'The apparent consumption of fossil energy as an indicator of modernisation in Latin America by 1925: A proposal using foreign trade statistics'[1]

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In the interpretation of the process of economic modernisation of the last two centuries, it is widely accepted that the productivity gains achieved through the development of new energy carriers (from wood to coal, and later to petroleum and electricity) play an important role. From this viewpoint, the Industrial Revolution has been interpreted as the 'process that allowed the exploitation at great scale of new energy sources by means of inanimate converters'[2] and it has been argued that coal – and later oil- was 'a strategic item in the rise and diffusion of the industrial civilisation'.[3]

It is within this context that it has also been claimed that 'economic history makes it evident that the industrial standing of any country may be gauged, with a fair degree of accuracy, from its development of mechanical power'.[4] Of the 33 countries that constitute Latin America and the Caribbean at present, we have historical national accounts for a handful of them. Consequently, the comparative analysis of the economic performance of region as a whole has been constrained to the countries for which historical economic indicators have been constructed.[5] The more constrained, the earlier the period considered. The issue of the lack of quantitative evidence does not only affect the comparative economic history of the region as a whole. The lack of quantitative substantiation is particularly troublesome for the individual economic histories of the smaller countries. For these, very little is known about their economic performance over the very long run.

In absence of comparable macroeconomic indicators for most of the Latin American economies beyond the 1930s, this paper presents an estimate of the apparent consumption per

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[2] Cipolla, *Historia económica de la población mundial*,, p.57.

[3] Wrigley, 'The supply of raw materials in the Industrial Revolution'.

[4] U.S. Department of Commerce (by J.R.Bradley), *Fuel and Power in Latin America*, p.1.

[5] Historical reconstructions of GDP series include those of Maddison, *Monitoring*. and the OxLAD, *Oxford Latin American Economic History Database (OxLAD)* (Latin American Centre at the Oxford University, 2002-03); available from http://oxlad.qeh.ox.ac.uk/index.php. which resulted in the study published as Thorp, *Progress, Poverty and Exclusion*. These studies include, respectively, 13 and 11 Latin American countries for the year 1925. Less countries or punctual GDP estimates for countries of the region can also be found in Bulmer-Thomas, *Economic History of Latin America*. and Hofman, *Economic Development of Latin America*.

head of coal and petroleum for 25 countries of Latin America and the Caribbean for the year 1925. This allows us to rank the Latin American countries and observe the relative distance among each other. For constructing our estimates, we use both the foreign trade statistics of the Latin American economies and that of their principal trade partners, plus data on home production of coal and petroleum. We use energy consumption as an indicator of economic modernisation.[6]

As a result, the paper contributes to several literatures. On the one hand, it offers a contrast of the foreign trade statistics of the Latin American countries with that of the advanced economies (UK, USA and Germany), showing that the former are far more reliable than previously thought by the literature. On the other hand, the paper adds to the environmental and energy history studies by doubling the number of countries for which energy consumption estimates were previously available in Latin America. Last but not least, the paper contributes to the wider economic history debate in Latin America providing the basis for a comparative analysis of modernisation performance, beyond the countries for which historical national accounts are currently available.

The paper is organised as follows. Section I furnishes the basis of our approach. The relationship between fossil energy consumption and economic modernisation is a long-standing proposal in the economic history literature, more recently entering models of economic theory and applied economics. In Section II the existing works that elaborated historical estimates of energy consumption in Latin America are surveyed and scrutinised. Our data set and some methodological considerations regarding the construction of the series of apparent consumption of fossil fuels are presented in Section III. In Section IV the results are displayed and analysed in the light of the precedent evidence of economic performance of the Latin American countries. Section V summarises the main findings and sets the agenda for further research.

I

The importance of fossil fuels for modern economic growth, which was inaugurated with the Industrial Revolution, did not escape the contemporaries. Among them, the British economist William Stanley Jevons has a prominent position. In his seminal work, he asserted 'coal, in truth, stands not beside but entirely above all other commodities. It is the material energy of the country—the universal aid—the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back in the laborious poverty of early times.'[7] Academics and non-academics recognised from the start the crucial role the new form of energy was to play in their daily life as much as in the progress of the nation. Just after a year of Jevons' publication, *The Times* insisted: 'Coal is everything to us. Without coal, our factories will

[6] See Carreras et al., 'El desarrollo económico de América Latina'.
[7] Jevons, *The Coal Question*.

become idle, our foundries and workshops be still as the grave; the locomotive will rue in the shed, and the rail be buried in the weeds. Our street will be dark, our houses uninhabitable'.[8] It was clear; the comfort of modern life was intrinsically tied to coal.

In the advent of the new century, the qualitative relationship between energy use and wealth was widely discussed and amply accepted by economists.[9] Nevertheless, it was not until the works of T. Read that an attempt was made to establish a quantitative relationship.[10] With his estimates of energy consumption ('world's work output', as he called it) for 30 countries in 1929 he concluded that 'a general relationship between work done per capita and economic well-being is observable; but a precise correlation is not yet possible'.[11] Of course, the correlation between wealth and energy per capita was difficult to be found back then, since no standard procedure for the valuation of national wealth was yet available.

Almost simultaneously, in 1934, Lewis Mumford published a book that reviewed history from an energetic viewpoint for the first time: *Technics and Civilisation.*[12] Following the ideas of Patrick Geddes, Mumford proposed that industry has in fact been developing steadily over the last millennium. He broke this down into three overlapping phases, characterised by a specific mix of power and materials. Thus the 'eotechnic' phase (1000-1750) was defined by water-and-wood; the 'paleotechnic' phase (1700-1900) was coal-and-iron based, and the 'neotechnic' phase (1850 onwards) was characterised by an electricity-and-alloy complex.[13] In his view, history could be interpreted in terms of successive episodes of 'energy releases'. Each of them would provide more energy for society, an improvement in the supply regularity, more flexibility in the distribution, and a more efficient use. Economic historians such as C.Cipolla and E.A.Wrigley would reformulate some of these ideas, regarding the importance of energy to the modern economic development, some 30 years later.

In his *Economic History of World Population*, C. Cipolla proposed a view of human history based upon energy consumption.[14] Humankind history could be divided in three stages split by two revolutions. The first one, the Neolithic revolution, started around 10,000 years ago when hunter-gatherers settled in small communities and learned to produce their own food, sowing cereal grains and breeding better plants. In energetic terms, this implied a process by

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[8] 'Editorial,' *The Times*, April 19 1866.
[9] Hobson, *Work and wealth: A human valuation.*; Carver, *The economy of human energy*.
[10] Read, 'The World's Output of Work'. His earlier estimates of the world's energy output were published in several journals over the previous years. A decade later he also published the estimates for 1939, see Read, 'World's Output of Work'.
[11] Read, 'The World's Output of Work', p.55. About the role played by fossil fuels he précised: 'about two-thirds of the work of the world is done by coal and nearly a quarter by petroleum, while water power amounts to less than one tenth'.
[12] Mumford, *Technics and civilisation*. here read from the Spanish translation Mumford, *Técnica y civilización*..
[13] Actually, Pattric Geddes, was possibly the first one to interpret history in a physical key. See Martínez Alier, *La Ecología y la Economía*.
[14] Cipolla, *The Economic History of World Population*. here from the Spanish book Cipolla, *Historia económica de la población mundial*,.

which 'humans controlled and increased the array of biological converters' (plants and animals).[15] The second energetic revolution would be what we all refer to as the Industrial Revolution. In words of C.Cipolla, it was the 'process that allowed the exploitation at great scale of new energy sources by means of inanimate converters'.[16] With the introduction of new energy sources, the Industrial Revolution changed dramatically the energy budget of human societies. Agricultural societies dispose of a very limited energy supply, mostly from an organic base. Industrial societies have at their disposal greater energy possibilities, chiefly form inanimate sources.

The historical significance of these changes, especially from the development of the steam engine, is that humanity progressively obtained higher levels of disposable energy per head. Part of this translated only into more energy consumption per capita (heating, lighting, transports, etc) but also into more energy per labourer, and consequently, greater labour productivity.[17] Thanks to these, industrial societies entered into a new cycle of economic growth, which at the same time, acted as stimulus for the progress of new energy forms: 'the more energy produced, the more energy was seek out'.[18] The increase of disposable energy for the industrial society and its effect on productivity, implied the expansion of the real income per capita, improved welfare levels, and satisfied needs well above the purely basic ones. In summary 'due to the exploitation of the new forms of energy, the greater abundance of capital, and a more efficient use of production factors, real income is greater in industrial societies than in agricultural societies'.[19]

The very same year of the publication of Cipolla's book, another prominent economic historian, E.A.Wrigley, published an article entitled 'The supply of raw materials in the Industrial Revolution'.[20] On it he started to delineate a thesis, very close to the ideas of C.Cipolla, which years later will be published in the form of the book *Continuity, chance and change: the character of the Industrial Revolution in England.*[21] Almost simultaneously to the publication of this book, downward revisions of the growth rates of the classic period of the Industrial Revolution started to appear.[22] Unlike Cipolla, Wrigley had the time to include them in his later assessments. Nevertheless, a 'slower' Industrial Revolution did not move him an

[15] Cipolla, *Historia económica de la población mundial*,, p.57.
[16] Cipolla, *Historia económica de la población mundial*,, p.57.
[17] Cipolla, *Historia económica de la población mundial*,, p.65.
[18] Cipolla, *Historia económica de la población mundial*,, p.63.
[19] Cipolla, *Historia económica de la población mundial*,, p.79.
[20] Wrigley, 'The supply of raw materials in the Industrial Revolution'.
[21] The original versión in English was published in 1988. Here we use the Spanish translation Wrigley, *Cambio, continuidad y azar: carácter de la revolución industrial inglesa*.
[22] Originally in Crafts, *British economic growth during the Industrial Revolution*. The scale of the change implied by the Crafts revision was substantial. His estimates of growth rates in England between 1760 and 1831 imply that national output in 1760 must have been approximately 60 per cent larger than supposed in earlier works. Similarly, whereas Dean and Coale estimated that output per head rose by 87 per cent over this period, Crafts put the comparable figure at only 29 per cent, (tab. 2.11, p. 45). These estimates have been subsequently revised over the 1990s.

inch from his main line of argument.[23] According to Wrigley, what was extraordinary about the rate of growth of product per head in England in the century between 1750 and 1850 was not that it was so low but that it did not turn negative. Given the rate of population growth over the period, output per head and depressed living standards were to be expected. To escape from this danger, to avoid the growth curve becoming asymptotic, it was essential to break free from the constraint imposed by the energy budgets of organic economies, which depended almost exclusively upon annexing as much as possible of the annual inflow of energy from plants, humans and animals. Such economies were incapable of sustaining growth over a prolonged period since the maximum quantity of heat and mechanical energy, which could be secured in this fashion, was modest. Escape was possible because a succession of technical innovations made coal applicable in a widening range of applications where heat energy was needed, and at a later stage, because of the ingenuity and perseverance of men such as Newcomen and Watt, the burning of coal could be made to overcome bottlenecks in the use of mechanical energy also. The significance of the gradual circumventing of the energy bottleneck was not that it produced a sudden acceleration in the rate of the growth of the economy or in the level of individual productivity. It was that it removed a barrier, which would otherwise have tended slowly to constrict growth. Only at a much later stage in the process by which the organic economy gave way to a mineral-based energy-intensive economy did the full benefit emerge in the form of a significantly higher rate of economic growth both in aggregate and per head.

