

On the Origins of ISI: The Latin American Cement Industry, 1900–30*

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Abstract. This article explores the achievements of industrialisation in Latin America in the period before 1930, the date traditionally considered to be the start of the ISI process. It analyses the development of a basic industrial sector, the cement industry, which was driven by a natural substitution of imports. It quantifies the expansion of demand in each of the countries in the region, and then moves on to consider the growth of the industry in Latin America in the period between 1900 and 1930. Although cement consumption grew briskly, particularly in the most underdeveloped economies, disparities in levels of consumption and production among countries in the region continued to be very great in 1930, while the gap between Latin America and the most industrialised economies grew slightly.

Keywords: Cement industry, import substitution industrialisation (ISI), Latin America, economic history

Introduction

The contemporary economic history of Latin America was, for many years, dominated by the assumption that a period dominated by exports, from the middle of the nineteenth century to 1929, was succeeded by another of inward-looking industrialisation or import substitution industrialisation (ISI), which started with the international economic crisis of the early 1930s and lasted until 1980. According to this traditional theory, arising from the structuralist focus of the Economic Commission for Latin America (ECLA) in the 1950s and 1960s, but also championed by economists and historians favouring dependency theory, the process of industrialisation in Latin

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America did not start until the 1930s, when countries in the region stopped being dependent on exports and international markets.

For some time now research in economic history at the highest academic level has questioned and indeed refuted this interpretative model, although it still enjoys great prestige in many areas of the social sciences, including history textbooks.¹ In the 1970s a number of Latin American economic historians began to challenge this dependency paradigm by bringing to light the achievements of an early period of industrialisation which unfolded during the era of globalisation between 1870 and 1929. The rigorous research conducted by historians on the largest economies of the region (those of Argentina, Brazil, Mexico and Chile) allowed Colin Lewis, in a survey of the theme dated 1986, to argue on the basis of sound empirical data that the beginnings of this industrialisation were not to be found in 1930 or even 1914, but in the 1880s, if not before.² At that time analysts of development sympathetic to Marxist and dependency viewpoints also began to recognise that the industrial development of these large economies started before 1930.³ The most recent syntheses of economic history and industrialisation in Latin America reaffirm this idea, connecting the industrial growth of the period before 1930 to both the forward and the backward linkages generated by the export sector itself.⁴ First, the growth of exports required, and indeed encouraged, the improvement and modernisation of transport and communications infrastructure,

¹ Stephen H. Haber, 'Introduction: Economic Growth and Latin American Historiography', in Stephen H. Haber (ed.), *How Latin American fell behind* (Stanford, 1989), pp. 1–33.

² Cited from the Spanish translation of the updated version, Colin M. Lewis, 'La industria en América Latina antes de 1930', in Tulio Halperín Donghi et al., *Historia económica de América Latina desde la independencia a nuestros días* (Barcelona, 1997), p. 202. For historical work on domestic industrialisation processes, see the review of the bibliography by Stephen H. Haber, 'The Political Economy of Industrialization', in Victor Bulmer-Thomas, John H. Coatsworth and Roberto Cortés Conde (eds.), *Cambridge Economic History of Latin America. Vol. II: The Long Twentieth Century* (Cambridge, 2006), pp. 717–22.

³ Christian Anglade and Carlos Fortín, *The State and Capital Accumulation in Latin America* (Basingstoke, 1985). Until the 1980s the argument that the origins of industrialisation were to be found well before 1930 generated more debate than new empirical evidence. However, historical work in the last two decades has placed more emphasis on the latter: see, for example, the work on the Argentine case by Juan C. Korol and Hilda Sabato, 'Incomplete Industrialization: An Argentine Obsession', *Latin American Research Review*, vol. 25, no. 1 (1990), pp. 7–30, and Fernando Rocchi, *Chimneys in the Desert: Industrialization in Argentina During the Export Boom Years, 1870–1930* (Stanford, 2006).

⁴ Enrique Cárdenas, José Antonio Ocampo and Rosemary Thorp (eds.), *An Economic History of Twentieth Century Latin America* (Basingstoke, 2000), vol. I, p. 23; Enrique Cárdenas, José Antonio Ocampo and Rosemary Thorp (eds.), *An Economic History of Twentieth Century Latin America* (Basingstoke, 2000), vol. III, p. 2; José Antonio Ocampo, 'América Latina y la economía mundial en el siglo XX largo', *El Trimestre Económico*, vol. 71, no. 284 (2004), pp. 725–88; Haber, *The Political Economy*, pp. 537–40. For a more detailed assessment, see Victor Bulmer-Thomas, *The Economic History of Latin America Since Independence* (Cambridge, 2003), pp. 127–36.

which in turn produced spectacular effects on market integration.⁵ Second, the increased export activity resulted in higher income for a relatively broad section of society, thus raising consumer demand. This then stimulated the appearance and development of manufacturing industries located in the Latin American countries themselves, which then managed to become established, at least in some places, thanks to the tariff protection provided by the state. Moreover, the export of certain primary materials such as minerals and food, including sugar and meat, prompted the creation of industries of transformation, given that there were advantages to processing these types of goods in their place of origin.

Is the historiography ready to offer an assessment of the scope of this early (pre-1930) industrialisation in Latin America as a whole? Without wishing to discredit in any way the work done on the subject in recent decades by numerous researchers, the answer to this question is still no. Evidence of this is the fact that the latest state of the art essay limits itself to the four largest economies.⁶ Therefore, the call made a few years ago by two renowned specialists for new quantitative data to help anchor the economic history of Latin America on more solid foundations remains perfectly valid.⁷

This article aims to answer that call, particularly the request for new empirical evidence addressing the need for comparability and the wish to place the cases of individual countries in an international context. In a modest way this article will shed new light on the progress of industrialisation in the period preceding that which is traditionally considered the ISI era. In order to do this it analyses the performance of one particular sector, the cement industry. It presents figures for the net importation, production and consumption of cement between 1900 and 1930. The principal contribution offered is the quantification of these variables for the whole of Latin America; all twenty of the countries which were sovereign states at the time are included in this study. This empirical knowledge provides us with an overview of the different levels of development in a basic industry, the cement industry, which were found in Latin America during the first three decades of the twentieth century. In this period cement was crucial for the construction of infrastructure and other civil engineering projects (roads, bridges, dams, port installations, reservoirs, etc.). At the same time cement, or concrete, was

⁵ William R. Summerhill, 'The Development of Infrastructure', in Victor Bulmer-Thomas, John H. Coatsworth and Roberto Cortés Conde (eds.), *Cambridge Economic History of Latin America* (Cambridge, 2006), Vol. II, pp. 293–326.

⁶ Haber, *The Political Economy*, *passim*.

⁷ John H. Coatsworth and Alan M. Taylor, 'Introduction', in J. H. Coatsworth and A. M. Taylor (eds.), *Latin America and the World Economy Since 1800* (Cambridge, 1998), pp. 1–17.

beginning to be used in the construction of buildings, particularly taller ones, which relates its consumption to urban development.⁸

The article is structured as follows. A brief initial section clarifies the belated development of the modern cement industry in the most developed countries at the end of the nineteenth century. The second section deals with the precise quantification of the commercial flow of cement between Latin America and the rest of the world, and then goes on to ascertain the degree to which domestic demand in each of the Latin American economies was satisfied by imports. The third section is a systematic presentation of empirical evidence, both qualitative and quantitative, for the early stages and subsequent changes in production in the Latin American cement industry. The fourth part moves on to the apparent consumption of cement, paying special attention to the huge inequalities among the countries of the area, as well as between the region as a whole and the most developed economies.

The birth of a new industry, Portland cement

Portland cement, which for a long time was also known as ‘artificial cement’, as opposed to the so-called Roman or natural cement, was a late fruit of industrialisation. There was a pressing need for the improvement and extension of the transport and communications infrastructure. To satisfy this need a cement was required which was longer lasting and more resistant than those traditionally used. It was no accident that it was in Great Britain, between 1757 and 1796, where, after much experimentation, the procedure of burning clayey limestone to produce a high-quality natural cement was invented. The result was christened by James Parker, its creator and patent owner, as Roman cement. This was the start of the modern cement industry.⁹

⁸ Concrete is a wet mixture of Portland cement, sand and aggregate. Strengthened with steel rods, ‘reinforced concrete’ is a substitute for steel. In Mexico around 1910 it began to be used in public works, but it was still rarely found in buildings in 1920: see Federico Sánchez Fogarty, *Medio siglo de cemento en México* (Mexico City, 1957), p. 13. However, by this time it was considered the best material for the structures of buildings in Argentina and Uruguay: see W. W. Ewing, *Construction Materials and Machinery in Argentina and Bolivia* (Washington, 1920), pp. 64 and 76–7; W. W. Ewing, *Construction Materials and Machinery in Uruguay* (Washington, 1920), pp. 16–7. In the two Southern Cone countries it was used in all public works. Brazil was a little slower to introduce the material, due to its great economic disparities. Cement and concrete were, however, already widely used in construction activities carried out in big cities; see W. W. Ewing, *Construction Materials and Machinery in Brazil* (Washington, 1920), p. 25. On the other hand brick, adobe, stone and wood were still the main construction materials used in Bolivia around 1920, cement being hardly used: see W. W. Ewing, *Construction Materials and Machinery in Argentina and Bolivia*, pp. 161 and 173. We can assume that this was also true for the region’s poorest economies.

⁹ A. J. Francis, *The Cement Industry 1796–1914: a history* (Newton Abbot, 1977), p. 26.

