Understanding the Latin American Gap during the era of Import Substitution[1]:

Institutions, Productivity, and Distance to the Technology Frontier in Brazil, Argentina and Mexico's Manufacturing Industries, 1935-1975

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ABSTRACT

Latin American countries failed to catch up with the income levels of advanced economies in the twentieth century due primarily to their inward-looking strategies, macroeconomic instability and weak institutional framework. However, during the middle of the century they succeeded in industrialising and increased their shares in world production regardless of their lack of competitive assets and low technology levels. This project reassesses these facts providing new estimates of real output and comparative productivity levels for manufacturing industries between Brazil, Mexico, Argentina, and the United States. Decomposing manufacturing productivity at industry levels using official production records and foreign trade statistics, I apply growth accounting techniques and a distance to the frontier approach to explore the main factors behind the industrial divergence in parallel with the historical and institutional features that affected productivity growth after the Great Depression. Furthermore, I suggest that a learning process evolved in leading sectors according to the distance to the technology frontier, facilitated by institutions and policies, which despite its shortcomings engendered an uneven pattern of heterogeneous productivity growth across manufacturing industries. Factors such as a weak structure of human capital, misaligned public incentives and trade-union relations during the years were crucial for the retardation of Latin American industry.

INTRODUCTION

Until the middle of 1980s, the preferred strategy for nearly all late-industrialising countries to attempt to catch up with the industrial core countries of Western Europe and the United States was Import-Substituting Industrialisation (henceforth ISI). A set of policies with the objective of developing an internal manufacturing sector, granting high levels of protection to domestic producers and essentially closing these countries to international trade, were one of the main elements of this development strategy. After the 1930s to the 1980s, in spite of the efforts of Latin American countries following ISI, these were unable to gain significant ground to the industrial leaders. Figure 1 illustrates this point. By 1950, Argentina's GDP per capita accounted just nearly half of the United States, while Mexico and Brazil's levels were only around a quarter or less. However, this relative income apparently remained roughly stable throughout these years, before the decline of the 1980s.

The persistence of the gap during this period has rested in a variety of interpretations. From the *dependencia school* to the so-called new economic history, a

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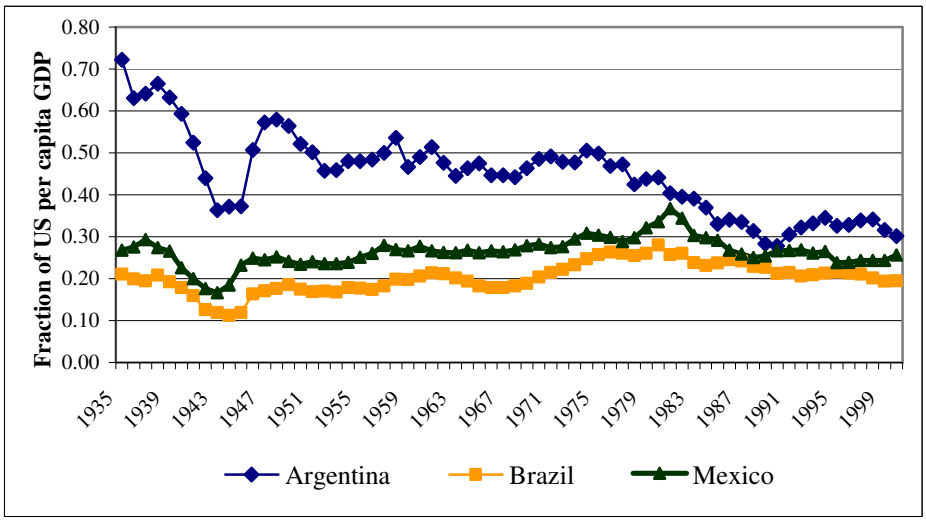
vast literature explaining the phenomena arouse in the last half century.[3] Recent findings by Prados de la Escosura (2007) have shown that major Latin American countries widened their income gap to a set of leading industrial countries after the 1930s.[4] In addition, Cole, et al. (2003) suggest that after the post-WWII period, productivity – measured as total factor productivity (TFP) - grew at slow rates compared to the US, and thus was falling behind of the world's technology frontier.[5]

Figure 1. Evolution of per capita GDP relative to the United States (1990 International GK$)



Source: *Total Economy Database*, A. Maddison (2010).

Market distortions generated by policies pursued during ISI were considered to be harmful for technological progress and growth has become the traditional story of the economic retardation of the region.[6] However, still among other mixed outcomes during this period, there is no agreement on how relatively backward or sophisticated Latin American industrial structures were during this period in the light of evidence from case studies of the existence of highly competitive industries in different modern branches in Brazil, Mexico and Argentina.[7]

In order to further understand the dismal performance in these countries during ISI, it is necessary to examine more closely the sources of economic growth on a disaggregated basis. Throughout the last half of the century, the US economy represented the productivity frontier, with levels higher than those of any other region. The productivity gap between the US and most countries in the world steadily narrowed after WWII.[8] Seemingly, on an aggregated level, this was not the case for Latin American economies, which in the big picture did not accomplish any catch up in productivity.

The purpose of this project is to attempt to fill the gap in the literature of Latin American industrialisation after the Great Depression by constructing production-side measures of output and productivity for manufacturing industries of three major countries of the region. This will allow us to explore on a systematic basis the

[3] See an overview in Cárdenas et al., *An economic history*; Love, 'The origins'; and Coatsworth, 'Structures'
[4] Prados de la Escosura 'When did Latin America fall behind?'
[5] Cole, et. al., 'Latin America in the rearview mirror'
[6] See view from Taylor, 'On the costs of inward-looking development'; and Edwards, 'Crisis and reform'.
[7] Teitel and Thoumi (1986), Katz (1987, 2000) and Colistete (2009) among others, have shown evidence of significant productivity growth and technological advances in manufacturing industries during the post-War period.
[8] Broadberry, 'Technological leadership and productivity'

performance of these industries making use of an international comparative perspective to understand the economic transformations that Latin America experienced during the classic period of ISI. The innovation of the research relies not only in the level of disaggregation, but also in the theoretical approach to explain how far each branch and industry was from the worldwide 'best practices' and how this gap changed over time.

