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Energy as an indicator of modernization in Latin America, 1890-1925

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SUMMARY

In the absence of comparable macroeconomic indicators for most of the Latin American economies before the 1930s, the apparent consumption of energy is used in this paper as a proxy of the degree of modernization of Latin America and the Caribbean. This paper presents an estimate of the apparent consumption per head of modern energies (coal, petroleum, and hydroelectricity) for 30 countries of the region, 1890 to 1925. As a result, it provides the basis for a quantitative comparative analysis of modernization performance beyond the few countries for which historical national accounts are available in Latin America.

Energy as an indicator of modernization in Latin America, 1890-1925

In the interpretation of the process of economic modernization 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'¹ and it has been argued that coal – and later oil- was a strategic item in the rise and diffusion of the industrial civilisation.²

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'.³ Of the 33 countries that constitute Latin America and the Caribbean at present, we have series of comparable historical national accounts for a handful of them.⁴ Consequently, the comparative analysis of the economic performance of the region as a whole has been constrained to the countries for which historical economic indicators have been constructed. The earlier the period we consider, the more constrained the sample becomes. 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 the absence of comparable macroeconomic indicators for most of the Latin American economies before the 1930s, the apparent consumption of energy is used in this paper as a proxy of the degree of modernization of Latin America and the Caribbean.⁵ For this purpose this paper presents an estimate of the apparent consumption per head of coal, petroleum and hydroelectricity for 30 countries and colonial territories of Latin America and the Caribbean for the period 1890-1925. The foreign trade statistics of the principal trade partners of Latin American and Caribbean countries and territories are used to construct the new estimates. To these, the data on home production of coal, petroleum, and hydroelectricity are added where needed. From a conceptual standpoint, the argument is that the apparent consumption of modern energies - which in the period 1890-1925 correspond to mineral coal,

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3 petroleum, and the first steps of hydroelectricity - makes evident the pace at which the most modern
4 activities evolve within a country.
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8 Therefore, this research achieves, for the first time, a comparative homogeneous indicator of
9 economic progress for the whole of the region. This is an evident breakthrough in the economic history of
10 Latin America and the Caribbean. Until this very moment, similar coverage was only possible from 1945
11 thanks to the GDP figures of the United Nations prepared by the ECLA. Previous statistical compilations,
12 such as Maddison (2001), Thorp (1998) or, Bulmer-Thomas (2003), offer numerous series of a wide range
13 of indicators, but none covering the entire region with a homogeneous indicator on annual basis as it is
14 done here.
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23 The article is organised as follows. Section I furnishes the basis of the approach taken; The
24 relationship between energy consumption and economic modernization is a long-standing proposal in
25 economic history literature, more recently entering models of economic theory and applied economics. In
26 Section II, the works that elaborated historical estimates of energy consumption for Latin America are
27 surveyed and scrutinised. In Section III, before starting to analyze the new annual series, a contrast is
28 made between the trade data of the Latin American countries versus the data offered by their main
29 partners in 1925 for coal and oil, with the only purpose of establishing the reliability of the data used. In so
30 doing, the foundations of the estimates are made fully explicit. In Section IV, the patterns of modern energy
31 consumption in Latin America and the Caribbean are discussed displaying the figures of the 30 annual
32 series estimated. The data on energy consumption are later on used in Section V to propose a new
33 periodization of the main phases of Latin American economic modernization between 1890 and 1925.
34 Finally, Section VI includes the recapitulation and conclusions.
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51 I

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53 The importance of modern energy sources for the economic growth which commenced with the
54 Industrial Revolution did not escape contemporary witnesses. In his seminal work, Jevons asserted 'coal,
55 in truth, stands not beside but entirely above all other commodities. It is the material energy of the
56 country—the universal aid—the factor in everything we do. With coal almost any feat is possible or easy;
57 without it we are thrown back in the laborious poverty of early times.'⁶ Academics and non-academics
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3 recognised from the start the crucial role the new form of energy was to play in their daily life as much as in
4 the progress of the nation. Just a year after of Jevons' publication, *The Times* insisted: 'Coal is everything
5 to us. Without coal, our factories will become idle, our foundries and workshops be still as the grave; the
6 locomotive will rue in the shed, and the rail be buried in the weeds. Our street will be dark, our houses
7 uninhabitable'.⁷ It was clear; the comfort of modern life was intrinsically tied to coal.

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14 At the advent of the new century, the qualitative relationship between energy use and wealth was
15 amply discussed and widely accepted by economists.⁸ Nevertheless, it was not until the works of Read that
16 an attempt was made to establish a quantitative relationship.⁹ With his estimates of energy consumption
17 ('world's work output', as he called it) for 30 countries in 1929 he concluded that 'a general relationship
18 between work done per capita and economic well-being is observable; but a precise correlation is not yet
19 possible'.¹⁰ Of course, the correlation between welfare and energy per capita was difficult to find back then,
20 since no standard procedure for the valuation of national income was yet available.

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Almost simultaneously, in 1934, Mumford published a book that reviewed history from an
energetic viewpoint for the first time.¹¹ Following the ideas of Patrick Geddes, Mumford proposed that
industry had in fact been developing steadily over the last millennium.¹² 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. Similarly Cottrell, an American sociologist, described the evolution of social and economic change in
terms of energy.¹³ He also emphasized the importance of energy transitions, as the shift from animate
energy sources (human labor and draft animals) to inanimate energy sources and their associated
converters (fossil fuels, steam, and the internal combustion engine). Economic historians such as Cipolla
and Wrigley would reformulate some of these ideas, regarding the importance of energy to modern
economic development, some years later.

Cipolla proposed a view of human history based upon energy consumption.¹⁴ The history of
humankind could be divided into three stages split by two revolutions: the Neolithic revolution and the
Industrial Revolution. 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,

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3 chiefly form inanimate sources. The historical significance of these changes, especially from the
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5 development of the steam engine, is that humanity progressively obtained higher levels of disposable
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7 energy per head. Part of this translated only into more energy consumption per capita (heating, lighting,
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9 transports, etc) but also into more energy per labourer, and consequently, greater labour productivity.¹⁵ As
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11 a result of these, industrial societies entered into a new cycle of economic growth, which at the same time,
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13 acted as a stimulus for the development of new energy forms: 'the more energy produced, the more energy
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15 was sought out'.¹⁶ The increase of available energy to industrial society and its effect on productivity
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17 implied the expansion of real income per capita, improved welfare levels, and the satisfaction of needs well
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19 above the purely basic ones. In summary 'due to the exploitation of the new forms of energy, the greater
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21 abundance of capital, and a more efficient use of production factors, real income is greater in industrial
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23 societies than in agricultural societies'.¹⁷
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27 Simultaneously to the publication of Cipolla's book, Wrigley published an article where he started
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29 to delineate an analogous thesis.¹⁸ An elaborated version was published years later in the form of the book
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31 *Continuity, chance and change*.¹⁹ Unlike Cipolla, Wrigley had the time to include in his later assessments
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33 the downward revisions of the growth rates of the classic period of the Industrial Revolution which
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35 appeared at the time.²⁰ Nevertheless, a 'slower' Industrial Revolution did not move him an inch from his
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37 main line of argument.²¹ According to Wrigley, what was extraordinary about the rate of growth of product
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39 per head in England in the century between 1750 and 1850 was not that it was so low but that it did not
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41 turn negative. Given the rate of population growth over the period, output per head and depressed living
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43 standards were to be expected. To escape from this danger, to avoid the growth curve becoming
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45 asymptotic, it was essential to break free from the constraint imposed by the energy budgets of organic
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47 economies, which depended almost exclusively upon annexing as much as possible of the annual inflow of
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49 solar energy from plants, humans and animals. Such economies were incapable of sustaining growth over
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51 a prolonged period since the maximum quantity of heat and mechanical energy, which could be secured in
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53 this fashion, was modest. Escape was possible because a succession of technical innovations meant coal
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55 could be used in a widening range of applications where heat energy was needed, and at a later stage, in
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57 the use of mechanical energy also. The significance of the gradual circumvention of the energy bottleneck
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59 was not that it produced a sudden acceleration in the rate of the growth of the economy or in the level of
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3 individual productivity. It was that it removed a barrier, which would otherwise have tended slowly to
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5 constrict growth. Only at a much later stage in the process by which the organic economy gave way to a
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7 mineral-based energy-intensive economy did the full benefit emerge in the form of a significantly higher
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9 rate of economic growth both in aggregate and per head.

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11 Most economic historians accept the crucial role played by modern energy sources, especially
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13 fossil fuels, in the process of economic development along the lines just described. In fact, primary energy
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15 consumption per capita has been signalled as a proximate and measurable determinant of growth in
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17 historical exercises.²² Thus economic history literature endorses, in the main, approach of using fossil
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19 energy consumption as a proxy of the degree of economic modernization of a group of countries in
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21 absence of more explicit macroeconomic indicators. Yet, support must be also sought out from the
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23 economic literature, in the form of theoretical and applied studies.

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27 Economic literature tended to focus on how energy demand is driven by economic development,
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29 and/or how a potential energy shortage may strangle economic growth, rather than how energy contributes
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31 to economic development.²³ Nevertheless, support can also be drawn from theoretical and applied
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33 economic literature where the focus tends to be on how energy demand is driven by economic
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35 development, and/or how a potential energy shortage may strangle economic growth. On the empirical
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37 side, numerous studies aim at providing evidence about whether the level of energy inputs thrusts
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39 economic growth or whether it is the output level what governs the energy input.²⁴ According to the latest
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41 results the relationship between energy availability and output levels seems to be quite strong.²⁵
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43 Multivariate tests demonstrate that the level of energy use is significant for explaining the level of output.²⁶
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45 The relevant fact for our purposes is that the overall positive correlation between economic growth and
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47 energy growth remains one of the most important stylized facts we can draw from history, even if the extent
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49 of this correlation and its patterns over time are highly variable.²⁷
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53 Furthermore, the correlation between economic output and energy consumption is strong and
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55 positive, but not all forms of energy have the same impact on economic output. Remaining trapped in
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57 traditional/organic forms of energy seems to have a negative correlation with the level of development
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59 attained by any one country. The explanation probably lies with the original thought of Wrigley in relation to
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the limits of the organic economy outlined above. Evidence of the positive correlation of modern forms of

energy with economic output but negative correlation for traditional forms of energy and output for Latin America is shown in Figures 1 and 2.

[FIGURE 1: **Modern energy per capita (coal, oil & hydroelectricity) vs GDP per capita in Latin American countries, 1937**]

[FIGURE 2: **Ratio of organic energy consumption on total energy consumption and GDP per capita for Latin American countries, 1937**]

These results, together with the economic history literature, weight in favour of considering that this article is built on solid ground. In the absence of better economic indicators, modern energy use is a valid guide to determining the modernization level of various countries at a given point in time. Those activities making use of the brand new technologies of the late nineteenth century and the dawn of the twentieth were, with all probability, users of coal, petroleum and/or electricity.

The use of modern energies brought about increases in efficiency and productivity in most sectors of the economy, but especially in industry and transports, without forgetting the widespread diffusion of new ways of lighting in any modern city and home. Thus, comparing a wide collection of countries through their apparent consumption of modern energies reveals, more than anything else, the relative degree of economic activity above the subsistence level.

Although energy consumption is an aggregated indicator of economic activity, it should not be used as direct substitute of major economic indicators as income and/or product. Precisely because it does focus on the modern sectors of the economy, energy consumption may exaggerate the relative differences across countries. As a proxy, energy tends to push upwards industrial, mining, commercial, and/or urban countries and pushes downwards predominantly agrarian and/or rural economies. Yet, in absence of sufficient data for the reconstruction of the national accounts, the apparent consumption of modern energy offers a good proxy for the trends and evolution of economic prosperity.