But progress was not fast, and for a century the industry never became more than nascent.¹⁰ Roman, or natural, cement was obtained from a specific natural mix of limestone and clay, which meant that production was restricted due to the relative scarcity of the raw material and its lack of homogeneity. Numerous British technicians and entrepreneurs strove to produce artificial cement from a chemical compound by burning and crushing limestone, sandstone and clay mixed in an exact proportion. In 1824 Aspdin crowned this search with success, taking out a patent for the manufacture of what he termed ‘Portland cement’. During the following decades it was used only on a limited scale. It had to battle with the preference for the supposedly more attractive Parker cement, as well as demonstrate its superiority in terms of resistance and quality. It also faced the challenge of reducing high costs of production. This reduction in costs did not truly arrive until the last decade of the nineteenth century, which was a turning point in the development of the industry.¹¹ The fundamental technological innovation which made it possible was the rotary kiln. Fuelled by pulverised coal or oil, this was perfected by the North American company, Atlas Portland Cement, in 1898.¹² The cement industry finally took off.

The emergence of the industry can be exemplified by the case of the United States. In 1895 the manufacture of Portland cement represented barely 10 per cent of the cement produced in the country. There was a sudden rise in the last five years of the century. In 1900 Portland production had increased to a level ten times that of 1895, and was equivalent to the production of natural cements. In the following decade its rise continued; production more than doubled over each five-year period, and Portland cement eventually replaced natural cement completely.

The factor which stimulated the sector was the possibility of the unlimited increase in production of a better quality product at a falling cost.¹³ In 1913 the total production of cement in Europe weighed in at a figure just short of 20 million tonnes, while in the United States it topped 15.5 million tonnes.

¹⁰ I use the expression from E. J. Hadley, *The Magic Powder: history of the Universal Atlas Cement Company and the cement industry* (New York, 1945), p. 62.

¹¹ Francis, *The Cement Industry*, pp. 115–40 and 231–56. ¹² Hadley, *Magic Powder*, p. 33.

¹³ Once again the situation in the United States can be used as an example. According to calculations based on monthly price indices, after 1900 the price of Portland cement dropped appreciably, to such an extent that in 1912 it was two-thirds of the price that it had been in 1895 (for price series, see <www.nber.org/databases/macroeconomy/contents>). This change was in marked contrast to that of construction materials in general, which rose in price by 44 per cent between 1895 and 1912. This implies that the price of Portland cement relative to other construction materials was halved. In the following period this tendency became more striking. Between 1918 and 1929 the price of construction materials fluctuated around two and a half times the level of 1895, while the price of Portland cement was the same.

The two regions accounted for 91 per cent of world production, estimated at 39 million tonnes.¹⁴

By 1929 the situation of the industry at international level had changed, although not spectacularly. Europe and the United States had managed almost to double pre-war production levels, recording 35 million tonnes and 29 million tonnes, respectively. Despite this, the importance of the two regions in total world production, which had now risen to 74 million tonnes, had declined to approximately 86 per cent.¹⁵ New producers had emerged in Asia, Oceania, even in Africa, and also in Latin America.

The role of imports in Latin American demand

At the beginning of the twentieth century Latin American markets absorbed a significant part of the cement exports from European countries which possessed more dynamic and competitive industries.¹⁶ These commercial exchanges were of more importance for the Latin American nations, and for some time Europe became their almost exclusive source of supply. The European industrial powers could offer cement at advantageous prices, not only because they had managed to reduce production costs, but also because the costs of transatlantic transport were offset by the fact that ships returned to Europe loaded with equally bulky products exported by Latin America (minerals, cereals, timber and other tropical primary products).¹⁷

The relative significance of the Latin American republics as importers varied. Table 1 reflects this very clearly. At the dawn of the century Argentina and Brazil absorbed well over half the cement imported into the region. Together with the third biggest importer, Mexico, they accounted for 70 per cent, and with the fourth and fifth, Chile and Cuba, totalled more than 90 per cent of all imports. The relative significance of the first two increased further in the years preceding the Great War, reaching a maximum of two-thirds of all imports into the region. Over the period as a whole only Mexico lost significant strength as an importer. This was not a transitory phase. By the

¹⁴ For production figures by country, see Ingvar Svennilson, *Growth and Stagnation in the European Economy* (Geneva, 1954), pp. 282–3. The world total is taken from an estimate made by Federico Federico in an article published in the Italian magazine *Il Cemento*, reprinted in the magazine *El Cemento* (Barcelona), vol. III, no. 22 (1931), pp. 92–5.

¹⁵ See Svennilson, *Growth and Stagnation*, pp. 282–3, for the European and North American production figures. The sources for the data for the other countries and at world level are Société des Nations, *Annuaire Statistique de la Société des Nations 1932/33* (Geneva, 1933), p. 131, and United Nations, *Statistical Yearbook 1948* (New York, 1949), p. 229.

¹⁶ According to my calculations, around 1913 about half of the cement exported by Europe outside the continent went to Latin America.

¹⁷ See Bureau of Mines, *The Cement Industry of Latin America* (Washington, 1940), p. 3. Figures for foreign trade reveal that in most Latin American countries the actual weight of cement imports far exceeded that of other products, except for iron and steel goods and coal.

Table 1. *The Significance of Cement Imports for Each Country within Total Imports for Latin America (per cent)*

	1900/02	1911/13	1928/30
Argentina	30.8	35.1	28.0
Bolivia	0.0	0.4	0.6
Brazil	26.9	28.9	27.7
Colombia	0.2	0.8	7.1
Costa Rica	0.5	0.5	1.3
Cuba	9.6	9.5	1.4
Chile	11.0	9.6	12.0
Ecuador	0.4	0.3	1.0
El Salvador	0.2	0.2	0.9
Guatemala	0.3	0.2	0.5
Haiti	0.3	0.5	0.6
Honduras	0.1	0.1	0.3
Mexico	13.2	4.0	1.7
Nicaragua	0.1	0.1	0.3
Panama	—	0.9	1.6
Paraguay	0.3	0.1	0.3
Peru	1.4	2.0	2.9
Dominican Rep.	0.2	0.8	1.7
Uruguay	3.8	4.8	2.1
Venezuela	0.8	1.1	8.0

Sources: Argentina: Dirección General de Estadística de la Nación, *Anuario del comercio exterior de la República Argentina* (Buenos Aires, 1904–31); Bolivia: Dirección General de Aduanas, *Comercio especial de Bolivia: exportación-importación* (La Paz, 1912–31) and Oficina Nacional de Estadística Financiera, *Anuario: comercio exterior de Bolivia* (La Paz, 1929–32); Brazil: Directoria de Estatística Comercial (from 1929, Departamento Nacional de Estatística), *Comercio exterior do Brazil* (Rio de Janeiro, 1912–31); Chile: Oficina Central de Estadística, *Estatística comercial de la República de Chile* (Valparaiso, 1901–16), and *Anuario estadístico de la República de Chile: comercio exterior* (Valparaiso/Santiago, 1917–31); Colombia: Dirección General de Estadística, *Comercio exterior de la República de Colombia* (Bogotá, 1915–9), and Departamento de Contraloría, *Anuario estadístico: comercio exterior* (Bogotá, 1920–31); Costa Rica: Dirección General de Estadística, *Anuario estadístico* (San José, 1911–31); Cuba: Secretaría de Hacienda, *Comercio exterior* (Havana, 903–31); Ecuador: Dirección General de Estadística, *Comercio exterior de la República del Ecuador en la década 1916–1925* (Quito, 1927), and *Comercio exterior de la República del Ecuador en los años 1925 y 1926* (Quito, 1928); El Salvador: Dirección General de Estadística, *Anuario estadístico de la República de El Salvador* (San Salvador, 1914–21), *Estatística comercial* (San Salvador, 1922–31); Guatemala: Ministerio de Hacienda y Crédito Público, *Memoria de las labores del Ejecutivo en el ramo de Hacienda y Crédito Público* (Guatemala, 1926, 1929–31); Haiti: Administration of the Customs, *Report of the Receivership of Customs* (Washington, 1919–24), Financial Adviser-General Receiver, *Annual Report of the Financial Adviser-General Receiver for the Fiscal Year* (Washington, 1925–28), and Fiscal Representative, *Annual Report of the Fiscal Representative for the Fiscal Year* (Washington, 1929–32); Mexico: Secretaría de Hacienda y Crédito Público, *Comercio exterior y navegación* (Mexico, 1902), *Anuario de estadística fiscal* (Mexico, 1913–14), *Anuario del comercio exterior y navegación* (Mexico, 1920–28), and Departamento de Estadística Nacional, *Anuario Estadístico: Comercio exterior y navegación* (Mexico, 1920–22); 1926–32; Nicaragua: Administración de Aduanas, *Memoria del Recaudador General de Aduanas y las Estadísticas del Comercio* (Managua, 1921–31); Paraguay: Dirección General de Estadística, *El comercio exterior del Paraguay* (Asunción, 1928); Peru: Superintendencia General de Aduanas, *Estatística especial del Peru* (Callao, 1902, 1912–6; 1921; 1926–31); República Dominicana: Receptoría General de Aduanas, *Report of the ... fiscal period. Together with summary of commerce* (Washington, 1919–31); Uruguay: Dirección General de Estadística, *Anuario estadístico de la República Oriental del Uruguay* (Montevideo, 1901–12; 1916–31); Venezuela: Ministerio de Hacienda y Crédito Público, *Estatística mercantil y marítima* (Caracas, 1907–31).