Firstly, we establish different benchmark estimates (for 1935 and 1950) based on common census years in order to make a reliable and consistent analysis of comparative productivity from the selected sample of countries. We develop industry-specific conversion factors using producer output data, constructing Purchasing Power Parities (PPP's) which are based on the approach of the first bilateral comparison made by Maddison and van Ark (1987) for Brazil/US and Mexico/US in 1975.

We combine foreign trade statistics and industrial surveys in order to proceed for the derivation of purchasing power parities from values of output and quantities produced by each sector. This combination of sources is necessitated due to the lack of price information provided by the original industrial surveys for earlier years for these countries. Therefore, with this combination of data on inputs (labour and capital) and output, we compile measures of labour, capital and total factor productivity.

Secondly, after obtaining disaggregated growth accounting estimates, we proceed systematically to analyze the evolution of sectors that converged/diverged to the US levels. In our explanation of the productivity differences we focus on whether low or high knowledge barriers were present that allowed for imitation of new technologies which limited or promoted the degree of absorptive capacity necessary for technological catch up.

This document it is organized as follows; Section I presents a review of the recent literature related to this period. In section II, a short overview is given of the economic performance in major Latin American countries; section III presents the main political and institutional developments after the Great Depression. Section IV assesses the theoretical background, followed by section V on data issues and sources. In section VI, we make a preliminary and simple comparative analysis of the industrial census of 1935 based on exchange rate conversions, and finally in section VII we explain the industry of origin methodology, an example of aggregation of the work in progress, followed by some final remarks.

I. LITERATURE REVIEW

For many years, the conventional view by economic historians was that Latin America's economic retardation had its origins in the nineteenth century right after its colonial independence. However, Prados de la Escosura's recent estimates, challenged this view by showing with new series that the income gap of Latin American countries with the 'leading economies' widened significantly during the twentieth century and particularly after 1938.[9] At the same time, these findings contradict the perception of a supposedly 'golden age' of development that Latin American economies experienced after WWII. [10]

Several scholars have considered Latin America's trade regime during ISI as a possible source for its lack of development.[11] Specifically, they argue that these economies have been largely closed to international trade using quantitative restrictions and other trade barriers to attract foreign investment, this contrasts especially when

[9] Prados de la Escosura, 'When did Latin America fall behind?'
[10] As is seen in the textbook of Thorpe, 'An economic history of Latin America'.
[11] See for instance Balassa (1989), Edwards (1995), Taylor (1998), and Cole et. al. (2005).

compared with countries that successfully reduced their gap relative to the industrial leaders in a similar period.

Taylor (1998) argues that much of the dismal performance in Latin American countries during ISI was due to the failure to achieve capital deepening (low investment path). This was attributable to a series of market distortions (raising artificially capital prices to subsidize domestic firms) created by wrong policy choices and the lack of trade openness that persisted and worsened throughout the years causing economic divergence.[12] Hofman (1998) stresses another important aspect arguing that the lack of technological progress and underperformance was due to a string of macro/microeconomic misallocations and technical inefficiencies generating factor productivity stagnation, owing mostly to structural differences of the countries (scarcity or abundance of inputs). Moreover, Katz (1987) suggested that the lack of production planning and organization to introduce process change within industries contributed to the inefficiency in manufacturing.

Acemoglu et al. (2003) show with the example of Argentina and other countries that those countries that have pursued distortionary policies, including large budget deficits and misaligned exchange rates, appear to have suffered more macroeconomic volatility and have also grown more slowly during the postwar period. However, more interestingly he suggests that these distortionary policies are more likely to be symptoms of underlying institutional problems rather than the main causes of economic volatility.[13]

Haber (2006) argues that governments enacted protectionist policies at the behest of manufacturers, responding to specific political and economic problems, and that they did not have a formal development strategy as such.[14] Nonetheless, during the sixties the ECLAC picked up the industrialisation topic trying to formalize the process that was already underway defining import substitution industrialisation in stages.[15] The period from the 1930s to mid-1950s consisted of a policy substituting consumer goods, in a second period there was a policy of substituting intermediate goods (1950s-1960s) and finally policies were directed at substituting capital goods (1960s-). According to Hirschman (1968) this was at the end hardly going to be completed due to the extreme need of external borrowing.

II. ECONOMIC PERFORMANCE IN LATIN AMERICA: AN OVERVIEW

Before the start of the twentieth century, major Latin American economies were already incorporated into the growth process of the world economic order. The so-called *belle époque* of liberalism during the nineteenth century where the first age of globalisation dominated the scene in world development came in Latin America to an end with the Great Depression in 1929. Latin American countries that were experiencing fast growth through their export-based economies (see table 1), were forced drastically to turn their production and specialization patterns due to the interruption of international capital flows, the fall in primary products prices, and to protectionist policies that U.S. and the United Kingdom promoted after 1929.

From the 1930s to the 1970s, Brazil and Mexico were among the fastest growing economies of the world. Although Argentina enjoyed its golden years a few decades earlier, these three major Latin American countries succeeded in industrializing and

[12] Taylor, 'On the costs of inward-looking development'.
[13] Acemoglu et. al., 'Institutional causes'
[14] Haber, 'The political economy'
[15] ECLAC is the acronym for the United Nations Economic Commission for Latin America and the Caribbean.

increased their shares in world production during the second half of the twentieth century despite their lack of competitive assets in technology, physical and human capital.[16] While much of the industrial preconditions were established at the closing decades of the nineteenth century, the decades after 1930 represented a period of important macroeconomic and institutional developments in these economies. However, the Great Depression was felt heavily in the region, reducing drastically the volumes and prices of their main exports.

The decline in Latin American exports and the freely floating exchange rates produced sharp currency devaluations. These depreciations caused high levels of implicit protection for the manufacturing sector due to the increase of import prices, boosting domestic production.[17]A combination of heterodox macroeconomic policies (with the abandonment of the gold standard) in the midst of declining world trade made ISI an implicit phenomenon without an explicit state-planned policy in a first stage.[18] Manufacturing sectors became a big part of the overall production shares of their economies, becoming the leading engines of growth.[19]

Table 1. Export growth in selected regions

	Annual rate (%)		
	1870-1913	1913-1929	1929-1950
Latin America	3.6	3.4	1.4
Western Europe	3.2	0.2	-0.3
North America	4.7	3.2	1.8
World	3.4	0.9	0.3

Source: E. Grilli (2005).