Most economic historians accept the crucial role played by fossil fuels in the process of economic development along the lines just described. In fact, primary energy consumption per capita has been used as a proximate and measurable determinant of growth in historical exercises.[24] Thus the economic history literature endorses, in the main, our approach of using fossil energy consumption as a proxy of the degree of economic modernisation of a group of countries in absence of more explicit macroeconomic indicators. Yet, we must also seek out support from the economic literature, in the form of theoretical and applied studies.

The economic literature tended to focus on how energy demand is driven by economic development, and/or how a potential energy shortage may strangle economic growth, rather than how energy contributes to economic development.[25] Toman and Jemelkova found a limited amount of relevant literature for their conceptual discussion in order to identify the channels through which increased availability of energy might act as a key stimulus of economic

[23] What follows it is a summary from Wrigley, 'The Industrial Revolution'..
[24] Maddison, 'Growth Accounts...,'.
[25] On the first aspect, see the survey by Toman and B.Jemelkova, 'Energy and economic development: an assessment of the state of knowledge'. on the second issue see, for instance Solow, 'The Economics of Resources or the Resources of Economics'. Solow, 'Intergenerational Equity and Exhaustible Resources'. Stiglitz, 'Growth with exhaustible natural resources: efficient and optimal growth paths'.

development along different stages of the development process.[26] In spite of that, they found some important illustrations of a disproportionate role for energy. However, that evidence also underscores the importance of energy development in concert with other forms of development. On the empirical side, numerous studies aim at providing evidence about whether the level of energy inputs thrusts economic growth or whether it is the output level what governs the energy input.[27] In general, the results of econometric bivariate tests were not very convincing. Surely this was due to omitted variables such as labour, capital, technological change, etc.[28] Nonetheless, the survey of the newest applied literature by Stern and Cleveland reveals that the relationship between energy availability and output levels seems to be quite strong.[29] More robust multivariate test demonstrated that the level of energy use is significant for explaining the level of output.[30]

These results, together with the economic history tradition, incline us to consider that our work relies on solid ground. In absence of better economic indicators, energy use is a valid guide to distinguish the modernisation level of various countries at a given point in time. How firm is this guide for further extrapolations of the countries' actual economic performance is discussed below.

II

Ours is not the first attempt to reconstruct the apparent consumption of energy in Latin America in historical terms. Other studies have provided punctual estimates and some historical series of energy consumption in Latin America are available. Most of them, however, start in the post-war period and provide data for a limited number of countries. In fact, energy studies were relatively scarce before the energy crisis of the 1970s. The concerns about energy scarcity raised then also affected Latin America. Some of the resulting reports are reviewed here, yet they did not attempt any kind of historical reconstruction of the data.

The first monograph about energy in Latin America we are aware off, is a report by the United States Department of State published in 1931. The reports departs from the idea that the use of coal, petroleum, and water 'is an index of industrial attainment, and that their availability in a country will strongly affect that country's future position (…).'[31] The objective of the

[26] Toman and B.Jemelkova, 'Energy and economic development: an assessment of the state of knowledge'.
[27] See for instance Kraft and A.Kraft, 'On the relationship between energy and GNP'.; Akarca and T.Long, 'On the relationship between energy and GNP:A reexamination'.;Yu and B.Hwang, 'The relationship between energy and GNP:Further results.'.;Yu and Choi, 'The causal relationship between energy and GNP:An international comparison'.; Erol and E.S.H.Yu, 'On the causal relationship between energy and income for industrialized countries.'.;Abosedra and H.Baghestani, 'New evidence on the causal relationship between United States energy consumption and gross national product'.
[28] Stern and Cleveland, 'Energy and Economic Growth', pp.26-28.
[29] Stern and Cleveland, 'Energy and Economic Growth'.
[30] Stern, 'A multivariate cointegration'.;Oh and Lee, 'Causal relationship'..
[31] U.S. Department of Commerce (by J.R.Bradley), *Fuel and Power in Latin America*, p.1.

report was not academic, but to explore the double role of Latin American as supplier of raw materials and growing market for the US products. Nevertheless, the report offers an appealing review of the energy availability of a long list of countries, although extremely unequal in coverage and detail.[32] In some cases information does not go beyond stating the existence or absence of national production of coal and petroleum. For most countries, patchy data on imports, industrial consumption and prices of coal and oil, electric installed capacity, and existence of public utilities (railways, tramways, etc) are provided, mostly for the second half of the 1920s. A punctual estimate of the coal and fuel-oil consumption and potential and developed waterpower for 18 countries is given for the year 1928.[33] Although informative for US merchants, the disparity of data used, particularly those relating to coal and water, make the final estimates not comparable across countries, as it is recognised in the first page of the report.

Another punctual estimate of energy consumption for Latin American countries was the one by T.Read already mentioned. His earlier calculations were predominantly for the US and were mostly based on data for 1924-25. He later included a larger number of countries from all over the world (30 in total), and used the latest figures available that were quantitatively the largest (usually 1929). [34] His results may therefore be roughly taken as representing the high-water mark. Read's estimates of 'daily output of work' include the amount of work done by humans, coal, petroleum and waterpower, measured in millions of horsepower hour. Among the 30 countries, he listed five Latin American countries. Ranked by 'daily output per capita' these were: Chile, Argentina, Mexico, Peru, and Brazil. Read's results for 1939 did not alter this first Latin American energy ranking.[35]

R.Prebisch produced the first historical series of apparent consumption of energy for several Latin American countries for the ECLA's *Economic Survey of Latin America 1949.*[36] The *Survey*, as its own title indicated, had essentially an economic focus. Nonetheless, for each of the 4 countries analysed in detail (Argentina, Brazil, Chile and Mexico), there was a subheading dedicated to energy. Basically, Prebisch included the energy section in order to reinforce the 'dependence' argument elaborated all along the text. No comparative effort was made though. In fact, the type of energies, the units displayed and the time span considered are different in each case: in the case of Argentina the units chosen were 'tones of oil equivalent', the items displayed domestic and imported fuels and the years 1925-48; for Brazil coal and hydroelectricity produced in the country plus imported fuels measured in million of kilowatt-

[32] The list of countries includes Argentina, Brazil, Bolivia, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, the Guayanas, Honduras, Mexico, Nicaragua, Panama, Peru, Porto Rico, Dominican Republic, Salvador, Uruguay, Paraguay, Venezuela, and some of the Caribbean (British, Dutch and, French West Indies plus the Virgin Islands)
[33] U.S. Department of Commerce (by J.R.Bradley), *Fuel and Power in Latin America*, p.44.
[34] Read, 'The World's Output of Work', p.56.
[35] Read, 'World's Output of Work', p.144. Although coal data for Argentina could not be gathered for 1939 according to the autor.
[36] United Nations. Economic Commission for Latin America, *Economic Survey of Latin America 1949*.

hour for 1920-49; the only series displayed for Chile refers to the total amount of energy consumed quantified in millions of kilowatt-hour for 1925-1948, which apparently included firewood, coal, petroleum and gasoline; for Mexico coal, petroleum, natural gas and electricity add up to a total figure (the only one shown) given in millions of kilowatt-hours of energy consumed for 1925-48.

All sorts of compound sources were used to assemble the *Survey* series: some estimates from the World Energy Conference, some data from national energy committees such as the Argentinean, plus official data from yearbooks, national and international trade statistics, data from private companies such as hydropower companies, but also more obscure scholarly estimates of the time. Moreover, the equivalences established between the different energy carriers and the way apparent consumption was calculated remain unclear, especially for the countries where the total apparent consumption is the only figure displayed (Mexico and Chile). In some instances, the sources quoted are in-house estimates by the ECLA. The consistency of the series overall is doubtful, mostly when the ECLA itself declined to use the estimates of the *Survey* in its monograph about energy published within the decade.

The ECLA's concerns about the availability of energy in Latin America translated into a monograph dedicated exclusively to it, *Energy in Latin America,* published in 1957. The opening sentence of the monograph makes clear the importance of the matter: 'energy plays a decisive, albeit indirect role, in economic development, since, to the extent that it is available, it stimulates or hinders economic growth'.[37] From this it derives that 'an increasing and rational use of energy is (…) essential for raising productivity levels and for remedying the technical and economic backwardness of under-developed countries in general, and of vast areas of Latin America, in particular'.[38] Furthermore, it asserts that 'the amount of energy consumed in the production process per worker can give a first indication of the degree of development of an economy'.[39] In view of the outstanding role played by energy in economic activity, the main purpose of the study was to describe the characteristics of energy consumption in Latin America and to outline the future requirements.

Energy in Latin America put together basic statistical series on the various aspects of energy consumption for 20 countries of Latin America and the Caribbean. It aimed at covering the period 1925 to 1955 but 'in many cases it was not possible to complete the time series and hence only some characteristics year were presented, even if, on more than one occasion the procedure involved the use of estimates.'[40] For most countries the series go from the mid 1930s to 1955, and only for 7 countries estimates went beyond 1930 (see Figure 1). It is worth mentioning the absence of Brazil from this last group, which data is only given from 1939,

[37] United Nations. Economic Commission for Latin America, *Energy in Latin America,* p.3.
[38] United Nations. Economic Commission for Latin America, *Energy in Latin America,* p.3.
[39] United Nations. Economic Commission for Latin America, *Energy in Latin America,* p.6.
[40] United Nations. Economic Commission for Latin America, *Energy in Latin America,* p.10.

completely ignoring the previous estimates of Prebisch. For the construction of the series no new data were elaborated, but estimates already published were used. As a consequence, the sources used differ greatly across countries. In the study, the countries are grouped in three categories according the quality and detail of the statistical information available. The first one grouped the best-served countries: Argentina, Brazil, Colombia, Chile and Mexico. These countries counted with a sizeable amount of statistical compilations and specialised studies by 1957, although none covering the period prior to 1925. In general, the data provided for these five countries are more reliable, or at least are more contrasted and sophisticated.[41] The second group includes Cuba, Peru, Uruguay and Venezuela. For these countries, national yearbooks and trade statistics are combined with international sources, such as the United Nations *Statistical Yearbook*, plus some industry publication in the case of the oil producers (Peru and Venezuela) and the reports of the governmental energy departments where existed. Far less information was available for the third group of countries, namely: Bolivia, Costa Rica, Dominican Republic, Equator, Guatemala, Haiti, Honduras, Nicaragua, Panama, Paraguay and Salvador. Few national statistics were used in these cases. Instead, United Nation statistics were chiefly used: the already quoted *Statistical Yearbook*, along with the *Statistical papers*.[42]

[FIGURE 1: Time coverage by source]

Possibly, the broader historical energy study ever was the one directed by Joel Darmstadter (1971).[43] It included data of commercial inanimate energy output, trade and consumption for about 100 territories covering the bench-mark years 1925, 1929, 1933, 1937, 1938, 1950, 1953, 1955, 1957 and the annual years 1960-65. Although it only produced two punctual estimates before 1930, it includes 11 Latin American and Caribbean countries, that is, the larger set yet for these early dates (see Figure 1). This is a careful and detailed study. It offers the raw series (national production, exports, imports, bunkers and hydroelectricity) used in order to elaborate the apparent consumption of energy for each country. It made explicit all the conversion factors used for each type of energy carrier, including hydroelectricity (measured by heat content of the power produced rather than by coal-equivalent fuel requirements at thermal

41 For instance, in the case of Argentina, the data provided by the study includes the elaborated from 1925 by the Argentine Committee to the World Energy Conference and the Instituto de Estudios Económicos del Transporte, and from 1944 the Dirección Nacional de Energía (energy body of the government).

