Geographical deviations in foreign trade statistics: a study into European trade with Latin American Countries, 1925[1].

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Abstract

We have analyzed the spatial accuracy of European foreign trade statistics compared to Latin American. We have also included USA's data because of the importance of this country in Latin American trade. We have developed a method for mapping discrepancies between exporters and importers, trying to isolate systematic spatial deviations. Although our results don't allow a unique explanation, they present some interesting clues to the distribution channels in the Latin American Continent as well as some spatial deviations for statistics in individual countries. Connecting our results with the literature specialized in the accuracy of foreign trade statistics; we can revisit Morgernstern (1963) as well as Federico and Tena (1991). Morgernstern had had a really pessimistic view on the reliability of this statistic source, but his main alert was focused on the trade balances, not in gross export or import values. Federico and Tena (1991) have demonstrated how accuracy increases by aggregation, geographical and of product at the same time. But they still have a pessimistic view with relation to distribution questions, remarking that perhaps it will be more accurate to use import sources in this latest case. We have stated that the data set coming from foreign trade statistics for a sample in 1925, being it exporters or importers, it's a valuable tool for geography of trade patterns, although in some specific cases it needs some spatial adjustments.

Paraules clau: economic geography, statistical accuracy, foreign trade statistics.

Jel codes: N01, N70, N76

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I- Introduction

Economic geography theories have become fashionable in the last years, and a set of models is now available to the study of international trade following spatial considerations. From an economic history view, it means an open research line to get it back in time. We have new theories to be tested, and we have some models to use for it, but… how about our data. At this point, arises the main problem we have focused: are our historical foreign trade statistical data good enough?.

This question has been answered before in many different ways. Some authors argued that they have simple no statistical value. Others have only forgotten this question, and have used it. If many researchers use a source it becomes reliable by itself. Some other authors have chosen the richest country source, i.e. Great Britain, USA or Germany, as a guarantee of the data. This has been very usual in the Latin-American case, in which unreliability seemed to reach a maximum[2].

Even today, statistical data are far from being ideal; the question is how far are we from reality. Our approach has been to quantify statistical disagreements between different countries, comparing each bilateral data. In doing so, we can isolate the geographical assignment problem, either in the richer exporter either in the poorer importer.

In an international scale, if you are working in comparative data between countries, things seem not to change drastically using one or another country statistic[3]. But in a regional scale, the fact is that using only exporter's data omits some little importers. On the other side, the importer data increases the geographical diversity, but sometimes limited the sector detail. Our main conclusion is that Latin-American data are good enough as long as we can explain part of the biases from a geographical point of view. Exporters' data are also valuable, taking into account proximity biases and scale effects.

The paper has been organized as follows. In section II we discuss the causes of disagreements between trade statistics, isolating the geographical assignment one. In section III, we present the pessimistic view of Morgernstern assuming that we can explain discrepancies by geographical patterns. Section IV describes Latin American coal, oil and cement markets, from the point of view of the main suppliers.

[2] Platt (1971) has emphasize Latin American statistical deficiencies, although he refers to prior-1914. An exception is S. Kuntz (2002) who has also revalidate Mexican Foreign Trade Statistics, for some years.
[3] Rubio and Folchi (2005b) have developed a non-parametric test which results in such differences not being statistical significant.

Section V shows the main maritime routes for Latin American trade related to each exporter country. In section VI, using GIS methodologies, we correlate statistical discrepancies between trade partners with maritime routes. This is the core of our argument in which we can demonstrate that there are geographical biases in the exporters data and that can be identified using the importer information. Section VII emphasizes our main conclusions.

II- Statistical discrepancies between trade partners: the geographical assignment problem

Foreign Trade Statistics have been broadly used for many studies of international trade. Anyway their value as a source of accurate information has not always been accepted. The main problem in their accuracy consists in the lack of homogeneity, which makes impossible any attempt of comparability.

The fact is that we have two data series that are supposed to be the same. Exports of a country are imports of its trade partner, so these two figures have to match perfectly. But as long as they have been collected from two different countries, they almost never coincide exactly. Deep analysis of the nature of these discrepancies had been developed after the Second World War. In 1953, Allen and Elly had found five reasons for the fact that a country's exports don't coincide with its trade partner's imports, although it must be the same:

1/ The first cause of statistical discrepancies was the different definitions of each commodity.