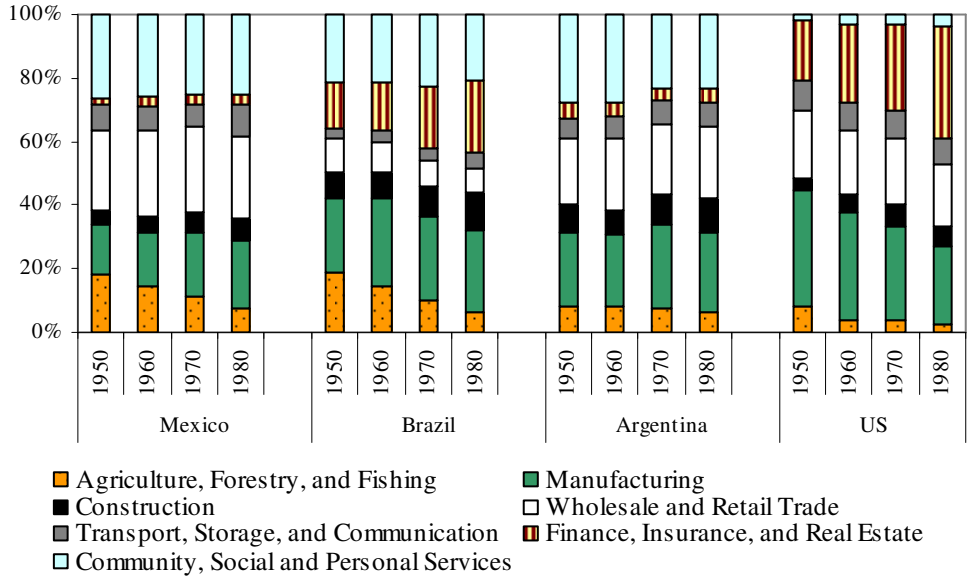
The time and pace of product specialization played a major role in the productivity performance for each country. For instance, the rise of the Brazilian coffee bean industry and the earlier production of foodstuffs in Argentina at the end of the nineteenth century were important preconditions triggering the rapid growth of manufactures during the thirties, allowing them to pursue a massive import substitution in other sectors such as intermediate and investment goods. However, these specialization shifts in manufacturing did not happen automatically. Institutions during ISI evolved progressively according not exclusively to market conditions, but to arrangements of labor unions in a framework of a corporate state, which that not only diverged from the context in the United States and Europe, but also within Latin American countries.

This change of development paradigm not only meant a challenge to the world in the midst of depression and wars, it also represented the pessimism from liberal policies in their search for self-sufficiency. Even though the exhaustion and collapse of ISI was foreseeable by the 1960s, living standards improved during this period.[20] Some scholars have argued that these improvements were mostly acknowledged by an active government intervention of unsustainable government investments and social expenditure which under weak taxation systems lead to high levels of debt accumulation unleashing a debt crisis and a 'lost decade' of macroeconomic adjustment

[16] Hikino and Amsden, 'Staying behind, stumbling back' (p.287)
[17] Haber, op cit.
[18] Díaz-Alejandro, 'Latin America in the 1930's'; Maddison, 'Two crises'; Haber, 'The political economy of industrialization'.
[19] Timmer and de Vries (2009) have argued a significant presence of sectoral productivity accelerations not only in manufacturing but in market services as well.
[20] Astorga, et al., 'The standard of living in Latin America'

during the 1980s.[21] Although there are claims alleging a process of a 'truncated industrialization' that was interrupted by the 'shock therapy' policies and economic reforms in subsequent years, the prevailing view of underperformance in productivity in Latin America countries is mostly attributed to the persistence of market distortions and competitive barriers that were created during the second half of the century.[22]

Figure 2. Sectoral composition of gross value added



Source: Derived from data by Timmer and de Vries (2009).

Table 2. Commodity composition of Latin American exports in 1929 (% of total)

Argentina	Wheat 29.2; maize 17.6; meat 12.8; linseed oil 12.6
Brazil	Coffee 71.0
Mexico	Silver 20.6; other minerals 47.0
Chile	Nitrates 42.1; copper 40.4

Source: A. Maddison (1991)

Moreover, it is also important to point out how the overall performance in the region was shaped by institutional developments around this period. The adverse shocks of war and depression reinforced import substitution and contributed to a rise of the share of manufactures but at the expense of efficient expansion of capacity.[23] Nonetheless, industrial production continued to grow during the thirties reaching levels of more than 60 percent above the 1929 levels by the end of the decade. This was possible by the continued protective mantle of the weak foreign trade position.[24] A significant proportion of industry in GDP can be observed in table 3. As it is shown, industry was an important component of growth even before 1929. This might have contributed to the economic recovery in the following years.

[21] Dornbusch, R. and Edwards, S., *The Macroeconomics of Populism in Latin America* (Chicago, 1991).
[22] Taylor, 'On the costs of inward-looking'.
[23] Fishlow, 'Brazilian development'.
[24] Baer, *Industrialization and economic development in Brazil*, pag. 16.

Table 3. Ratio of Manufacturing in Total GDP and Growth Rate
(Percentages)

	Manufacturing/GDP			Annual Rate of Growth	
	1928	1939	1945	1932-1939	1939-1945
Mexico	11.8	16.0	19.1	10.3	8.0
Brazil	12.5	14.5	17.2	6.7	4.5
Argentina	19.5	22.7	24.7	6.4	3.1

Source: ECLAC, *Series Históricas de Crecimiento de America Latina*, (1978).

As table 4 shows, GDP growth in the referred economies was quite respectable compared to the US. Negative growth rates of labor productivity in Argentina turned positive after 1929 and Brazil and Mexico took off afterwards. As we have mentioned, manufacturing sectors were the 'engine of growth', and governments knew that positive linkages in these industries would generate high employment rates. Thus, the promotion of these sectors via tax exemptions, trade tariffs, and other non-tariff barriers that were demanded by industrialists were a common policy instruments to promote growth. However, the structure of sectoral shares was not only dominated by manufacturing. The tertiary activities had an important share, and in subsequent decades this pattern became more evident with increasing activity in retail and whosale trade (figure 2).