This is not the first attempt to reconstruct the apparent consumption of energy in Latin America in historical terms. Other studies have provided point estimates and some historical series of energy

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3 consumption in Latin America are available. Most of them, however, start in the postwar period and provide
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5 data for a limited number of countries.
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8 The first monograph about energy in Latin America we are aware of is a report by the United
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10 States Department of Commerce published in 1931. The report sets out from the idea that the use of coal,
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12 petroleum, and water-power 'is an index of industrial attainment, and that their availability in a country will
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14 strongly affect that country's future position'.²⁸ The objective of the report was not academic, but to explore
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16 the double role of Latin America as supplier of raw materials and growing market for the United States
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18 products. Nevertheless, the report offers an appealing review of the energy availability for a long list of
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20 countries, although extremely unequal in coverage and detail. In some cases information does not go
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22 beyond stating the existence or absence of national production of coal and petroleum. For most countries,
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24 patchy data on imports, industrial consumption and prices of coal and oil, electric installed capacity, and
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26 existence of public utilities (railways, tramways, etc) are provided, mostly for the second half of the 1920s.
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28 A punctual estimate of the coal and fuel-oil consumption and potential and developed waterpower for 18
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30 countries is given for the year 1928.²⁹ Although informative for United States merchants, the disparity of
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32 data used, make the final estimates not exactly comparable –to say the least-, as it is recognised in the first
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34 page of the report.
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38 Another punctual estimate of energy consumption for Latin American countries was the one by
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40 Read already mentioned. His earlier calculations were predominantly for the United States and were mostly
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42 based on data for 1924-25. He later included a larger number of countries from all over the world (30 in
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44 total), and used the latest figures available that were quantitatively the largest (usually 1929).³⁰ His results
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46 may therefore be roughly taken as representing the high-water mark. Read's estimates of 'daily output of
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48 work' include the amount of work done by humans, coal, petroleum and water-power, measured in millions
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50 of horsepower hour. Among the 30 countries, he listed five Latin American countries. Ranked by 'daily
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52 output per capita' these were: Chile, Argentina, Mexico, Peru, and Brazil. Read's results for 1939 did not
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54 alter this first Latin American energy ranking.³¹
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58 Prebisch produced the first historical series of apparent consumption of energy for several Latin
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60 American countries for the ECLA's *Economic Survey of Latin America 1949*.³² The *Survey*, as the title
indicated, had an essentially 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 throughout the text. No comparative effort was made though. In fact, the type of energies, the units displayed, and the time spans considered were different for each country, making use of a wide range of compound sources. 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'.³³ 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'.³⁴ 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'.³⁵ 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 1925-55 but 'in many cases it was not possible to complete the time series and hence only some characteristic years were presented, even if, on more than one occasion the procedure involved the use of estimates'.³⁶ For most countries the series go from the mid 1930s to 1955, and only for seven countries estimates went beyond 1930. Mention should be made of the absence of Brazil from this last group, whose data are only given from 1939, completely ignoring the previous estimates of Prebisch aforementioned. For the

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3 construction of the series no new data were elaborated, but estimates already published were used. As a
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5 consequence, the sources used differ greatly across countries. In the study, the countries are grouped in
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7 three categories according to the quality and detail of the statistical information available. The first one
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9 grouped the best-documented countries: Argentina, Brazil, Colombia, Chile and Mexico. These countries
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11 had a sizeable number of statistical compilations and specialised studies by 1957, although none covering
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13 the period prior to 1925. In general, the data provided for these five countries are more reliable, or at least
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15 are more contrasted and sophisticated. The second group includes Cuba, Peru, Uruguay and Venezuela.
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17 For these countries, national yearbooks and trade statistics are combined with international sources, such
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19 as the United Nations *Statistical Yearbook*, plus some industry publication in the case of the oil producers
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21 (Peru and Venezuela) and the reports of the governmental energy departments where they existed. Far
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23 less information was available for the third group of countries, namely: Bolivia, Costa Rica, Dominican
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25 Republic, Ecuador, El Salvador Guatemala, Haiti, Honduras, Nicaragua, Panama and Paraguay. Few
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27 national statistics were used in these cases. Instead, United Nations statistics were chiefly used: the
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29 already quoted *Statistical Yearbook*, along with the *Statistical papers*.³⁷
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34 Possibly, the broadest historical energy study ever was the one directed by Joel Darmstadter
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36 (1971).³⁸ It included data of commercial inanimate energy output, trade and consumption for about 100
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38 territories covering the bench-mark years 1925, 1929, 1933, 1937, 1938, 1950, 1953, 1955, 1957 and the
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40 period 1960-65. Although it only produced two point estimates before 1930, it included 11 Latin American
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42 and Caribbean countries (Argentina, Bolivia, Brazil, Colombia, Cuba, Chile, Ecuador, Mexico, Peru,
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44 Uruguay, and Trinidad & Tobago), that is, the largest set yet for these early dates. This is a careful and
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46 detailed study. It offered the raw series (national production, exports, imports, bunkers and hydroelectricity)
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48 used in order to elaborate the apparent consumption of energy for each country. It made explicit all the
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50 conversion factors used for each type of energy carrier, including hydroelectricity (measured by heat
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52 content of the power produced rather than by coal-equivalent fuel requirements at thermal generating
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54 plants). Perhaps, the only weakness of this study, if it may be considered as such, is the massive use of
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56 secondary sources for trade data, mostly the United Nations (including ECLA) and the League of Nations
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58 estimates. Equally, for domestic production third parties estimates were almost exclusively used, namely
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60 the British Institute of Geological Sciences and the United States Bureau of Mines.³⁹

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3 From the preceding paragraphs, emerges that only three studies provide historical series of
4 energy consumption in Latin America, namely ECLA (1951), ECLA (1957) and, Darmstadter et al. (1971).⁴⁰
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7 Respectively, they provide data for 5, 7 and, 11 Latin American and the Caribbean countries for the year
8 1925, the earliest considered. There is more than enough ground for endeavouring to estimate the energy
9 consumption of these countries for the first quarter of the twentieth century.
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18 Before displaying the new annual series, a contrast of the foreign trade data of the Latin American
19 countries versus those of their main partners in 1925 for coal and oil is called upon, in order to establish the
20 reliability of the data used. The choice of the year is in no way arbitrary: 1925 is the overlapping year with
21 the existing series, none of them covering any previous year. In so doing, the foundations of the new
22 estimates for the period 1890-1925 are made fully explicit.
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29 By 1925, at the end of the period that we are studying, most Latin American countries were net
30 importers of coal and petroleum products, mostly from the United Kingdom, the United States and,
31 Germany; Mexico and Peru also supplied petroleum within the region. Therefore, in order to estimate the
32 apparent consumption of fossil fuels, it seems sound to approach the matter making use of the available
33 trade statistics, and supplement those with home production data in the case of the extracting countries.
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43 Trade data can be obtained from the countries of origin from where the fuels were exported or, from the
44 destination countries, which imported the energy.

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45 Of the 33 countries that constitute Latin America and the Caribbean at present, 18 published
46 trade statistics in 1925, although only 15 offer sufficient detail about the country of origin and the type of
47 products imported. From the exporter countries side, namely, United States (coal and oil), United Kingdom
48 (coal), and Germany (coal), information is available, with varying degrees of detail, for all 33 territories.⁴¹
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199 A first look at the data offered by the importing countries reveals some useful trade patterns. As
200 shown in Table 1, the 'G3' provided 98 per cent of the total amount of coal Latin America bought in 1925.

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3 The United Kingdom is the country with the greatest share, 69 per cent. The United States are next with a
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5 quota of 26 percent. Germany had much smaller shares (3.4 per cent).
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8 A closer look at the coal trade patterns modifies somewhat the first impression. The United States
9
10 was the main supplier (85-100 per cent) of coal for Cuba, Ecuador, El Salvador, Guatemala, Haiti, Mexico,
11
12 Nicaragua, and Dominican Republic, while for the larger consumers of the Southern Cone (Argentina,
13
14 Chile, and Brazil) the United Kingdom was the main supplier (60-80 per cent). Colombia and Peru showed
15
16 no preference and imported similar amounts from these two suppliers.⁴² One main exception was Bolivia,
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18 which imported more coal from the neighbouring countries (mostly Chile) than from the G3 altogether. Coal
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20 entered the Argentinean market also from Chile. None of that coal was actually of Chilean origin. Finally, it
21
22 must be noted that, although with small relevance for the overall trade, other suppliers were also involved:
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24 Australia supplied Chile and the Netherlands both Chile and Argentina.
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29 [TABLE 1: coal trade patterns]
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34 In the case of petroleum, regional trade played a much greater role. Seven Latin American countries
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36 were oil producers by 1925 –Argentina, Colombia, Ecuador, Mexico, Peru, Trinidad & Tobago and
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38 Venezuela.⁴³ Together they amounted to 15 per cent of the world's petroleum output, while the United
39
40 States represented 72 per cent. In other words, Latin America extracted more than half of the petroleum
41
42 obtained in the world outside the United States. At the same time, Mexico continued to be the second
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44 largest oil producer in the world, a position briefly lost to the Soviet Union, only to be regained by Latin
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46 America three years later by Venezuelan wells.
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50 Three countries were the main suppliers of oil products to the region, United States, Mexico, and
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52 Peru. A little more than half of the oil imported by Latin American countries had its origin in the United
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54 States, as can be seen in Table 2. Although the United Kingdom and Germany are sometimes mentioned
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56 as suppliers of oil products in the trade statistics of the Latin American countries in 1925, they provided
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58 negligible amounts. The remaining half of the oil was mostly supplied within the region.
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3 Mexico supplied 40 percent of the tonnes imported according to the importing countries data.
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5 Peru, the third main producer of the region, provided 8 percent. It may be worth mentioning that while the
6
7 Venezuelan petroleum output was much greater than the Peruvian one, the former massively exported
8
9 crude to refineries of the Dutch West Indies (Aruba, Curacao). From there it was re-exported, mostly to the
10
11 United States and Europe. Direct exports from Venezuela to the rest of the region remained very low, with
12
13 the exception of neighbouring Colombia. The list of alternative suppliers is larger than in the case of coal,
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15 but they had a small weight on the overall trade and mostly acted as mere intermediaries. So for instance,
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17 the main oil supplier to Bolivia was again Chile, while for Colombia most of the petroleum products came
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19 from Costa Rica. This clearly demonstrates the role of intermediaries played by some countries in the case
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21 of oil (Panama is the other main case).
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28 [TABLE 2: Petroleum trade patterns]
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32 One main message distils from this first look at the data. Theoretically, it would suffice to collect
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34 data from three exporting countries to cover over 90 per cent of the fossil fuels imported by the Latin
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36 American countries. Nevertheless, all the data available at both ends, importers and exporters, were
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38 collected for the comparison exercises in this section since a priori, the more data collected the more
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40 refined the new estimates would be. The approach taken presents a number of inconveniences and
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42 methodological challenges. These were grouped in three main kinds: 1) problems of classification and units
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44 of measurement; 2) contrast of volumes between the data provided at origin by the exporting countries and
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46 the data registered at the country of destination by the importing countries; 3) methodological problems in
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48 relation to the consumption of home produced coal and petroleum. Some of these needed lengthy and
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50 detailed discussions, clearly exceeding the size of one single article, and can be found elsewhere.⁴⁴ Details
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52 aside, no more than the main issues and decisions made regarding contrast of sources and methodology
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54 are offered here.
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58 The total figure of coal and petroleum imports according to their own domestic sources was
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60 obtained for 17 countries. For 15 cases it was possible to distinguish the country of origin of the products.

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3 One way of checking the reliability of the standardization criteria was to contrast these data with volumes
4 registered in the country of origin by the exporting countries. Among the main reasons for using all the
5 available data was the general, but not definitive, pessimistic tone of economists, economic historians and
6 Latinamericanists alike, regarding the poor quality of trade figures in general. The issue of the (in)accuracy
7 of the foreign trade statistics remains in the economic literature to the present day.⁴⁵ Yet, in historical
8 terms, the accuracy of foreign trade statistics seems to be more robust than generally thought.⁴⁶ Regarding
9 Latin American trade statistics, the position is somewhat mixed although traditionally pessimistic.⁴⁷
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18 In the absence of evidence in the literature, a test was needed regarding the level of accuracy of
19 the trade statistics at both ends. There is a wide array of potential matters that could help to explain the
20 expected differences between the volume and value annotated at the port of origin and the registered at
21 destination: different accounting methods (CIF versus FOB, fiscal versus calendar years, etc), pricing
22 methods (official, declared, fiscal...), misclassification of products, different units of measurement,
23 geographical misallocation, etc. Nevertheless, the data match is surprisingly acceptable.
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31 Consider first the case of the quantities of coal imported from G3 shown in Table 3. The contrast
32 of the volume imported according to both types of sources reveals that for a first group of countries a very
33 close match (2 to 7 per cent differences): Argentina, Brazil, Colombia, Cuba, Dominican Republican,
34 Ecuador, and Nicaragua. A second group of countries (Chile, El Salvador, and Peru) exhibits a less
35 satisfactory correspondence, with differences between both sources on the 15-35 percent range. Finally,
36 four countries show irreconcilable differences, measured in percentages, between their statistics and those
37 reported by the exporting countries, these are Bolivia, Costa Rica, Haiti, and Mexico. But even for these
38 countries, the actual amounts of tonnes missing are very small to have a significant impact on the
39 impression we get from a country as a small, medium or large consumer of coal whichever source we look
40 at. When the region is taken as a whole, and the coal exports recorded to Latin America by G3 are
41 confronted with the total aggregated imports as declared by the destination countries, the gap reduces to 1
42 per cent of the total.
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[TABLE 3: Coal quantities contrast by source]

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3 In the case of petroleum products the contrast must be done in absolute and comparable totals.
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5 The absolute totals shown in Table 4 (panel A) simply contrast the total amounts of petroleum registered by
6 the importing country with the aggregation of the exports to that country reported by the United States,
7 Mexico, Peru, Argentina, Chile, Germany and the United Kingdom. These are not exactly comparable
8 magnitudes. On the one hand, there may be alternative suppliers included in the total amount reported by
9 the importing countries. These alternative suppliers -Venezuela, Puerto Rico, Panama- are not included in
10 the figure summed from the exporters data. On the other hand, exporters (especially the United Kingdom
11 and Germany) may not report minor quantities sold to small countries, but these amounts show up in the
12 Latin American home statistics. With the absolute totals the contrast of quantities between both sources is
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dismal.

[TABLE 4: Contrast of petroleum data]

When the contrast is made solely on the basis of the comparable data, the gap improves for most countries. Table 4 (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 sizeable number of tonnes are missing from the home statistics, for the rest of the countries the match between tonnes reported at origin and at destination port is acceptable. Since the countries with the greater divergences are the small consumers, the gap between importers and exporters data of the total for the region is as small as 2 per cent. The impact of these differences on the final estimates of apparent consumption per capita of individual countries 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 goes beyond the topic of this article 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 accept the existence of statistically significant differences between the data provided by the exporters and the data registered by the importing countries.⁴⁸

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3 The aggregation of trade –net of exports- and domestic production of coal and petroleum allows
4 the elaboration of new estimates of apparent consumption of fossil fuels per capita for Latin America and
5 the Caribbean countries in 1925. The new estimates for 1925 were elaborated for both the foreign and the
6 domestic sources. The foreign sources provide data for 32 territories; with the domestic sources,
7 alternative estimates can be elaborated for 17 countries. Table 5 shows the contrast of these two
8 elaborations with the estimates previously available for the same year of 1925 (ECLA 1949 and 1957, plus
9 Darmstadter 1971). The new estimates withstand the test entirely. The robustness of the new estimates in
10 relation to the old ones supports the new estimates for which no previous reference existed (Barbados,
11 Bermuda, Dominican Republic, Honduras, Jamaica, Nicaragua, all of the West Indies –Danish, Dutch,
12 French and British- Panama, Paraguay and, Venezuela).