42 United Nations. Department of Economic Affairs, *World Energy Supplies*.. Issued annualy since 1952, it is the most regular and comprehensive of the publications of international bodies dedicated to energy. By using successive editions of it, it is posible to construct a limited set of statistical series for the years 1929, 1927 and annualy from 1949. According to Dramstadter 'in doing so, one must allow for fairly significant breaks in historical continuity of the data, for changes in geographic classifications, and for limitations in the scope of particular energy series' Darmstadter et al., *Energy in the World Economy, A Statistical Review of Trends in Output, Trade and Consumption since 1925*, p.826.

43 Darmstadter et al., *Energy in the World Economy, A Statistical Review of Trends in Output, Trade and Consumption since 1925*.

generating plants). Perhaps, the only weakness of this study, if it may be considered so, is the massive use of secondary sources for trade data, mostly the United Nations (including ECLA) and the League of Nations estimates. Equally, for domestic production third parties estimates were almost exclusively used, namely the British Institute of Geological Sciences and the US Bureau of Mines.[44]

The oil crisis in the mid 1970s compelled the research agenda to include energy issues. Nonetheless, none of the works produced thereafter made any effort to improve the historical data series already mentioned. In 1974 the ECLA reacted to the changing oil markets and the ill effects on the Latin American economies with a symposium.[45] The resulting volume is a compilation of articles reviewing different aspects of energy in the region, from supplies of primary and secondary energies, to the economic and financial impacts of the surging oil prices, ending with possible strategies and action programs to overtake the crisis. The statistical evidence provided was scarce and did not go beyond 1960. The relevance of the volume comes from the Latin American perspective on the energy problem.

The work of J.W. Mullen has a misleading title: *Energy in Latin America; the historical record* since the period considered is relatively short, 1950-75, and no continuous series are provided but decennial bench-marks 1950, 1960 and 1970.[46] It can hardly be considered an historical analysis; even so, it proposed a synoptic view that can be of interest regarding the evolution and characteristics of the main energy sectors, especially petroleum.

Non-commercial energy sources, far less frequent in energy reports, were the concern of the book by Dunkerley, Ramsay and Cecelsky (1979).[47] Of massive use in households of fewer resources for heating, cooking and lightight, the data available on non-commercial energies has always been very poor. This hindered a systematic survey of the consumption of these fuels among the world's poorer. Yet, the book included an attractive approach to the issue of sources and forms of non-commercial energies, and the feasibility of developing these alternative sources in order to increase the amount disposable energy and to improve the well being of the needy. In fact, the energy requirements of less developed countries were a recurrent concern of these authors. In a latter work they present an exhaustive analysis of the typical energy consumption patterns of the developing countries in contrast to the industrialized world.[48] The book does not provide much statistical evidence, just few benchmarks restricted to the post-1973 period, with little reference to Latin America (Argentina, Brazil, Colombia, Mexico and

[44] A t third source, also third party, was used for some early estimates: Rudolf Regul, *Energiequellen der Welt,* (Hamburg: Hanseatische Verlagsanstalt, 1937). For the specification of sources see Darmstadter et al., *Energy in the World Economy, A Statistical Review of Trends in Output, Trade and Consumption since 1925*, pp.835-859.
[45] United Nations. Economic Commission for Latin America, *Latin America and the current energy problems*.
[46] Mullen, *Energy in Latin America: the historical record*.
[47] Ceselski et al., *Household energy and the poor in the Third World*.
[48] Dunkerley et al., *Energy strategies for developing nations*.

Venezuela). It is, however, a useful work for a theoretical approach to the specific question of energy consumption in developing countries, given their productive structure –larger weight of the agricultural sector-, the larger share of non-commercial energy sources, and a consumption pattern institutionally and culturally determined.

From the preceding paragraphs, it derives that only three studies provide historical series of energy consumption in Latin America, namely ECLA (1951), ECLA (1957) and, Darsmstadter et al.(1971). Respectively, they provide data for 5, 7 and, 11 countries of Latin America and the Caribbean before 1930, mostly benchmarks. There is more than enough ground for our endeavor to estimate the energy consumption of these countries for the first third of the twentieth century. In this regard, the estimates presented in this paper for 1925 are the joining point with the existing series. Our intention in the medium term is to complete the Latin American from 1900 (1890 where possible) using the same methodology presented here. For this we first need to demonstrate the consistency of our approach contrasting our results with the presented estimates.

III

By 1925, most Latin American countries were net importers of coal and petroleum products, mostly from the United Kingdom, the United States and, Germany; Mexico and Peru also supplied petroleum within the region. Therefore, in order to estimate the apparent consumption of fossil fuels, it seemed sound to approach the matter making use of the available trade statistics, and supplement those with home production data in the case of the extracting countries. Trade data can be obtained from the countries of origin from where the fuels were exported or, from the destination countries, which imported the energy.

Of the 33 countries that constitute Latin America and the Caribbean at present, 18 elaborated trade statistics in 1925, although only 15 offer sufficient detail about the country of origin and the type of products imported (see Table 1). From the exporter countries side, namely, United States (coal and oil), United Kingdom (coal), Germany (coal) and Belgium (coal), information is available, with varying degrees of detail, for all 33 territories. These four countries are referred hereon as ‘G4’. It is worth mentioning here the meticulous detail of the United States statistics, which turns out to be crucial for the data reconstruction of the smaller countries, especially for the Caribbean. The decision was made to use both, the foreign trade statistics from the Latin American economies and that of their principal trade partners, plus data on home production of coal and petroleum for constructing the new estimates of apparent consumption of fossil fuels.

[TABLE 1: availability and sources]

A first look at the data offered by the importing countries reveals some useful trade patterns.[49] As shown in Table 2, the 'G4' provided 98 per cent of the total amount of coal Latin America bought in 1925. The United Kingdom is the country with the greatest share, 68 per cent. The United States are next with a quota of 26 percent. Germany and Belgium had much smaller shares (3.4 and 0.05 respectively). The shares are similar if values are used instead of tones, as shown in Table 3.

A closer look to the coal trade patterns modifies somewhat the first impression. The United States were the main supplier (85-100 per cent) of coal for Cuba, Ecuador, Salvador, Guatemala, Haiti, Mexico, Nicaragua and Dominican Republic, while for the larger consumers of the Southern Cone (Argentina, Chile and Brazil) the United Kingdom was the main supplier (60-80 per cent). Colombia and Peru showed no preference and imported similar amounts from these two suppliers.[50] One main exception was Bolivia, which imported more coal from the neighbouring countries (mostly Chile) than from the G4 altogether. Coal entered the Argentinean market also from Chile. None of that coal was actually of Chilean origin. Finally, it must be noted that, although with small relevance for the overall trade, other suppliers were also involved: Australia supplied Chile and the Netherlands both Chile and Argentina.

[TABLE 2: coal trade patterns, quantities]
[TABLE 3: coal trade patterns, values]

In the case of petroleum, the regional trade played a much greater role. Not in vain seven Latin American countries were oil producers by 1925 –Argentina, Colombia, Ecuador, Mexico, Peru, Trinidad and Venezuela-. Together they amounted to 15 per cent of the world's petroleum output, while the United States represented 72 per cent. In other words, Latin America extracted more than half of the petroleum obtained outside the United States. At the same time, Mexico continued to be the second larger oil producer in the world, a position briefly lost to the Soviet Union, only to be regained to Latin America three years later by Venezuelan wells.

Three countries were the main suppliers of oil products to the region, but these had little to do with the G4. The main suppliers to Latin America and the Caribbean of petroleum products were the United States, Mexico and Peru. A little more than half of the oil imported by Latin American countries had its origin in the United States, as it can be seen in Table 4. Although the United Kingdom and Germany are sometimes mentioned as suppliers of oil products in the trade statistics of the Latin American countries, they provided negligible amounts. This helps to

[49] Domestic and foreign sources are listed in Table 1. Exchange rates were taken from U.S. Department of Commerce, *Commerce Year Book*.
[50] Although none of the domestic sources of the Caribbean had been checked, from the US reports it is clear that these countries were captive of the US from the coal mining strikes in the UK in the first decades of the twentieth century.

explain why petroleum trade to Latin America is mostly invisible in British and German statistics. The remaining half of the oil was mostly supplied within the region.

Mexico supplied 40 percent of the tonnes imported according to the importing countries data. Peru, the third main producer of the region, provided 7 percent. It may be worth mentioning that while the Venezuelan petroleum output was much greater than the Peruvian one, the former was massively exported crude to refineries of the Dutch West Indies (Aruba, Curacao). From there it was re-exported, mostly to the United States and Europe. Direct exports from Venezuela to the rest of the region remained very low, with the exception of neighbouring Colombia. The oil refined in the Dutch West Indies appears in occasion as of Venezuelan origin in some trade statistics, but most times as arriving from Aruba, Curacao or even the Netherlands. For what it matters, we considered oil from the Dutch West Indies as Venezuelan oil. The list of alternative suppliers is larger than in the case of coal, but they had a small weight on the overall trade and mostly acted as mere intermediaries. So for instance, the main oil supplier to Bolivia was again Chile, while for Colombia most of the petroleum products came from Costa Rica. This clearly demonstrates the role of intermediaries played by some countries in the case of oil (Panama is the other main case).

[TABLE 4: Petroleum trade patterns]

One main message distils from this first look at the data. Theoretically, it would suffice to collect data from three to four exporting countries to cover over the 90 per cent of the fossil fuels imported by the Latin American countries. Nevertheless, all the data available at both ends, importers and exporters, were collected for the exercises in this paper, since a priori, the more data collected the more refined the new estimates would be. The approach taken presented a number of inconveniences and methodological challenges that needed to be discussed in order to elaborate the new estimates. These were grouped in three main kinds: 1) problems of classification and units of measurement; 2) contrast of values and volumes between the data provided at origin by the exporting countries and the data registered at the country of destination by the importing countries; 3) methodological problems in relation to the consumption of home produced coal and petroleum. Some of these needed lengthy and detailed discussions, clearly exceeding the size of one single paper, and can be found elsewhere.[51] Sparing the details, no more than the main issues and decision made are offered here.