2/ A second cause of statistical deviations is the geographical assignment. It comes from the fact that some countries assigned imports to the last harbor where the ship had stopped and not to the country where the commodity had been produced. Bourne (1872) remarked it for the British statistics from the year he wrote: *'Goods shipped in Calcutta, by a vessel coming round the Cape of Good Hope or through the Suez Canal, will be taken as arriving from Bengal; but should they break their voyage by a railway transit across the Isthmus, and be reshipped at Alexandria, they will be entered as if from Egypt.'*[4]

Platt (1971) had also stressed the geographical assignment question for the period before the First World War: *'Latin American trade figures in the nineteenth century, in common with those of most other trading nations, were founded on the assumption that the national origin of imports was generally the last port of shipment, while the destination of exports was taken to be the port at which they were landed.* (…) *British rails contributed to the expansion of Mexican railways in the early 1880's, but they arrived from ports in Texas. Before the improvement of the port of Buenos Aires, late in the nineteenth century, a substantial proportion of Argentine imports was transhipped from ocean steamers at Montevideo, but the new docks reversed the flow, so that Uruguayan imports might now arrive through Buenos Aires*.' [5]

[4] Bourne (1872), p. 203.
[5] Platt (1971), p. 119-120.

Otherwise some countries also registered the first destination where their exports had gone and not the final country where the commodity would be consumed. We focus on the assignment question as the main problem for bilateral trade data, trying to neutralize all other causes.

3/ A third element of statistical discrepancies identified by Allen and Elly is closely related to the first one. It consists in the different levels of aggregation each country used for the compilation of its statistics.

4/ All previous discrepancies can appear either on weights or in values. But the fourth cause of differences is only related to the valuing system of each country. Transport costs were usually thought to be included in imports but not all countries followed this convention. Systems of pricing the commodities were also different.

Some countries used official values, the more accurate the more recent they were stated. Other countries used declared values, the less tariffs they impose, the more accurate they were. Finally it also interferes the rate of exchange each country used to translate foreign values into its own currency. We have avoided all these problems not using values but volumes of trade.

5/ A last cause of discrepancies refers to the capability of the trade agents to bring the information in an accurate manner. In this sense, discrepancies can be attributed to an intentionally concealment or simply to omissions[6].

Following this theory, duties make more confident the country efforts to obtain information about its imports. But it also arises a big suspicion about the reliability of the information given by an agent, which resulted in him paying for it. As a result of these opposite interests, tariffs have an important ambiguous effect on the accuracy field.

As we have seen, there is a quite diverse set of arguments to explain statistical discrepancies between trade partners. Anyway in this paper we focus only on the geographical assignment problem. We try to verify the hypothesis of exporters' trade data being systematically deviated by maritime routes. To do that we have to neutralize all the other problems like the valuing systems or the criteria used in the definition of the tradable products.

We have avoided point one and three, i.e. problems of definition and aggregation, by using homogeneous goods, important enough not to be aggregated with others: these are coal, oil and cement. The use of weights has eliminated the fourth problem, the valuing one.

[6] For example, re-exportations have sometimes been registered as exports. The most well known cases are the Nederthands and Austria-Hungary. For the second, see Don (1968).

III- Morgernstern's pessimistic results: can we explain the signs through geography?

Allen and Elly (1953) had offered a systematic analysis of the causes that can explain discrepancies between trade partners' statistics. Otherwise Morgernstern (1963) elaborated an index to measure the importance of such bilateral discrepancies. This author weighed the absolute difference between the two countries' statistics for the single amount of trade for one of them. This measure is a percentage of one of the two countries' volume trade:

$$(1) \quad \frac{I_1 - E_2}{I_1} \qquad (2) \quad \frac{E_1 - I_2}{E_1}$$

I_1= Imports from country A following A's statistics
E_1= Exports from country A following A's statistics
I_2= Imports from country B following B's statistics
E_2= Exports from country B following B's statistics

Morgernstern's index was applied to different years: 1909/13, 1928, 1935, 1938, 1948, 1952, 1956 and 1960. The countries used for those comparisons were supposed to have the best statistics: United States, Canada, Belgium, Great Britain, Germany and France. Although the sample had to be the best in statistical accuracy, Morgernstern's measures had presented quite pessimistic results.

The pessimistic view had been supported by these two elements: huge differences and arbitrary signs. We are not going to focus the amount of discrepancies because we assumed they are not so huge[7]. Instead, we focused on the pretended arbitrary signs.

We think that they are not as arbitrary as Morgersntern had stated. If we take into consideration the spatial dimension, we find some interesting patterns, which allow us to explain the direction of such sign discrepancies, through the maritime routes[8].

[7] Rubio & Folchi (2005a), Carreras & Tafunell (2005), Rubio & Folchi (2005b).
[8] Carreras-Marín (2005)

Table 1. Statistical trade discrepancies of coal, oil and cement, foreign and own statistics[9].