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27 [Table 5: comparison of new vs. old estimates]
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31 The proportions of coal and petroleum in the apparent consumption of energy deserve some attention in
32 relation to modernization issues.⁴⁹ The fact that for the Central American countries, coal was mostly
33 irrelevant already by 1925 provides an interesting hint. Had they been involved in the technologies of the
34 first industrial revolution, they would have used coal. It seems these countries never made use of the
35 classic steam engine, but made a jump straight to combustion engines, thus to petroleum products. The
36 United States' technological leadership on this technology and its influence in this area also support this
37 hypothesis. On the contrary, the countries of the Southern Cone made great use of coal. In fact, Argentina,
38 Chile, Uruguay, and Brazil consumed more energy from coal than from oil, and together consumed more
39 than half of the coal consumed in the region (Panama excluded). Two possible explanations can be
40 advanced for this fact. On the one hand, these bigger countries initiated their industrialisation process
41 during the nineteenth century, thus tying their energy consumption patterns to the prevailing coal
42 technology. On the other hand, path dependence also affected trade. In this regard, the strong historical
43 commercial relationship of Argentina with the United Kingdom adds a further bias towards coal.

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60 The encouraging results of the exercises in this section prompt to extend the new estimations using the
foreign sources as the keystone for reconstructing backwards to the 1890s, since absolutely no estimates

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3 of energy consumption are available before 1925. Yet in order to achieve a more complete view of the
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5 consumption of modern energies, it is unavoidable to take into account the newest energy of the time:
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7 hydroelectricity.
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10 There is very little information regarding hydroelectric production in Latin America at this early stage;
11 the closest in time is the one by the United Nations which produced an estimate of the hydroelectric
12 production in Latin America by 1929. The solution was to project backwards the electricity production of
13 1929 using the stock of electrical generators of each country. Assuming that no electrical machinery was
14 produced in the whole of the subcontinent, for the construction of the stock of electricity generators the
15 trade statistics were used again, this time those of the United States, the United Kingdom, Germany and
16 Switzerland. Then the value of the stock of imported generators was assessed and deflated with the
17 estimated Swiss export price index of electrical machinery. These series are transformed into hydroelectric
18 production using the factor found for 1929.⁵⁰ Nevertheless, the figures of hydroelectric power have almost
19 no impact on the total energy consumption levels of most Latin American countries, except for the smaller
20 Central American countries, especially Costa Rica. This is shown by contrasting the numbers of fossil
21 consumption (in Table 5) with the ranking of total modern energy consumption (Table 6).
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35 The sum of imports, established with the G3 data allow us to cover 30 countries and territories, plus
36 national production of modern energies (net of exports), including hydroelectric power, constitute our
37 indicator of apparent consumption of modern energies; divided by population is the gauge used through the
38 rest of the paper.
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45 IV

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48 Table 6 offers the ranking of energy consumption per 1,000 habitants for 1890, 1900, 1913 and 1925.
49 Leaving aside the colonial possessions for the moment, the first thing that draws our attention is the wide
50 gap in modern energy consumed across the subcontinent. In 1890, the average Uruguayan disposed of
51 730 times the energy (specifically coal) of an average Salvadorian or Guatemala's habitant. By 1900 close
52 to nothing had changed, but in 1913 and 1925 the difference widened even more once Panama entered
53 the list. Excluding Panama, given its exceptionality discussed below, the five countries above the regional
54 average (weighted) –Uruguay, Chile, Argentina, and Cuba-, consumed in 1890, 17 times more per capita
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3 than the twelve countries below the average; the proportion was reduced to 12 times by 1900, and
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5 remained thereafter (13 times in 1913; precisely 12 by 1925).
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8 From this depiction, it is clear that the differences in the levels of economic modernization across Latin
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10 America were already present by 1890 and changed very little in the following decades. The early
11
12 integration to world markets seems to be as important as the natural endowment. Among the large
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14 consumers only Uruguay and Cuba had absolutely no national production of modern energies. Yet
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16 Uruguay has been present in the world market since the first half of the nineteenth century with its 'tasajo'
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18 exports and Cuba was the first supplier of sugar to the international markets from the 1830s; Chile was well
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20 endowed with mineral coal for home consumption, but also with silver and cereals first and, nitrates and
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22 copper later for exports. Argentina joined later, but with force, the international trade flows.
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27 [TABLE 6: Levels of energy consumption per capita in LA&C]
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32 Another potential explanation lies with the opportunity cost of the transition from traditional energies of
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34 organic origin to modern fossil fuels. While Uruguay and Argentina had no option but the fossils, for their
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36 rich regions of the pampas did not offer much to burn as energy, the cases of Cuba and Chile –better
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38 endowed with wood and sugar cane for burning- are better explained by the fact that their export activities
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40 grew much faster than the organic energy they could provide. In this regard, it is quite possible that the
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42 countries with access to the Amazon (Brazil in particular, but also Peru, Ecuador, Colombia, and
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44 Venezuela, plus the Guyana) had higher opportunity costs for modernising given the abundance of wood.
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46 In the small economies of Central America and the Caribbean, always in the end positions of our
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48 modernization list, the handicaps collude: a poor natural endowment, a late integration in the world markets
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50 and the perpetuation of traditional small economic activities, made it possible to continue without much
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52 need for modern energies. For these economies, the energy surge came with the delayed arrival of
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54 railways, in fact the larger consumer of modern energies of the time.
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58 It is clear that the differences in the levels of energy consumption per capita were already present by
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60 1890. Also the existence of clusters of countries (large vs small consumers) was also present from the
beginning. Uruguay, Chile, Argentina, and Cuba are the four countries at the head of economic

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3 modernization –see Figure 3, below-. Reporting of Argentina as a rich a prosperous country is common-
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5 place in the economic history literature.⁵¹ What is somehow surprising here is that it does not take the first
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7 position in our indicator of economic modernization. Yet, as said earlier, this indicator tends to push
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9 upwards industrial, mining, commercial and/or urban countries and push downwards predominantly
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11 agrarian and/or rural economies. Therefore, the explanation for the Argentinean case surely lies within the
12
13 marked agricultural profile of its economy, which implied relatively low modern energy consumption (limited
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15 to the railways and the urban centres). By contrast, the mining intensity of the Chilean economy, which
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17 needed to melt its copper before export, and the extensive and dense railway network of Cuba, plus their
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19 key role as bunkering ports in the main commercial routes help to understand their higher levels of energy
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21 consumption. In the Cuban case, the increase of modern energies is a further indicator of the replacement
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23 of the traditional organic fuel of the sugar industry: the sugar cane bagasse resulting from the crushing
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25 process which traditionally fuelled the industrial process. Bagasse was first replaced by mineral coal and
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27 later on by petroleum. For its part, Uruguay appears as the largest consumer of modern energies, by some
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29 means an unexpected position. Sharing the traffic of the River Plate with the Argentinean colossus, it is
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31 possible that even if only a few of the bunkering activities of Montevideo's port actually corresponded to
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33 ships entering or departing from Buenos Aires, the per capita estimate for Uruguay would come down –
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35 given the large scale of the port activities relative to the small population of the country.⁵²
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40 As noted earlier, the position of Panama is exceptional. With US backing, Panama seceded from
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42 Colombia in 1903 and promptly signed a treaty with the US allowing for the construction of a canal and US
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44 sovereignty over a strip of land on either side of the structure (the Panama Canal Zone). The Panama
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46 Canal was built by the US Army Corps of Engineers between 1904 and 1914. Over the construction period,
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48 but overall once opened, the Canal received huge amounts of coal and petroleum for bunkering purposes.
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50 With less than half a million inhabitants it is implausible that the Republic of Panama consumed between
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52 half and a million tonnes of oil equivalent however prosperous the former Colombian province might have
53
54 been. It is not possible at this time to distinguish between the energy consumption of the Republic of
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56 Panama and that of the Panama Canal. As a bunkering post, the consumption of the Canal was among the
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58 highest in the region. Most of the Caribbean colonial possessions must also be considered as bunkering
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60 stations of their metropolis, thus their energy consumption has to be taken with precaution.

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3 Oil producers within the region deserve special attention. Mexico closed the gap with the leaders over
4 the 1920s but still did not reach the top of the list. Petroleum abundance was not *per se* an advantage at
5 that stage –they consumed very little of it and mostly related to the petroleum industry itself- a clear
6 symptom of the difficulties for modernising their economies. It was not easy to shake off the burden of the
7 predominance of activities based on organic energies and the late integration in the world markets, both
8 rooted in the pre-1890 period.
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18 [Figures 3 to 9: Tonnes of oil equivalent per 1,000 habitants by country 1890-1925]
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23 Among the countries in the midrange of Table 6 we find Brazil, the largest country in the region by most
24 measures.⁵³ Although it manages to increase its consumption per capita, Brazil loses positions in the
25 ranking, which is probably related to the opportunity cost of switching to modern energies for a country with
26 huge woodland resources. In fact, the only jump for Brazil occurs between 1900 and 1913, and for the last
27 period energy consumption levels fall slightly. The Peruvian case is similar to the Brazilian, one of losing
28 positions, but it is different inasmuch as Peru was the oldest of the oil producers of the region. The
29 evolution of these two countries can be observed in Figure 3. While Peru stagnated from 1908 reflecting
30 exhaustion after the effort of the preceding decades of overlapping petroleum, copper and silver surges.⁵⁴
31 Brazil interrupted its progress with the outbreak of First World War, which severely hurt its coffee trade, and
32 did not recover until 1925. In this group of midrange consumers of Table 6 we also find Costa Rica and
33 Puerto Rico. The former surpassed Brazilian and Peruvian levels of energy consumption after the war, the
34 latter carried on losing positions, being unable to keep pace with Cuba.
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49 At the bottom of Table 6 the same countries are systematically found: Haiti, El Salvador, and
50 Guatemala, a group of small and poor economies in Central America and the Caribbean –see Figures 5
51 and 6-.⁵⁵ The trajectory of Haiti earns by its own merits the category of ‘regional minimum’ by 1925 and
52 allows it to be described as the least developed country in the region. The worst of it all is that it was not so
53 at the beginning. Haiti is a story of decline in the long run, especially from 1896 through 1905, and from
54 1913 through 1919, barely compensated for by the period in between. On the other half of the island, in
55 contrast, the Dominican Republic moves in the opposite direction: only up (with some minor downs). So it
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3 does Honduras, which by 1925 already reached the levels of Costa Rica, in part thanks to the railway
4 construction initiated in 1913, undertaken by US investors.
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7 El Salvador could have turned into another 'Haiti', where lethargy set in. But from 1910 it slowly started
8 its modernization process, hardly noticing the effect of the First World War, all explained by the railway
9 construction by foreign investors. The same factor explains the growth of Guatemala from 1895 to 1913,
10 which basically stagnated after experiencing very little or null modernization besides the railway itself. The
11 only exception in this respect may be Nicaragua, whose levels of energy consumption continued to
12 increase once the expansion of the railway network concluded. This strong relationship between the size of
13 the railway network and modern energy consumption by 1890 can be seen in Figure 10.
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25 [Figure 10: **Energy consumption (toe) and railroads (km) per capita in 1890**]
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29 A final separate group is constituted by the Andean region, Colombia and Ecuador (and the landlocked
30 Bolivia and Paraguay - for whom insufficient data prevent from offering confident time series data at this
31 time). Colombia suffered the secession of Panama and it did not recover until the 1920s. Ecuador is more
32 like Honduras and the Dominican Republic, despite increasing levels of energy consumption per capita, it
33 is not enough to leave the bottom of the ranking.
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40 The comparisons and contrasts reveal clearly that for most of the Andean and Central American
41 regions the first globalisation was nothing more than a lost opportunity. In contrast, a few other small
42 economies, such as Costa Rica, Panama, Dominican Republic, Jamaica or Puerto Rico, managed to find
43 their niche in the world economy. They made the most from it, but the benefits were not always capitalised
44 on the longer run. Latin America and the Caribbean fragmented into portions that pursued modernization at
45 very different paces. The emergence at this time of regional clusters is a relevant finding.
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53 Finally, it is possible to make a more precise assessment of the modernization levels of the region in
54 contrast with two other economies: the US and Spain. The distance to the world leader, the US, was
55 abysmal even for the most modern of the Latin American countries. The average Latin American
56 consumed less than 2 percent of the energy consumed by the representative US inhabitant throughout the
57 period. But the US was already the most energy intensive country in the world. A more realistic comparison
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3 is the one with Spain. Relative to Spain, the leader countries of the region –Argentina, Chile, Cuba,
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5 Uruguay, even Mexico by the mid 1920s- have higher energy consumption per capita than Spain. The
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7 implication is that these five were more modern countries than Spain. This proposition is further grounded if
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9 we consider that it is fully consistent with the standard knowledge on GDP and migratory flows over the
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11 period. Yet, this contrast, also reveals how far from modernising where most of the rest of the countries of
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13 the region: consuming less than a tenth of the level of a country still on its way to modernity as was Spain
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15 at the time.
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25 In a second level of examination we focus on the different chronologies of the economic modernization
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27 of the regions. There is a clear-cut difference between the pre First World War era –with high
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29 modernization rates (5.1 per cent yearly per capita modern energy consumption growth)- and the war and
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31 postwar era –when modernization slowed down (1.9 per cent yearly growth per capita). The first period –
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33 1890-1913- has been properly described as the first globalization, or the years of the making of an
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35 integrated international economy. According to the best of our knowledge, some Latin American and
36
37 Caribbean countries fully enjoyed the opportunities provided by the increased specialization and integration
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39 of the world economy. All these opportunities implied a larger consumption of modern energy sources.
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44 [Table 7: **Rates of growth of per capita modern energy consumption (%)**]
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49 The figures in Table 7 provide data to support this view. The whole of the region had a yearly increase
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51 in modern energy per capita consumption of 5.1 per cent. It more than trebled. The large Latin American
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53 economies had a growth rate in the same range: Argentina, 4.7, Brazil, a bit lower, 3.7, but Mexico, much
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55 higher, 11.0. Mexico manages to change from an underperformer in Latin American terms to an over
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57 performer. These are the years of the “porfiriato”, up to the abrupt revolutionary interruption of 1910. The
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59 “medium” size progressive economies also enjoy a good time: Cuba at 5.5 per cent, Chile at 4.8, but
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Uruguay, perhaps the richest by 1890, only 2.1. These six countries represent 83.8 per cent of total