[51] A detailed discussion these issues can be found in Folchi and Rubio, 'El consumo aparente de energía fósil en los países latinoamericanos hacia 1925: una propuesta metodológica a partir de las estadísticas de comercio exterior'. Specifically for the second issue see Rubio and Folchi, 'On the accuracy of Latin American trade statistics: a nonparametric test for 1925'.

Unfortunately, trade statistics are not always as specific and detailed as it would be convenient. This is at the origin of classification and measurement problems. Neither coal nor petroleum products were listed in the most suitable fashion. Ideally, products should be identifiable as precisely as possible in order to be able to calculate the energy content of different types of coals and petroleum products.[52] In practice, products descriptions were slightly more detailed in the exporters statistics than in the countries of destination. But even the 'detailed' listings did not go beyond three categories for coal, up to a dozen for petroleum products. Besides, 'detailed' was not synonym of 'useful': having two categories is not much more useful than having just one, when these are 'coal' and 'all other' as in the case of Haiti or Dominican Republic.[53] Given that, for instance, four metric tones of anthracite have the calorific power of six metric tones of lignite, the issue is not a minor one, when anthracite cannot be told apart from lignite.

Classification and units of measurement problems were more often present in the case of petroleum and derivatives. On the first place the list of petroleum products was longer and offered greater variation across countries. In addition, the same product could have very different names, but also the same wording could stand for completely different products: gasoline, for instance, took a whole range of names across Latin America, at the same time paraffin could refer to anything from candle paste to a kind of liquid fuel used for heating. Meaningless aggregations such as 'mineral oils' or 'crude oil for fuels' were also commonplace. This variety of nomenclatures and aggregations called for a sum of all entries in a comprehensive total in order to be able to make some data contrast.

A second problem remained: the units of measurement. While the United States systematically expressed petroleum exported quantities in volume –gallons-, Latin American countries employed mostly weight –metric tones, kilogram- and to a lesser extend volume units –litters, cubic meters-. Data were all converted to metric tones using the conversion factors shown in Table 5. Conversions from volume to weight, in the case of petroleum products, are highly sensitive to the density (gravity) of the products.[54] Therefore, the more aggregate the statistical category was the less exact the conversion become.

[TABLE 5: petroleum volume to weight conversions]

[52] Wherever posible, non-energy purpose products, such as asphalt, were excluded from the calculations. Nevertheless, these were a very small amount of the total imports of coal and petroleum.

[53] The whole listing for coal and petroleum products as specified in the original sources can be found in Folchi and Rubio, 'El consumo aparente de energía fósil en los países latinoamericanos hacia 1925: una propuesta metodológica a partir de las estadísticas de comercio exterior'., cuadro 4.1.2.

[54] For instance, a metric tone will have some 1273 litters if the product is kerosene but only 1050 litters if the product is fuel-oil. So if we only knew the volume of 'mineral oils' we had to decide upon the average composition of it and apply an average conversion factor.

Using these criteria, data were standardised. For 17 countries we obtained the total figure of coal and petroleum imports according to their own domestic sources, and in the 15 cases shown above. One way of checking the reliability of the standardization criteria was to contrast these data with values and volumes registered at the country of origin by the exporting countries. Among the main reasons for using all the available data was the general, but not definitive, pessimistic tone of economist, economic historians and latinamericanist alike, regarding the poor quality of trade figures in general, and that of the Latin American countries in particular. The issue of the (in)accuracy of the foreign trade statistics remain in the economic literature to the present day.[55] Yet, in historical terms, the accuracy of foreign trade statistics seems to be more robust than generally thought.[56] Regarding Latin American trade statistics, the position is somewhat mix although traditionally pessimistic.[57]

Since the literature did not come to the rescue, we needed to test for ourselves the level of accuracy of the trade statistics at both ends. There is a wide array of potential matters that could help to explain the expected differences between the volume and value annotated at the port of origin and the registered at destination: different accounting methods (CIF versus FOB, fiscal versus calendar years, etc), pricing methods (official, declared, fiscal…), misclassification of products, etc. Nevertheless, the data match is surprisingly acceptable.

Consider first the case of the quantities of coal imported from G4 shown in Table 6. The contrast of the volume imported according to both types of sources reveals that for a first group of countries a very close match (2 to 6 per cent differences): Argentina, Brazil, Colombia, Cuba, Ecuador, Nicaragua and, Dominican Republican. A second group of countries (Chile, Salvador and Peru) exhibits a less satisfactory correspondence, with differences between both sources on the 20 percent range. Finally, four countries show irreconcilable differences between their statistics and the reported by the exporting countries, these are Bolivia, Costa Rica, Haiti and Mexico. However, when the region is taken as a whole, and the coal exports recorded to Latin America by G4 are confronted with the total aggregated imports as declared by the destination countries, the gap reduces to 1 per cent of the total.

[TABLE 6: Coal quantities contrast by source]

[TABLE 7: Coal value contrast by source]

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[55] See, for instance, Makhoul, 'Exploring the accuracy of international trade statistics'.
Parniczky, 'On the inconsistency of world trade statistics'.
Rozansky and Yeats, 'On The (In)Accuracy Of Economic Observations - An Assessment Of Trends In The Reliability Of International-Trade Statistics'.
[56] Federico and Tena, 'On The Accuracy Of Foreign-Trade Statistics (1909-1935) - Morgenstern Revisited'.
[57] Kuntz, 'Nuevas series del comercio exterior de México, 1870-1929'.

Regarding values the discrepancies were, as expected, greater. The differences on the unitary value (US$/Tone) between the registry of the importer and that of the exporter fluctuate between $0.64 in the best case (Dominican Republic) to the $20.41 in the worse case (Mexico). On average, the difference is 30 percent. These results can be observed in Table 7. No pattern can be observed in any direction, such as the expected CIF versus FOB.

In the case of petroleum products the contrast must be done in absolute and comparable totals. The absolute totals shown in Table 8 (panel A) simply contrast the total amounts of petroleum registered by the importing country with the aggregation of the exports to that country reported by the United States, Mexico and Peru, Argentina, Chile, Germany and the United Kingdom. These are not exactly comparable magnitudes for several reasons. There may be alternative suppliers, included in the total amount reported by the importing countries, these alternative suppliers -Venezuela, Puerto Rico, Panama- are not included in the 'exporters' add up figure. Furthermore exporters (especially the United Kingdom and Germany) may not report quantities sold to smallish countries, but these amounts show up in the Latin American home statistics. With the absolute totals even the contrast of quantities between both sources are dismal.

[TABLE 8: Contrast of petroleum data]

When the contrast is made solely on basis of the comparable data, the gap improves. Table 8 (panel B) report the results. Comparable totals only include the amounts for which information is available at both ends. Comparable totals add up the same set of countries. Except for the cases of Colombia, Ecuador and Dominican Republic where a relatively sizeable amount of tones is missing from the home statistics, for the rest of the countries the match between tones reported at origin and at destination port is acceptable.[58] Since the countries with the greater divergences are the small consumer, the gap between importers and exporters data of the total for the region is as small as 2 per cent. In values, the differences are again, greater, coming down to some 20 per cent for the whole region. The impact of these differences in the final estimates of apparent consumption per capita are however relatively small.

An important question remains regarding the statistical significance of these gaps. How wide should the difference be in order to be sure that these figures are statistically different? This question exceeds the topic of this paper and has been discussed elsewhere with very positive results. The conclusion of the several exercises performed is that only in very few cases, we can

[58] The Colombian case is actually better off in the absolute comparison. The explanation lies in the imports reported as from Costa Rica in the Colombian trade statistics. This is very likely to be oil from the United States in fact, and so it shows in the US Department of Commerce figures.

accept the existence of statistically significant differences between the data provided by the exporters and the registered by the importing countries.[59]

The last the methodological matters need to be briefly discussed: the estimation of the consumption from home produced fuels. The figures of domestic production of coal are available for Latin America, yet in absence of sufficient detail regarding the types of coal produced and the monetary valuation of such production.[60] As a first proxy, the domestic production of coal was priced identically to the exported coal of each country, since coal producers were generally coal exporters too, even if in small amounts. In the case of petroleum, the estimation of consumption from domestic production is slightly more complex. While Argentina, Colombia and Ecuador consumed domestically the oil they extracted, most of the oil extracted in Mexico, Peru, Trinidad and Venezuela was exported.[61] There are not many problems with the former group, apart from ignoring to what use the oil was put to. So for this group the domestic production is simply added to the imports and valued at international crude oil prices. The exporters are more problematic. If they only exported crude oil, the amount of oil left for domestic consumption would be the difference between production and exports. Since their exports included derivatives, the estimate of domestic consumption from home production is not so simple. It was estimated that by 1925, the by-products from a barrel of 42 gallons of crude oil were: 20.7 gallons of fuel oil, plus 13.6 gallons of gasoline and naphtha, some 3,4 gallons of kerosene, and 1,8 gallons of lubricants; the rest, about 2,5 gallons was lost in the process.[62] In other words, 6 per cent of the volume was lost in the process of refining and was not longer available.[63] These were taken into account in order to avoid the over-estimation of the amount of energy disposable for these countries.[64]

Once imports and consumption from home production were estimated for coal and oil, they were aggregated into a single figure of apparent consumption of fossil fuels, converting all units to tones oil equivalents using the standard conversion factors of the IEA.

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[59] See Rubio and Folchi, 'On the accuracy of Latin American trade statistics: a nonparametric test for 1925'. In this paper thhe Wilcoxon Matched-Pairs Ranks test is used to determine whether the differences between the data registered by exporters and importers are meaningful, and if so, whether the differences are systematic in any direction.

[60] Coal production was taken from Mitchell, *Historical Statistics*.

[61] Oil production obtained from the American Petroleum Institute, *Petroleum Facts and Figures*.

[62] American Petroleum Institute, *Petroleum Facts and Figures*, p.116.

[63] Over the 1920s the cracking process will minimise the refining losses progressively. That explains why in present estimates no allowance is made for the refining losses when estimating home consumption of oil producers.

[64] In the most extreme case, México, where refined products accounted for 40 % of the exports, the adjustment due to the losses in refining amounted to some 390 thousand tones of crude oil. That is much more of the oil imports of most of the countries of the region and represented some extra 25 kg of oil for each of the 15 million Mexican. For the precise adjustments see Cuadro 4.1.10 in Folchi and Rubio, 'El consumo aparente de energía fósil en los países latinoamericanos hacia 1925: una propuesta metodológica a partir de las estadísticas de comercio exterior'.

IV

The aggregation of trade and domestic consumption of coal and petroleum allows the elaboration of a ranking of apparent consumption of fossil fuels per capita for Latin America in 1925. The ranking can be elaborated using the foreign or the domestic sources. The foreign sources provide data for all 33 territories, but population information exists only for 25.[65] With the domestic sources, alternative estimates can be elaborated for 17 countries. The contrast of these two elaborations with the estimates previously available for 1925 (ECLA 1949 and 1957, plus Dramstadter 1971) is shown in Table 9. The new estimates withstand the test entirely.

