

Brazil and the Middle-Income Trap: Its Historical Roots

Eduardo da Motta e Albuquerque

This paper evaluates the alternation between catching up periods and falling behind periods in Brazilian economic history, with data from 1870 to 2016. This alternation expresses the middle income trap. A tentative theoretical framework is presented, suggesting a two-dimensional process, with external forces (basically technological revolutions in leading countries) increasing the gap between Brazil and the leading economy, and internal forces (basically planned or unplanned internal efforts, especially industrial policies) reducing that gap. The historical origins of this long term middle income trap is discussed, with a special focus in the role of income inequality.

Keywords: Underdevelopment, Development, Middle income trap, Catching up, Falling behind

JEL Classification: O1, O43, N16

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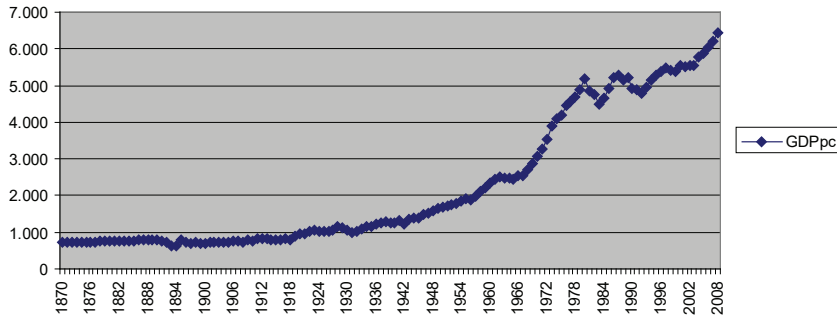
I. Introduction

Penn World Table (Summers and Heston 1991) and data from Maddison (see Maddison 2010, as an illustration) opened new avenues of research with new empirical opportunities for long-term, intercountry comparisons. In the investigation on Brazil, the Maddison data feed Figure 1, which presents the growth of the Brazilian economy over time. Between 1870 and 2008, Brazil's gross domestic product (GDP) per capita increased from US\$ 713.00 to US\$ 6,429.00 (in 1990 International Geary-Khamis dollars). An intertemporal comparison revealed that the Brazilian GDP per capita in 1870 was equal to the Japanese GDP per capita in 1870, and that the Brazilian GDP per capita in 2008 was similar to the US GDP per capita in 1929 or 1939.

However, the global economy has changed during this period. Between 1870 and 2008, four technological revolutions accelerated the growth in the dynamic center of the system (Freeman and Louçã 2001, p. 141). An evaluation of the meaning of this Brazilian economic growth, as presented in Figure 1, demands a broader context, and necessary international comparisons are feasible through the data from Maddison. A dynamic picture of the Brazilian growth is shown in Figure 2, which plots the data vis-à-vis the US economy (Y = the ratio between Brazilian GDP per capita and US GDP per capita).¹ The trajectory shown in Figure 2 is a long-term pattern wherein between 1870 and 2008, the Brazilian GDP per capita oscillated around 20% of the US GDP per capita (average ratio = 0.20).

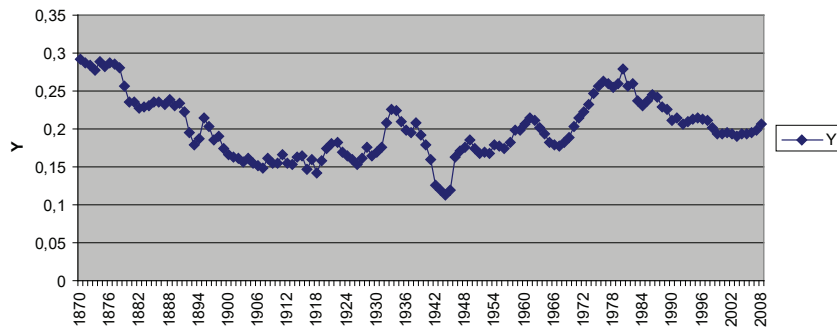
The Brazilian ratio (Y) and the Japanese ratio (Y) with the US economy in 1870 were similar. According to the data from the Maddison Project, between 1700 and 1870, Brazil and Japan had very similar trajectories vis-à-vis the US. In 1700, both economies had similar ratios vis-à-vis the US (ratios in the neighborhood of 1.00: Japan = 1.08; Brazil = 0.87), and during the 18th and 19th centuries, the US economy grew