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3 modern energy consumption in 1913 Latin America. But a number of other small countries are also
4 showing amazing performances. Guatemala shows a 20.1 per cent growth rate, Ecuador a 14.2 per cent,
5 Honduras, 12.4, Costa Rica, 8.6, Peru, 7.5, El Salvador, 6.9. All of them, but Peru, were small countries –
6 in population terms-, in the tropical region, and initially very poor. They jump from extremely low levels of
7 modern energy consumption per capita to simply low levels.
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12 On the other hand, a few countries fully missed their opportunities: Colombia is the most spectacular
13 with a –4.0 per cent, Venezuela, -1.3, Nicaragua, -0.3, and Haiti, 2.4. The Colombian case is highly
14 interesting as it reflects the loss of its wealthiest province –Panama, independent from 1903. It is unfair to
15 consider both countries as separate entities, as what remained of Colombia was much poorer by 1903. If
16 we consider Colombia and Panama together what we get is a yearly increase of 10.5 per cent, close to the
17 Mexican levels for instance. The other three cases seem real. By the early 1890s Nicaragua enjoyed
18 some advantage compared with most Central American economies (except Costa Rica) but could not
19 sustain it subsequently, and there could have been some intraregional convergence. The energy data
20 suggest that such a trend did exist: Guatemala and Honduras overcame Nicaragua and approached Costa
21 Rica. Only El Salvador remained stagnant.
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36 Venezuela and Haiti do not have any excuse for their underperformance. Haiti is the most intriguing
37 country, as it becomes the poorest one –in per capita energy consumption terms- precisely during these
38 years. At the starting point Haiti was on the same range than Dominican Republic –the other half of the
39 Hispaniola island- or Colombia. By 1913, after more than two decades of low growth, it was close to the
40 bottom. Haiti reached this position during the War. The very small colonial territories followed quite
41 different paths, generally positive, but with some curious exceptions such as British Guyana.
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50 It is worth highlighting the fact that the highest growth rates correspond to the Andean axis, from
51 Mexico to Peru. The temperate Southern countries did well, but just below the average. Brazil, and mostly
52 Uruguay and Venezuela appear as clear underperformers. The region as a whole managed to increase its
53 modern energy consumption a third quicker than the US. A catching-up experience, but it was not
54 spectacular. Neither was the intraregional catching up spectacular. For all the rapid growth of the poorer
55 countries that our figures unveil, the fact is that the 1890 ranking was quite similar in 1913. Only Mexico
56 made a promising difference.
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3 A closer look at the Latin American average evolution suggests an accelerating trend, particularly
4 since 1902, peaking in 1911. The growth rate for 1890-1902 for the whole region is 4.5, while 1902-11
5 jumps to 8.1. A more conventional breakdown into decades –before and after 1900- provides the same
6 acceleration trend –but a bit blurred- from 3.6 in 1890-1900 to 6.4 in 1900-13. The acceleration is quite
7 general, with clear upturns for Argentina, Brazil and Chile, all of which jump to the 6-8 range in 1900-13
8 from 1 per cent per year or less in the last decade of the nineteenth century. The only significant economy
9 experiencing the contrary movement is Mexico, which goes down to 3.6 from 21.4. But this can be
10 explained by the Mexican Revolution. Indeed, growth rates outside Mexico during the Edwardian era are
11 really impressive. Only Uruguay experiences slow growth (1.9 per cent). The comparison with the US
12 figures underlines the strong dynamism of the early twentieth century economic upswings for the whole of
13 Latin America, even compared with the world energy consumer leader.

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16 We usually accept that Revolutionary Mexico suffered from an acute shortage of data. The modern
17 energy consumption approach, using exports from the major western economies, allows overcoming a bit
18 of this shortcoming: Mexican figures go down one-third for 1910-14. But the road down includes a very
19 good 1911, and the strong recovery after 1914 has to be underlined.

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22 The outbreak of the First World War was a watershed for Latin America, as for the rest of the world. It
23 is fair to mention that the years immediately prior to the war were of economic crisis or deceleration for
24 some of the large economies (Argentina, Brazil, Mexico, and Uruguay), with a 10.8 fall for 1911-12, only
25 partially recovered in 1913. The overall Latin American and Caribbean performance was quite bad: 30.2
26 per cent fall from 1913 to the through of 1919 (and a 35.1 fall if comparing 1911 to 1919). Contrary to what
27 happened during the prewar globalization years, when the per capita energy consumption was growing for
28 almost every country, the war years showed very different country experiences. If we focus on the period
29 1913-18, when most of the impact was felt, we have countries with yearly growth rates ranging from –33.0
30 per cent in Guatemala to +24.7 per cent for its neighbour Honduras. These extremes were not isolated.
31 The largest economies also experienced such a discrepancy. Argentina fell at a 29.0 per cent rate and
32 Brazil at a 15.6, but Mexico grew at 11.5. Uruguay went down at 14.5 and Chile at 5.3, but Cuba remained
33 almost stagnant (-0.1). The downs were more important than the ups, as happened with the whole of the
34 region (-6.2), but what is the most striking is the diversity of the experience, even among close neighbours.

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3 Generally speaking, all the economies closely linked with the European markets –United Kingdom, mainly,
4 but also Germany and France- suffered the most the war. This was the case of all the large South
5 American economies –Brazil, Argentina, Chile, and Uruguay-, and for some others like Guatemala (-33.0),
6 Costa Rica (-23.8), Haiti (-17.2), Jamaica (-14.5), in Central America, and the Caribbean. But these were
7 the only eight economies suffering more than the average.
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12 A number of economies enjoyed positive growth during the war years. Below the Honduras maximum
13 rate it was Nicaragua (18.6), Venezuela (17.9), Dominican Republic (13.6), El Salvador (12.9), Mexico
14 (11.5), Trinidad & Tobago (3.2), and Peru (1.3). In the negative range, but above the regional average,
15 were Panama (-3.2), Ecuador (-3.6), and Colombia (-5.1) , just as the previously mentioned cases of Chile
16 (-5.3) and Cuba (-0.1).
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25 The fluctuations during the war years unveil a number of country and regional features. Argentina
26 reduced its energy consumption at an accelerating rate, mirroring the war economy developments in
27 Western Europe: increasingly poor economic conditions and increasingly risky and expensive freight rates.
28 It is not surprising that the worst moment was 1918, at 18 per cent of the 1913 value. Brazil, on the
29 contrary, suffered a tough decline over 1914-16, but it was smoother during 1916-18, when the actual
30 minimum was reached at a level of 42.8 per cent of that of 1913. It is likely that Argentina reflected the
31 pattern of the wheat and meat European importing markets, both difficult to compress. Brazil reflected the
32 coffee and the colonial European importing markets, a luxury that could be skipped from the start of the
33 war. Indeed, the only Latin American countries to suffer a long and deep fall during the First World War
34 were of the Argentina or of the Brazil kinds: Costa Rica, Guatemala and, Uruguay, a total of five. Two of
35 them large economies, and one more a medium size prosperous economy, The other two small and poor,
36 even if promising. But it is impossible to distinguish, for other countries, anything similar to what they
37 suffered.
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53 Mexico fully recovered from the Revolution. The 1911 maximum was difficult to reach, but it is
54 impossible to draw a negative picture for 1914-18. Cuba also enjoyed relatively good years, around 1911-
55 13 levels: not extraordinary, but not bad. Chile had a poor 1915, but the other years were in the 1910-13
56 range, and much better than 1912. There was the occasional bad year, like in Ecuador (1915) or in
57 Jamaica (1918), but the norm was stability or stagnation. It is also difficult to find big spurts, although
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3 Honduras, Nicaragua, Dominican Republic, and El Salvador are cases in point. They were small
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5 economies, but they enjoyed –without doubt- a golden era during the First World War.
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8 Can we assign any responsibility for what happened to the Panama channel? As we know, it was
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10 inaugurated in mid 1914, and was itself a real watershed in American life. Were the poor performance of
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12 the South Atlantic economies and the relatively good development of the Pacific rim linked to the new
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14 shipping routes opened by the Panama channel? It is quite likely. The energy consumption figures suggest
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16 that this interpretation could be true. Mexico and the Central American Republics which happened to be
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18 just in the middle of the new route from the US East and West coasts did quite well. The Andean countries
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20 reduced dramatically their distance from the Northern Atlantic world and could enjoy many more business
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22 opportunities. On the contrary, Brazil, Uruguay and Argentina had to be net losers.
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25 For a few economies the worst came in 1919. Recovering from the Great War was not easy at all.
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27 For the whole of Latin America 1920 seemed to be the recovery year, but 1921 did not continue the growth
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29 trend, and 1922 collapsed again. Only 1923 provided a better performance than any previous year,
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31 including 1911. The following years, 1924/25, confirmed the recovery and the new growing trends. As far
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33 as it can be seen from the figures, three economies were outstanding from 1920-25: Honduras (25.1),
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35 Panama (25.4), and Colombia (47.0). The dynamism of Colombia and of Panama had local roots in the
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37 success of the Channel, for Panama, and in the combination of coffee exports and early import substitution
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39 policies in Colombia. Ecuador (10.1), Dominican Republic (8.8), and Costa Rica (8.8) also did rather well.
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43 In relation to the US it is interesting to note that the gap did not widen. It is true that the gains obtained
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45 over the first decade of the twentieth century were completely eroded in the War. Yet, the recovery up to
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47 1925 placed Latin America relative to the US at the same level it was by 1910. The evolution with respect
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49 to Spain is more clearly convergent throughout. While the regional average energy consumption was below
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51 40 per cent of the Spanish consumption in 1890, by 1925 the region had achieved 60 per cent of the ex-
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53 metropolis consumption.
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In the absence of comparable macroeconomic indicators for most of the Latin American economies before the 1930s, this paper presents an estimate of the apparent consumption per head of coal, petroleum and hydroelectricity for 30 countries of Latin America and the Caribbean for every year from 1890 to 1925. This allows elaborating a ranking of the Latin American countries and observing the changing relative distance among each other. To construct the new estimates, both the statistics of the Latin American economies and that of their principal trade partners by 1925 were contrasted, and then rely on the trade partners' data to reconstruct backwards to 1890. To these data on home production of coal, petroleum (net of exports) and hydroelectricity were added. Energy consumption is used as an indicator of economic modernization.

As a result, the article 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 (United Kingdom, United States and Germany), showing that the former are far more reliable than previously thought. On the other hand, the article adds to the environmental and energy history studies by providing energy consumption estimates for years which were previously unavailable for 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 modernization performance, beyond the countries for which historical national accounts are currently available.

According to the new estimates of energy consumption per capita, and taking them as a proxy of economic modernization, the main findings are that Argentina, Chile, Cuba, and Uruguay were already well ahead of all the others by 1890 (when the new series start). On the contrary, the small Andean and Caribbean economies failed to start their modernization until just before the First World War, when foreign investment in railways impacted on their traditional economies. Social archaism and a very tiny domestic market were strong brakes against further progress. Brazil, Mexico, and Peru were around the Latin American average. Their modern sectors, grounded in mid-nineteenth century, were unable to push traditional activities out of their archaism.

In a more general way, the article demonstrates that countries differed in their ability to benefit from the opportunities created by the first globalisation; that the First World War did not have the same

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3 impact across the region; that, clearly, Latin American economies had heterogeneous experiences in their
4 recovery from the war. Finally, the entire region, up to 1925, remained at a very low level of modern energy
5 consumption; consequently, the final conclusion is that despite the undeniable degree of advance made
6 over the first quarter of the twentieth century, the degree of economic modernization reached by Latin
7 American countries was overall patchy and uneven.
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(Quito, 1928).

