increasing income levels), which are both demand-side, from strictly supply-side determinants such as exports composition and investigating the effects in the population of Latin America and the Caribbean may likely be the subject of study for further research.

The results outlined here suggest that food trade negotiations by Latin America and the Caribbean countries within the WTO would benefit from including the unequal exchange discourse, both ecologically and caloric. The recognition of these hidden costs would not be the only advantage, but also the full understanding of the determinants of dietary changes, usually explained by demand-side variables only.

Even if caloric unequal exchange opens new options for understanding international trade, productive structures and its impacts on consumption, this concept is not a substitute for studying existing power relationships in trade as well as using complementary approaches that involve monetary and biophysical issues.

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