[TABLE 9: old and new estimates of apparent consumption of fossil fuels]

The only substantial differences are the ones with the Dramstadter estimation corresponding to oil producing/exporting countries, such as Mexico and Trinidad. The allowance made for losses in refining applied to the new estimates (was not done in their exercises) wholly explains it. In all events, the robustness of the new estimates in relation to the old ones supports the new estimates for which no previous reference existed (Barbados, Bermuda, Dominican Republic, Honduras, Jamaica, Nicaragua, Other British West Indies, Panama, Paraguay and, Venezuela). Furthermore, these are very encouraging results for extending the new estimations using the very same methodology; backwards to the 1900s, since no estimates are available before 1925, and forward to the 1940s for those countries with no estimates. The ground is plenty of opportunities to contribute as seen in Figure 1.

Few comments are due before analysing the results. In the first place it is worth commenting the exceptional high value of fossil fuels per capita obtained for Panama according to foreign sources.[66] The most logic explanation of this massive value is the role played by the Channel as bunkering station both for coal and oil. The statistics did not differentiate between the fuels having the Republic of Panama as destination and the fuels destined to the Channel subsequently loaded to ships. Similar situations of bunkering fuels being recorded as exports to (imports of), be imaginable of Bermuda, the Other British West Indies and, to some extend, of Cuba too.

The proportions of coal and petroleum in the apparent consumption also deserve some attention, already in relation to modernisation issues. The fact that for the Central American countries, coal was mostly irrelevant in 1925, provides an interesting hint. Had they been involved in the technologies of the first industrial revolution, they would have used coal. It seems these countries never made it for the classic steam engine, but made a straight jump into

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[65] Population figures are those of U.S. Department of Commerce, *Commerce Year Book*. Vol. II.
[66] That is over 2 tones of oil equivalent per person per year in Panama . Figures in Table 9 are expressed in tones per hundred habitants in order to facilitate the reading of the smaller countries.

combustion engines, thus to petroleum products. The United States technological leadership on these and its influence in this area also support this hypothesis. On the contrary, the countries of the Southern Cone made great use of coal. In fact, Argentina, Chile, Uruguay and Brazil consumed more energy from coal than from oil, and together consumed more than half of the coal consumed in the region (Panama excluded). Two possible explanations can de advanced for this fact. On the one hand, these bigger countries initiated their industrialisation process during the nineteenth century, thus tied their energy consumption patterns to the prevailing coal technology. On the other hand, path dependence also affected trade. In this regard, the strong historical commercial relationship of Argentina with the United Kingdom adds a further bias towards coal technologies. In spite of this, Latin America appears in general to be very intensive in petroleum already in 1925.

The type of petroleum products imported provides additional information regarding the level of modernisation of the countries. For instance, while imports of gasoline are a clear indicator of modernisation, imports of kerosene point to underdevelopment. The former was tied to the newest technology of the time: the combustion engine. The latter was the representative of the modern lighting of the nineteenth century but clearly downgrading by virtue of electric lighting. By its part, imports of crude oil and fuel oils indicate modernisation in two possible ways, either the crude was refined within the country or used as combustible in heavy industry or oil burning engines like modern ships, trains and first-movers. The composition of petroleum imports by kind of product is shown in Table 10. All countries imported gasoline, although it had varying degrees of importance in the individual ‘petroleum baskets’. For most countries, gasoline was the item with most weight in value terms. Exceptions in this respect were Chile, Cuba and Peru where crude oils, fuel oils and lubricants generated the greatest expenses. It is noticeable, that Guatemala, Haiti and Brazil were the ones with the largest proportional expenses in kerosene.

[TABLE 10: composition of oil imports by type of product]

Ranking the Latin American countries by their apparent consumption of fossil fuels per capita adds further information about their modernisation levels. The rankings corresponding to the different estimations are shown in Figure 2. Excluding Panama and Bermuda for the reasons outlined above, the first impression from the rankings is the existence of four well-differentiated groups. A first group of top consumers of fossil fuels includes Cuba, Chile, Argentina and Uruguay. These countries consumed well above 250 kilos of oil equivalent per habitant (25 TOE per 100 habitants). A second group of intermediate consumers, ranging from more than 50 to 190 kilos per habitant, was integrated by Mexico, Barbados, Honduras, Trinidad and Tobago, Peru, Costa Rica and Brazil. The third group comprises the countries consuming less than 50 kilograms per habitant, which were the Dominican Republic, Venezuela, Jamaica, Guatemala, Ecuador and Colombia. Finally, less than 10 kilos per habitant, were consumed in a fourth group of extremely-low consumer countries comprised by El Salvador, Bolivia, Haiti and Paraguay.

[FIGURE 2: Rankings of apparent consumption per capita]

This ranking of fossil energy consumed per capita can give a first indication of the degree of economic modernisation of the different Latin American economies by 1925. That is not to say that direct inferences about the level of wealth, well-being or even output per capita can be extracted from here. Without knowledge of the economic structure of the country, the climate and the distribution of urban to rural population (among others), such inferences will be misleading. The structure of the production is perhaps the factor that exerts the greatest influence. Some activities require more energy than others to make the same contribution to the gross domestic product. For example, industry, specially heavy industry and mining, are heavier consumers of energy than agriculture. That is why the relative positions of Argentina and Chile in the ranking of energy consumed per capita come as no surprise. All known estimates of GDP per capita situate Argentina in 1925 ahead of Chile by a wide margin.[67] Whilst the agrarian sector had a crucial role in the generation of wealth for Argentina, the mining sector did the same for Chile. The former needed far less energy per unit of output than the latter. Therefore, inferring from the apparent consumption of fossil fuels a definitive economic advantage, in terms of output, for Chile over Argentina will be simply wrong.

Nevertheless, the ranking of Latin American countries according to their apparent consumption of fossil fuels has some powerful messages. The four groups are sufficiently differentiated to mistake a very low energy consumer for an advanced country or vice versa. Cuba was, by 1925, surely was among the most developed countries of the region. It was definitively ahead of countries that 50 years later were in a much better position than her, such as Brazil, Mexico or Venezuela. The Central American republics ask for more differentiation among them. There is a wide gap from the best positioned (Honduras, Costa Rica, Dominican Republic) and the ones in the tail (Nicaragua, El Salvador). At the same time the levels exhibited Bolivia, Haiti and Paraguay leave no room for misunderstandings about their relative underdevelopment within Latin America in 1925. Since so very little is known quantitatively about the economic performance of the smaller countries of the region, this first quantitative evidence of fossil energy consumption constitutes an important landmark.

[67] See Maddison, *Monitoring*.; Thorp, *Progress, Poverty and Exclusion*. and Hofman, *Economic Development of Latin America*.

V

In absence of comparable macroeconomic indicators for most of the Latin American economies beyond the 1930s, this paper presents an estimate of the apparent consumption per head of coal and petroleum for 25 countries of Latin America and the Caribbean for the year 1925. This allows us to rank the Latin American countries and observe the relative distance among each other. For constructing our estimates, we use both the foreign trade statistics of the Latin American economies and that of their principal trade partners, plus data on home production of coal and petroleum. We use energy consumption as an indicator of economic modernisation.

As a result, the paper contributes to several literatures. On the one hand, it offers a contrast of the foreign trade statistics of the Latin American countries with that of the advanced economies (UK, USA and Germany), showing that the former are far more reliable than previously thought by the literature. On the other hand, the paper adds to the environmental and energy history studies by doubling the number of countries for which energy consumption estimates were previously available in Latin America. Last but not least, the paper contributes to the wider economic history debate in Latin America providing the basis for a comparative analysis of modernisation performance, beyond the countries for which historical national accounts are currently available.

However, a number of caveats apply to the results presented and open a wide research agenda. For sure energy consumption is associated to economic development, but the precise correlation varies greatly from one economy to another. If any kind of inference of this type is to be made, the economic structure of the individual countries must be known. The 'energetic style' of an economy will define the definitive relationship between energy consumption and output. In addition, the results presented are restricted to fossil fuels. Indeed, these have a tighter relationship to modern technologies, thus to modern economic growth, but other energies had their role to play too. That is the case of alternative modern energies such as water-power and hydroelectricity. Possibly, they only have a sizable effect in 1925 for the estimates of Brazil, but they should be included in future research nevertheless. Non-commercial energies, particularly firewood, were widely used in Latin America, even in modern machines such as trains and furnaces. In some instances, modernisation went through these non-commercial energies first. All efforts should be made to try to include them to.

The foremost item in the research agenda, however, is to extend the estimations, backwards to the 1900s and forward to the 1940s, using the same methodology employed in this paper. These forthcoming series would serve to see the changes taking place within the individual economies, as much as, the changes in the relative positions of the countries within the region.

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Chile: Oficina Central de Estadística, *Anuario Estadístico de la República de Chile: Comercio Exterior* (Valparaíso, various years).

Colombia: Departamento de Contraloría, *Anuario Estadístico. Comercio Exterior* (Bogotá, various years).

Costa Rica: Dirección General de Estadística, *Anuario Estadístico* (San José, various years).

Cuba: Secretaría de Hacienda, *Comercio Exterior* (La Habana, various years).

Dominican Republic: Receptoría General de Aduanas, *Report of the...fiscal period.Together with summary of commerce* (Washington D.C., various years).

Ecuador: Dirección General de Estadística, *Comercio Exterior del Ecuador en los años...* (Quito, various years).

El Salvador: Dirección General de Estadística, *Estadística comercial* (San Salvador, various years).

France: Direction Générale des Douanes, *Tableau générale du commerce et de la navigation* (Paris,, various years).

Germany, *Der Auswärtiger Handel Deutschlands,* (Berlin,, various years).

Guatemala: Ministerio de Hacienda y Crédito Público, *Memoria de las labores del Ejecutivo en el ramo de Hacienda y Crédito Público,* . (Guatemala, various years).

México: Departamento de Estadística Nacional, *Anuario Estadístico: Comercio exterior y navegación* (México D.F., various years).

Nicaragua: Administración de Aduanas, *Memoria del Recaudador General de Aduanas y las Estadísticas del Comercio de...*, (Managua,, various years).

Paraguay: Dirección General de Estadística, *El comercio exterior del Paraguay* (Asunción, varoius years).

Peru: Superintendencia General de Aduanas, *Estadística especial del Perú* (Callao, various years).

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United Nations. Economic Commission for Latin America, *Energy in Latin America*. Vol. UN: E/CN.12/384/Rev.1 (Geneva, 1957).

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U.S. Department of Commerce, *The Foreign Commerce and Navigation of the United States* (Washington D.C., various years).

U.S. Department of Commerce, *Commerce Year Book.* Vol. II (Foreign Countries) (Washington, various years).

U.S. Department of Commerce (by J.R.Bradley), *Fuel and Power in Latin America, Trade Promotion Series, No.126* (Washington, 1931).

United Kingdom: Statistical Office of the Customs and Excise Department, *Annual Statement of the Trade of the United Kingdom with Foreign Countries and Britain possessions* (London,, various years).