¹ This ratio (a variable, Y) was used by Summers and Heston (1991, p. 362). Y is defined simply as "the ratio of the country CGDP to that of the United States" (p. 342). Country GDP (CGDP) is the "real GDP per capita (current international prices)" (p. 362). On the basis of this definition, the variable Y will be utilized throughout the present paper as the ratio between the GDP per capita from one country (Brazil, South Korea, Russia, China, and so on) and that of the US. In other words, Y reveals each country's relative level in relation to the US in terms of GDP per capita.



Source: Maddison (2010), author's elaboration

FIGURE 1
 BRAZIL, GDP PER CAPITA
 (GDP PER CAPITA IN 1990 INTERNATIONAL GEARY-KHAMIS DOLLARS) (1870–2008)



Source: Maddison (2010), author's elaboration

FIGURE 2
 RATIO OF GDP PER CAPITA BETWEEN BRAZIL AND THE US (Y)
 (GDP PER CAPITA IN 1990 INTERNATIONAL GEARY-KHAMIS DOLLARS) (1870–2008)

faster than the economies of Japan and Brazil, with ratios decreasing in 1870 to 0.302 and 0.292, respectively.² The Japanese and Brazilian trajectories were similar until 1894 (Japanese $Y = 0.251$; Brazilian $Y =$

² According to Maddison (2010), between 1820 and 1903, the US economy was catching up and forging ahead of the UK economy. In 1820, the ratio between the US and the UK was 0.74, and in 1903, the US GDP per capita overtook the UK GDP per capita.

0.231), at which point they diverged. In 1900, the Japanese Y was 0.29³ while the Brazilian Y decreased to 0.17. Japan performed two catch-ups during the 20th century (Odagiri and Goto 1993), reaching ratios of 0.43 in 1939 and 0.419 in 1963, whereas Brazil oscillated around a ratio of 0.20 (Figure 2).⁴

With an economic history punctuated by fractures and interruptions, the Brazilian economy was unable to achieve stable growth trajectories. The growth trajectories were interrupted by turning points in 1922, 1933, 1949, 1961, 1976, and 1980.

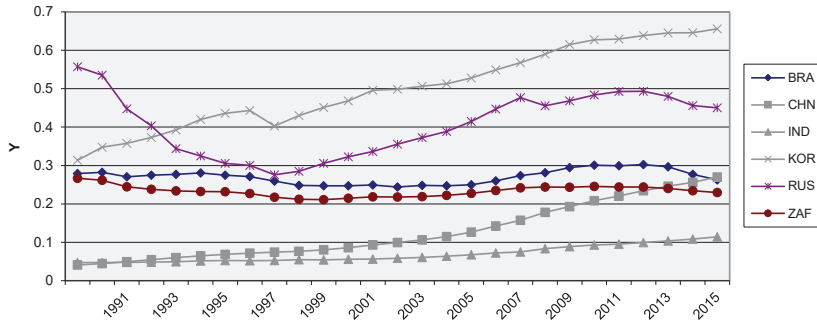
Figure 2 presents the context for the discussion in this paper, highlighting the dynamic comparison between Brazil, the country under investigation, and the US, the leading country since the 1870s. The Figure presents periods when the Y increases and Brazil reduces its gap vis-à-vis the US. The gap-reducing periods organize the paper into different “catching-up periods.” As presented in Figure 2, the catching-up periods are unstable, short, and interrupted. However, in 2008, the Brazilian economy lagged behind the US economy by a similar gap in 1895, when the economy was structurally very different. This lag is related to the positive side of the middle-income trap (MIT). The middle-income level is difficult to preserve, and the limited catching-up periods were important to, at least, preserving that 1895 level.