	Coal (TM)			Oil (TM)			Cement (TM)		
	Foreign*	Own	% Dif.	Foreign**	Own	% Dif.	Foreign^	Own	% Dif.
Argentina	2.919.083	3.111.754	-6,6	426.949	506.598	-18,7	261.177	269.241	-3,1
Bolivia	664	6.077	-814,8	20.051	16.286	18,8	1.975	5.133	-159,9
Brasil	1.811.936	1.713.187	5,4	505.753	553.286	-9,4	221.825	238.343	-7,4
Colombia	3.125	3.252	-4,1	3.732	11.624	-211,4	18.933	26.035	-37,5
Costa Rica	78	808	-933,1	38.776	35.723	7,9	20.775	8.480	59,2
Cuba	701.707	659.389	6,0	1.281.949	1.243.587	3,0	72.613	91.695	-26,3
Chile	194.797	253.034	-29,9	782.058	850.303	-8,7	56.931	48.852	14,2
Ecuador	1.131	1.187	-5,0	1.489	17.195	-1054,6	8.162	11.311	-38,6
El Salvador	113	154	-36,6	19.926	10.536	47,1	3.108	15.983	-414,2
Guatemala	3.287	264	92,0	65.439	50.251	23,2	2.635	2.158	18,1
Haiti	83	156	-86,7	4.696	5.505	-17,2	9.638	5.025	47,9
Honduras	No Data	No Data		No Data	No Data		4.319	24.233	-461,0
Mexico	118.643	65.746	44,6	361.448	333.516	7,7	31.439	1.944	93,8
Nicaragua	2.476	2.646	-6,9	7.281	15.647	-114,9	2.105	0	100,0
Peru	32.542	38.389	-18,0	8.001	6.912	13,6	60.336	4.171	93,1
R. Dom.	9.484	9.697	-2,2	31.842	48.981	-53,8	4.926	1.185	75,9
Uruguay	No Data	No Data		No Data	No Data		12.021	35.524	-195,5
Venezuela	No Data	No Data		2.287	14.816	-547,7	No Data	No Data	
Total	5.799.150	5.865.739	-1,1	3.561.676	3.720.765	-4,5	792.920	789.313	0,5

Source: Foreign Trade Statistics for each country, 1925 (Statistics from Latin American countries and its European and USA partners). *Coal exporters are UK, USA and Germany. **Oil exporters are USA, Mexico and Peru. ^Cement exporters are Germany, Belgium, UK, USA, France and Norway.

The disappearance of disagreements between each country by total aggregation indicates that such divergences can have a geographical nature (see table 1). This argument has been used by Federico and Tena (1991), but in a very different way. They argue that through this geographical compensation, total foreign trade data gain reliability. These authors still distrust on bilateral data, although they suggest the possibility of importers to be more accurate than exporters in its geographical assignment[10]. Meanwhile Federico and Tena neutralized geography in order to achieve accuracy; we go into the geographical problem trying to find an explanation.

[9] Oil exports from Peru are not included in our work. The imbalance of this country is about 2.5% in volume, it was concentrated in two countries, Argentina and Chile (this second country very connected to the problems with the Bolivian data). Anyway, the Peru pattern fits well in our hypothesis of trade routes (positive differences with the neighbours countries, Argentina, Chile, Bolivia and Colombia, and negative differences with Ecuador and other Caribbean countries (Guatemala, Costa Rica and El Salvador)). For more details of data see Rubio & Folchi (2005a, 2005b).

[10] Federico and Tena (1991): 'The percentage of errors was higher in record by country, undoubtedly the worst part of all trade statistics. Declarations of traders about the origin and destination of goods were not reliable, and customs were interested in checking them only if differentiated tariffs by country were applied (hence it is likely that accuracy was greater on the import side). In general there was a tendency to overestimate the trade with neighbouring or transit countries and underestimate, to the same extent, that with distant ones; this bias was particularly serious for land transport.', p. 262-263.

For coal, oil and cement 1925 data, total differences are below 5%, which is not significant. But things behave not so well for each country. We explain these individual discrepancies by geographical patterns. With our method, we refuse the arbitrary argument meanwhile we find a systematic explanation of it. As long as we can explain discrepancies, we validate the source for any further analysis, especially, all the analysis which compare some magnitudes of all the Latin American countries.

IV- Cement, petroleum and coal in the Latin American markets[11]

We have chosen a sample of products to test our hypothesis about the influence of maritime routes to explain statistical discrepancies between Latin America and its trade partners. The sample includes three products in 1925[12]: cement, petroleum and coal. There are three main considerations justifying their selection:

1/ As long as transport costs have an important influence over all them, we hope to emphasize any geographical deviation coming from their distribution.