Table 2. *Net Cement Imports, in tonnes (annual averages)*

	1900/04	1905/09	1910/13	1914/19	1920/24	1925/29
Argentina	69,405	219,256	417,020	169,206	194,953	418,331
Bolivia	163	283	4,325	2,729	6,707	9,456
Brazil	65,358	177,774	341,302	140,700	237,994	433,249
Colombia	681	2,277	9,418	10,957	26,854	97,675
Costa Rica	1,016	2,480	5,811	2,861	4,088	15,541
Cuba	20,090	61,077	108,747	120,296	104,613	51,139
Chile	24,656	73,086	108,704	46,417	48,861	123,658
Ecuador	744	2,031	3,195	3,985	10,323	13,697
El Salvador	330	685	2,219	3,775	4,816	17,828
Guatemala	485	764	2,523	2,509	2,951	6,798
Haiti	655	1,527	5,880	4,929	4,261	10,628
Honduras	191	626	1,538	2,431	4,812	3,857
Mexico	37,612	87,781	60,020	19,671	27,568	27,509
Nicaragua	168	234	1,165	1,559	1,612	3,479
Panama	0	2,594	11,093	9,065	6,880	18,680
Paraguay	616	1,078	1,359	1,599	2,105	3,513
Peru	4,398	13,344	22,961	21,520	35,870	58,319
Dominican Rep.	292	1,879	8,793	12,233	16,570	26,748
Uruguay	9,253	24,608	54,807	4,759	8,876	29,509
Venezuela	2,400	5,718	11,947	8,052	17,701	101,253
Latin America	238,516	679,101	1,182,825	588,250	768,415	1,470,867

Source: Working document, to be published by the ECLA Division of Statistics and Economic Projections.

end of the 1920s Mexico had stopped being a large importer. The same thing happened to Cuba a little later. Argentina experienced the same phenomenon, but much less intensely. On the other hand Brazil and Chile appeared to be immune to it. This was even more the case with Colombia and Venezuela, whose purchases from abroad went from representing a negligible portion of the region's total to 7 per cent and 8 per cent respectively. Obviously these changes, as well as others of lesser significance which appear in Table 1, are due to differences in the rate of increase in cement imports over the period. Table 2 clarifies this point but in turn poses another important question.

The most noticeable feature of Table 2 is not the disparity between the absolute magnitudes of imports to the different countries, but their very different developments. If we compare the figures for the final five-year period (1925–29), with those for the first (1900–04) we will notice that, as well as the general upward tendency, there was a diversity of trajectories. Imports for countries that started with very low levels increased substantially more than the level for the region as a whole: see the cases of Colombia, the Dominican Republic, Bolivia, El Salvador, Venezuela, Nicaragua, Honduras, Ecuador, Haiti, Costa Rica, Guatemala and Peru (in order of greater to lesser growth). This might appear to reflect a positive and optimistic pattern of

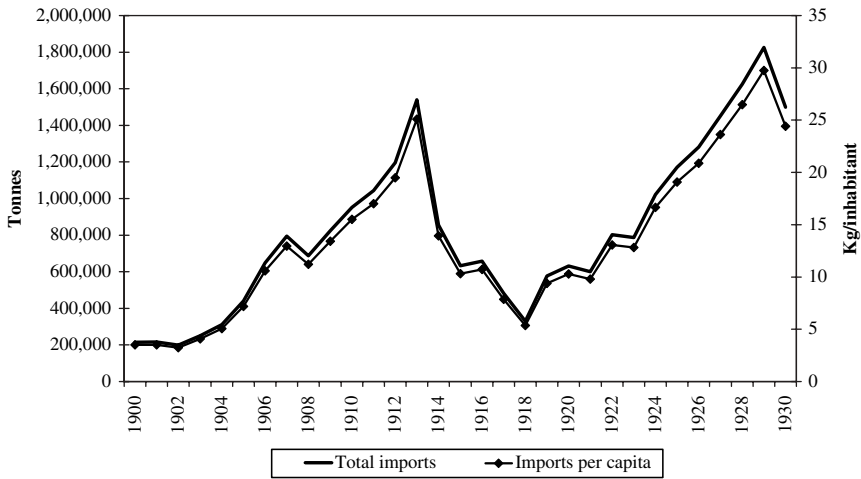


Fig. 1. *Latin American Cement Imports, 1900–30.* Sources: See table 2 and, for population data, Maddison, *The World Economy*, table 4a.

growth in which the most underdeveloped economies tended to converge with the most advanced. However, at first sight it is surprising to note that imports to the most advanced economies stopped growing, and even began to decrease. The most extreme case is that of Mexico, whose overseas purchases dropped with the revolution and civil war, and did not recover during the 1920s. Although no other country showed import volumes for 1925–29 below those seen at the start of the century, it is clear that in the more developed Latin American economies the strong growth exhibited during the first decade of the century stopped with the outbreak of the First World War, and did not resume after it ended. Argentina and Uruguay illustrate this pattern perfectly. In the second half of the 1920s the former only just managed to match the import volumes of the years before the conflict, while the latter fell well short. The same thing happened with Cuba, although the island maintained a rising trend until the end of the war. Brazil and Chile followed a different path. In 1925–29 their imports clearly surpassed the levels of 1910–13. However, in relative terms their growth was well below that recorded by the dozen nations mentioned earlier, which made up the group of small importers.

Figure 1 affords us an overview which sheds light on the true scope of the phenomenon observed in the economies which historians have considered to be the most developed in the region. It is plain to see that in the decade preceding the Great War consumption of cement grew, via imports, at an unstoppable rate. Over one decade (1903–13) it multiplied by the not inconsiderable factor of 6. The outbreak of the war caused total imports

to halve. During the war the decline continued until 1918, when import volumes fell to levels only seen fifteen years previously. More worthy of our attention is not this phenomenon, common to many activities related to international trade, but the slow rate of recovery after the war. Ten years were to pass before total imports and imports *per capita* equalled and overtook those of 1913. In the face of this data we should ask ourselves: is it credible that Latin America did not manage to recuperate pre-war levels of cement consumption until 1928, just before the Great Depression (when the levels immediately fell again, as can be seen in Figure 1)? The answer is negative. There was a growing divergence between the figures for consumption and those for imports, which was filled by local production.

The emergence of the cement industry and the progress of import substitution

The origins of the Latin American cement industry go back to 1872, when a small factory was established in Rosario (Argentina) to produce Roman cement for the local market.¹⁸ This initiative enjoyed only a brief existence, like others which emerged a little later in the same country, since production costs were double the price of imported cement. The birth of the modern Latin American cement industry did not occur until 1895, based on Portland cement. It was the work of two Spanish businessmen in Havana (Cuba). Its beginnings were not promising. The factory was modestly equipped, reaching a capacity of only 20 tonnes a day. It closed down in 1910.¹⁹ However, by this time several new plants with superior capacities had started operating in other countries, as can be seen in Table 3.

Brazil was the second country to produce Portland cement, in 1897 in Rodovalho (São Paulo state). But, as in Argentina a few years previously, this and other initiatives in the country, backed by Italian, French, and German investors, met with little success.²⁰ They operated in irregular fashion and either soon closed down or suspended production for long periods.²¹

¹⁸ The following paragraphs draw their information from Bureau of Mines, *The Cement Industry*, and Juan de las Cuevas Toraya, *Un siglo de cemento en Latinoamérica* (Mexico, 1999). These publications contain detailed and systematic information on the companies established in the region.

¹⁹ For more information, see Juan de las Cuevas Toraya, *100 años del cemento cubano* (Havana, 1995).

²⁰ See Wilson Suzigan, *Indústria brasileira: origen e desenvolvimento* (São Paulo, 2000), pp. 264–71, as well as the publications cited in the following note.

²¹ See W. W. Ewing, *Construction Materials and Machinery in Brazil*, p. 45. The troubled history of the first factories on Brazilian soil might lead one to the conclusion that Brazilian cement production did not really start until 1926, with the installation of a factory in Perús (São Paulo state) by the Companhia Brasileira de Cimento Portland, as argued by the main authorities on the early stages of Brazilian industrialisation: see A. Villela y W. Suzigan,

After the turn of the century, plants opened up in Cuba (1901 and 1912), Guatemala (1901), Mexico (1906 and 1909), Argentina (1908), Chile (1908), Colombia (1909 and 1913), Venezuela (1909) and finally, Uruguay (1912). Most of them were destined to have long and productive lives.²² Despite this, many of them experienced great difficulties in the initial years before the First World War, since the technology they used could not produce a high-quality, uniform product, which was sufficiently cheap to compete with cement imported from Europe. Only the Mexican industry escaped the pressure of competition, thanks to the natural advantage provided by the fact that the main centres of consumption were far from the

Política do governo e crescimento da economia brasileira (Rio de Janeiro, 1977) and Claudio Haddad, 'Crescimento do produto real brasileiro, 1900/1947', in F. R. Versiani and J. R. Mendonça de Barros (eds.), *Formação econômica do Brasil: a experiência da industrialização* (São Paulo, 1977). For more details see Carlos M. Peláez, *História da industrialização brasileira* (Rio de Janeiro, 1972), pp. 195–208. I have applied the same criteria with respect to Argentina and have not taken into account the very small amounts of cement which could have been produced before the opening of the Fábrica Nacional de Cemento Portland in 1908.

²² In fact only three were destined for a short life, the two plants opened in Cuba and the one opened in Colombia in 1913. The first plant (El Almandares, located in Havana) closed down in 1921, unable to cope with competition from a new factory installed by North Americans in Mariel in 1918. The second had an almost ephemeral existence. Built between 1912 and 1913 in the vicinity of Guantánamo, it closed down after the outbreak of the First World War. Finally, the survival of the Compañía Industrial de Cemento Antioqueño, which kept an extremely inefficient plant running in the district of Medellín between 1913 and 1919, was possible only because of the exceptional circumstances of the time.