Uruguay: Dirección General de Estadística, *Anuario estadístico de la República Oriental del Uruguay* (Montevideo, various years).

Venezuela: Ministerio de Hacienda y Crédito Público, *Estadística mercantil y marítima* (Caracas, various years).

Table 1: Summary of previous studies estimations and sources for Rubio and Folchi (2005) of apparent consumption of energy for year 1925

	Previous studies estimations			Rubio and Folchi	
	ECLA 1951	ECLA 1957	Dramstadter 1971	domestic source (destination countries)	foreing source (countries of origin)
LATIN AMERICA					
Argetina	yes	yes	yes	yes	yes
Bolivia			yes	yes	yes
Brazil	yes		yes	yes	yes
Colombia			yes	yes	yes
Costa Rica		yes		yes	yes
Cuba			yes	yes	yes
Chile	yes	yes	yes	yes	yes
Ecuador			yes	yes	yes
El Salvador		yes		yes	yes
Guatemala		yes		yes	yes
Haiti		yes		yes	yes
Honduras					yes
Mexico	yes	yes	yes	yes	yes
Nicaragua				yes	yes
Panama					yes
Paraguay				yes*	yes
Peru			yes	yes	yes
R. Dominicana				yes	yes
Uruguay			yes	yes*	yes
Venezuela				yes*	yes
CARIBEEAN					
British Honduras					yes
Puerto Rico					yes
Bermuda					yes
Barbados					yes
Jamaica					yes
Trinidad and Tobago			yes		yes
Other Brith W.I					yes
British Guiana					yes
W.I.I., Danish (virgin islands)					yes
W.I.I.,Dutch					yes
Dutch Guiana					yes
W.I.I., French					yes
French Guiana					yes
TOTAL OF COUNTRIES	4	7	11	18	33

* Data from Paraguay, Uruguay and Venezuela, althought exist,do not detail the countries of origing of the products.

Domestic sources:

Argentina: Dirección General de Estadística, Anuario del comercio exterior de la República Argentina (Buenos Aires).
Bolivia: Dirección General de Aduanas, Comercio especial de Bolivia. Exportación-Importación (La Paz).
Brazil: Directoria de Estatistica Commercial, Commercio exterior do Brasil (Rio de Janeiro, variours years).
Chile: Oficina Central de Estadística, Anuario Estadístico de la República de Chile: Comercio Exterior (Valparaíso).
Colombia: Departamento de Contraloría, Anuario Estadístico. Comercio Exterior (Bogotá).
Costa Rica: Dirección General de Estadística, Anuario Estadístico (San José).
Cuba: Secretaría de Hacienda, Comercio Exterior (La Habana).
Dominican Republic: Receptoría General de Aduanas, Report of the...fiscal period.Together with summary of commerce (Washington D.C.).
Ecuador: Dirección General de Estadística, Comercio Exterior del Ecuador en los años... (Quito).
El Salvador: Dirección General de Estadística, Estadística comercial (San Salvador).
Guatemala: Ministerio de Hacienda y Crédito Público, Memoria de las labores del Ejecutivo en el ramo de Hacienda y Crédito Público, . (Guatemala).
México: Departamento de Estadística Nacional, Anuario Estadístico: Comercio exterior y navegación (México D.F.).
Nicaragua: Administración de Aduanas, Memoria del Recaudador General de Aduanas y las Estadísticas del Comercio de..., (Managua,).
Paraguay: Dirección General de Estadística, El comercio exterior del Paraguay (Asunción, varoius years).
Peru: Superintendencia General de Aduanas, Estadística especial del Perú (Callao).
Uruguay: Dirección General de Estadística, Anuario estadístico de la República Oriental del Uruguay (Montevideo).
Venezuela: Ministerio de Hacienda y Crédito Público, Estadística mercantil y marítima (Caracas).

Foreing sources:

Belgium: Ministère des Finances, Tableau annuel du commerce avec les pays étrangers (Bruxelles).
Germany, Der Auswärtiger Handel Deutschlands, (Berlin,).
U.S. Department of Commerce, The Foreign Commerce and Navigation of the United States (Washington D.C.).
United Kingdom: Statistical Office of the Customs and Excise Department, Annual Statement of the Trade of the United Kingdom with Foreign Countries and Britain possessions (London).
For oil Mexican, Venezuelan and Peruvian statistics were used too as 'foreing source'

Table 2
Coal trade patterns, countries of origin of coal in 1925
(15 countries, quantities)

Country	Imports Total (Tones)	UK (Tones)	UK %	US (Tones)	US %	Germany (Tones)	Germany %	Belgium (Tones)	Belgium %	Total G4 (Tones)	Total G4 %	Others (Tones)	Others %
Argentina	**3.178.473**	2.768.735	87,11	150.569	4,74	192.450	6,05	225	0,01	3.111.979	97,91	66.495	2,09
Bolivia	**15.709**	4.614	29,37	1.017	6,48	446	2,84	0	0,00	6.077	38,68	9.632	61,32
Brasil	**1.727.050**	1.081.395	62,62	631.318	36,55	474	0,03	2.016	0,12	1.715.203	99,31	11.847	0,69
Chile	**264.070**	208.829	79,08	38.210	14,47	5.995	2,27	520	0,20	253.554	96,02	10.516	3,98
Colombia	**3.263**	1.609	49,31	1.643	50,34	0	0,00	0	0,00	3.252	99,65	11	0,35
Costa Rica	**808**	312	38,60	496	61,40	0	0,00	0	0,00	808	100,00	0	0,00
Cuba	**659.389**	7.366	1,12	652.023	98,88	0	0,00	0	0,00	659.389	100,00	0	0,00
Ecuador	**1.278**	77	5,99	1.095	85,69	15	1,20	0	0,00	1.187	92,88	91	7,12
El Salvador	**154**	0	0,00	154	100,00	0	0,00	0	0,00	154	100,00	0	0,00
Guatemala	**264**	0	0,00	264	100,00	0	0,00	0	0,00	264	100,00	0	0,00
Haití	**156**	0	0,00	156	100,00	0	0,00	0	0,00	156	100,00	0	0,00
México	**65.845**	380	0,58	65.324	99,21	43	0,07	0	0,00	65.746	99,85	99	0,15
Nicaragua	**2.646**	357	13,50	2.289	86,50	0	0,00	0	0,00	2.646	100,00	0	0,00
Perú	**39.235**	17.660	45,01	17.813	45,40	2.916	7,43	0	0,00	38.389	97,84	846	2,16
R. Dom.	**9.764**	0	0,00	9.697	99,31	0	0,00	0	0,00	9.697	99,31	67	0,69
Total	**5.968.104**	**4.091.333**	**68,55**	**1.572.067**	**26,34**	**202.339**	**3,39**	**2.761**	**0,05**	**5.868.500**	**98,33**	**99.604**	**1,67**

Source: Domestic sources, as listed in Table 1.

NOTES: Bolivia's main supplier was Chile wiht 9.317 tones, this is 59-3 % of Bolivan imports. Other suppliers to Argentina and Chile were Australia (9103 tones to Chile), Hollland (55084 tones to Argentina and Chile) and Chilean coal to Argentina (8843 tones)

Table 3
Coal trade patterns in Latin America: by country of orgin in in 1925

(15 contries, values)

Country	Total US$ (1925)	UK US$ (1925)	%	US US$ (1925)	%	Germany US$ (1925)	%	Belgium US$ (1925)	%	Total G4 US$ (1925)	%	Others US$ (1925)	%
Argentina	**34.393.041**	29.954.051	87,09	1.626.988	4,73	2.082.097	6,05	2.431	0,01	33.665.568	97,88	727.473	2,12
Bolivia	**148.491**	53.359	35,93	8.932	6,02	455	0,31	0	0,00	62.747	42,26	85.745	57,74
Brasil	**15.254.683**	9.732.788	63,80	5.402.663	35,42	10.540	0,07	13.408	0,09	15.159.399	99,38	95.284	0,62
Chile	**1.420.159**	967.597	68,13	200.908	14,15	53.249	3,75	5.295	0,37	1.227.050	86,40	193.109	13,60
Colombia	**28.679**	11.789	41,11	16.180	56,42	0	0,00	0	0,00	27.970	97,53	709	2,47
Costa Rica	**7.636**	3.384	44,32	4.252	55,68	0	0,00	0	0,00	7.636	100,00	0	0,00
Cuba	**3.114.860**	52.481	1,68	3.062.379	98,32	0	0,00	0	0,00	3.114.860	100,00	0	0,00
Ecuador	**9.473**	878	9,27	7.392	78,03	192	2,03	0	0,00	8.462	89,33	1.011	10,67
El Salv.	**7.071**	0	0,00	7.068	99,96	0	0,00	0	0,00	7.068	99,96	3	0,04
Guatemala	**3.279**	0	0,00	3.279	100,00	0	0,00	0	0,00	3.279	100,00	0	0,00
Haití	**2.771**	0	0,00	2.771	100,00	0	0,00	0	0,00	2.771	100,00	0	0,00
México	**568.527**	9.324	1,64	555.681	97,74	1.788	0,31	0	0,00	566.793	99,69	1.734	0,31
Nicaragua	**11.920**	382	3,21	11.538	96,79	0	0,00	0	0,00	11.920	100,00	0	0,00
Perú	**293.486**	158.416	53,98	105.665	36,00	17.752	6,05	0	0,00	281.834	96,03	11.653	3,97
R. Dom.	**77.837**	0	0,00	77.157	99,13	0	0,00	0	0,00	77.157	99,13	680	0,87
Total	**55.341.914**	**40.944.450**	**73,98**	**11.092.854**	**20,04**	**2.166.074**	**3,91**	**21.135**	**0,04**	**54.224.513**	**97,98**	**1.117.401**	**2,02**

Source: domestic sources as in Table 1.