2/ Being they a typical standard product, we can avoid problems caused by different statistical definitions of each commodity.

3/ Each of them is related mainly to one unique supplier: 65% of coal came from UK, near a 60% of cement came from the tandem Germany-Belgium and almost a 60% of petroleum came from USA. This allows us to use each product as an indicator of each country's pattern (see table 2).

Table 2. Exports, by country of origin, to Latin America, 1925.

	Coal		Oil		Cement	
	TM	%	TM	%	TM	%
UK	3.803.163	65,6	1.652	0,0	79.445	9,3
United States	1.637.853	28,2	2.050.057	57,6	159.209	18,7
Germany	358.134	6,2	685	0,0	336.621	39,5
Mexico	-		1.494.725	42,0	-	
Chile	-		12.270	0,3	-	
Belgium	-		-		187.568	22,0
France	-		-		33.284	3,9
Norway	-		-		56.625	6,6
Total	5.799.150	100,0	3.559.389	100,0	852.752	100,0

Source: Foreign Trade Statistics of the exporter's countries (1925).

UK was the main supplier of coal for Latin America, but its share in each importer country was not the same for the entire region (see map 1). British coal was hegemonic in Argentina, Bolivia, Brazil and Chile, countries that were the main importers. USA dominated the rest of countries (especially,

[11] All the product market analysis in that section are using foreign trade data. There aren't important differences in the results if you repeat the analysis with own data.
[12] We choose 1925 because we can consider it as a "normal" year. The effects of the I WW were dismissed and the distortions of the 1929 crisis weren't arriving yet.

the Caribbean countries), in a close relation with the energy transition process, from coal to petroleum, in those countries. British higher trade shares were around 70%. USA achieved shares over 80% in the Caribbean and Central America, but they were around 60% in the case of Peru and Colombia. The German coal had little trade shares [13] and it was mainly related to the British dominated countries.

Map 1. Coal trade in Latin America

Source: Foreign Trade Statistics of the exporter's countries (1925).

In the cement trade case, suppliers were less concentrated (see map 2). Germany accounted for near a third of total exports, but Belgium and USA were also important, representing around a 15% [14]. France, Great Britain and Norway were also cement suppliers, although with much small shares [15]. As well as in the coal trade, there were also some differences country by country.

[13] Only 5% of total trade was German, and it only was with some countries (Argentina, Chile, Peru and Bolivia).
[14] USA represented a 13% by foreign statistics or 18% by own statistics. Belgium had 20% in both statistics.
[15] In the case of France, the difference between foreign and own statistics are wider (4% for own statistics and 20% for foreigner). The other countries were less relevant, United Kingdom and Norwegian exports were the 10% of total imports in Latin America.

USA's dominium over the Caribbean and Central American countries appear also in this case, with shares over 70%[16]. Germany was the first partner in the other cases, although its market shares were lower than USA's. Belgium, France and Norway had a secondary role, except in the Argentinean market where Belgium was the first supplier. UK was far from that, except in Ecuador, Chile, Brazil and Bolivia[17].

Map 2. Cement trade in Latin America

Source: Foreign Trade Statistics of the exporter's countries (1925).

Oil trade was much more concentrated by suppliers, including in this case a Latin American producer: Mexico (see map 3). European countries had no presence, related to American trade. USA's oil production was located at the two coastlines, but a major part of it was shipped by Texas and distributed through the Caribbean islands to the south of the continent. Californian oil was instead traded through the Pacific side. The Mexico Gulf was the departure for Mexican oil, going then to the Caribbean. USA's market shares were extremely high in most of the cases, over 80%. Mexico was the first supplier only for Brazil, Costa Rica, Cuba and Guatemala.

[16] Colombia had also a big dependence of USA's cement if we use its own statistics (69%). This country was underestimated by USA because of the geographical assignment problem of the exporter, as we will show later on.
[17] British shares in those countries were more than 50% according to foreign sources, and more than 30% according to Latin American sources.

Map 3. Oil trade in Latin America

Source: Foreign Trade Statistics of the exporter's countries (1925).

V- Trade routes between Latin America and its suppliers

European and North American commodities were sent to Latin American through two principal maritime routes (see map 4). The first one started in Europe and arrived to America through Brazil; then, a main route went south passing by Uruguay and Argentina, and an other secondary route go to the Caribbean and Pacific countries through Venezuela, Atlantic-Colombia and Panama. This can be denominated the Atlantic route.