In Guatemala, close to the capital, the small factory owned by Carlos Novella (1,500 tonnes) was established and is still running today. In Mexico it seems that two local enterprises started small-scale production at the beginning of the century. They soon folded: see Sánchez Fogarty, *Medio siglo de cemento*, p. 6. Production of Portland cement started in earnest in Mexico with the company Cementos Hidalgo, sited in the town of the same name in Nuevo León, with a capacity of 36,000 tonnes. Three years later it was joined by La Tolteca, located on the outskirts of Mexico City. The Cruz Azul company commenced operations in 1910. All three companies are still active today. In 1908, Argentina and Chile both followed by establishing factories. The Fábrica Nacional de Cemento Portland opened in Rodríguez del Busto (province of Córdoba, Argentina) with a production capacity of 12,000 tonnes, while in Chile the Fábrica de Cemento El Melón, located in La Calera, halfway between Valparaiso and Santiago, opened with an initial potential capacity of 40,000 tonnes, which made it for several years the largest producer of cement in Latin America: see Gabriel Palma, 'From an Export-Led to an Import-Substituting Economy: Chile, 1914–39', in Rosemary Thorp (ed.), *Latin America in the 1930s: The Role of the Periphery in World Crisis* (Basingstoke, 2000), pp. 44–5. The Argentine company lasted twenty years, while the Chilean is still going strong. In 1909 Colombia and Venezuela joined the cement producing countries, the former with a plant created by the Samper family close to Bogotá (with an initial capacity of 3,600 tonnes), and the latter with the La Vega plant on the outskirts of Caracas, opened by the Fábrica Nacional de Cementos, with a capacity of 7,500 tonnes. The Samper Bush brothers' plant located at the mine at La Calera soon became obsolete and was replaced by another nearby. The Venezuelan plant stayed open until 1990. Finally, Uruguay opened a factory just when war broke out in Europe. The Fábrica Uruguaya de Portland in Sayago, on the edge of Montevideo, with a capacity of 45,000 tonnes, was in operation until 1994.

Table 3. *Production Capacity of the Cement Industry in Latin America, 1895–1929 (in thousands of tonnes)*

Years	Argentina	Bolivia	Brazil	Colombia	Cuba	Chile	Ecuador	Guatemala	Mexico	Peru	Uruguay	Venezuela	Total
1895	—	0	0	0	6	0	0	0	0	0	0	0	6
1900	—	0	25	0	6	0	0	0	0	0	0	0	31
1905	—	0	—	0	66	0	0	6	0	0	0	0	72
1910	12	0	25	7	66	40	0	6	150	0	0	8	314
1914	12	0	50	9	60	40	0	6	150	0	50	16	393
1919	187	0	25	9	197	60	0	8	150	0	50	20	706
1924	272	0	—	7	206	100	20	24	300	3	50	22	1,004
1929	340	4	120	10	411	180	20	32	300	60	270	40	1,787

Source: Juan de las Cuevas, *Un siglo de cemento*, p. 191.

coast.²³ By 1914, the plants set up in the countries mentioned above had 28 kilns in operation, of which only 13 were modern horizontal kilns, with a modest average capacity (14,000 tonnes). All the kilns operated using the ‘dry’ process which, when compared with the ‘wet’ process, had the advantage of saving energy, but at the cost of producing an impure cement of variable quality. The rest of the production process, from extraction of the minerals to packaging, was characterised by the use of rudimentary methods and technology. All this was probably due to the fact that the prospects of the business did not appear, for the moment, to be very promising. Because of this, foreign capital was not especially drawn to investing in such entrepreneurial ventures.²⁴

The First World War radically changed the situation of the markets in Latin America. Due to supply shock there was a profound disruption in the industry. Variable levels of production in Europe and, even more, the acute shortage of shipping together with soaring freight charges meant that the price of imported cement shot up. As a US official report was to put it later, ‘[t]his embarrassing situation was the incentive for establishment or extension of domestic cement industries in many countries’.²⁵ The list of producers grew longer: Cuba (1918), Argentina (1919), Peru (1922), Ecuador (1923), and two more in Mexico (1923).²⁶ Once the first generation of factories had become established, two more facilities opened in Argentina in the period of expansion during the decade following the war (1928 and 1929).²⁷

²³ The six factories opened in the country before 1929 were all situated in the Mexican *altiplano* or high central plains, separated from the coast by mountainous terrain, making the transport of cement to the area economically impractical. This same factor was also decisive in the establishment of the cement industry in Bolivia, although the country’s extreme poverty delayed this until 1926. In Mexico’s case the initial problems were caused by the civil war: see Stephen H. Haber, *Industry and Underdevelopment: The Industrialization of Mexico, 1890–1940* (Stanford, 1989), pp. 126–36.

²⁴ Foreign capital only played a significant role in the ventures in Chile (mixed Anglo-Chilean capital), in Cuba at El Almendares (French, Spanish, and Cuban capital), two of the Mexican ventures (Anglo-North American capital), and in Uruguay (originally German capital).²⁵ Bureau of Mines, *The Cement Industry*, p. 2.

²⁶ The Compañía Cubana de Cemento Portland, located in Mariel (province of Pinar del Río), lit its first two kilns, with a capacity of some 137,000 tonnes, in 1918. This was followed a year later by the plant started in Sierras Bayas (Province of Buenos Aires) by the Compañía Argentina de Cemento Portland, with a capacity of 150,000 tonnes. Peru’s turn came when the Compañía Peruana de Cemento Portland El Sol opened a small factory capable of producing 3,000 tonnes near Lima. In Ecuador the Compañía Anónima de Industrias y Construcciones installed a factory with an annual capacity of 20,000 tonnes in Estero Salado, close to Guayaquil. Mexico saw its productive base broaden in 1923 with the firm Cementos Portland Monterrey, in the state of Nuevo León (45,000 tonnes capacity) and the Compañía de Cemento Portland Landa (3,000 tonnes) in Puebla.

²⁷ The factory in Olavarría (Province of Buenos Aires), owned by the Compañía Industrial Argentina Loma Negra, added 80,000 tonnes to the nation’s potential output. A year later, Juan Minetti Canteras added a further 120,000 tonnes with his plant in the Dumesnil station, in the Province of Córdoba.

In this context Brazil (1926) and Bolivia (1928) joined the club of cement producing countries.²⁸ There were also attempts that ended in failure, such as in Paraguay (1926) which, together with Bolivia's later entry, shows how important was the volume of demand, irrespective of the natural protection derived from geographical position.²⁹ While the cement industry spread there was also a period of profound technological renewal, both in the recently opened factories and the original plants. Almost as many kilns were installed (27) as in the period before the war. This time nearly all of them were rotary kilns, providing greater capacity but, more importantly, greater productivity than the earlier kilns. Furthermore, half of the new kilns used the 'wet' process, which meant that more uniform and better quality cement could be produced. This technological advance was accompanied by technical improvements in some of the other operations involved in cement production, such as the partial mechanisation of mineral haulage, and the crushing and grinding of raw materials and clinker.

This process of equipping plants with modern technology and the corresponding increase in efficiency was largely due to foreign investment. It came mainly from the United States, more specifically from the Loan Star Cement Corporation.³⁰ The majority of the machinery installed in the plants was manufactured in the United States, with German and Danish equipment playing a secondary role.³¹ Investment, from abroad as well as from home,

²⁸ As noted already, the Companhia Brasileira de Cimento Portland, opened a factory in Perú (São Paulo state), with an initial capacity of 60,000 tonnes. In Viacha, close to La Paz, the Sociedad Boliviana de Cemento built a small factory with the capacity to produce 2,000 tonnes.

²⁹ In truth, the Paraguayan initiative came about in 1912, sponsored by a French investment group, but failed as a consequence of the war. In 1926 a local company managed to repair and finish work on the factory but was not able to run it on a regular basis.

³⁰ Lone Star carried out its investment policy through its financial subsidiary, the International Cement Corporation. This corporation, with its headquarters in New York, created the Compañía Cubana de Cemento Portland, the Compañía Argentina de Cemento Portland, and the Compañía Peruana de Cemento Portland. It also acquired the Uruguayan cement factory which it completely renovated and registered as Compañía Uruguaya de Cemento Portland. The crisis of the 1930s was no check to Lone Star, which went on to broaden its portfolio of investments. Independently, Canadian and British capital provided the bulk of the funds for the Companhia Brasileira de Cimento Portland. Peruvian and North American investors put up the money for the Bolivian cement business. In Ecuador, German capital played an important part, conditional on the factory being equipped by Krupp. As for the small factory set up in 1901 by the engineer Novella in Guatemala, equipped with second-hand German machinery, it was modernised in 1917 thanks to an agreement with United Fruit, which provided the majority of the capital. Finally, in 1923 an Anglo-Canadian consortium took over the factory in Ecuador.

³¹ During the first wave of development the German companies, Polysius and Krupp, and the Danish company, F. L. Smidth, were among the major suppliers of technology used in Latin American installations. After the second wave of development the cement industry was fitted out with machinery which came, in approximately equal parts, from the United

was doubtlessly stimulated by the prospect of profiting from the new situation. The First World War drove Latin America to look for greater autonomy, if not self-sufficiency, in the area of cement supply, while at the same time there was a slow but sustainable rise in demand.

In this way a dozen Latin American countries managed, before the Great Depression, to start up domestic cement industries. The others were not ready to do so until much later, either as a result of the changes that took place after World War II or under the auspices of the ISI strategies promoted by ECLA and the Latin American states in the 1950s. The first of these reasons is true for Nicaragua and the Dominican Republic, which set up their industries in 1942 and 1947 respectively, while the second reason applies to El Salvador (1953), Haiti (1954), Panama and Paraguay (1957), Honduras (1959) and finally, Costa Rica (1964). Given that all these nations have small economies, the process of import substitution was able to develop at great speed in the 1930s.³² The task of this article, however, is not to analyse this period, but the one immediately before. The argument here is that during the first three decades of the twentieth century the foundations of ISI were laid, and that the process in fact started before the 1929 crisis.