Table 4
Petroleum trade patterns: origin of Latin American petroleum imports in 1925

	Petroleum imports, quantity	Petroleum imports, value	Petroleum imports over total imports	Main countries of origin (percentages over all petroleum products imported)								Main countries of oiigin	
				US		Mexico		Peru		other			
	tones	USA $	% on value	% on quantity	% on value	% on quantity	% on value	% on quantity	% on value	% on quantity	% on value	% on quantity	% on value
ARGENTINA	689.207	$55.950.728	6,7%	39%	36%	30%	26%	29%	38%			98%	99%
BOLIVIA (a)	22.593	$826.992	3,5%	32%	32%			9%	17%	54%	35%	95%	84%
BRAZIL	508.814	$21.206.344	5,1%	41%	72%	58%	27%					99%	99%
COLOMBIA (b)	9.600	$516.545	0,6%	37%	69%			5%	7%	48%	9%	90%	84%
CHILE	906.661	$10.120.779	6,9%	77%	67%	13%	19%	10%	14%			100%	100%
COSTA RICA (c)	47.272	$675.295	4,8%	3%	33%	79%	38%	3%	19%	15%	9%	100%	99%
CUBA	1.284.027	$13.131.274	4,4%	30%	54%	69%	45%					100%	100%
ECUADOR	13.100	$661.074	4,8%	12%	32%			88%	68%			100%	100%
El SALVADOR	22.549	$562.864	2,9%	88%	68%			12%	31%			100%	99%
GUATEMALA	68.458	$1.486.015	6,3%	45%	33%	50%	55%	4%	7%			99%	95%
HAITI(d)	6.113	$471.230	2,3%	72%	73%					17%	16%	89%	89%
MEXICO	366.451	$6.243.085	3,2%	99%	100%							99%	100%
NICARAGUA	14.648	$497.224	4,8%	49%	60%	32%	6%	19%	32%			100%	99%
PERU(e)	8.084	$1.007.916	1,4%	92%	91%					6%	6%	98%	97%
R.DOMINICANA(f)	37.649	$1.558.378	6,1%	42%	45%	26%	6%			16%	32%	84%	82%
TOTAL 15 countries	4.005.226	$114.915.743		51%	52%	40%	25%	8%	21%	1%	1%	99%	99%

Sources: domestic sources as in Table 1

NOTES:

(a) other= Chile

(b) other= Costa Rica (Colombia reports 4500 tones of gasoline from Costa Rica)

(c) other= Panamá

(d) other= Curazao (Venezuelan oil), the remaining 10% from Panamá and Puerto Rico in equal shares

(e) other= United Kingdom

(f) other= Puerto Rico; also the Dutch West Indies are responsible for a similar percentage

Table 5: conversion factors for petroleum products from volume to weight

	Barrels per metric ton		Gallons per metric tone		Litters per metric tone		**Barrels per metric ton**	**Gallons per metric tone**	**Litters per metric tone**
	approximate ranges						*mean*	*mean*	*mean*
	min	*max*	*min*	*max*	*min*	*max*	*value used*	*value used*	*value used*
Crude oils	6,6	8,0	277	336	1049	1272	7,3	307	1160
Aviation gasolines	8,2	9,1	344	382	1304	1447	8,7	363	1375
Motor gasolines	8,1	9,0	340	378	1288	1431	8,6	359	1359
Kerosines	7,6	8,2	319	344	1208	1304	7,9	332	1256
Gas oils	7,1	7,8	298	328	1129	1240	7,5	313	1184
Fuel oils	6,5	6,9	273	290	1033	1097	6,7	281	1065
Diesel oils	6,9	7,8	290	328	1097	1240	7,4	309	1168
Lubricating oils	6,7	7,5	281	315	1065	1192	7,1	298	1129
Asphaltic bitumens	5,8	6,4	244	269	922	1017	6,1	256	970

Source:
http://www.eppo.go.th/ref/UNIT-OIL.html

Table 6
Imports of coal in Latin America by 1925, quantities .
Differences between importers and exporters registries

Country	Metric Tones Source: Importer	Source: Exporters	Difference % I>E	E>I
Argentina	3.111.979	2.925.091	6,01	-6,39
Bolivia	6.077	664	89,07	-814,78
Brasil	1.715.203	1.814.136	-5,77	5,45
Colombia	3.252	3.125	3,92	-4,08
Costa Rica	808	78	90,32	-933,05
Cuba	659.389	701.707	-6,42	6,03
Chile	253.554	195.197	23,02	-29,90
Ecuador	1.187	1.131	4,77	-5,01
El Salvador	154	113	26,78	-36,57
Guatemala	264	3.287	-1144,81	91,97
Haití	156	83	46,44	-86,71
México	65.746	118.643	-80,46	44,59
Nicaragua	2.646	2.476	6,42	-6,87
R. Dominicana	9.697	9.484	2,19	-2,24
Perú	38.389	32.542	15,23	-17,97
TOTAL	**5.868.500**	**5.807.758**	**1,0**	**-1,0**

:Sources: As in Table 1

Table 7
Imports of coal in Latin America by 1925, unitary values.
Differences between importers and exporters registries

Country	Unit Value (US$/Tone) Importers	Exporters	Differences I>E	E>I
Argentina	10,81	6,23	42,35	-73,45
Bolivia	7,12	9,50	-33,33	25,00
Brasil	11,61	5,43	53,22	-113,76
Colombia	8,59	6,99	18,58	-22,82
Costa Rica	9,71	20,58	-111,99	52,83
Cuba	5,91	6,88	-16,33	14,04
Chile	7,24	5,50	24,08	-31,71
Ecuador	10,25	11,13	-8,55	7,88
El Salvador	45,91	17,31	62,29	-165,16
Guatemala	12,42	5,64	54,62	-120,38
Haití	17,81	15,30	14,09	-16,40
México	24,93	4,52	81,88	-451,99
Nicaragua	3,06	4,54	-48,54	32,68
R. Dom.	7,96	7,32	7,99	-8,68
Perú	7,00	6,05	13,54	-15,67
PROMEDIO	12,69	8,86	30,2	-43,2

Sources: As in Table 1

Table 8: Contrast of petroleum data

A) Absolute total imports of petroleum products, in 1925

Organised by destination coutry

Contrast of domestic and foreing sources

importer	Tones imported (domestic source)	Tones imported (source:Country of origin)	Value imported (domestic source)	Value imported (source: Country of origin)	quantity differences	value differences
Argentina	688.026	670.109	51.937.854	25.395.035	3%	51%
Bolivia	22.027	18.227	772.970	428.352	17%	45%
Brasil	505.753	552.147	21.019.438	19.591.826	-9%	7%
Colombia	9.232	11.888	481.215	985.099	-29%	-105%
Costa Rica	47.272	36.799	675.295	606.716	22%	10%
Cuba	1.281.949	1.352.397	13.098.023	17.101.243	-5%	-31%
Chile	906.641	923.112	10.120.543	12.359.821	-2%	-22%
Ecuador	13.100	27.838	661.074	628.118	-113%	5%
El Salvador	22.549	12.072	562.864	434.678	46%	23%
Guatemala	68.247	50.794	1.449.398	902.237	26%	38%
Haiti	7.141	5.165	541.216	395.072	28%	27%
Honduras	-	107.916	-	1.511.229		
Mexico	361.448	324.330	6.241.741	6.237.097	10%	0,1%
Nicaragua	14.643	11.639	495.542	705.560	21%	-42%
Panama	-	832.308	-	8.688.861		
Paraguay	-	197	-	19.344		
Peru	8.006	6.743	996.818	859.199	16%	14%
R.Dominicana	41.983	46.908	1.771.773	1.569.392	-12%	11%
Uruguay	226.045	183.686	7.381.505	5.347.064	19%	28%
Venezuela	2.287	14.021	266.904	771.165	-513%	-189%
Bermuda	-	8.910	-	188.702		
British Honduras	-	2.967	-	166.544		
Barbados	-	712	-	55.752		
Jamaica	-	7.423	-	572.941		
Trinidad and Tobago	-	1.154	-	113.144		
Other British W.I.I.	-	85.452	-	1.284.524		
Danish W.I.I.	-	35.370	-	238.585		
Dutch W.I.I.	-	3.931	-	135.362		
French W.I.I.	-	2.506	-	211.000		
British Guiana	-	542	-	66.419		
French Guiana	-	350	-	25.484		
Dutch Guiana	.	1.537	-	103.557		
Puerto Rico	-	58.784	-	502.281		
LA(17)	**4.226.350**	**4.247.873**	**118.474.172**	**94.317.674**	-1%	20%
LA(33)		**5.339.148**		**107.699.121**		

Sources: listed in Table 1.

Two types of blank data,1) the source did not report imports/expots to that country
2)the source was not available (that is the whole Caribbean, Honduras, Panama) o
it was unsuitable to identify origins (Paraguay, Uruguay and Venezuela)

A negative sing in the differences means that tones or dollars are missing from the importer report
A possitive sing in the differences implies that tones or dollars are reported in exess by the importe

B) Comparable total imports of petroleum products, in 1925

Organised by destination coutry

Contrast of domestic and foreing sources

importer	Tones imported (domestic source)	Tones imported (source:Country of origin)	Value imported (domestic source)	Value imported (source: Country of origin)	quantity differences	value differences
Argentina	677.196	670.109	51.570.043	25.395.035	1%	51%
Bolivia	21.498	18.227	697.604	428.339	15%	39%
Brasil	505.753	552.147	21.019.438	19.591.826	-9%	7%
Colombia	4.410	11.888	413.221	985.099	-170%	-138%
Costa Rica	40.275	36.799	610.590	606.716	9%	1%
Cuba	1.281.942	1.352.397	13.097.509	17.101.243	-5%	-31%
Chile	906.540	923.112	10.117.282	12.359.821	-2%	-22%
Ecuador	13.015	27.838	648.061	628.118	-114%	3%
El Salvador	22.536	12.072	560.298	434.678	46%	22%
Guatemala	68.151	50.794	1.437.579	902.237	25%	37%
Haiti	5.446	5.165	419.584	395.072	5%	6%
Honduras						
Mexico	361.438	324.330	6.239.267	6.237.097	10%	0,03%
Nicaragua	9.958	11.639	460.075	705.560	-17%	-53%
Panama						
Paraguay						
Peru	7.443	6.743	918.867	859.199	9%	6%
R.Dominicana	30.784	46.908	1.035.414	1.569.392	-52%	-52%
Uruguay						
Venezuela						
Bermuda						
British Honduras						
Barbados						
Jamaica						
Trinidad and Tobago						
Other British W.I.I.						
Danish W.I.I.						
Dutch W.I.I.						
French W.I.I.						
British Guiana						
French Guiana						
Dutch Guiana						
Puerto Rico						
LA(15)	**3.956.383**	**4.050.166**	**109.244.833**	**88.199.432**	-2%	19%
excl. Argentina	*3.279.188*	*3.380.057*	*57.674.790*	*62.804.396*	-3%	-9%

Sources: listed in Table 1.