The second one arrived to the Caribbean countries[18] and through the Panama Channel, achieved the Pacific. It can be said the North route. USA's goods to be sold to countries at the Pacific coast or elsewhere use its Pacific route. Meanwhile, USA's commodities to Latin American countries at the Atlantic coast used the Atlantic route going to Brazil trough the Caribbean islands.

Map 4. Trade Routes, 1929.

Source: Berglund, A. (1931). p. 99.

The United Kingdom's trade to Latin American countries had three important partners, Brazil, Uruguay and Argentina; that suggests the importance of the Atlantic Route as a European one. We have studied the weigh of each route for each country with data coming from navigation records. In the case of UK, more than a 75% of trade (in quantities) went through the Atlantic route to Brazil,

[18] The European products could arrived to the Caribbean countries by two ways, the first one is through Brazil and Venezuela; the second one, was by the Atlantic Route 2, arriving directly or through USA.

Uruguay and Argentina[19]. In the case of USA, more than a 75% went to the Caribbean countries, meanwhile more than a 90% of USA's trade came from the Atlantic coast[20].

USA's ships used its own flag only for a 60% of its sea trade, and these ships went mainly to the Caribbean and Pacific countries. Meanwhile British ships brought a 20% of USA's trade, mainly by the Atlantic route. The rest of USA's trade used other country's ships, much of them Norwegian[21]. Taking into account USA's and UK's data from navigation, we assume that the Atlantic route was mainly British, while the North route was dominated by USA.

Germany had a bad situation for its own ships, after the IWW. As a consequence, in 1925, part of the German trade traveled through other country's ships. A different nationality of the ship could have a confusing effect in the geographical origin of its cargo. For this reason, it has been necessary to consider that the German trade to Latin America went by both routes, through Britain or USA.

A further consideration has to be made, about the relevance of USA, UK, and Germany, to the Latin American market. These three countries accounted for the major part of total imports of that region[22]. As a consequence, we think that our sample can be representative of a much wider trade pattern.

[19] *Accounts relating to trade and navigation on the United Kingdom, for each month during the year 1925.* December 1925. p. 238-241.
[20] *Foreign commerce and navigation of the United States. Calendar year 1925. Vol. II.* P. 121-123.
[21] *Foreign commerce and navigation of the United States. Calendar year 1925. Vol. II.* P. 121-123.
[22] Bulmer-Thomas (1987); Bulmer-Thomas (2003); Carreras et al. (2003). p. 10. Show us the importance of a few numbers of countries (USA, UK, Germany, France and Belgium) as a foreign trade partners for the Latin America imports.

VI- Trade routes and the geographical assignment problem: is there any connection?

VI.A- Coal trade statistics

Geographical patterns arise by mapping the signs and the magnitude of the statistical divergences between Latin America coal data and its trade partners[23] (see map 5). The fact that differences in Brazil, Cuba, and Mexico had a positive sign, meanwhile in Argentina and Chile had a negative one, point out the importance of the extreme countries.

A positive sign means that the exporter data are bigger than the importer. It indicates that Cuba, Brazil and Mexico can be overestimated in the exporter statistics, probably because they were first harbors in both maritime routes. This would be a proximity bias included in the exporter data. A negative sign appears if exporter's data are smaller than importers'. This phenomenon indicates an underestimation of distant or small countries by the exporter.

In other words, we assume that some goods assigned to Brazil, Cuba and Mexico went really to the other Latin American countries, and doing so we trust more on the importer side of information. We validate this risky assumption by analyzing the geographical discrepancies for each country, using GIS methodologies.

Map 5- Statistical discrepancies in total coal trade

Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925).

[23] Coal's total trade between Germany, United Kingdom and United States.

British coal trade show a very important positive sign with Brazil, which means British data being bigger than the Brazilian, i.e. exporter's figure being bigger than importer's. Negative signs for the other countries increase to the same extent that they are distant to Brazil. We think that this is a result of the British coal using the Atlantic route. We can even reinforce these results adding Germany to the British coal trade (see map 6), assuming that the Atlantic route is the best way to arrive to the Latin American countries, German coal sailing into British ships[24].

Map 6- British and German coal trade discrepancies with Latin America

Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925).

The first main harbor, Brazil, appears to be clearly overestimated by both British and German statistics. The cause could be a probably tendency to register the first main harbor of a maritime route[25], assigning all his cargo to this first destination. The fact that signs change for the next countries, being then British and German trade statistics smaller than Latin American's, indicates a British underestimation[26]. If they had assign too much of its trade to the first harbor, i.e. Brazil, they will assign much less to the next.