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3 El Salvador: Dirección General de Estadística, *Estadística comercial* (San Salvador, various years).
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7 Guatemala: Ministerio de Hacienda y Crédito Público, *Memoria de las labores del Ejecutivo en el ramo de*
8 *Hacienda y Crédito Público*, (Guatemala, 1926).
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10 Mexico: Secretaría de Hacienda y Crédito Público, *Comercio exterior y navegación* (México D.F., 1902)
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14 Mexico: Departamento de Estadística Nacional, *Anuario Estadístico: Comercio exterior y navegación*
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17 Nicaragua: Administración de Aduanas, *Memoria del Recaudador General de Aduanas y las Estadísticas*
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43 *Series, No. 126* (Washington, 1931).
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52 *(Montevideo, various years)*.
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59 various years).
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Notes

¹ Cipolla, *Historia económica*, p.57.

² Wrigley, 'The supply of raw materials'

³ US Department of Commerce, *Fuel and Power*, p.1.

⁴ Only for Brazil and Uruguay, GDP yearly data are available since 1870. For Argentina, Chile, Colombia, Mexico - with gaps-, Peru, and Venezuela data series are available from the 1900s. See Maddison, *Monitoring and Thorp, Progress, poverty and exclusion*. Yet, before 1930 very little is known of the smaller countries, not to mention other non independent territories, for which in some cases absolutely no quantitative evidence is available. Bulmer-Thomas, *Economic history of Latin America* provides two punctual GDP p.c. estimates for all the independent countries and Puerto Rico in 1913 and 1928. Astorga et al., 'The standard of living', provide estimates every ten years without going beyond what has been mentioned. Some punctual GDP estimates for countries of the region can also be found in Hofman, *Economic development of Latin America*.

⁵ See Carreras et al., 'El desarrollo económico de América Latina'.

⁶ Jevons, *The coal question*, p. 1.

⁷ 'Editorial,' *The Times*, April 19 1866.

⁸ Hobson, *Work and wealth: A human valuation*; Carver, *The economy of human energy*.

⁹ Read, 'The world's output of work'. A decade later he also published the estimates for 1939, see Read, 'output of work'.

¹⁰ Read, 'The world's output of work', p.55.

¹¹ Mumford, *Technics and civilisation*. here read from the Spanish translation Mumford, *Técnica y civilización*.

¹² Actually, Geddes was possibly the first one to interpret history in a physical key. See Martínez-Alier and Schlüpmann, *Ecología y economía* .

¹³ Cotrell, *Energy and society*.

¹⁴ Cipolla, *Economic History* here from the Spanish version Cipolla, *Historia económica*.

¹⁵ Ibid, p.65.

¹⁶ Ibid, p.63.

¹⁷ Ibid, p.79.

¹⁸ Wrigley, *Continuity, chance and change*, here the Spanish translation is used instead: Wrigley, *Cambio, continuidad y azar*.

¹⁹ Wrigley, 'The supply of raw materials'.

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²⁰ Originally in Crafts, *British economic growth*.

²¹ What follows it is a summary from Wrigley, E. A. 'The Industrial Revolution', (Document prepared for a meeting of the Energy, Pollution and Growth Network, 2003).

²² Maddison, 'Growth accounts'.

²³ On the first aspect, see the survey by Toman and Jemelkova, 'Energy and economic development' on the second issue see Solow, 'The economics of resources'; Solow, 'Intergenerational equity'; Stiglitz, 'Growth with exhaustible natural resources'.

²⁴ There are a flotilla of papers on the issue: Kraft and Kraft, 'On the relationship between energy and GNP'; Akarca and Long 'A re-examination'; Yu and Hwang, 'Further results'; Yu and Choi, 'An international comparison'; Erol and Yu 'Energy and income for industrialized countries'; Abosedra and Baghestani, 'New evidence'.

²⁵ Stern and Cleveland, 'Energy and economic growth'

²⁶ Stern 'A multivariate co-integration analysis of the role of energy'; Oh and Lee 'Causal relationship'.

²⁷ Grübler, 'Transition in energy use'.

²⁸ US Department of Commerce, *Fuel and power*, p.1.

²⁹ US Department of Commerce, *Fuel and power*, p.44.

³⁰ Read, 'The world's output of Work', p.56.

³¹ Ibid, p.144. Although no coal data could be gathered for Argentina in 1939 according to the author.

³² ECLA, *Economic Survey 1949*.

³³ ECLA, *Energy in Latin America*, p.3.

³⁴ Ibid, p.3.

³⁵ Ibid, p.6.

³⁶ Ibid, p.10.

³⁷ UN, *World energy supplies*. Issued annually 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 possible to construct a limited set of statistical series for the years 1927, 1929 and annually from 1949.

³⁸ Darmstadter et al., *Energy in the world economy*.

³⁹ For the specification of sources see Darmstadter et al., *Energy in the world economy*, pp.835-859.

⁴⁰ Although the oil crisis in the mid 1970s compelled the research agenda to include energy issues, none of the works produced thereafter made any effort to improve the historical data series already mentioned. See ECLA, *Latin America and the current energy problems* and Mullen, *Energy in Latin America*. A brief comment on these and other

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minor contributions to the most recent energy history of Latin America can be found in Rubio, M. d. M. and Folchi, M. 'Energy as an Indicator of Modernization in Latin America by 1925', *UPF Economics and Business Working Papers*, N°868 (2005).

⁴¹ We have been able to estimate annual series for 30 out of 33.

⁴² Although none of the domestic data 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.

⁴³ Reported dates of first oil production and exports are: Peru: production 1896, exports from 1897; Mexico: production 1901, meaningful exports from 1911; Argentina: commercial production 1908, very small exports from 1915; Trinidad & Tobago commercial oil production from 1909, exports almost entirely to the UK from 1911; Venezuela and Ecuador official start of oil production 1917, exports from 1920 in the first case and 1925 in the second; Colombia: production 1922, exports from 1926.

⁴⁴ A detailed discussion these issues can be found in Folchi and Rubio, 'El consumo aparente de energía fósil'.

⁴⁵ See, for instance, Makhoul, 'Exploring the accuracy of international trade statistics'; Parniczky, 'On the inconsistency of world trade statistics' and Rozansky and Yeats, 'On the (in)accuracy of economic observations'.

⁴⁶ Federico and Tena, 'On the accuracy of foreign-trade statistics'.

⁴⁷ Kuntz, 'Nuevas series'.

⁴⁸ Rubio, M. d. M. and Folchi, M. 'On the accuracy of Latin American trade statistics: a nonparametric test for 1925', *UPF Economics and Business Working Papers*, N°879 (2005).

⁴⁹ On the issue of the exceptional early transition from coal to oil of the Latin American countries see Folchi and Rubio, 'la especificidad de la transición energética'.

⁵⁰ We are indebted to Tafunell for sharing his estimations of hydroelectricity. See Tafunell, X., 'La producción hidroeléctrica'.

⁵¹ Díaz Alejandro, *Essays*; Della Paolera & Taylor, *A new economic history*.

⁵² By 1905, on an average round trip Liverpool-New York consumed 5,000 Tons of coal, therefore few misallocated ships bunkering would make a great difference for Uruguayan energy consumption per capita. A recent research paper by Bertoni and Roman, 'Estimación y análisis' re-estimated downwards the Uruguayan energy consumption taking bunkering into account, which still remains among the highest in the continent.

⁵³ Leff, 'Economic Development'; Summerhill, 'Transport' and Summerhill, 'Railroads'.

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⁵⁴ Thorp and Bertram, *Peru*.

⁵⁵ Pérez Brignoli, 'Central America'.

For Review Only

TABLES

Table 1. Coal trade patterns: countries of origin of Latin American coal imports in 1925
(15 countries according to their own trade statistics)

Country	Total Coal Imports Tonnes (1)	Main countries of origin (% over all petroleum products imported)				
		UK	US	Germany	Total G3	Others
		% (2)	% (3)	% (4)	% (5)	% (6)
Argentina	3,178,473	87.00	5.00	6.00	98.00	2.00
Bolivia	15,709	29.00	6.00	3.00	39.00	61.00
Brazil	1,727,050	63.00	36.00	0.03	99.00	0.81
Chile	264,070	79.00	14.00	2.00	96.00	3.78
Colombia	3,263	49.00	50.00	0.00	99.00	0.35
Costa Rica	808	39.00	61.00	0.00	100.00	0.00
Cuba	659,389	1.00	99.00	0.00	100.00	0.00
Dominican R.	9,764	0.00	99.00	0.00	99.00	0.69
Ecuador	1,278	6.00	86.00	1.00	93.00	7.00
El Salvador	154	0.00	100.00	0.00	100.00	0.00
Guatemala	264	0.00	100.00	0.00	100.00	0.00
Haiti	156	0.00	100.00	0.00	100.00	0.00
Mexico	65,845	1.00	99.00	0.07	99.85	0.15
Nicaragua	2,646	13.00	86.00	0.00	100.00	0.00
Peru	39,235	45.00	45.00	7.00	97.00	2.16
TOTAL	5,968,104	69.00	26.00	3.00	98.00	1.72

Notes: col. 2-6 as percentage of 1. 'G3' adds up cols. 2-4. Chile was Bolivia's main suppliers with 9,317 tonnes; this was 59.3% of Bolivia's coal imports. Other suppliers to Argentina and Chile were Australia (9,103 tonnes to Chile), Holland (55,084 tonnes to Argentina and Chile) and Chilean coal to Argentina (8,843 tonnes). Not listed countries did not produce trade statistics for 1925, except for Paraguay, Uruguay and Venezuela for which it was not possible to resolve the country of origin of the merchandise in sufficient detail.

Sources: Domestically produced statistics; Argentina: Dirección General de Estadística, *Anuario del comercio exterior*; Bolivia: Dirección General de Aduanas, *Comercio especial*; Brazil: Directoria de Estadística Comercial, *Comercio exterior*; Chile: Oficina Central de Estadística, *Anuario Estadístico*; Colombia: Departamento de Contraloría, *Anuario Estadístico*; Costa Rica: Dirección General de Estadística, *Anuario Estadístico*; Cuba: Secretaría de Hacienda, *Comercio Exterior*; Dominican Republic: Receptoría General de Aduanas, *Report of the...*; Ecuador: Dirección General de Estadística, *Comercio Exterior*; El Salvador: Dirección General de Estadística, *Estadística comercial*; México: Departamento de Estadística Nacional, *Comercio exterior y navegación*; Nicaragua: Administración de Aduanas, *Memoria del Recaudador*; Peru: Superintendencia General de Aduanas, *Estadística especial*;

Table 2. Petroleum trade patterns: origin of Latin American petroleum imports in 1925.
(15 countries according to their own trade statistics)

Countries	Main countries of origin (% over all petroleum products imported)					
	Petroleum Imports	US	Mexico	Peru	Others	Main countries of origins
	Tonnes (1)	% (2)	% (3)	% (4)	% (5)	% (6)
Argentina	689,207	39.00	30.00	29.00		98.00
Bolivia	22,593	32.00		9.00	54.00 ^a	95.00
Brazil	508,814	41.00	58.00			99.00
Colombia	9,600	37.00		5.00	48.00 ^b	90.00
Chile	906,661	77.00	13.00	10.00		100.00
Costa Rica	47,272	3.00	79.00	3.00	15.00 ^c	100.00
Cuba	1,284,027	30.00	69.00			100.00
Dominican Rep.	37,649	42.00	26.00		16.00	84.00
Ecuador	13,100	12.00		88.00		100.00
El Salvador	22,549	88.00		12.00		100.00
Guatemala	68,458	45.00	50.00	4.00		99.00
Haiti	6,113	72.00			17.00 ^d	89.00
Mexico	366,451	99.00				99.00
Nicaragua	14,648	49.00	32.00	19.00		100.00
Peru	8,084	92.00			6.00 ^e	98.00
TOTAL	4,005,226	51.00	40.00	8.00	1.00	99.00

Notes: col. 2-6 expressed as percentage of 1; col.6 adds up col.2-5

^a Other = Chile

^b Other = Costa Rica (Colombia reports 4,500 tonnes of gasoline from Costa Rica)

^c Other = Panama

^d Other = Curaçao (Venezuelan oil), the remaining 10% from Panama and Puerto Rico in equal share

^e Other = United Kingdom

Sources: as in Table 1.

Table 3. Imports of coal in Latin America by 1925, quantities. Difference between importers and exporters registries

Country	Metric tonnes			Difference %	
	Source importers	Source exporters	I-E tonnes	(I-E)/I	(E-I)/E
	(1)	(2)	(3)	(4)	(5)
Argentina	3,111,979	2,925,091	186,888	6.01	-6.39
Bolivia	6,077	664	5,413	89.07	-814.78
Brazil	1,715,203	1,814,136	-98,933	-5.77	5.45
Chile	253,554	195,197	58,357	23.02	-29.90
Colombia	3,252	3,125	127	3.92	-4.08
Costa Rica	808	78	730	90.32	-933.05
Cuba	659,389	701,707	-42,318	-6.42	6.03
Dominican Rep.	9,697	9,484	213	2.19	-2.24
Ecuador	1,187	1,131	56	4.77	-5.01
El Salvador	154	113	41	26.78	-36.57
Guatemala	264	3,287	-3,023	-1,144.81	91.97
Haiti	156	83	73	46.44	-86.71
Mexico	65,746	118,643	-52,897	-80.46	44.59
Nicaragua	2,646	2,476	170	6.42	-6.87
Peru	38,389	32,542	5,847	15.23	-17.97
TOTAL	5,868,500	5,807,758	60,746	1.00	-1.00

Notes: col. 3 is the difference of col.1 minus col.2. Col.4 is col.3 divided by col.1 expressed in %. Col.5 is the difference col.2 minus col.1 divided by col.3 expressed in %.