Table 4 collates quantitative information on production for the period. Here it is necessary to emphasise the obvious point that most of the figures for the earlier years are not fully reliable. The lack of statistical data for production in some years has led to the calculation of upper and lower bound figures between which the real amounts should lie. The drawing up of these limits was based on apparently solid empirical evidence, but it is undeniable that the early years are prone to fairly wide margins of error.³³ One only has to examine the last two rows to be aware of this. Between the minimum hypothetical level for cement production in Latin America in

States and Europe. See Kock-Petersen, 'The Cement Industry', in L. J. Hughlett, *Industrialization of Latin America* (New York, 1946), p. 69.

³² At the start of the Second World War, according to my calculations, the total production of the Latin American cement industry already covered 86 per cent of demand (apparent consumption). After the war, this high level was not reached again until 1953. Following this, the process of ISI was quickly completed.

³³ Detailed and comprehensive information is available on how the production capacity of the cement industry in all the Latin American and Caribbean countries developed, thanks to the research work of De las Cuevas, *Un siglo de cemento*. Where information is not available, two hypothetical production values have been calculated, based on the capacity of the country's installations, one corresponding to a maximum probable level (90 per cent of installed capacity) and the other to a minimum probable level (20 per cent of installed capacity). These percentages are not arbitrary but appear to be the most realistic after examining the known empirical evidence. It was only under exceptional circumstances that cement factories went beyond the upper limit or reduced their production to below the minimum numbers here; the first was difficult to exceed for technical reasons, while to go below the second would have been unsustainable for reasons of economic profitability.

Table 4. *Estimated Cement Production, in tonnes (annual averages)*

		1900/04	1905/09	1910/13	1914/19	1920/24	1925/29
Argentina		0	4,000	3,725	9,817	94,920	214,860
Bolivia	Upper bound						7,632
	Lower bound	0	0	0	0	0	1,696
Brazil		0	0	0	0	0	63,044
Colombia	Upper bound		6,300	5,975	8,100		
	Lower bound	0	1,400	2,300	1,800	6,000	7,860
Cuba	Upper bound	43,200	59,400	55,350	49,900		
	Lower bound	9,600	13,200	12,300	21,217	98,600	254,820
Chile	Upper bound		36,000	36,000			
	Lower bound	0	8,000	8,000	55,275	64,489	101,344
Ecuador	Upper bound					18,000	16,654
	Lower bound	0	0	0	0	4,000	8,254
Guatemala	Upper bound	2,700	5,400	5,400	6,900	15,840	21,366
	Lower bound	600	1,200	1,200	1,533	3,520	6,806
Mexico		0	35,000	45,000	27,500	72,398	174,660
Peru		0	0	0	0	4,120	37,507
Uruguay	Upper bound			45,000	39,167		
	Lower bound	0	0	10,000	10,000	42,400	143,200
Venezuela	Upper bound		7,200	10,450	16,200	19,460	28,669
	Lower bound	0	1,600	4,311	3,600	7,140	14,109
Latin America	Upper bound	45,360	111,500	184,400	212,859	423,779	1,054,428
	Lower bound	10,080	47,800	79,925	130,742	393,539	1,014,534

Source: See table 2. The production figures for the earlier years have been kindly supplied by Carmen Astrid Romero for Colombia, and Magdalena Bertino and Luis Bértola for Uruguay.

1900–04 and the maximum hypothetical level there is a ratio of 1:4.5. This ratio is more than halved after 1907 but it still remains high for the next ten years. It is only after 1919 that the margins of uncertainty become practically irrelevant (6 per cent on average for 1919–30). In other words, it is extremely risky to state with precision what the level of production was for the period before 1919. The quantitative estimates put forward in this article do not, however, suffer excessively from such statistical uncertainty because during these early years domestic production was of little importance in comparison with imports, which fulfilled the bulk of the demand.

In the early years of the century the cement industry managed only to put down roots in the region. Production for 1900–04 represented no more than between 1 and 4 per cent of what it would be a quarter of a century later. Although in the following decade it grew vigorously, multiplying by a factor of between four and eight, production did nothing more than trail behind the formidable growth in demand. The great step forward came after World War I, not so much in the sense that the rate of growth accelerated, but because production had now reached respectable volumes. Table 4 also illustrates a diversity of trends. Cement production in Colombia, Cuba, Guatemala,

Table 5. *Development of Cement Import Substitution Process*¹

	1900/04	1905/09	1910/13	1914/19	1920/24	1925/29
Argentina	0	1	1	7	33	33
Bolivia	0	0	0	0	0	28
Brazil	0	0	0	0	0	11
Colombia	0	50	29	29	19	8
Cuba	48	34	23	22	48	82
Chile	0	22	17	56	58	47
Ecuador	0	0	0	0	38	45
Guatemala	72	75	54	57	70	63
Mexico	0	28	44	56	71	86
Peru	0	0	0	0	8	38
Uruguay	0	0	29	70	82	83
Venezuela	0	37	32	49	42	18
Total 12 countries	10	10	10	24	35	41

Note: ¹Expressed as percentages. Calculated from the proportion between estimated production (taking the average value between the upper and lower bounds) and apparent consumption.

Source: See table 2.

Venezuela, and to a lesser extent in Chile, increased gradually. On the other hand, in Argentina, Peru, Brazil and Uruguay it took off suddenly at a particular moment. Mexico followed an unusual pattern which can be blamed on the socio-political disruptions suffered by the country. More remarkable was Ecuador, where production remained stagnant.

The figures in Table 4 raise questions about the achievements in cement production that occurred in individual countries, once differences in their economic significance within the region are taken into account. Viewing the data from this perspective, the years preceding World War I were characterised by Mexico's industry being in first place, with the trailblazing Cuba coming in second. Third place was hotly disputed between the Chilean and Uruguayan cement industries. The other industries in the region all produced on a smaller scale. If we move on to 1929, Cuba and Argentina share the top positions, together contributing 47 per cent of Latin America's production. Mexico and Uruguay are also level in the second tier. These four countries supplied three-quarters of the region's production. Chile adds a further 10 per cent. Cement manufactured elsewhere in the region is relatively insignificant. Even Brazil manages only 6 per cent of the total.

These differences in volumes of domestic production are obviously linked to demand in each individual country. This is related, to some extent, to the size of the economies and their level of development. How did the process of income substitution develop in each? Table 5 highlights this phenomenon accurately.

If we consider the countries which started a local industry before 1930 as a group, it is clear that progress was, at best, modest until 1914. Domestic

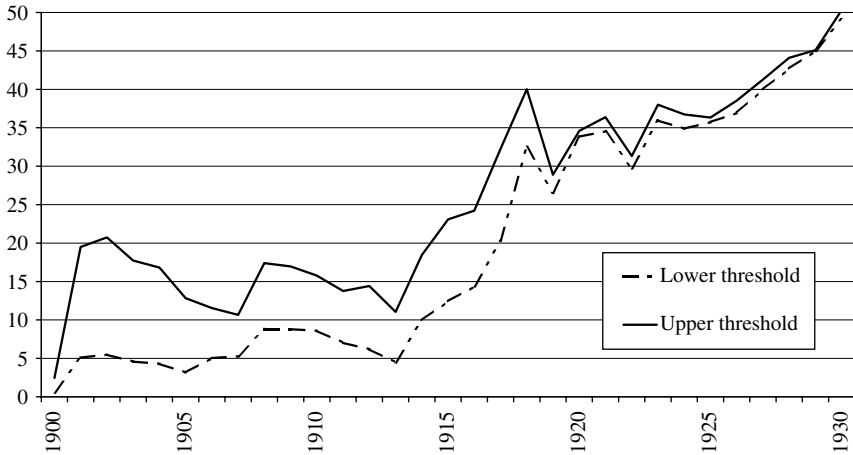


Fig. 2. Cement Production as percentage of Apparent Consumption, 1900–30. Sources: See table 2.

production only covered about 10 per cent of aggregate demand in these countries.³⁴ The rise that one would expect as a consequence of World War I is clearly reflected in the data in the lower part of the table. The share of total consumption coming from domestic production rose immediately to 24 per cent. After this point there was a markedly upward trend which led, a decade later, to production equalling imports. As can be seen more clearly in Figure 2, by 1930 the region's factories supplied exactly half of cement consumption. It is therefore possible to affirm that, as far as this industrial sector is concerned, the halfway point on the road to ISI had been reached before Latin America was hit by the Great Depression.

Table 5 provides data on the chronology of ISI in each country. Progress differed from one to another, although they did share some basic features. In some countries the actual foundation of the cement industry was so late that one can hardly talk about a process of ISI before the Great Depression. This group includes Bolivia, Brazil and Peru. The remaining countries experienced a much earlier development in the first decade of the century. This larger group comprised Argentina, Colombia, Cuba, Chile, Guatemala, Mexico, Uruguay, Venezuela and the latecomer, Uruguay, which started its industry in 1912. Only Ecuador did not fit this pattern, nor was it one of the countries which took longer to instigate ISI. Another aspect common to practically all the producers was the substantial share of consumption supplied by local production from the very beginning. In this sense it should be emphasised

³⁴ This percentage should be taken only as an estimate, since it is an abstraction of the margins of error existent in the production figures. These margins vary between ± 4 or 5 percentage points.

that Argentina appears to be a separate case. Locally produced Argentine cement grew in importance in an extremely gradual way, even when imports collapsed as a consequence of the hostilities in Europe. The jump in production occurred only after this time, and it did not have a large impact since the boost in production was not accompanied by a reduction in imports. However, when scrutinised more closely, the Argentine example was not as anomalous as it may seem. Output grew in most of the cement producing countries of the region without a corresponding fall in imports, thanks to an escalation in domestic demand. The slowing down of the process of import substitution evident in Figure 2 was experienced in all these countries in the years before the First World War, with the exception of Mexico, and this suggests that the competitiveness of European cement with respect to the domestic product was such that increases in demand tended to be satisfied by increased imports. The scarcity of European cement during the War altered this balance, if only temporarily in some countries such as Chile and Venezuela. In the years before the crisis of 1929 only in Cuba and Mexico are there signs of sustained growth in domestic production seriously displacing imports. This is the main difference from what happened after 1930. While, until then, ISI had taken many steps forward without having sacrificed imports, after the onset of the crisis domestic production really took over.