Table 4. Growth and productivity
(Average annual compound growth rates)

	1913-1929	1929-1950	1950-1973
Total GDP			
Brazil	4.7	5.0	6.9
Mexico	0.8	4.0	6.5
Argentina	3.5	2.5	4.0
US	3.1	2.6	3.7
	1929	1938	1950
Labor productivity (GDP per man hour)			
Brazil	3.0	3.9	3.9
Mexico	1.0	3.4	4.2
Argentina	-0.2	2.7	2.6

Source: Hofman and Mulder (1998).

III. POLITICS AND INSTITUTIONS AFTER THE GREAT DEPRESSION

Productivity developments not only come from the production process itself, it is also the outcome of individual and collective decisions undertaken by economic and social actors. In this sense, in the policymaking process some actors can be favored by economic decisions that provide them with rents leading to negative/positive effects on productivity. [25] Moreover, these decisions may have to do with changing institutions and economic policies over time. In the case of major Latin American countries, key economic sectors such as manufacturing, experienced important institutional changes throughout the twentieth century and some crucial ones after the 1930s.

[25] Stein et. al., 'Policymaking'

Protectionist policies enacted from the US and UK, such as the Smoot-Hawley tariff in 1930 and the British Commonwealth Preferences settled in Ottawa in 1932, changed the pattern of international trade in nearly every single country. The highly trade-dependent Latin American countries were affected heavily. Exports, net incomes and employment collapsed, making 'reactive countries' such as Mexico, Argentina and Brazil in Diaz-Alejandro's terminology to respond abandoning the gold standard rules in order to promote their products and to reactivate their economies.[26] A period of industrial interventionism started in the region, still without a structural element that could have been considered strictly as a national strategy in Latin America.

However, the state expanded its influence in many economic sectors, especially in agriculture and manufacturing, creating special programs directed to stimulate domestic investment. Supporting manufacturers was part of a program of export substitution, where price support schemes were intended to internalize the economic activity.[27] Rural exodus to industrial cities created a large workforce demanding participation in national policies. Labor unions gained importance in the political structures, and around the thirties at the time when newly Latin American polities entered into power, these were forced to have a mandatory membership to the state. Labor rights and benefits were implemented; such as a social security program and minimum wage for urban workers.

Governments headed by Getúlio Vargas (1930-1945) in Brazil, Lázaro Cárdenas in Mexico (1934-40) and Agustin Justo in Argentina (1932-1938), followed in separated contexts state interventions in which 'corporatist policies' (understood as social arrangements where employers associations and labor representations in unions were attached to the state), played a major role.

This corporate model had the aim of controlling labor relations at the firm level, limiting wage demands to the growth of productivity. According to Eichengreen, manufacturing wages in Western Europe and Japan grew by 3 percent per year after the Second World War, allowing rapid growth in tandem with their high productivity levels.[28] However, in Mexico, Argentina, and Brazil, these relations evolved in a different way.

In 1930, the Brazilian revolution brought into power a coalition of forces lead by Vargas, an era of economic nationalism in the midst of a clash of strong economic interests between landowners, industrialists and workers. Vargas advocated a program of social reform and economic modernization by imposing tariffs to favor manufacturers. In the following years, the so-called *Estado Novo*, established a new Constitution which gave absolute power to the President, and even though at the beginnings of Vargas' administration the agenda apparently tended to favor left-wingers representations, it rather repressed communist labor movements. New legislations were issued to force labor unions to be attached to the Government as state agencies, controlling and supervising them through the Ministry of Labor.

Labor relations in Brazil after WWII were very complex. Industrialists (employers) and labor representations in Sao Paulo were in constant tension and conflict, and left-wingers controlled the national agenda towards social reform that industrialists rejected. This lack of 'social compact for growth' in turn, prevented industrial real wages to grow in tandem with productivity. However, a profitable

[26] Díaz-Alejandro argued a distinction between reactive and passive countries; reactive were the ones that could depreciate their exchange rate and speed up the relative price adjustment faster than others and viceversa.
[27] Lewis, 'Industry in Latin America'.
[28] Eichengreen, 'Institutions and economic growth'.

environment for manufacturing firms surged due to this slow growth of real wages behind faster movements in productivity.[29]

During the same period, the Mexican economy was experiencing a decline in mining and oil activities which where the leading sectors at the end nineteenth century, in turn, these were being replaced by agriculture and manufacturing.

The corporate-state model surged in Mexico after the Revolution during a period called *Maximato*.[30] During this period, a new party emerged - Partido Nacional Revolucionario - or PNR, later renamed PRI. However, when Lázaro Cardenas was addressed as President, he gave a leftist ideology to the party, involving land reform, state control of natural resources, insurance, and a strong labor wing in the party. The *Confederación de Trabajadores de México* or *CTM* was formed, in which most of labor unions were organized and subsequently integrated into the official party. The consolidation of the party provided the basis of both popular support for the new state and control over the labor force. [31]

In spite of its leftist rhetoric, the government was successful in developing a good cooperation between industrialists (foreign and domestic) and workers representations. Manufacturers received fiscal privileges, protection and favors from the state if they stayed in line supporting the official policy.

In the case of Argentina, the depression years witnessed substantial changes in its industrial base, including certain branches of manufacturing such as textiles and metallurgy. These new factories produced for the domestic market and most of them had foreign, especially British interests.[32] Conservative governments before the period of populist leader Juan D. Perón began to intervene directly in the economy. The *infamous decade* (1930-1943) had significant changes in the labor politics of the country. Left-wing trade unions began to occupy a space in public life and strengthened a labor movement, which at the time was founded the *Confederación Nacional del Trabajo* or CNT, having a strong influence in labor contract decisions.

This brief description of the political environment in these countries, questions how this could have affected industrial performance and how industries evolved differently than in the US and other industries in advanced economies. Labor unrest in Latin America responded to different aspects of the labor market environment. However, the common denominator in Brazil, Mexico, and Argentina were the strong left-wing components in labor unions searching to have a determinant weight in wage bargaining. The level of the political pressures on industrial wages must have varied in each country due to different configurations of the corporate-state model promoted by ISI.

[29] Colistete, 'Productivity, wages and labor politics'

[30] Name given to the period in which Plutarco Elías Calles, referred as 'the "Maximum" leader of the Mexican revolution' and who was president from 1924-1928, had indirect power in the following years to name his presidential successors and maintaining his political power.