As long as distance increases[27], the probability of having registered the last harbor decreases, because the difficulty of extracting such information in the European origin also increases[28]. The more distant a country was, the more difficult to identify it, as a destination of a ship or part of its cargo. As a result, the sign of the statistical discrepancies is higher with distance to the first harbor.

[24] The important Latin American partners for the German coal are the same as the important UK partners.
[25] When the shipment had some stops, in different countries, in their route.
[26] In some cases in Central America, the British statistics didn't quote their exports.
[27] We don't understand distance as a physical distance, but as an ordinal sea neighbourhood (using GIS methodologies).
[28] The criteria for the destination of UK exporters were the *'last destination of it"*. They can make an assignment error if a ship stopped in many countries and sold only part of their cargo every time. Societé des Nations (1928).

But this is only a marginal phenomenon, we refer only to a small trade share, not to the big trade figures.

It has also to be remarked here, that we are assuming in our argument that the assignment problem is mainly in the exporter country. As a consequence we consider importers' statistics accurate enough in its geographical distribution[29]. In this sense, we are revaluating the Latin American foreign trade statistics. Anyway, our analysis focuses on the signs of discrepancies, but we don't avoid the explanation of the volume discrepancies, even thought they are negligible in an important part of the data analysis.

In the case of USA the coal data shows a very different pattern (see map 7). Positive signs, i.e. an overestimation of USA's statistics, are now located into the Caribbean region, through Panama and the nearest countries in the Pacific coast. Positive signs become negative, as an indicator of underestimation of USA's statistics, as distance increases.

Map 7- USA's coal trade discrepancies with Latin America

Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925).

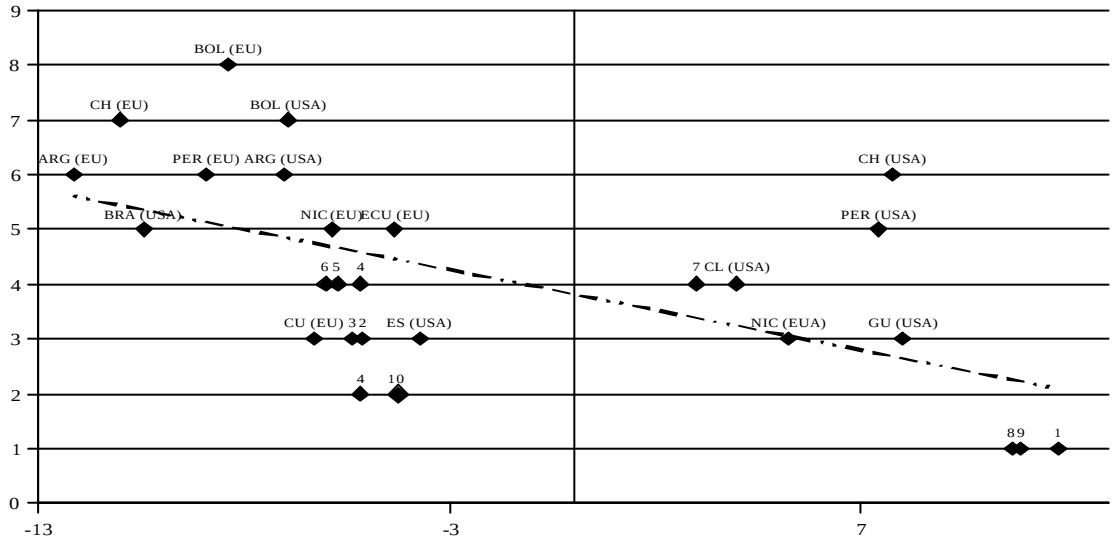
It is now not only a matter of the signs, but of quantities. Cuba and Mexico have the biggest positive discrepancies; meanwhile Argentina and Chile had the biggest with the negative sign[30]. The North

[29] Federico and Tena (1991), Carreras-Marín (2005).
[30] The Chilean case has some problems due to the Bolivian imports, that were assigned to Peru or Chile. The Bolivian case is quite the same as the Swiss, for which Bourne (1872) said: 'There are some countries, such as Switzerland, from her having no ports, with which we appear to have no trade; and many others, Austria for instance, which show but little, because the greater part passes through others; although our relations with both these may in reality be as direct as it is in cases where it is more clearly manifest.' p. 203.

route shows one pattern for the Caribbean and the Pacific countries and another pattern going from Cuba to Venezuela, Brazil, Uruguay and Argentina. In any case, the quantitative significance of this second trade was much smaller than that coming through the other coast of the continent.