Two types of blank data,1) the source did not report imports/expots to that country
2)the source was not available (that is the whole Caribbean, Honduras, Panama) o
it was unsuitable to identify origins (Paraguay, Uruguay and Venezuela)

A negative sing in the differences means that tones or dollars are missing from the importer report
A possitive sing in the differences implies that tones or dollars are reported in exess by the importe

Table 9: Old and new estimates of apparent consumption of fossil fuels per capita for Latin America in 1925

(tones of oil equivalent per 100 habitants)

	ECLA 1951	ECLA 1957			Darmstadter et al 1971			Rubio and Folchi					
	Total energy	Petroleum	Coal	**Total fossil energy**	Petroleum	Coal	**Total fossil energy**	Petroleum domestic sources	Coal domestic sources	**Total fossil energy** domestic sources	Petroleum foreign sources	Coal foreign sources	**Total fossil energy** foreign sources
	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab	TOE/100 hab
Argentina	**34,1**	9,4	18,1	**27,5**	16,6	19,1	**35,7**	15,1	18,2	**33,3**	15,0	17,2	**32,2**
Barbados											0,4	13,87	**14,3**
Bermuda											29,6	31,36	**60,9**
Bolivia					1,0	0,5	**1,5**	1,0	0,5	**1,4**	0,8	0,02	**0,8**
Brasil	**6,5**				1,9	5,1	**7,0**	1,7	4,5	**6,1**	1,8	5,06	**6,9**
Chile	**51,5**	22,4	24,6	**47,0**	22,8	21,9	**44,7**	22,0	27,0	**49,0**	22,4	28,09	**50,5**
Colombia					2,4	1,1	**3,5**	2,2	0,0	**2,2**	2,2	0,03	**2,2**
Costa Rica		9,6	0,2	**9,7**				9,3	0,1	**9,4**	7,0	0,01	**7,0**
Cuba					39,2	13,6	**52,8**	37,9	13,1	**50,9**	40,0	14,51	**54,5**
Ecuador					1,9	-	**1,9**	2,0	0,0	**2,1**	2,9	0,05	**2,9**
El Salvador		1,7	0,0	**1,7**				1,7	0,0	**1,7**	0,9	0,01	**0,9**
Guatemala		3,0	-	**3,0**				4,5	0,0	**4,5**	3,4	0,15	**3,5**
Haití		0,2	0,0	**0,2**				0,3	0,0	**0,3**	0,2	0,00	**0,2**
Honduras											12,7	0,16	**12,9**
Jamaica											0,9	3,78	**4,6**
México	**19,2**	7,2	5,4	**12,6**	24,0	7,0	**31,0**	12,2	6,7	**18,9**	12,0	7,19	**19,2**
Nicaragua								2,2	0,3	**2,5**	1,8	0,26	**2,0**
Other Brith W.I											14,1	6,66	**20,8**
Panamá											181,8	48,39	**230,1**
Paraguay											0,02	0,002	**0,03**
Perú					5,4	1,8	**7,2**	6,0	1,8	**7,9**	6,0	1,80	**7,8**
R. Dominicana								4,0	0,6	**4,6**	4,5	0,63	**5,1**
Trinidad and Tobago					22,8	2,5	**25,3**				4,4	4,23	**8,6**
Uruguay					13,6	15,3	**28,9**	14,4	15,0	**29,4**	11,7	17,19	**28,9**
Venezuela								3,5	1,1	**4,6**	3,9	1,09	**5,0**
Countries included	4	7	7	7	11	11	11	17	17	17	25	25	25

Note:population figures from the US Commerce Year Book, except for Dramstadter wher we show his own per capia calculation

Table 10: Composition of petroleum imports by type of product in Latin America by 1925

(share over total imports of petroleum products for each country)

	Crude oil		Gasoline (naphta, bencin, etc)		Gas-oil and fuel oil		Kerosene		paraffin		lubricants	
	% quantity	% value	% quantity	% value	% quantity	% value	% quantity	% value	% quantity	% value	% quantity	% value
ARGENTINA	52%	27%	37%	62%	1%	0,3%	10%	6%	1%	4%		
BOLIVIA	75%	33%	11%	28%			6%	13%	7%	26%		
BRASIL			28%	54%	51%	17%	20%	28%	0,2%	0,8%		
COLOMBIA	0,5%	1%	71%	42%	9%	8%					18%	46%
CHILE	93%	72%	4%	22%			2,3%	5,5%				
COSTA RICA	93%	33%	4%	26%	1%	10%			2%	28%	0,1%	2%
CUBA	9%	22%	2%	5%	88%	61%					1,3%	11%
ECUADOR	18%	12%	18%	32%	37%	9%	16%	16%	7%	21%	3%	8%
EL SALVADOR	78%	34%	13%	41%			7%	14%			2%	10%
GUATEMALA	76%	17%	5%	11%			17%	59%	1%	9%	0,4%	3%
HAITI			38%	41%	3%	1%	46%	39%	7%	8%	5%	11%
MEXICO	73%	39%	20%	26%			2%	16%			5%	19%
NICARAGUA	47%	9%	21%	34%	19%	29%	11%	15%			3%	13%
PERU	12%	0%	7%	4%			1%	0%	36%	42%	40%	48%
R.DOMINICANA			26%	51%	56%	15%	9%	14%			6%	13%

Source: domestic sources listed in Table 1.

Figure 1: Estimates of apparent consumption of energy in Latin America 1900-1940, coverage according to sources

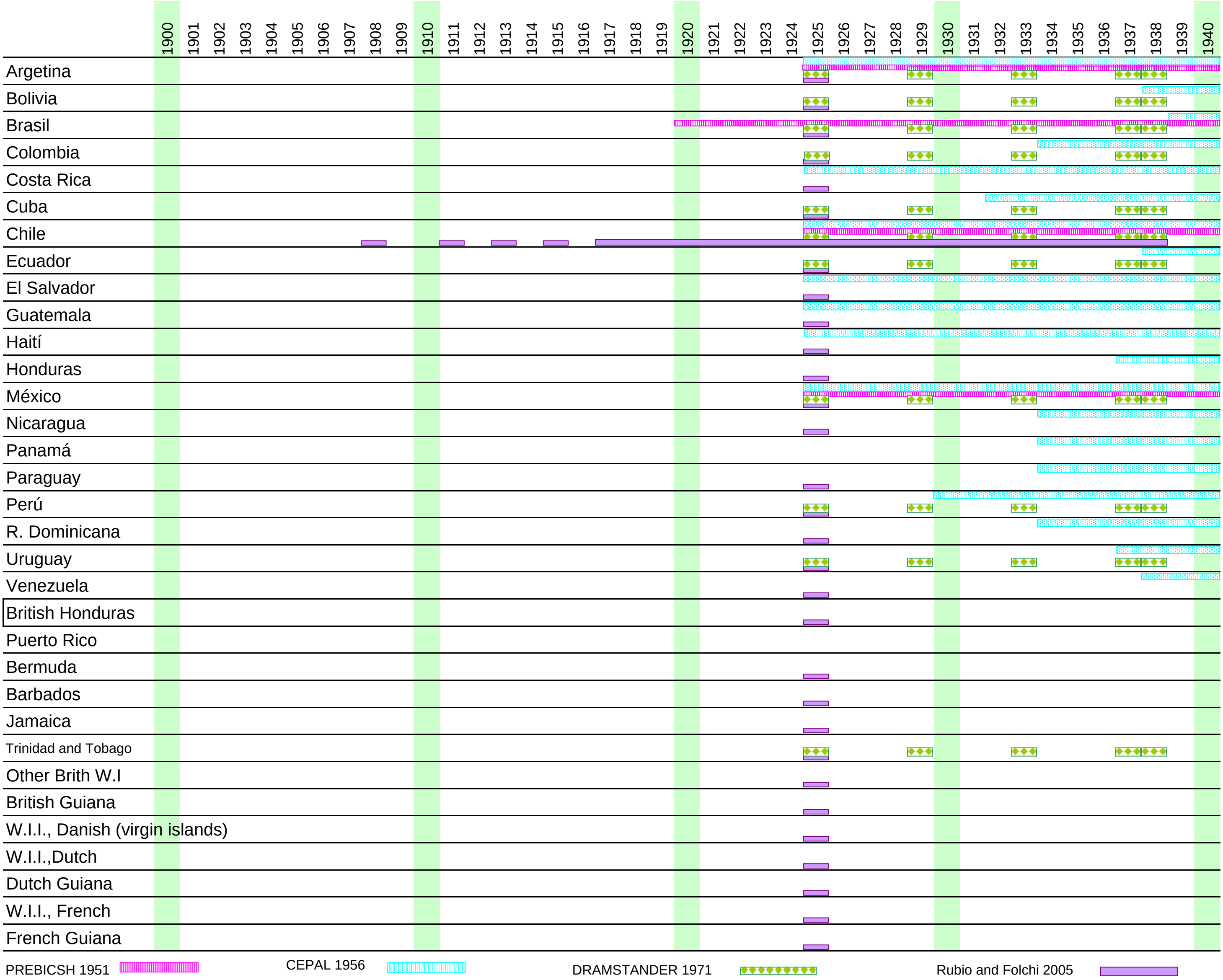
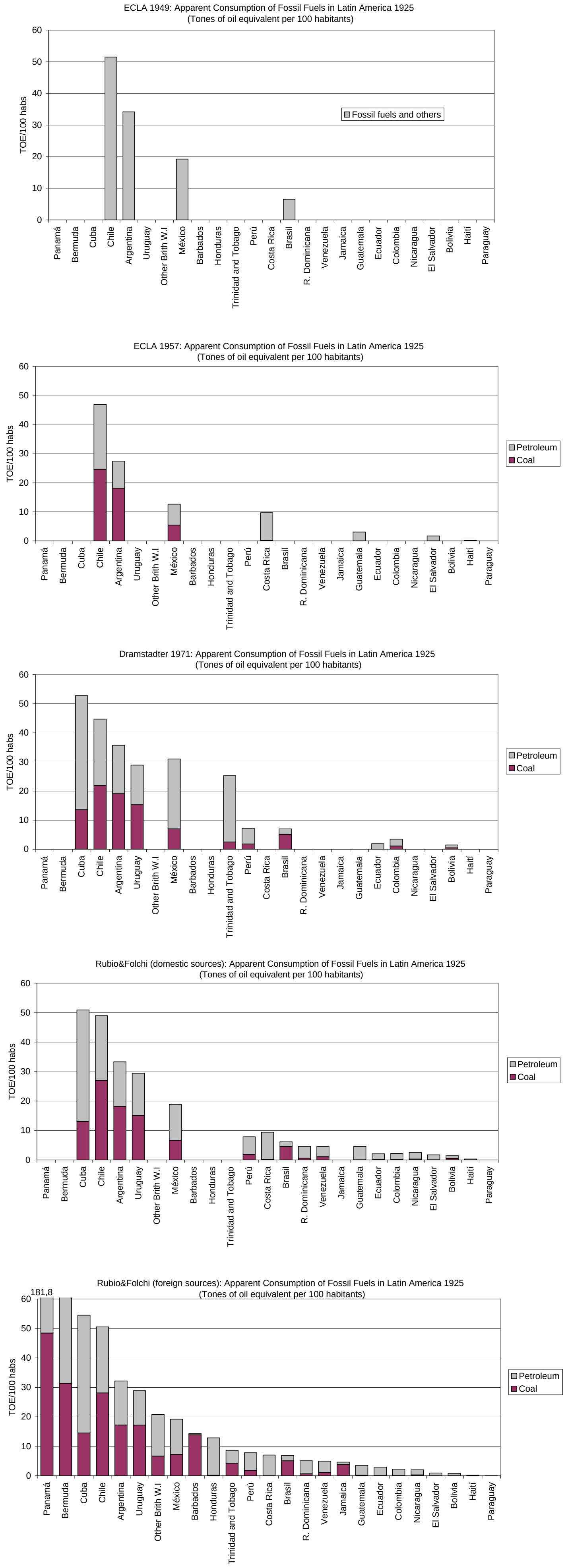


Figure 2: Rankings of apparent consumption of fossil fuels in Latin America by 1925, five estimates and consumption by type of fuel



Sources: Data from Table 9