[31] Maddison, et al. 'The political economy of poverty.'

[32] Rapoport, 'Argentina'.

IV. THEORETICAL BACKGROUND

Policy choices and weak institutions are a major part in the complex evolution of the development gap, not only at the international level, but also within their societies, where income inequality has played a major role for centuries restricting the creation of 'good institutions' and growth.[33] However, the unequal conditions on the continent have not always been the same. Inequality levels in Latin America were lower than Europe during colonial times but since 1800, dramatic increases can be detected in the twentieth century.[34] These inequalities are inexorably related to the differences in industrial performance over the years.

From the production side it is difficult to make a generalization of a general pattern of the continent performance. Major countries in the region such as Argentina and Chile had already developed a strong export industry base since the middle of the nineteenth century, while Brazil and Mexico also had different economic structures and institutional settings compared to the developed world. However, even in an international perspective, in the twentieth century major Latin American economies experienced divergent patterns of growth. For instance, in some cases international growth downturns meant growth ignition for these countries.

Unlike developed countries, were long-term economic growth comes mainly from technological innovation, the dynamics of growth in developing countries, comes less from approaching the world technological frontier and more from the promotion of activities with higher levels of productivity, adapting or adopting the existing technology and entering the world markets for manufactures and services.[35]

In the neoclassical Solow model, the long-run rate of economic growth is only determined by 'exogenous' technological change and by changes in the rate of population growth. However, the way in how this variable of technology change is conceived within the model, is what has led many theorists to believe that this component is endogenous, varying depending on the research efforts by firms, the level of schooling and, more generally, the existence of an appropriate institutions that foster the operation of market forces playing a prominent role in explaining the observed uneven process of technical change across countries (Fagerberg, 1994).

Early literature from economic historians on convergence such as Gerschenkron (1962) and Abramowitz (1986) have described how by pushing out the technological frontier, countries in the lead create opportunities of international technological diffusion. This allows backward economies to catch up, mainly because imitation is easier than innovation. Productivity levels will, thereby, tend to converge. This convergence is, however, conditional upon the settings like 'social capabilities' of absorption of these more advanced technologies, which at the same time, depends on factors comparable to those underlying technical change. These ideas have been further developed in the neo-Schumpeterian growth model on technical change, emphasizing on the accumulative nature of technological change, constraining firms on the possibilities of what they can do by their past behavior.

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[33] Robinson, James A., 'The Latin American equilibrium', in *Falling behind: Explaining the development gap between Latin America and the United States*, Fukuyama, F., ed. (Oxford, 2008); Engerman S. and Sokoloff, K., 'Factor endowments, inequality and paths of development among new world economies' *NBER WP*, no. 9259 (2002).

[34] Williamson, G. Jeffrey, 'Five centuries of Latin American Inequility'; and Frankema, 'The historical evolution'

[35] Ocampo J.A., Jomo K. and Vos, R. 'Explaining growth divergences' in *Growth divergences*, Ocampo, J.A., Jomo K, and Vos R., eds. (United Nations, 2007).

Distance to the Frontier Approach

Recent contributions emphasize the different roles that "appropriate" institutions and policies may play in both backward or advanced economies, and the distinction between innovation activities and adoption of existing technologies from the (world) technology frontier (Acemoglu, et al., 2006).

Following a standard Cobb-Douglas type production function, with constant returns to scale and augmented by a variable reflecting the level of Total Factor Productivity, (TFP) and this can be represented as follows:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{1-\alpha} \qquad 0 < \alpha < 1$$

where A_{it} is a productivity parameter attached to the technology used in industry *i* at time *t*. K_{it} represents the flow of a unique intermediate product used in this sector, each unit of which is produced one for one by final output or in an aggregate version, by capital. And L_{it} is the labor input used in that industry. Therefore, aggregate output is the sum of the industry-specific outputs Y_{it} measured by value added at factor costs.

In this standard neoclassical model, the rate of growth of A_{it}, is determined by the rate of exogenous technical progress. To the extent that it is equally accessible, this is assumed the same for all countries in each sector under consideration. Once one does, however, allow for technological diffusion between countries, one has to allow for the fact that countries with a less advanced technology can benefit from the possibility of imitation from countries that are technologically more advanced.

Consequently, one should expect that the further a country's technology is behind the technological frontier, the greater are its possibilities of technical advance through imitation, and, therefore, the stronger will be its TFP growth. As the Schumpeterian scheme followed by Aghion and Howitt (1998), where an innovation leapfrogs the best technology available before the innovation resulting in a new technology parameter A_{it} in the innovating industry *i*, which is some multiple γ of its preexisting value. Moreover, it encompasses the case of an innovation that catches up to the world technology frontier $\bar{A}$. We can consider a country in which in any industry leading edge innovations take place at the frequency μ_n and the imitation take place at the frequency μ_m. Thus, the rate of growth of TFP of country it is expressed as follows:

$$A_{it+1} - A_{it} = \mu_n(\gamma - 1)A_{it} + \mu_m\left(\bar{A}_{it} - A_{it}\right)$$

and hence the growth rate will be

$$g_{it} = \frac{A_{it+1} - A_{it}}{A_{it}} = \mu_n(\gamma - 1) + \mu_m\left(a_{it}^{-1} - 1\right)$$

where

$$a_{it} = \frac{A_{it}}{\bar{A}_{it}}$$

is an inverse measure of the "distance to the frontier."

This scheme allows us to analyze how an industry's growth performance will vary with its proximity to the technological frontier a_{it}, and to what extent the industry will tend to converge to that frontier and what kinds of policy changes are needed to sustain convergence (Aghion and Howitt, 2009).

V. DATA

Data continuity and availability have been one of the main impediments of the progress of the so-called 'new economic history' approach in Latin America.[36] Statistical series suffer from important discontinuities during crucial periods of international economic change. For instance, there is not a single homogenous and uninterrupted annual data series of Gross Domestic Product (GDP) for the first half of the twentieth century that comes directly from an economic survey without any manipulation by interpolation or extrapolation techniques. Nevertheless, there have been many efforts to collect and reconstruct statistical information with a standardized time span. ECLAC (established in 1948), assembled official country-based statistics on economic, social and demographic variables. Unfortunately, most of this information suffers from the problem of aggregation and standardized data typically is available from 1950 onwards.