Sources: col.1 domestically produced trade statistics as in Table 1. Col. 2 is the sum of the data offered by the main trade partners in coal (the G3 of Table 1). Germany, *Der Auswärtige Handel Deutschlands*; US, Department of Commerce, *The Foreign Commerce*; United Kingdom: Statistical Office of the Customs and Excise Department, *Annual Statement of the Trade*;

Table 4. Absolute and Comparable imports of petroleum products in 1925 data
(Contrast of domestic and foreign sources)

Importer	A) Absolute imports of petroleum products			B) Comparable imports petroleum products		
	Tonnes imported (domestic source)	Tonnes imported (country of origin source)	Quantitative differences %	Tonnes imported (domestic source)	Tonnes imported (country of origin source)	Quantitative differences (E-F)/E %
	(1)	(2)	(3)	(4)	(5)	(6)
Argentina	688,026	670,109	3.00	677,196	670,109	1.00
Bolivia	22,027	18,227	17.00	21,498	18,227	15.00
Brazil	505,753	552,147	-9.00	505,753	552,147	-9.00
Chile	906,641	923,112	-2.00	906,540	923,112	-2.00
Colombia	9,232	11,888	-29.00	4,410	11,888	-170.00
Costa Rica	47,272	36,799	22.00	40,275	36,799	9.00
Cuba	1,281,949	1,352,397	-5.00	1,281,942	1,352,397	-5.00
Dominican R.	41,983	46,908	-12.00	30,784	46,908	-52.00
Ecuador	13,100	27,838	-113.00	13,015	27,838	-114.00
El Salvador	22,549	12,072	46.00	22,536	12,072	46.00
Guatemala	68,247	50,794	26.00	68,151	50,794	25.00
Haiti	7,141	5,165	28.00	5,446	5,165	5.00
Honduras		107,916				
Mexico	361,448	324,330	10.00	361,438	324,330	10.00
Nicaragua	14,643	11,639	21.00	9,958	11,639	-17.00
Panama		832,308				
Paraguay		197				
Peru	8,006	6,743	16.00	7,443	6,743	9.00
Uruguay	226,045	183,686	19.00			
Venezuela	2,287	14,021	-513.00			
Bermuda		8,910				
Br. Honduras		2,967				
Barbados		712				
Jamaica		7,423				
T. & Tobago		1,154				
British W.I.I.		85,452				
Danish W.I.I.		35,370				
Dutch W.I.I.		3,931				
French W.I.I.		2,506				
British Guiana		542				
French Guiana		350				
Dutch Guiana		1,537				
Puerto Rico		58,784				
LA (17)	4,226,350	4,247,873	-1.00	3,956,383	4,050,166	-2.00
LA (33)		5,339,148				

Notes: Two types of blank data, 1) the source did not report imports/exports to that country; 2) the source was not available (that is the whole Caribbean, Honduras, Panama) or it was unsuitable for identifying origins (Paraguay, Uruguay and Venezuela). Col. 1 report the absolute total amount of imports reported in the trade statistics of the importing country. Col.2 sums all the petroleum exports reported by US, UK, Germany, Mexico and Peru. Col. 3 is the % difference between col.1 minus col.2 divided by col.2. Col.4 reflects only the amounts imported from those countries for which actual data exists on the countries of origin, which in turn is added up in col. 5. Col.6 is the % difference between col.4 minus col. 5 divided by col.5. A negative sign in the differences means that tonnes are missing from the importer reports. A positive sign in the differences implies that tonnes are reported in excess by the importer.

Sources: Col. 1 and 4 domestic sources as listed in Table 1. Col 2 and 5 trade statistics of the main trade partners: Germany, *Der Auswärtige Handel Deutschlands*; US, Department of Commerce, *The Foreign Commerce*; United Kingdom: Statistical Office of the Customs and Excise Department, *Annual Statement of the Trade*; México: Departamento de Estadística Nacional, *Comercio exterior y navegación*; Peru: Superintendencia General de Aduanas, *Estadística especial*;

Table 5. Old and new estimates of energy consumption of fossil fuels per capita for Latin America in 1925 (tones of oil equivalent per 1,000 habitants)

	ECLA ^a		ECLA ^b		Darmstadter et al			New estimates					
	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	domestic sources			foreign sources		
Latin American Republics													
Argentina	341.4	93.8	180.9	274.7	166.0	191.0	257.0	151.2	181.8	333.0	145.1	182.0	327.1
Bolivia					10.0	5.0	1.5	9.7	4.7	14.4	3.0	0.2	3.2
Brazil	65.0				19.0	51.0	70.0	16.7	44.8	61.4	15.8	51.4	67.1
Chile	515.0	223.5	246.0	469.5	228.0	219.0	447.0	220.1	269.6	489.7	201.9	261.	463.8
Colombia					24.0	11.00	35.0	21.6	0.3	21.9	21.9	0.3	22.2
Costa Rica		95.6	0.17	97.3				92.8	1.2	94.0	79.5	0.1	79.6
Cuba					392.0	136.0	528.0	378.7	130.5	509.2	346.4	137.0	484.0
Dominican R.								40.0	6.2	46.2	35.3	6.10	41.4
Ecuador					19.0	--	19.0	20.2	0.50	20.7	16.9	0.40	17.4
El Salvador		16.9	0.10	17.0				17.3	0.08	17.4	9.1	0.10	9.1
Guatemala		30.4	-	30.4				45.2	0.12	45.3	33.8	1.50	35.3
Haiti		2.2	0.04	2.2				3.2	0.05	3.2	2.1	0.00	2.1
Honduras											122.3	1.5	123.9
Mexico	192.0	72.1	54.2	126.3	240.0	70.0	310.0	122.3	66.5	188.8	159.8	68.5	227.9
Nicaragua								22.2	2.7	24.9	17.1	2.5	19.6
Panama											1,731.7	466.0	2,197.9
Paraguay											0.03	0.20	0.05
Peru					54.0	18.0	72.0	60.2	18.5	78.7	59.7	17.4	77.1
Uruguay					136.0	153.0	289.0	144.0	150.4	294.4	107.6	179.0	287.2
Venezuela								10.5	10.9	21.4	13.9	10.8	24.7

	ECLA ^a		ECLA ^b		Darmstadter et al			New estimates					
	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy	Petroleum	Coal	Total fossil energy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	domestic sources		foreign sources			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Colonies and Territories													
Barbados											3.5	146.4	149.9
Bermuda											85.3	403.3	488.6
Br. Guiana											0.8	62.5	63.3
Br. Honduras											61.1	9.80	70.9
Danish W.I.											1,468.9	1,832.0	3,301.6
Dch. Guiana											11.0	12.7	23.7
Dutch W.I											51.4	754.9	806.2
Fr. Guiana											12.2	5.8	17.9
French W.I.											3.2	128.1	131.3
Jamaica											7.2	37.5	44.7
Trinidad and Tobago					228.0	25.0	253.0	144.00	150.0	294.0	117.0	171.0	289.0
Nº countries	4	7	7	7	11	11	11	18	18	18	31	31	31

Sources : Col.1 ECLA, *Economic Survey* 1949; col.2-4 estimated from ECLA, *Energy in Latin America*; col.5-7 Darmstadter et al., *Energy in the world economy*; col.8-9 domestic sources as in Table 1, adding Uruguay: Dirección General de Estadística, *Anuario estadístico*; and Venezuela: Ministerio de Hacienda y Crédito Público, *Estadística mercantil y marítima*; col. 11 foreign sources as in Table 3; col.12 foreign sources as in Table 4. To the trade data in col.8 and 11 domestic petroleum productions (net of exports) were added from: Argentina, Colombia, Ecuador, Mexico, Peru, Trinidad & Tobago, (petroleum production): American Petroleum Institute, *Petroleum facts and figures*; Argentina (petroleum exports): Dirección General de Estadística, *Anuario del comercio exterior*; Colombia (petroleum exports): GRECO, *Comercio Exterior y Actividad Económica de Colombia en el siglo XX: exportaciones totales y tradicionales*, (Bogota, 2002 unpubl); Ecuador (petroleum exports): estimated at 90 per cent of production; Mexico and Venezuela (petroleum exports): Rubio, 'Towards Environmental Historical National Accounts'; Trinidad & Tobago (petroleum exports): Mitchell, *The Americas 1750-2000*; Perú (petroleum exports): Superintendencia General de Aduanas, *Estadística especial*. To the trade data in col.9 and 12 domestic coal productions (net of exports) were added from: Argentina (coal re-exports): Dirección General de Estadística, *Anuario del comercio exterior*; Chile (coal production): Dirección General de Estadística, *Anuario de Minería*; Chile (coal exports): Oficina Central de Estadística, *Anuario Estadístico*; Brazil (coal production): Martin, *Processus d'industrialisation*; Mexico (coal production): INEGI, *Estadísticas Históricas*. p.472; Perú and Venezuela (coal production): Mitchell, *The Americas 1750-2000*; Population data from Mitchell, *The Americas 1750-2000*, interpolated with census data in the same source when needed, except for West.I.I., Dutch Guiana, Dutch West.I.I. and French West.I.I where the source is Bulmer-Thomas, 'The wider Caribbean'. Col. 10 sums col.8 and 9. Col.13 adds col. 11 and 12.

Table 6
Levels of modern energy consumption per capita in Latin America and the Caribbean
Ranking for years 1890, 1900, 1913 and 1925

1890		1900		1913		1925	
Country	TOE/cap.*	Country	TOE/cap.*	Country	TOE/cap.*	Country	TOE/cap.*
Latin American Republics							
Uruguay	278.60	Uruguay	360.30	Panama	1,276.40	Panama	2,197.90
Chile	171.50	Chile	189.50	Chile	503.80	Chile	490.30
Argentina	116.90	Cuba	158.30	Uruguay	449.80	Cuba	484.00
Cuba**	114.30	Argentina	122.90	Cuba	391.70	Argentina	331.00
A.L. & C.	44.30	Mexico	70.60	Argentina	335.00	Uruguay	287.20
Brazil	33.30	A.L. & C.	63.40	A.L. & C.	142.90	Mexico	251.60
Peru	17.30	Brazil	34.50	Mexico	111.10	A.L. & C.	176.90
Puerto Rico**	16.20	Peru	27.50	Peru	91.40	Honduras	127.50
Costa Rica	13.30	Costa Rica	26.40	Costa Rica	89.30	Costa Rica	113.60
Venezuela	11.60	Puerto Rico	16.90	Brazil	76.70	Peru	89.60
Nicaragua	10.40	Dominican R.	8.30	Puerto Rico	26.10	Brazil	75.10
Mexico	10.10	Nicaragua	6.40	Guatemala	24.10	Puerto Rico	55.60
Colombia	8.70	Colombia	5.50	Dominican R.	16.90	Dominican R.	41.40
Dominican R.	5.80	Venezuela	5.50	Honduras	11.20	Guatemala	39.50
Haiti	3.10	Haiti	3.00	Ecuador	10.20	Colombia	26.50
Honduras	0.80	Honduras	2.80	Nicaragua	9.70	Venezuela	26.40
Ecuador	0.50	Guatemala	1.50	Venezuela	9.20	Ecuador	21.10
El Salvador	0.40	Ecuador	0.90	Haiti	5.40	Nicaragua	19.60
Guatemala	0.40	El Salvador	0.50	Colombia	3.40	El Salvador	12.60
				El Salvador	1.90	Haiti	2.10
Colonies and territories							
Bermuda	353.70	Danish W.I.	1,543.50	Danish W.I.	2,700.00	Danish W.I.	3,301.60
Br. Guiana	208.00	Bermuda	1,075.20	Dutch W.I	784.10	Dutch W.I	806.20
Br. Honduras	9.80	French W.I	82.20	Bermuda	572.50	Bermuda	488.60
		Dutch W.I	74.10	Trinidad & T.	484.60	Trinidad & T.	289.00
		Br. Guiana	65.20	Barbados	289.10	Barbados	149.90
		Dch. Guiana	49.90	Br. Honduras	106.20	French W.I.	131.30
		Br. Honduras	28.80	French W.I.	83.00	Br. Honduras	70.90
				Br. Guiana	73.50	Br. Guiana	63.30
				Dch. Guiana	57.90	Jamaica	44.70
				Jamaica	50.40	Dch. Guiana	23.70
				Fr. Guiana	27.30	Fr. Guiana	17.90
Pro memoria: United States and Spain							
United States	3,571.60	United States	4,913.20	United States	7,869.80	United States	8,889.90
Spain	123.00	Spain	194.20	Spain	274.30	Spain	255.10

Notes: TOE: Tonnes of oil equivalent. *TOE/cap are actually TOE per 1,000 habitants. **Cuba and Puerto Rico were Spanish colonies up to 1898. The former obtained independence in 1902, the latter remained under US influence till today. Modern energy includes fossil plus hydroelectric consumption.