At this point a question arises, or perhaps one should say it recurs, since it has perhaps always been present in this section of the paper: why did a dozen countries develop as cement producers at this time? Or in other words, upon what did the start and the growth of production depend? To begin with, one can surmise that the volume of demand played a decisive role. Given the large amount of capital needed to set up a cement factory and the technological characteristics of its operation, the industry is only viable economically, in the context of relatively open markets, if a demand capable of constantly absorbing a relatively high minimum volume of production exists. If this is the case, the key factor is the size of the market, which is determined, in essence, by the size of the country and its level of income, although an active policy of public spending can also boost demand significantly.

Figures 3 and 4 are a tentative way of testing this hypothesis. It can be seen in both figures that, in about 1929, the culminating point for the pre-crisis period of growth, a country's production was linked to consumption in aggregate terms and per inhabitant. To be more precise, it depended more on total consumption than on consumption per inhabitant.³⁵ This would explain why smaller economies such as those of Central America and the Caribbean,

³⁵ The adjustment of the line to the observations is significantly greater in relation to aggregate consumption than to *per capita* consumption; the respective R^2 figures are 0.633 and 0.449.

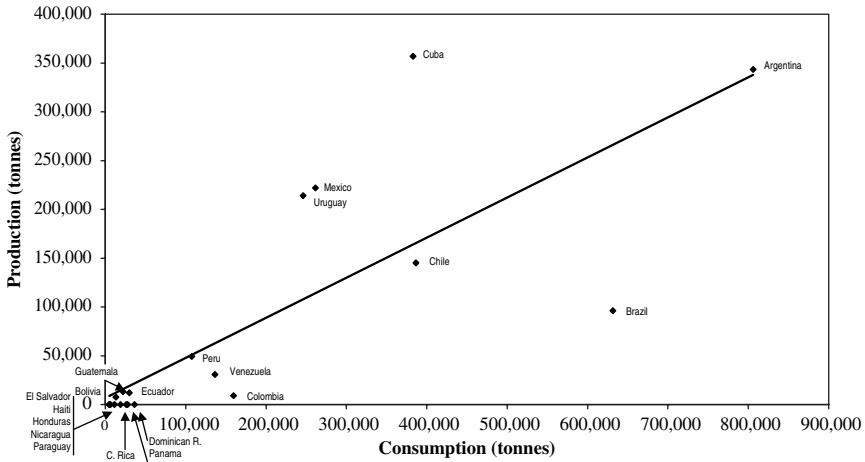


Fig. 3. *Consumption versus Cement Production in 1929.* Sources: See table 2.

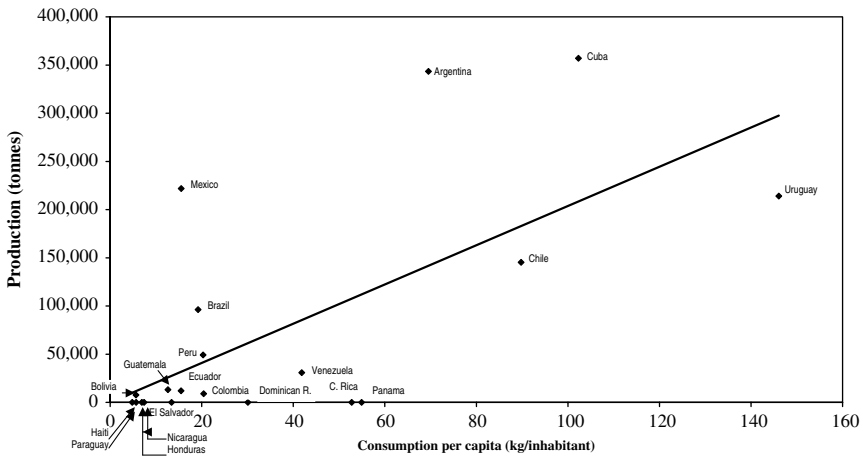


Fig. 4. *Consumption per capita versus Cement Production in 1929.* Sources: See table 2 and, for population data, Maddison, *The World Economy*, table 4a.

with the exception of Cuba, did not have a cement industry at this stage. Their total demand was too small, whatever their level of *per capita* consumption may have been. Of course, there is not a perfect fit. Taken separately, the Figures show that the production of some countries departed significantly from what could be predicted by looking at their levels of consumption. Colombia, Chile, Venezuela and, in particular, Brazil produced less than their levels of consumption would lead one to expect. Mexico, Uruguay, and, above all, Cuba produced more. By studying Figure 4 we will find an explanation for some of these deviations. Uruguay had an abnormally

high *per capita* level of consumption, while Brazil's was low in relation to its production, or to put it another way, production seems to be greater than its *per capita* consumption levels would suggest. Thus, putting together the deviations from the lines of best fit in the two graphs, the conclusion can be drawn that the countries where, by 1929, there was a disjuncture between the level of production and domestic demand were Cuba and Mexico (production in excess of what might have been expected), and Colombia, Chile and Venezuela (production below what might have been expected, though not so markedly).

This interpretation is obviously something of a simplification, designed merely to open up the subject. Since it is based on only one year's statistics it does not take into account the effects of business cycles or investment cycles, which were not necessarily the same throughout the whole American continent. Nor does it take into account the varying rates of public spending on infrastructure found in the region, which would not have depended automatically on the level of the country's income.³⁶ What is perhaps even more important is that it ignores the role played by supply factors. Even if we suppose that all the Latin American countries had equal access to the technology and foreign capital necessary for installing production plants, it is necessary to take into account the fact that not all of them had the natural resources that were required for cement production near enough to major centres of consumption.³⁷ In this sense, what could have made the difference was not the easy availability of the necessary capital, or even cheap energy.³⁸

³⁶ Cuba may serve as an example of the extraordinary importance that, on certain occasions, public works could have. See 'Evolución y perspectivas de la industria del cemento en Cuba', *Revista del Banco Nacional de Cuba* vol. 2, no. 7 (July 1936), p. 29. This case also highlights the fact that, on occasion, public sector demand could consolidate the development of the domestic cement industry. The special programme of public works approved in 1926 by the Cuban government contained an agreement guaranteeing supply at a prearranged price with the company which had a virtual monopoly on domestic production. This agreement meant that the company was able to work at full output. See De las Cuevas, *100 años de cemento*, pp. 35–6. Unfortunately, historians of Latin America have yet to draw up figures for public investment for this period which cover the whole region.

³⁷ Kock-Petersen, *The Cement Industry*.

³⁸ As has been shown, the Latin American cement industry depended on the combination of technology and investment provided by the most industrialised economies. It seems reasonable to assume that during this period there was little difference in the receptiveness of the Latin American republics to these initiatives. As for the supplies required for cement production, a distinction has to be made between energy resources and the main raw materials (limestone and clay). The kilns were fuelled by coal or oil. Although fuel consumption was very high, the common assumption that the cement industry was extremely energy-intensive has to be qualified. Taking the Spanish industry as an example, between 1922 and 1928 it used a quantity of coal equivalent to 31 per cent of the cement produced (both expressed in tonnes). We have to remember that the proportion of coal, as weight, in relation to mineral raw materials, would only have been around 17 per cent, given that almost two tonnes of raw materials produced one tonne of cement. See the cement

The supply factor which probably had most influence on delaying the start of the cement industry in some Latin American nations was the availability of deposits of raw materials close to points of fuel supply and large centres of consumption. This was the case, for example, in Brazil which was not ready to develop a cement industry successfully until deposits were discovered in the 1920s near the markets of Rio de Janeiro and São Paulo.³⁹ Moreover, economic policy has to be taken into consideration, especially tariff policy which had the power to provide incentives or disincentives to the establishment of domestic cement industries.⁴⁰ In short, the immediate demand factors provide a satisfactory explanation of the steps taken towards ISI before the crisis of the 1930s by Latin American cement industries, although in order to have a complete understanding of the phenomenon one would have to appreciate the roles played by other forces, essentially supply forces.

Cement consumption

The analysis of the apparent consumption of cement is interesting in its own right, as well as helping to clarify the development of the industry. Cement is a basic intermediate good in the construction sector. Its level of consumption, therefore, constitutes a good indicator of building activity and of capital investment in infrastructure. Differences in consumption over time and among countries reflect, in part, levels of income disparities. In situations of extreme poverty or underdevelopment, cheaper and more accessible natural materials of a vegetable or mineral type are used instead of cement (which

production figures and coal consumption figures in *Cemento* (Barcelona), vol. I, no. 5 (1929), pp. 159–60.

³⁹ Suzigan, *Indústria brasileira*, pp. 264 and 267.