Aggregate economic figures hide important information about specific phenomena. GDP at aggregate level by itself does not capture sectoral dynamics in a changing economy. However, the scope of decomposing statistical information depends mostly on the methodology survey design of the original source. The famous long span figures of Maddison (2005, 1998, 1987) have contributed in offering a standard use of long term data (most of it is focused on GDP levels and aggregate population measures) to make international comparisons. Recently the Groningen Growth Development Centre built a 10-sector database for Latin America extracted from the Systems of National Accounts (SNA) and other official sources of these countries. Unfortunately, there is no industry detail and the initial year in the majority of the cases starts after 1950.

Scholars at Oxford University along with the Inter American Development Bank (IADB) constructed a database for Latin America (OxLAD) of economic and social indicators covering twenty countries for the period 1900-2000. Their collections come from different international offices, national accounts and data from renowned scholars. Even though this represents a good source in terms of comparability, it lacks completeness. For instance, the industry sector includes only electricity, cement and beer, which are not the exactly the strong manufacturing branches in terms of overall production shares of these countries.

However, if we focus only on industry, the so-called 'censos industriales' (renamed afterwards *censos económicos*) are a complete survey covering the extractive and transformation industries, manufacturing sector, construction, commerce, transport and communication, and services. These are collected every five years but its initial year varies in each country. In Mexico, the first one started in 1930. In Argentina, it starts since late nineteenth century until 1917 and then was interrupted for many years and collected again since 1935. In Brazil the collection started in 1940 which corresponded to the previous year (1939). Nonetheless, an important limitation arises

[36] Haber, S. 'Introduction', in *How Latin America fell behind? Essays on the economic histories of Mexico and Brazil, 1800-1914,* Haber, S., ed. (Stanford, 1997)

from these surveys, namely currency convertibility. All values from these surveys are expressed in their own currencies and the structure of the survey does not provide the elements (values and quantities of produced items) to make a PPP conversion. We solve this limitation by collecting export prices on the most important items of the manufacturing sector from Mexico, Argentina and Brazil during the selected years and weight them with our available production records and foreign trade statistics:

Censo Industrial de México, 1930, 1935. 1940. 1945, 1950, 1955, 1960 and 1975.
Censo Industrial de la República de Argentina, 1935, 1947, 1954 and 1975.
Censo Industrial do Brasil, 1939, 1950, 1955, 1975.

Foreign trade statistics:

Estadísticas de Comercio Exterior de los Estados Unidos Mexicanos (1935, 1950, 1975)
Estadísticas de Comercio Exterior de la República de Argentina (1935, 1950, 1975)
Estatisticas do Comercio Externo do Brasil (1935, 1950, 1975)

VI. DISAGGREGATED COMPARATIVE MANUFACTURING USING EXCHANGE RATES CIRCA 1935

International comparisons using exchange rate conversions are questionable since they represent at best the relative price of tradables, and not that of non-tradable sectors. Moreover, sometimes they are not even representative for relative prices of tradables, as these tend to be affected by capital movements, monetary policy and speculation. However, in this attempt to measure and compare manufacturing, it is important to point out the differences between raw estimates (nominal) and real calculations using different methodologies, and also to offer a general view at first glance of the production shares and performance in an highly heterogeneous industry.

Industrial heterogeneity in manufacturing is related to many factors; natural resources, composition of human capital, and policy orientation, amongst others. Therefore, employment distribution varies across major Latin American countries. For instance, Brazil's food sector is one of the largest in employment share compared to the US, as well as Mexico's textiles where these sectors (in Brazil and Mexico) covered more than a third of the manufacturing labor force. It is possible to detect labor concentration in some industries due to patterns of specialization.

As table 5 shows, US manufacturing employment had a large share in engineering, shipbuilding and vehicles trade, which in part indicates how the capital goods industry was being developed compared to Brazil. Mexico incipient capital goods industry was not even registered in the official industrial census. However, Argentina's earlier period of industrialization during the XIX century with large amounts of British investments allowed it to develop some industries in car assembly and electricity.

Table 5. Distribution of Manufacturing Employment c.1935
(Percentages)

Branch/Country	Mexico	Argentina	Brazil	US
Textile Trades	34.8	8.5	23.1	14.8
Leather Trades	1.6	2.8	1.9	1.1
Clothing Trades	8.5	5.5	4.7	10.4
Iron and Steel Trades	9.5	7.1	6.3	10.7
Engineering, Shipbuilding and Vehicles Trades	2.3	20.0	3.9	19.6
Food, Drink and Tobacco Trades	23.5	20.6	35.9	11.9
Chemical and Allied Trades	4.5	3.4	9.1	5.3
Building Materials Trades	5.3	11.0	4.7	2.8
Timber Trades	5.4	8.5	2.8	6.8
Paper Trades	5.1	6.6	1.8	9.0
Miscellaneous Trades	2.4	7.1	5.8	3.8
Unassigned Trades	-	-	-	1.0
Non-ferrous Metals Trades	-	-	-	2.9
Total	100	100	100	100

Source: See appendix.

However, employment allocation is not always related to productivity levels in the short-run. For instance, Brazil's chemicals and engineering sectors had an important contribution in productivity levels, covering together more than one third of the value added per person in manufacturing which was very similar to the US distribution (Table 6). In the case of Mexico, the food, drink and tobacco sector covered more than a third of the share of value added per person, even though the textile sector employed more workers and employees overall.

Table 6. Distribution of Manufacturing Value Added per Person Employed by Branches
(Percentages)

Branch/Country	Mexico	Argentina	Brazil	US
Textile Trades	27.3	7.3	6.4	8.9
Leather Trades	0.9	3.9	4.5	0.9
Clothing Trades	5.1	4.1	3.4	7.3
Iron and Steel Trades	3.3	9.6	6.1	10.2
Engineering, Shipbuilding and Vehicles Trades	5.1	10.9	11.5	20.1
Food, Drink and Tobacco Trades	31.9	21.2	16.1	2.9
Chemical and Allied Trades	8.3	13.7	21.0	15.8
Building Materials Trades	6.4	11.4	6.7	9.2
Timber Trades	2.2	9.3	2.6	2.9
Paper Trades	4.1	3.2	4.3	4.3
Miscellaneous Trades	6.4	5.4	10.6	11.7
Unassigned Trades	-	-	3.6	5.1
Non-ferrous Metals Trades	-	-	3.2	0.8
Total	100	100	100	100

Source: See appendix.