Maps have drawn a clear picture that suggests our hypotheses are true. Furthermore, we have correlated distance and statistical discrepancies in order to find a relation between the two variables, which reinforce our argument (see graph 1). Using GIS methodologies, we have assign ordinal numbers to each Latin American country, according to its distance to the first harbor in each maritime route. For example, for the British data, Brazil is 1, and Uruguay is 2; meanwhile, for the USA, Cuba and Mexico are 1, and Brazil 3, and so on[31].

Graph 1- Distance and discrepancies in the coal trade[32]. Both routes.



Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925). The discrepancies are expressed in X = – log(abs(discrepancies)) for negative values and X = log(abs(discrepancies)) for positive values. For the graph labels: 1, BRA (USA); 2, MEX (EU); 3, DR (USA); 4, CL (EU); 5, CR (EU); 6, CR (USA); 7, ECU (USA); 8, CU (USA); 9, MEX (USA); 10, HT (USA). The (USA) means the exports of USA coal, and the (EU) means de the sum of the German coal exports and the United Kingdom coal exports.

The graph clearly shows that as long as distance increases (up Y axis), importers' data are bigger than exporters (increases the negative sign of the difference, left of X axis). On the other side, exporters' data are bigger, the nearest to the first harbor (increase the positive sign of the difference, down Y, right X). Showing this correlation, we can state that there was a proximity bias in the exporter statistics for coal trade in Latin American.

[31] We assign an ordinal number to a country related with every border that the shipment crossed in their long way from the first harbour to the final harbour; the GIS methodology plays an important role in that assignment.

[32] In the X-axis we show, for the negative values, minus logarithm of the absolute value of the statistical imbalance; for the positive values, is only the logarithm of the absolute value of the statistical imbalance. In the Y-axis are the values that we assign to the countries, related to their remoteness to the first country in every route.

VI.B- Cement trade statistics

As we have seen before, cement trade in Latin America, although remaining essentially European, was not a British dominium. If total discrepancies in this product were lower than in coal, individual differences were in fact higher (see table 1). The signs of such discrepancies show a completely different map, as that obtained with coal. There is also a close relation between distance and the amount of discrepancy, but its sign is exactly the opposite.

Distant countries as Chile have a positive sign, meaning bigger exporter's data. Nearer countries, as Brazil, have negative signs, meaning smaller exporter's data. The higher share of Germany can explain this unexpected result. Geographical assignments in Great Britain and Germany in 1925 were defined by different methods. Meanwhile the British one seems to have caused a tendency of overestimation the first harbor of a maritime route; the German system seem to have cause the same effect but at the end of the route[33].

Map 8-European cement trade discrepancies with Latin America

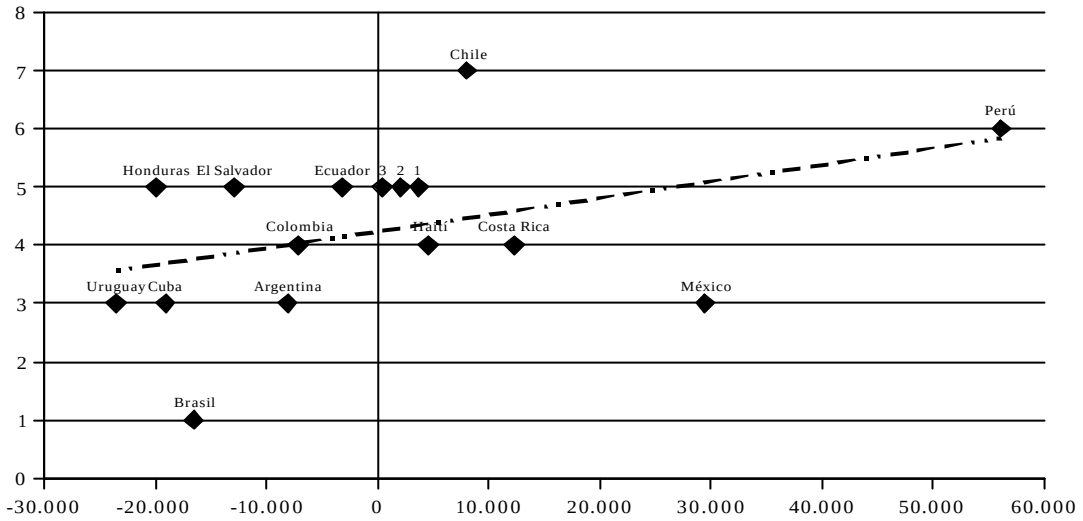
Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925).