Sources: Hydroelectric consumption from Tafunell, 'La producción hidroeléctrica'. For fossil fuels sources are those of col.13 in Table 5 with the following additions. Chile (coal production): for 1890-1902: *Boletín de la Sociedad Nacional de Minería* (various years).; for 1903-1907: Oficina Central de Estadística, *Estadística minera de Chile*; Population data as in Table 5 except for: 1890-1900 for Dominican Republic, Ecuador, El Salvador, Haiti, Nicaragua and Panama, where no census data were available thus the cumulative yearly growth rate of the population data for this countries by Maddison, *Historical Statistics* were used to *backcast* Michell's data. United States: Schurr and Netscher, *Energy in the American economy*; Spain: Rubio, 'Economía, energía y CO₂'

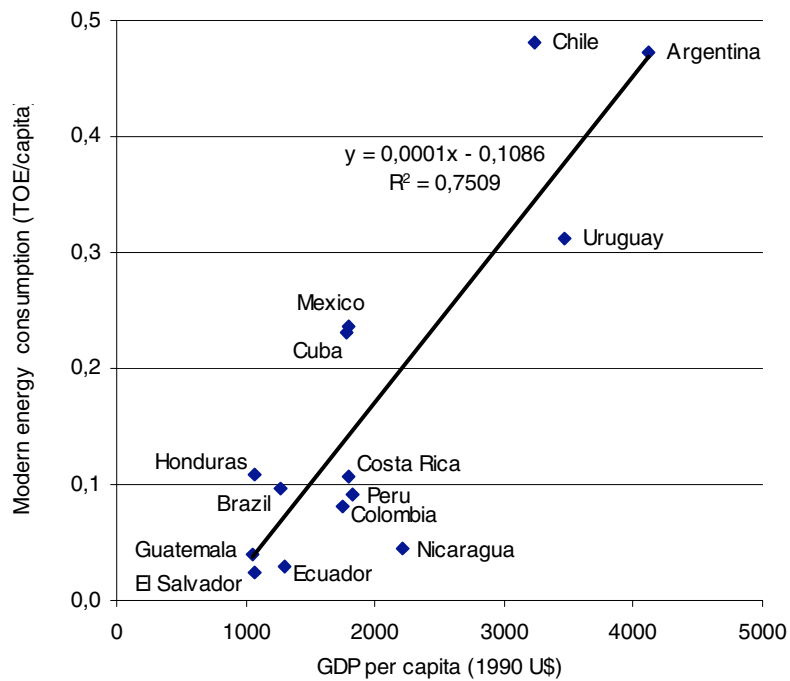
Table 7. Rates of growth of per capita modern energy consumption (%)

	1890-1900	1900-1913	1913-1918	1918-1925	1890-1913	1913-1925	1890-1925
Latin American Republics							
Argentina	0.50	8.00	-29.00	26.40	4.70	-0.60	2.80
Brazil	0.40	6.30	-15.60	12.60	3.70	-0.20	2.40
Chile	1.00	7.80	-5.30	3.30	4.80	-0.40	3.00
Colombia	-4.40	-3.70	-5.10	39.10	-4.00	18.60	3.20
Costa Rica	7.10	9.80	-23.80	25.2	8.60	1.80	6.20
Cuba	3.30	7.20	-0.10	3.10	5.50	1.80	4.20
Dominican Republic	3.60	5.60	13.60	3.70	4.80	7.80	5.80
Ecuador	5.90	21.00	-3.60	8.10	14.20	3.10	10.30
El Salvador	0.80	11.80	12.90	17.50	6.90	15.60	9.80
Guatemala	15.20	24.10	-33.00	42.20	20.10	4.00	14.30
Haiti	-0.30	4.60	-17.20	0.00	2.40	-7.60	-1.10
Honduras	13.90	11.30	24.70	20.90	12.40	22.50	15.80
Mexico	21.40	3.60	11.50	4.00	11.00	7.10	9.60
Nicaragua	-4.70	3.30	18.60	-5.10	-0.30	4.10	1.20
Panama			-3.20	10.40		4.50	
Peru	4.70	9.70	1.30	-1.20	7.50	-0.20	4.80
Puerto Rico	0.40	3.40			2.10	6.50	3.60
Uruguay	2.40	1.90	-14.50	7.30	2.10	-2.40	0.50
Venezuela	-7.10	4.00	12.00	10.60	-1.00	9.20	2.40
Colonies and territories							
Barbados			-1.50	-8.00		-5.30	
Bermuda	11.80	-4.70	9.00	-8.10	2.10	-1.30	0.90
British Guiana	-11.00	0.90	-2.50	-0.40	-4.40	-1.20	-3.30
British Honduras	11.30	10.60	-26.10	17.20	10.90	-3.30	5.80
French Guiana			-15.00	5.80		-3.40	
Jamaica			-14.50	9.90		-1.00	
Trinidad and Tobago			3.20	6.30		5.00	
LATIN AMERICA	3.60	6.40	-6.20	8.10	5.10	1.80	4.00
<i>Pro memoria: United States and Spain</i>							
United States	3.20	3.70			3.50	1.00	2.60
Spain	4.70	2.70			3.50	-0.60	2.10

Sources: as in Table 6

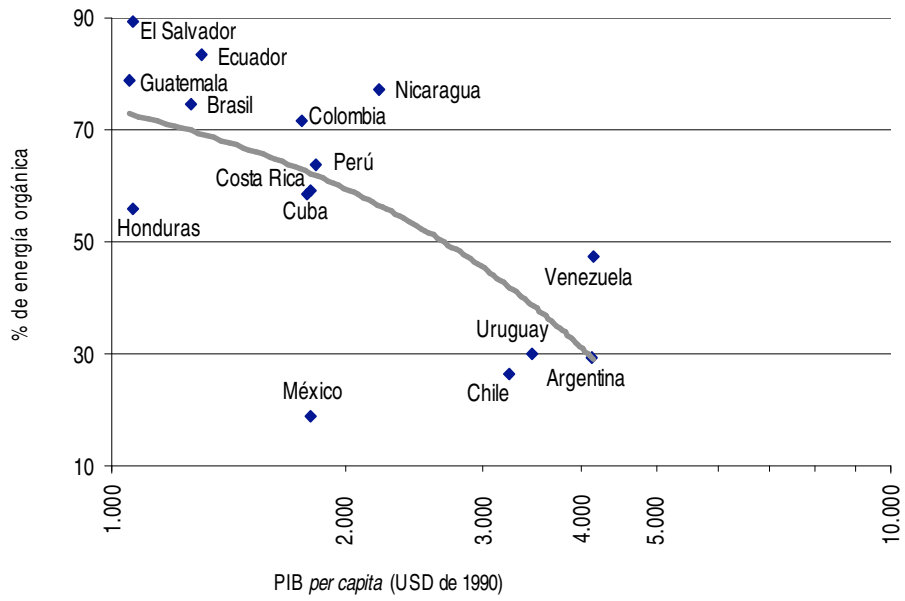
FIGURES

Figure 1. Modern energy per capita (coal, oil & hydroelectricity) vs GDP per capita in Latin American countries, 1937



Sources: Modern energy data from ECLA, *Energy in Latin America*. GDP from Maddison, *Monitoring* (2003).
 Note: Brazil data is for 1939.

Figure 2. Ratio of organic energy consumption on total energy consumption and GDP per capita for Latin American countries, 1937

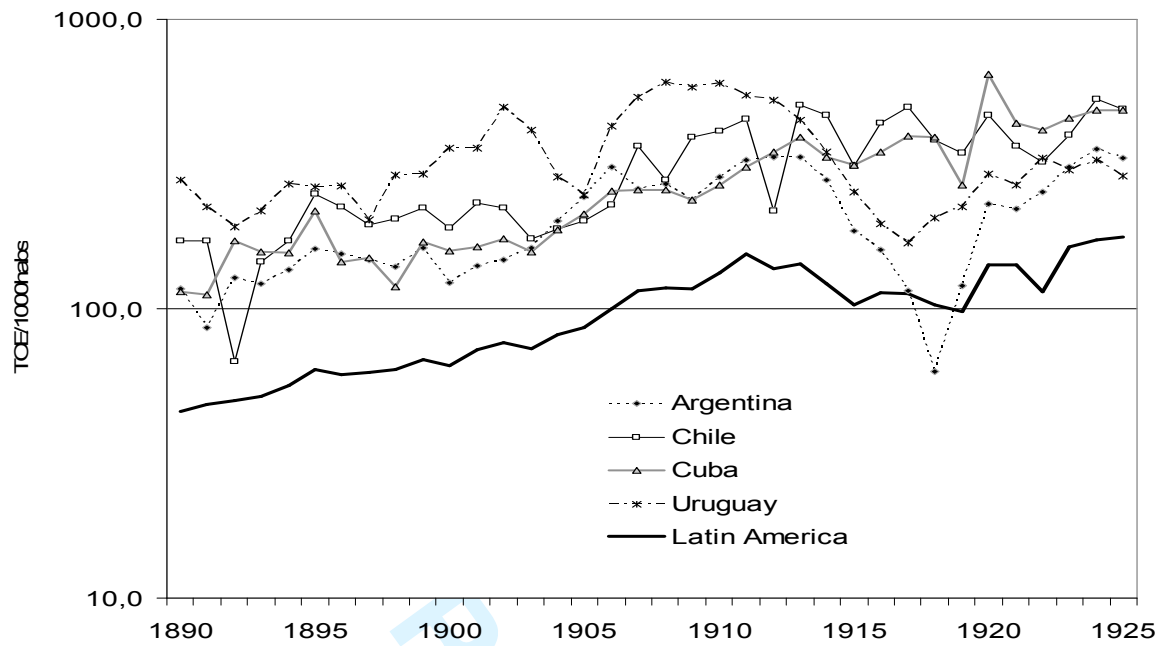


Source: Folchi and Rubio, 'la especificidad de la transición energética'

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Figure 3. Energy consumption of the large consumers

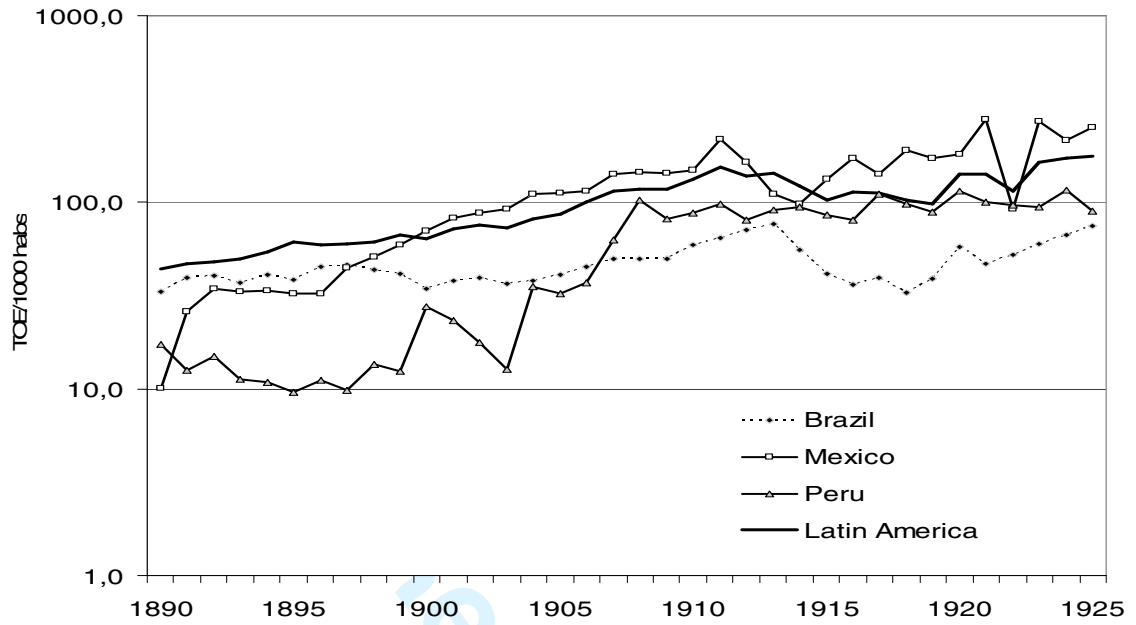
Argentina, Chile, Cuba & Uruguay, 1890-1925



Sources: same as Table 6

Figure 4. Energy consumption of the medium consumers

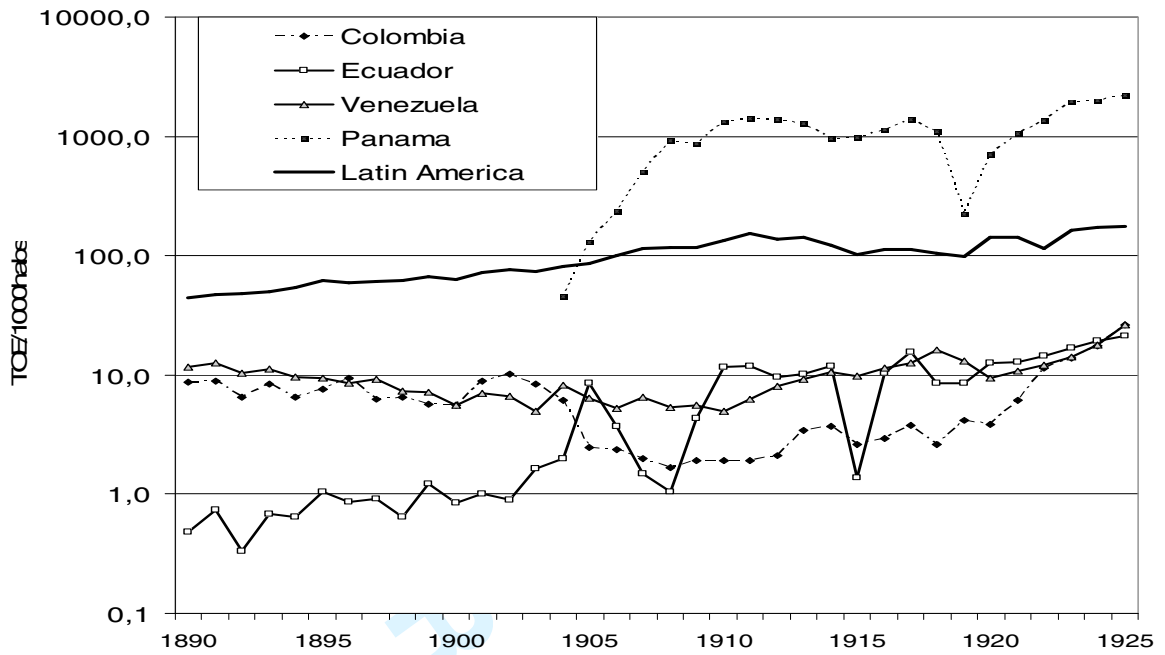
Brazil, Mexico & Peru , 1890-1925



Sources: same as Table 6

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Figure 5. Energy consumption of the 'Gran Colombia'.
Colombia, Panama, Ecuador y Venezuela, 1890-1925