As many have pointed out, industrialization in Latin America during the thirties was labor intensive and involved many medium and small firms in manufacturing.[37] Taking a closer look at the labor force, and observing the human capital content

[37] Diaz-Alejandro, *op cit*.

according to table 5, the textile trades employed ten times more workers than employees in manufacturing and even twenty times more in Argentina's textiles. This not only shows the labor-input intensity of the industry, it also gives a rough indicator on how skilled was labor force, considering that workers earned less than employees and their education levels were lower. For all cases, a large share of unskilled labor was allocated in textiles, as the opposed was the case in the chemicals sector, engineering and food.

Table 7. Worker/Employee Ratio in Manufacturing

Branch/Country	Mexico	Argentina	Brazil	US
Textile Trades	16.5	21.9	12.7	16.4
Leather Trades	9.0	9.3	0.8	9.6
Clothing Trades	11.0	9.9	4.8	11.4
Iron and Steel Trades	14.3	12.6	7.2	8.2
Engineering, Shipbuilding and Vehicles Trades	4.2	7.1	5.3	6.2
Food, Drink and Tobacco Trades	9.4	8.1	3.8	5.8
Chemical and Allied Trades	5.2	4.7	3.2	6.5
Building Materials Trades	11.1	15.4	7.3	4.2
Timber Trades	14.4	19.8	3.4	8.3
Paper Trades	6.1	6.3	6.4	10.6
Miscellaneous Trades	8.8	7.6	5.2	2.7

Source: See appendix.

In Argentina labor unrest in building materials industries, food and engineering industries was a common phenomenon during these years. However, average wage levels in these industries in some cases almost doubled the Brazilian wages. In some way, Brazilian labor demands lead by the left-wing representations had a reasonable argument in a comparative perspective. Although, this represented the cost for the employer and does not include a purchasing power parity value of a Brazilian basket, it gives some hints of the wage dispersion and the heterogeneity across industries.

Table 8. Average Wage by Branch
(at 1935 US Dollars)

Branch/Country	Mexico	Argentina	Brazil*	US
Textile Trades	195	298	112	792
Leather Trades	177	497	122	1019
Clothing Trades	175	637[a]	136	882
Iron and Steel Trades	300	374	172	1126
Engineering, Shipbuilding and Vehicles Trades	192	518	200	1246
Food, Drink and Tobacco Trades	147	113	115	1089
Chemical and Allied Trades	180	403	135	972
Building Materials Trades	181	332	170	1101
Timber Trades	147	296	139	971
Paper Trades	284	413	128	778
Miscellaneous Trades	125	403	139	1255
Unassigned Trades	-	-	-	1130
Non-ferrous Metals Trades	-	-	-	602

* Converted with 1939 US official exchange rate
[a] In the clothing branch was included clothing workshops and 'roperos'.
Source: See appendix.

According to table 9, a Mexican average wage in textiles was a quarter of the US levels which was in the middle between Brazil and Argentina. The latter had more than a third of the American levels. The high level of the Argentinean average wage in clothing (0.72) can be explained due to the inclusion of the clothing workshops and roperos that that industrial census recorded in their statistics. However, in Mexico and Brazil, the ratio of the average wage in this sector was around one fifth of the US levels.

Table 9. Wage differentials with US levels
(1935 US Dollars)

Branch/Country	Mexico	Argentina	Brazil
Textile Trades	0.25	0.38	0.14
Leather Trades	0.17	0.49	0.12
Clothing Trades	0.20	0.72	0.15
Iron and Steel Trades	0.27	0.33	0.15
Engineering, Shipbuilding and Vehicles Trades	0.19	0.42	0.16
Food, Drink and Tobacco Trades	0.13	0.10	0.11
Chemical and Allied Trades	0.19	0.41	0.14
Building Materials Trades	0.16	0.30	0.15
Timber Trades	0.15	0.31	0.14
Paper Trades	0.37	0.53	0.16
Miscellaneous Trades	0.10	0.32	0.11

Source: See appendix.

As it is shown in tables 10 and 11, manufacturing productivity levels had a large degree of dispersion across industries. It is possible to detect high levels of Brazilian chemicals and engineering, and a high level of Argentinean textiles as well. Mexico showed comparatively high productivity levels in food, drink and tobacco industries. The gap between productivity and wage levels that we found in these industries across countries, shed some light on the profitability of some industries and on how low the bargaining power of labor unions was, despite the constant struggles between industrialists, government and labor organizations during the epoch.

Argentina had an important lead in the size of the wage differential compared to Mexico and Brazil, especially in engineering, leather and clothing. Nevertheless, Brazil's low average wage in manufacturing contrasts with their high productivity levels, where engineering and chemicals overtook by far the levels of Mexico and Argentina.

Table 10. Manufacturing Productivity by Branch
(Value added per person employed at 1935 US Dollars)

Branch/Country	Mexico	Argentina	Brazil	US
Textile Trades	234	473	255	1359
Leather Trades	172	204	363	1947
Clothing Trades	177	254	273	1583
Iron and Steel Trades	92	187	327	2169
Engineering, Shipbuilding and Vehicles Trades	304	322	695	2324
Food, Drink and Tobacco Trades	455	155	390	3000
Chemical and Allied Trades	550	241	1053	3963
Building Materials Trades	356	226	453	2302
Timber Trades	103	306	215	1414
Paper Trades	241	187	349	2942
Miscellaneous Trades	427	57	282	2996

Source: See appendix.

Table 11. Manufacturing Productivity as Percentage of US levels
(Value added per person employed at 1935 US Dollars)

Branch/Country	Mexico	Argentina	Brazil
Textile Trades	0,17	0,35	0,19
Leather Trades	0,09	0,10	0,19
Clothing Trades	0,11	0,16	0,17
Iron and Steel Trades	0,04	0,09	0,15
Engineering, Shipbuilding and Vehicles Trades	0,13	0,14	0,30
Food, Drink and Tobacco Trades	0,15	0,05	0,13
Chemical and Allied Trades	0,14	0,06	0,27
Building Materials Trades	0,15	0,10	0,20
Timber Trades	0,07	0,22	0,15
Paper Trades	0,08	0,06	0,12
Miscellaneous Trades	0,14	0,02	0,09

Source: See appendix.