⁴⁰ Tariff policy possibly inhibited the development of a national cement industry in many countries, while in a minority it became a powerful stimulant. This is an aspect of the subject that is greatly in need of research. In Porfirian Mexico, thanks to the work of Graciela Márquez ('Tariff Protection in Mexico, 1892–1909: Ad Valorem Tariff Rates and Sources of Variation', in Coatsworth and Taylor (eds.), *Latin America*, pp. 407–42), it is known that the government clearly encouraged the sector in 1905 by strengthening the protectionist policy already in place. On the other hand, numerous countries maintained a very liberal policy, further skewed by the fiscal privileges conceded both to the public sector and to the large utilities companies (railways, electric companies). This policy was governed by the principle that construction materials could be imported free of import duties by the public sector and these utilities companies while other users had to pay more or less moderate tariffs. Most of the small Central American and Caribbean nations, realising they had practically zero possibilities of starting a domestic industry, inclined towards a liberal policy of economic encouragement; cement was imported without the payment of duties, in common with other supposedly strategic goods such as machinery. This fact should be emphasised, not only because it is little known, but also because of recent arguments that Latin American states were the most protectionist in the world: see John H. Coatsworth and Jeffrey G. Williamson, 'Always Protectionist? Latin American Tariffs from Independence to Great Depression', *Journal of Latin American Studies*, vol. 36, no. 2 (2004), pp. 205–32.

Table 6. *Apparent Consumption of Cement per capita, annual averages (Kg/inhabitant)*¹

	1900/04	1905/09	1910/13	1914/19	1920/24	1925/29
Argentina	13.7	35.7	57.8	21.9	30.5	57.4
Bolivia	0.1	0.2	2.3	1.4	3.1	4.9
Brazil	3.5	8.5	14.8	5.5	8.3	15.2
Colombia	0.2	0.7	2.7	2.8	5.0	14.0
Costa Rica	3.2	7.1	15.8	7.2	9.4	32.5
Cuba	26.1	47.7	61.0	57.7	64.0	84.8
Chile	8.1	25.1	38.0	27.9	28.8	53.3
Ecuador	0.5	1.3	1.9	2.3	8.0	13.8
El Salvador	0.4	0.8	2.2	3.5	3.9	13.2
Guatemala	1.4	2.9	4.0	4.4	7.7	12.1
Haiti	0.4	0.9	3.2	2.5	2.0	4.6
Honduras	0.4	1.1	2.4	3.6	6.2	4.3
Mexico	2.7	7.9	7.0	3.2	6.6	12.3
Nicaragua	0.3	0.4	2.0	2.6	2.5	5.2
Panama	0.0	8.5	32.9	22.4	14.0	37.2
Paraguay	1.3	2.1	2.4	2.4	2.9	4.3
Peru	1.1	3.3	5.4	4.8	7.9	18.6
Dominican Rep.	0.5	2.9	12.1	15.0	17.6	23.4
Uruguay	9.7	23.9	60.3	23.2	35.5	106.2
Venezuela	0.9	2.4	6.5	6.1	10.2	38.4
Latin America	4.2	10.8	17.4	9.4	13.2	25.4

Note: ¹Calculated by adding net imports to estimated production figures, averaging the values corresponding to the upper and lower thresholds.

Source: See table 2, and, for population A. Maddison, *The World Economy. Historical Statistics* (Paris, 2003).

are, of course, to the detriment of the possibility of a building supporting heavy loads or having a long and useful life etc). An example of this was Buenos Aires. At the beginning of the century it was still a ‘fragile’ city built largely of timber. A few years later it was transformed into a ‘solid’ metropolis constructed mainly of steel and cement.⁴¹ It is impossible to go into a detailed examination of these points, all of which merit a detailed study. Instead, attention is focused on the consumption averages for five-year periods as well as the figures for two specific years of historical importance, 1913 and 1929. This will permit the development of the first quantitative estimate of differences in cement consumption in Latin America.

Table 6 is highly revealing. In the region as a whole, cement consumption per inhabitant multiplied by a factor greater than six throughout the whole period.⁴² Growth was considerably stronger before the outbreak of World War I than in the second half of the period. This was true of all the countries

⁴¹ Fernando Rocchi, *Chimneys in the Desert*, p. 94.

⁴² If the average level of the first three years (1900–1902) is compared with the last three (1928–30), the *per capita* consumption multiplies by eight.

except two small producers (Ecuador and Guatemala) and one non producer (El Salvador). One might be tempted to attribute this deceleration to efforts made to boost domestic industry by erecting barriers to the entry of cement manufactured by more efficient foreign producers. But such a conjecture is, for now, groundless. The available empirical evidence suggests that, on one hand, domestic production grew as a result of expansion in demand and not purely as a substitute for imports, and, on the other, that the slower rate of increase in consumption after World War I affected those countries which had already commenced the process of ISI as much as those which had not. This might suggest a hypothesis involving the impact caused by the war, which put an abrupt end to the first era of globalisation and deprived the economies in the region of opportunities for growth via trade and international investment. The figures in Table 6 support, or at least lend some credence to, such a hypothesis. During the conflict, consumption plummeted, and it took years to recover. In the first five-year period after the war there was a half-hearted revival, but this did not succeed in reaching the earlier maximum levels. It was not until 1927 that the figures for *per capita* consumption for 1913 were reached and even overtaken. Some of the countries which had most benefited from integration with the international economy faced huge difficulties. Argentina did not manage to regain the 1913 level of *per capita* consumption until after it had recovered from the economic crisis of the 1930s (in 1937, to be exact). Chile recovered its previous maximum consumption only on the eve of the Great Depression (1928).

The most remarkable feature of the table, however, is not to be found in the development of consumption over time, but in the differences among Latin American republics. At the beginning of the century practically half the countries hardly used any cement; its annual consumption per inhabitant was negligible, less than one kilogram. On the other hand, it was already widely used in Cuba (26 kg), Argentina (14 kg), Uruguay (10 kg) and Chile (8 kg). In the second and third decades its use spread progressively in the less developed countries; around 1929 most of them surpassed the levels that the more developed countries had achieved in 1900. The table shows that the differences between countries in 1925–29 were enormous, although not so vast as in 1900–04. Bolivia, Haiti, Honduras, Nicaragua and Paraguay consumed around 5 kg a year, while Uruguay topped 100 kg, Cuba 80 kg, and Argentina and Chile both exceeded 50 kg.

It is extremely interesting to observe that these disparities correspond with those found in the levels of *per capita* income, although they are of a much higher order of magnitude, especially in the early years.⁴³ It could be said that

⁴³ If we accept, as a reasonable approximation, the information compiled by Angus Maddison, *The World Economy: Historical Statistics* (Paris, 2003), in 1900 *per capita* GDP in the

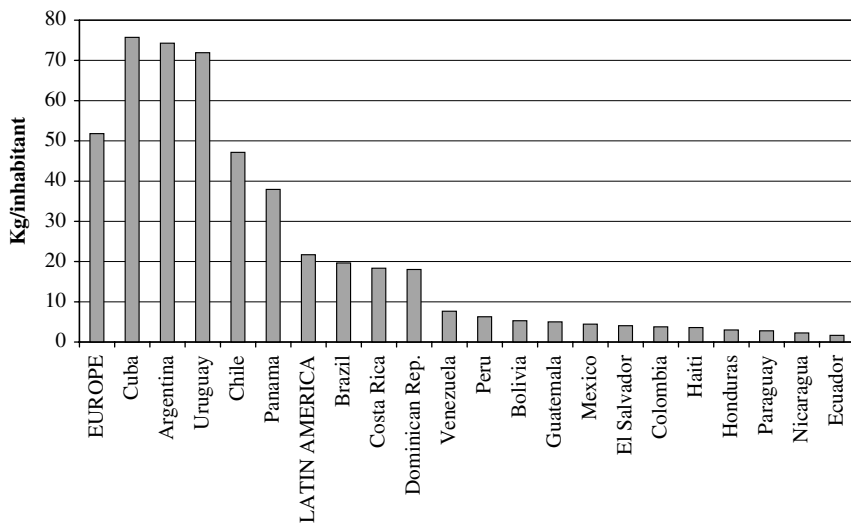


Fig. 5. Cement Consumption per capita in 1913. Sources: See table 2 and, for population data, Maddison, *The World Economy*, table 4a.

cement consumption is like a distorting mirror which enlarges and shrinks what it reflects. To what do we owe this exaggeration in differences of wealth? As with the consumption of modern sources of energy and certain new consumer durable goods, such as automobiles, cement was a product which substituted other traditional goods. Cement was affordable only by those public and private economic agents which had achieved a certain economic level.⁴⁴ Amongst lower income levels, consumption of these new goods was virtually non-existent. This is why cement consumption, as with the consumption of modern energy resources and similar products, does not depend exclusively on levels of investment in construction or on income, but it also expresses the extent of economic modernisation.

The intraregional differences exhibited in Table 6 are more clearly shown in Figures 5 and 6 which represent data for consumption per inhabitant in

richest country (Argentina) was four times higher than the poorest (Brazil) within the group of the eight large economies (there being no data for the rest). In 1929 the gap between Argentina and Brazil had reduced very slightly. It must be remembered that some small Central American and Caribbean countries, as well as maybe Bolivia and Paraguay, very possibly had a *per capita* income below that of Brazil.

⁴⁴ For the consumption of modern energy sources see César Yáñez, María M. Rubio and Albert Carreras, ‘Economic Modernisation in Latin America and the Caribbean between 1890 and 1925: A View from the Energy Consumption’, 44th Cliometrics Conference, June 2–4, 2006 (Binghamton, New York). The ranking for the consumption of cement per inhabitant in the Latin American nations corresponds exactly to the ranking for the consumption of energy.