The coal trade had differentiated routes (North and Atlantic) due the importance of the USA and UK; but the cement trade were more diffused, and both routes were used indistinctly. Distance,

[33] Systems of geographical assignment for each country come from Société des Nations (1928). The assignment for the UK exports was "*the final destination*", for German exports was "*consume*", and for USA exports was "*real destination*".

following the maritime routes, and statistical discrepancies correlate exactly in the opposite direction, as that found in the coal case (see graph 2). Bigger differences are located negatively near the first harbors, and they become positive as distance increases. We think that in here there is also a geographical bias, caused by the German assignment criteria based in the final consume location that was probably associated with the final destination of the maritime route. As a result intermediate harbors could be underestimated in German and other European statistics.

Graph 2- Distance and discrepancies in the cement trade. Total data.



Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925). We omit de Bolivian data because their problems as a country without seaport, produces data errors for the exporters countries. For the graph labels: 1, Rep. Dominicana; 2, Nicaragua; 3, Guatemala.

VI.B- Oil trade statistics

Meanwhile coal trade was essentially a British one, and cement trade was dominated by Germany, oil commerce was North-American[34]. Either the USA either Mexico used mainly the North route, passing through the Caribbean islands, as we can easily observe in the map of statistical discrepancies (see map 9). Mexico and Cuba show the biggest positive signs, meaning exporter's data over importer's one. Negative signs are located at the Atlantic coast, increasing with distance to the producers.

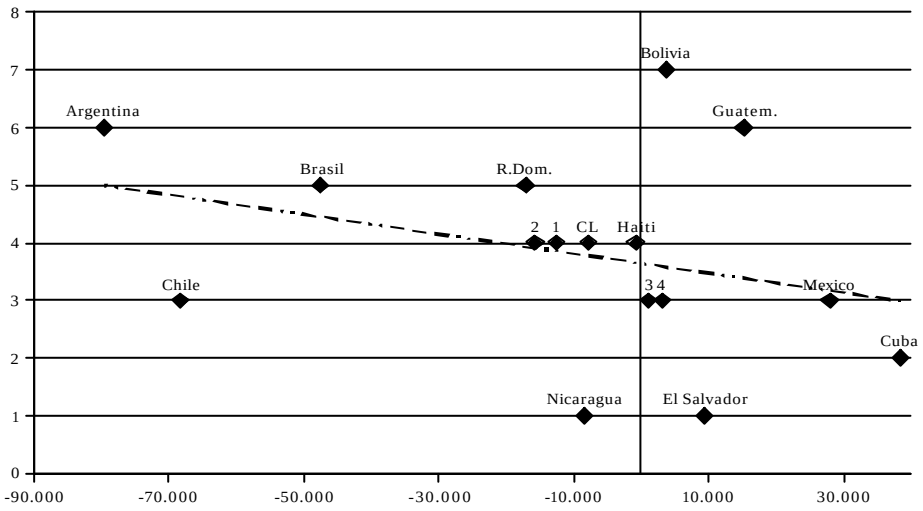
[34] Even though the Chilean statistic reflects oil exports to Bolivia, Chile wasn't an oil producer in 1925. Those figures are part of the problems with the Bolivian statistics and their neighbours.

Map 9-Oil trade discrepancies with Latin America

Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925).

The correlation between distance and statistical discrepancies show a very similar graph compared to the coal one. Results can be interpreted as we have done in that case. Exporter's sources overestimate nearest countries, and they underestimate distant countries [35].

Graph 3- Distance and discrepancies in the oil trade. North Route.



Source: Differences in Foreign Trade Statistics between the exporter's data and the importer's data (1925). For the graph labels: 1, Venezuela; 2, Ecuador; 3, Peru; 4, Costa Rica.

[35] In the three products, Bolivian data had important discrepancies related with their geographical situation without any seaport. In some cases we decided to omit it.

VI- Conclusions

We have developed a method in which statistical discrepancies between Foreign Trade Statistics have been analyzed in its spatial dimension. We have focused in the Latin American case that has been long considered a really bad example of statistical accuracy. We have chosen three homogeneous goods- coal, cement and oil-, because each of them reveals a specific geographical pattern for three main countries: UK, Germany and USA.

We have mapped statistical discrepancies between Latin America and its main suppliers, and we have also correlated an ordinal measure of distance, using GIS methodologies based upon maritime routes of that epoch, with such differences. Our main results can be summarized as follows:

1. Latin American Foreign Trade Statistics are good enough from the geographical point of view
2. Exporters' data have some marginal problems in its geographical assignment: UK and USA seems to have a proximity bias, meanwhile Germany had an overestimation by final destination.

Our results can help further research in this field, including more countries, more goods and more time points[36]. Anyway we think it can be a successfully preliminary work for the adoption of the geography as a variable in the economic theory in historical perspective.

[36] Similar results have been achieved by Carreras-Marin (2005) for an international sample of textile products in 1913.

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