VII. THE INDUSTRY OF ORIGIN APPROACH

The foundations of the industry of origin approach for international comparisons comes from the work of Rostas (1948) and Paige and Bombach (1959), and then was further developed by scholars at the University of Groningen led by Angus Maddison (1988). This approach derives purchasing power parities from values of output and quantities produced by sector of the economy, combining data on labour and capital, allowing to measure total factor productivity. Most of these comparisons have been bilateral, with the United States and/or the United Kingdom and Germany as benchmark countries[38], though multilateral techniques have also been applied to manufacturing and agriculture comparisons.

These comparisons aim to develop industry-specific conversion factors using producer output data instead of final expenditure information. From the quantity and value data of specific products, it is possible to calculate the average price of an item, a

[38] See for instance de Jong, Herman, and P. Woltjer, 'Depression dynamics'.

so-called *unit value*. By matching as many products as possible, unit value ratios are derived which can be weighted up to industry, branch and total manufacturing levels. These can then be used to express output of different countries in a common currency.

One major advantage of this approach is that in general all necessary information can be derived from a single primary source, which for manufacturing is the census of production or industrial surveys. These sources contain a great detail on the output and input structure by industry and information on the sales values and quantities of most products. For the Latin American case, as has been mentioned earlier, the data can be derived from the latest census of production from the so-called 'censos industriales'.

As the production censuses are not well harmonized across countries, our comparisons will be done in a three-country basis Argentina/US, Brazil/US and Mexico/US. As we have mentioned before, the advantage of comparing these three economies with the US is that this will provide an indication of the productivity gap between the countries and as such the potential of catch-up.

In this method, relative prices are referred to as unit value ratios (UVR's) instead of PPP's as they are based on ratios of unit values (UV's) of products. These unit values are derived by dividing ex-factory output values (o) by produced quantities (q) for each product i in each country:

$$UV_i = \frac{o_i}{q_i}$$

The unit value is a kind of average price at which a similar group of products was sold by all manufacturers in a given year. In each bilateral comparison, products are matched according to more or less detailed product descriptions, e.g. fruits, infants' textile products, etc. For each matched product, the ratio of the unit values of both is calculated:

$$UVR_i^{XU} = \frac{UV_i^X}{UV_i^U}$$

with *x* being either Argentina, Brazil or Mexico and *u* the base country, the United States. The UVR indicates the relative producer price of the matched product in both countries. Product UVR's are used to estimate UVR's at more aggregate levels: industries, branches and total manufacturing. Manufacturing output is the sum of output of branches, which in turn is the sum of the industries' output value. The value of an industry's output equals the sum of the values of the produced products. Within the comparison of each industry between two countries, only part of products can be matched as quantity information often lacks, it may be difficult to find comparable products, or countries produce unique products. The matched products can be considered as a sampled subset of products within an industry which relative price, under certain conditions, may be considered representative for the non-matched part.

Example of Aggregation: Paper and Manufactures, Argentina/USA, 1935

	Product matches	US			Argentina			UVR of product matches		
		Value (million US$)	Quantity (lbs)	Unit Value	Value (million Arg pesos)	Quantity (lbs)	Unit Value	At US weigths	At Arg weights	Fisher
Paper and Manufactures	7	**171048**			**476000**					
Printing paper	1	**52480**			**153797**			**167**	**167**	**167**
Standard newsprint		52480	104965	**0.50**	153797	1842	**83.5**	167.00	167.00	167.00
Writing paper and envelops	6	**118568**			**322203**			**1315**	**1252**	**1252**
Surface coated paper		15110	2900	**5.2**	21400	4	**5350**	1027	1027	1027
Uncoated paper		12720	1105	**11.5**	85727	5	**17145**	1489	1489	1489
Paperbound law books		11149	490	**22.8**	53750	2	**26875**	1181	1181	1181
Tissues		67162	11100	**6.1**	59342	6	**9890**	1635	1635	1635
Pulp in rolls		11292	4818	**2.3**	92054	28	**3288**	1403	1403	1403
Cigarrete paper		1135	1315	**0.9**	9943	7	**1420**	1646	1646	1646

FINAL REMARKS

Latin America's underdevelopment is rooted in its history. The complexity for assessing this relies also on its historical documents and primary sources. However, in the past decades new research has emerged provoking noteworthy discussions. The purpose of this project is to attempt to fill the gap in the existing literature of Latin American industrialisation after the Great Depression by constructing production-side measures of output and productivity for manufacturing industries of three major countries of the region. This will allow us to explore on a disaggregated basis the performance of these industries making use of an international comparative perspective to understand the economic transformations that Latin America experienced during the classic period of ISI. The innovation of the research relies not only on the level of disaggregation, but in also in the theoretical approach to explain how far each branch and industry was from the worldwide 'best practices' and how this gap changed over time.

PROJECTED CHAPTERS

1. 'The Political Economy of Manufacturing Productivity in Mexico, Brazil and Argentina in Early Import Substitution, 1935-1950' (work in progress)

2. 'Decomposing Manufacturing TFP Growth in postwar Latin America, 1950-1975'

3. 'The Distance to the US technology frontier of Latin American Manufacturing Industries, 1935-1975'.

4. 'Latin America and Eastern Europe's Industrial Patterns during the Post-War Period: Parallel Economic Histories?'

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APPENDIX

Data presented for 1935 was based in official industrial censuses as follows:
- Mexico: *II Censo Industrial de los Estados Unidos Mexicanos*, *1935.*
- Argentina: *IV Censo Industrial de la República de Argentina*, *1935*
- Brazil: *II Censo Industrial do Brasil*, 1939.
- US: *Biennial Census of Manufactures of 1935,* extracted from appendix in de Jong, H., and Woltjer, P., 'A Comparison of Real Output and Productivity for British and American Manufacturing in 1935', *Research Memorandum GD-108*, University of Groningen (March, 2009).

US dollar conversions were using official exchange rates for 1935 in Mexico and Argentina and for 1939 in Brazil:

Mexico: 3.59998416 =1 USD

Argentina: 3.061989999= 1 USD
Brazil: 16.65917004=1 USD (1939)