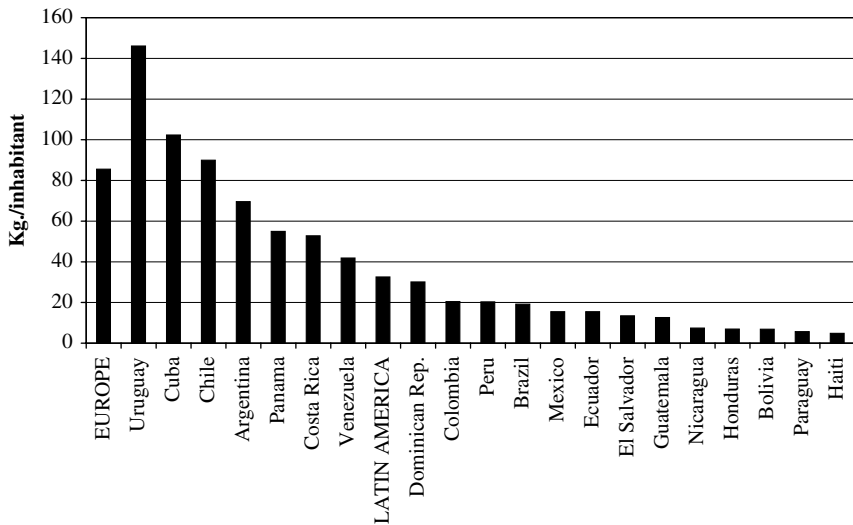


Fig. 6. *Cement Consumption per capita in 1929.*

Sources: See table 2 and, for population data, A. Maddison, *The World Economy*, table 4a.

1913 and 1929 respectively. Figures for European consumption have been added in order to compare the Latin American nations with those of the Old Continent.

In 1913 average consumption *per capita* for the region was approximately 22 kg. Latin America was well behind Europe (52 kg). It has to be said, though, that there were three countries which were clearly ahead of Europe as a whole: Cuba (76 kg), Argentina (74 kg) and Uruguay (72 kg). Chile (47 kg) was almost level with Europe, but somewhat behind the cluster of the three leaders in Latin America. Panama seems to be lagging, although it is possible that this estimate has distorted its position. Less disputable is the fact that Brazil, Costa Rica and the Dominican Republic had similar levels of consumption, only slightly below the regional average. The remaining countries were well below this figure and registered such small amounts that there is little sense establishing differences among them. Note that some cement-producing countries and also some of the large economies were included in these dozen 'poor consumers'.

Fifteen years later, at the dramatic turning point of the 1929 crisis, the relative positions had undergone some conspicuous changes. The region was still headed by the Southern Cone countries plus Cuba, but the four countries had swapped positions. Uruguay now held indisputable primacy, Chile had moved up to third position, challenging Cuba for second, while Argentina had been relegated to fourth. Costa Rica was competing fiercely with Panama to occupy fifth place, while Venezuela had spectacularly

overtaken the regional average. Brazil had taken the opposite course. The small Central American republics, with the exceptions of Panama and Costa Rica, plus Haiti, Bolivia and Paraguay, took up the rear. Unexpectedly, the other large underdeveloped economies (Colombia, Mexico, Peru) had managed to climb the table, slowly approaching the Latin American average.

In general terms, there are two, opposing, features which stand out. The first is the increase, of the order of 50 per cent, in the *per capita* consumption of cement in Latin America. The second is the maintenance of the gap that separated Latin America and Europe. This gap did not narrow at all between 1913 and 1929, and indeed it widened slightly. The 1929 *per capita* volume of cement consumed in the region represented 38.1 per cent of that consumed in Europe, four percentage points less than in 1913. On the other hand, there was no fall, but simple stagnation, in relation to the United States, although it was stagnation with a differential of great magnitude.⁴⁵ These are the two faces, one optimistic, the other pessimistic, of the situation that has been examined.

Conclusions

As is well known, cement is a basic construction material. The technology to manufacture it as a chemical compound (Portland cement) became known in the middle of the nineteenth century but, even in the most industrialised countries, Portland cement did not become clearly established until around 1900. Technological innovations introduced at the end of the nineteenth century resulted in a sharp drop in product price, as well as great improvements in quality and homogeneity, all of which were decisive for the rapid spread of its use around the world. This new technology would create, at the beginning of the twentieth century, an entry barrier for less developed countries. In order to exploit the huge potential economies of scale, very large factories requiring high levels of investment had to be built. They were equipped with sophisticated machinery which was only manufactured in two leading industrial countries (Germany and the United States), as well as another specialising in the sector (Denmark). The requirements of financial and technological capital, together with difficulties in supplying abundant and cheap fuel, meant that at the beginning of the twentieth century Latin American economies turned to imports to satisfy internal demand. The cement factories of the principal European industrial powers, Germany,

⁴⁵ If we assume that production was equivalent to consumption in the case of the United States, Latin American *per capita* levels of consumption would be, according to my calculations, based on information from Svennilson, *Growth and Stagnation*, 13.5 per cent of those of the powerful northern neighbour in both 1913 and 1925.

Great Britain, Belgium and France, supplied this demand and possibly used it to their advantage in their plans for expansion. The First World War broke this dynamic. Cement exports to Latin America only managed to recover the heights reached in 1913 at the end of the 1920s, and this in an environment in which consumption had experienced a considerable boost.

Before the hostilities of the Great War, eight Latin American nations – Cuba, Guatemala, Mexico, Argentina, Chile, Colombia, Venezuela and Uruguay (in chronological order) – had managed to establish regularly operating cement factories in their territory. We have here a phenomenon which could be defined, as José Antonio Ocampo has pointed out, as a natural substitution of imports.⁴⁶ From an economic point of view the rational location of a cement factory is where deposits of limestone and clay are found close to major centres of consumption as well as points of fuel supply. This is due to the fact that the final product is exceptionally costly to transport and also that its manufacture entails an extremely intense consumption of quarried minerals, even more intense than energy consumption. Because of this, most of the region's cement businesses faced enormous difficulties in the early years. It was not enough that they had been promoted and financed fundamentally by foreign investors, or that they had been equipped with machinery produced in the most advanced countries. On the whole, factory sizes were sub-optimal, and kilns were usually vertical as opposed to the horizontal rotary type. Until 1914, the Latin American cement industry, with the exception of Mexico, lived under the shadow of intense competition from its European and, to a lesser extent, North American counterparts.⁴⁷

The First World War radically altered the situation. Supplies were cut and shipping freights rocketed, sending up cement prices. This provided major growth opportunities for the domestic industries.⁴⁸ The pioneering factories consolidated their positions and eagerly increased capacity and production.

⁴⁶ Ocampo, 'América Latina'.

⁴⁷ Haber, *Industry and Underdevelopment*, pp. 32 and 40, attributes the status of a natural monopoly to the cement industry of the time, due to the fact that high transportation costs allowed the product to be sold only within a radius of 250 kilometres. But the exceptional nature of the Mexican case should not be overlooked: the Mexican industry enjoyed natural protection for geographical reasons. Its counterparts in the remainder of Latin America were not so fortunate.

⁴⁸ This seems to contradict the thesis which states that the war did not favour industrial development in the region, even in the places where it was most advanced: see Rory Miller, 'Latin American Manufacturing and the First World War: An Exploratory Essay', *World Development*, vol. 9, no. 8 (1981), pp. 707–16, and Bill Albert, *South America and the First World War: the Impact of the War on Brazil, Argentina, Peru, and Chile* (Cambridge, 1988). This thesis is probably correct in overall terms, but not when referring to the cement industry, given its specific characteristics.

In some cases they were pushed out of the market by a new generation of factories. In other cases internal demand grew at such an intense rate that the market was shared between established and new producers. New countries – Peru, Ecuador, Brazil and Bolivia – became cement manufacturers. All of them were equipped with more up-to-date and efficient technology, either installing it in new factories or renovating existing ones. Foreign investment, especially from the United States, played an essential part in this process. The progress of import substitution was gradual but sustained. Around 1930, just before purchases from abroad plummeted, cement manufactured in Latin America accounted for exactly half of that consumed. Only the smallest economies were left out of the ISI process. They did not embark on it until they were well into the stage of state-led industrialisation. The data available suggests that market size was the determining factor, more so than the degree of economic development or supply factors (the availability of raw materials, energy resources, access to outside investment).

Consumption of cement in Latin America grew swiftly in the first three decades of the twentieth century. The annual average growth rate rose to 9.6 per cent; in *per capita* terms the rate of increase was an impressive 7.7 per cent. This increase was certainly greater than that recorded for general industrial production, not to mention GDP. This fact should not come as a surprise since we are dealing with a product which, to some extent, was new. Its use was linked to levels of economic modernisation. According to product cycle theory, cement would only begin to be used above a certain minimum income level; later the poorer nations tended to use it in an attempt to demonstrate parity with richer states. This explains why differences in *per capita* consumption in Latin America were so enormous at the beginning of the century. The biggest consumer (Cuba) used a *per capita* amount of cement more than a thousand times higher than the smallest consumer (Bolivia).⁴⁹ At the end of the 1920s these regional disparities had noticeably diminished. The difference between the biggest consumer (Uruguay) and the smallest (Paraguay) was less than a multiple of 27. Thus, over the period, there was a clear tendency for the *per capita* levels of cement consumption between the Latin America republics to converge. Without doubt, this is a striking fact. So too is another: in contrast to the region's economic dynamics in 1913, the average *per capita* consumption was well below that for Europe and even further below the United States. In relative terms, this difference

⁴⁹ The spectrum is drastically reduced if we compare the second consumer with the second-last (Argentina and Colombia, respectively), although the ratio of 118:1 which found between them bears no proportion to their differential in terms of *per capita* income, which, according to figures from Maddison, would not be more than 3:1. See Maddison, *The World Economy*, table 4c.

was to be even greater in 1929. If we allow ourselves to assume that this gap in cement consumption could well reflect a similar gap in other investment expenditure, we would have to conclude that neither growth via exports nor an industrialisation spurt provided the Latin American economies with the means to avoid falling even further behind the more developed economies.