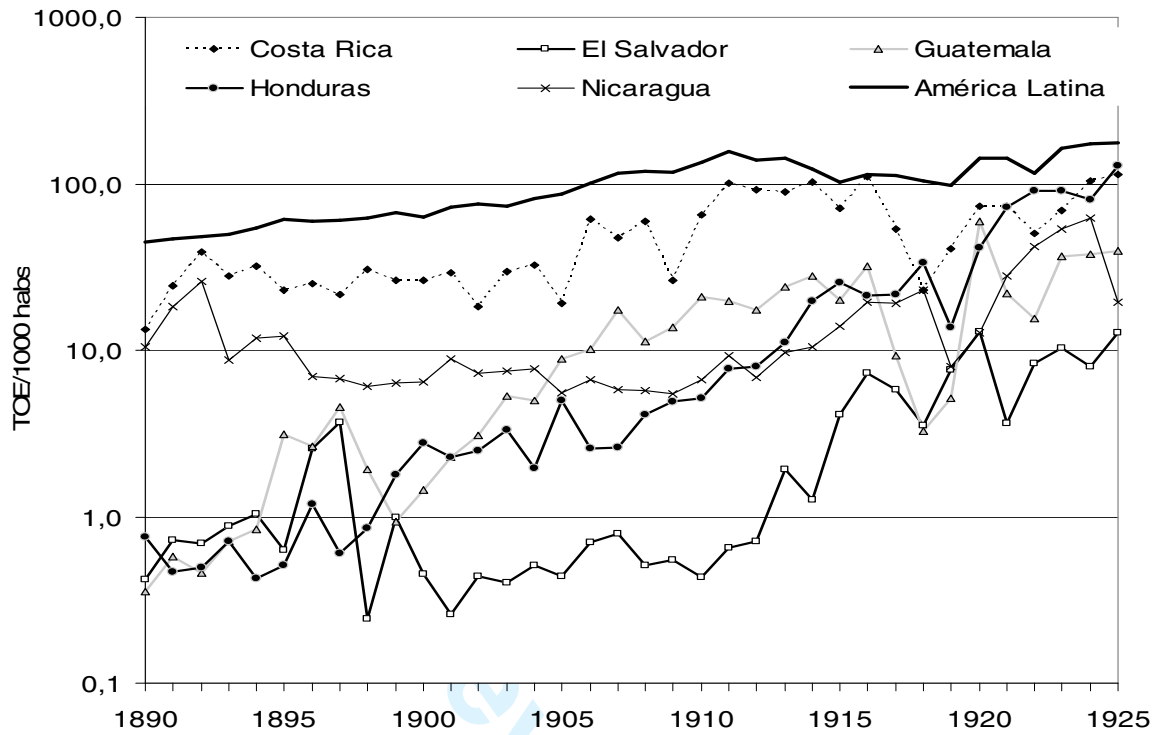
Sources: same as Table 6

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Figure 6. Energy consumption of Central America

Costa Rica, El Salvador, Guatemala, Honduras & Nicaragua,
1890-1925

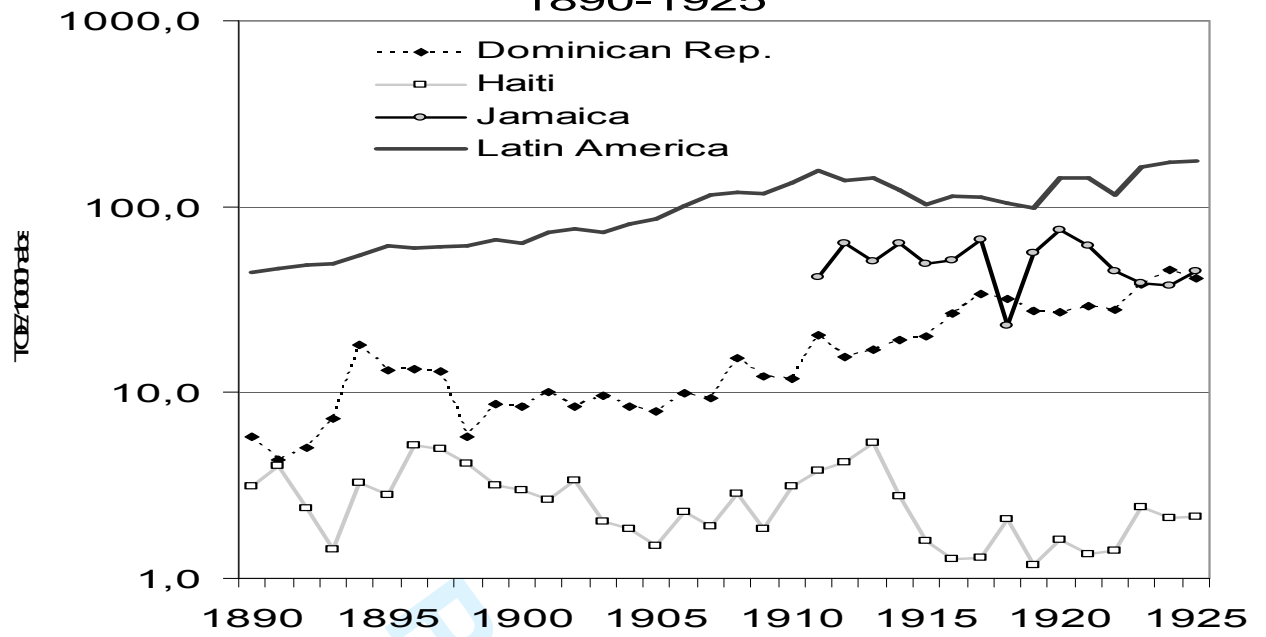


Sources: same as Table 6

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Figure 7. Energy consumption in two islands of the Caribbean

**Dominican Republic, Haiti & Jamaica,
1890-1925**

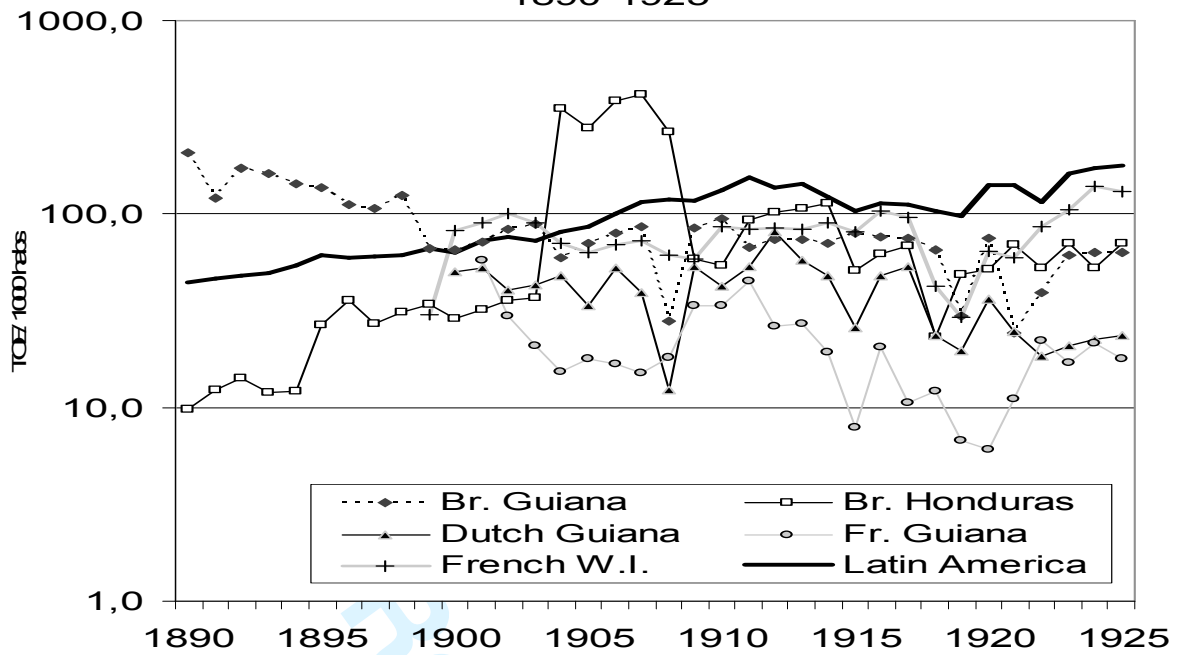


Sources: same as Table 6

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Figure 8. Medium energy consumers among the colonies and territories
 British Guiana, British Honduras, Dutch Guiana,
 French Guiana & French W.I.,
 1890-1925



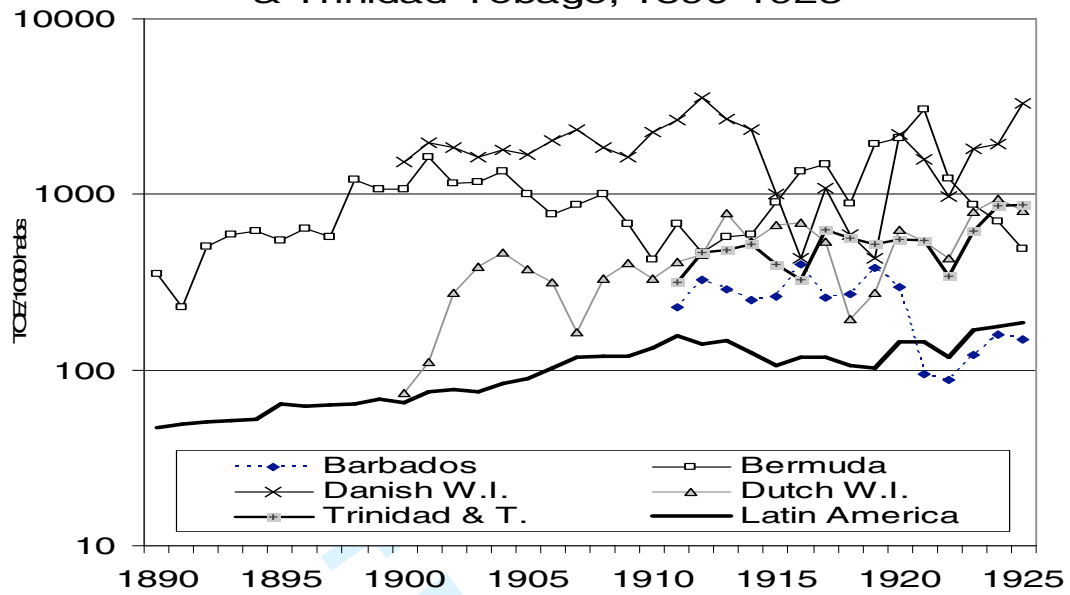
Sources: same as Table 6

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Figure 9. Energy consumption in the colonial islands of the Caribbean

Barbados, Bermuda, Danish W.I., Dutch W.I.
& Trinidad-Tobago, 1890-1925

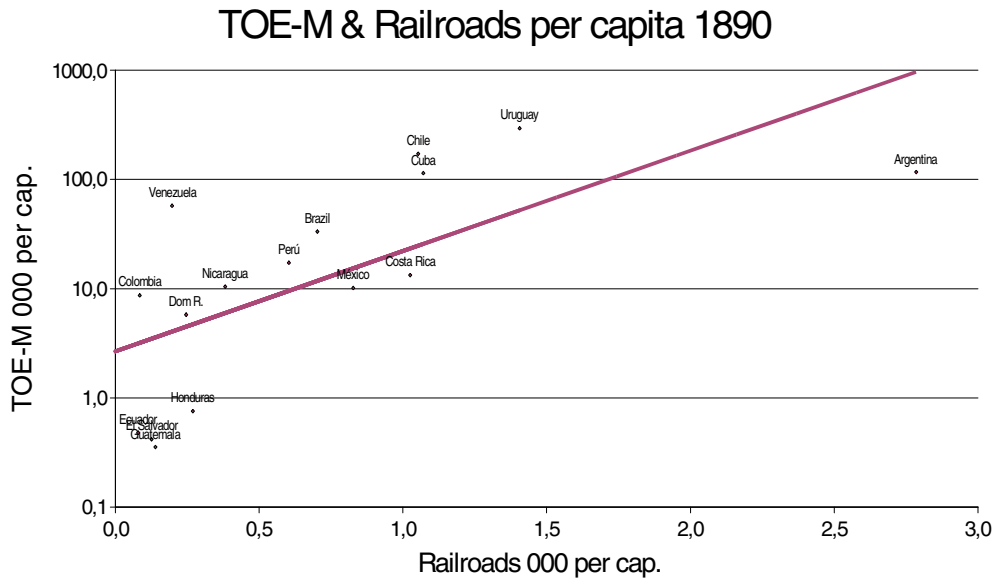


Sources: same as Table 6

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Figure 10: Energy consumption (toe) and railroads (km) per capita in 1890



Notes and sources: Actually per 1,000 habitants in both cases. Railways from Mitchell (2003), energy as in Table 6

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