The definition of catching-up periods is important to differentiate them from “spurts,” as defined by Gerschenkron (1952). The implications of catching-up periods for development have been discussed in several studies. For example, Gerschenkron (1952) mentions one spurt during the German catch-up. Moreover, Ohkawa and Kohama (1989, p. 15) mention three spurts during the Japanese catch-up; the first, between 1913 and 1919 (p. 29), the second in the late 1930s (p. 176), and the third in the “latter part of the 1950s and was largely sustained over the 1960s” (p. 270).⁵

³ At this point, the different levels of social capabilities may be shown by the data on illiteracy. According to Odagiri and Goto (1993, p. 79), “illiteracy among the youth was nearly absent by the beginning of this century.” In 1990 in Brazil, 65.3% of people older than 15 were illiterate (Braga 2015, pp. 31–32).

⁴ For comparison, in 1991, South Korea reached a $Y = 0.41$.

⁵ The ratio between Germany and the UK in 1850 was only 0.61, and in 1870, it was 0.58, revealing a larger Y vis-à-vis the Japanese. In 1913, that ratio was 0.71.



Source: World Bank (2018), author’s elaboration

FIGURE 3

RATIO OF GDP PER CAPITA BETWEEN SELECTED COUNTRIES AND THE US (Y)
 (GDP PER CAPITA, PURCHASING POWER PARITY (PPP), CONSTANT 2011 DOLLARS)
 (1990–2016)

Figure 3 complements Figure 2 by presenting data between 1990 and 2016.

Figure 3 is based on recent data (World Bank 2018) and utilizes a different methodology; therefore, the two figures for similar years (1990–2008) are different.⁶ Figure 3 assists in presenting the stability of the Brazilian trajectory after 1990 and suggests one additional catching-up period between 2002 and 2010.

The Figure 3 also shows a comparison of different trajectories. South Korea reveals a successful catch-up trajectory, South Africa and Brazil seem to be trapped between a $Y = 0.20$ and a $Y = 0.30$, Russia may be a new country in the trap (oscillating below $Y = 0.50$ after 2007), China’s trajectory may lead to overcoming the trap, and India may be advancing toward a $Y = 0.20$. This cross-country comparison is important for learning lessons on overcoming developmental traps and establishing dialogues between countries.

The two sets of data make it possible to organize a broad picture of Brazilian economic history and analyze the long-term dynamics of the relationship between Brazilian GDP per capita and US GDP per capita. Table 1 presents data from Figures 2 and 3, summarizing the seven

⁶For a comparison between two databases, the Y in 1990 was 0.21 in Figure 2 and 0.28 in Figure 3.

TABLE 1
CATCHING-UP PERIODS: DURATION (YEARS), INITIAL AND FINAL Y, Y INCREASE (%),
AND AVERAGE ANNUAL Y INCREASE (%) (1900–2016)

Catching-Up Period	Number of Years	Initial Y	Final Y	Y Increase (%)	Average Annual Y Increase (%)
1918–1922	5	0.14	0.18	27.61	5.52
1929–1933	5	0.16	0.23	36.59	7.32
1944–1949	6	0.11	0.19	65.18	10.86
1956–1961	6	0.17	0.21	23.03	3.84
1967–1976	10	0.18	0.26	47.76	4.78
1978–1980	3	0.25	0.28	9.82	3.27
2002–2010(*)	9	0.19(*)	0.23(*)	23.14	2.57

Source: Figure 1, Maddison (2010); Figure 2, World Bank (2018) for 2002–2010 (*). Author's elaboration.⁷

identified catching-up periods. The data on the duration and size of each catching-up period contributes to the organization of this paper.

After the Introduction, this paper is organized into four sections. Section II presents a tentative theoretical framework that suggests a bi-dimensional dynamic alternating between catching-up periods and falling-behind periods. Sections III and IV summarize the catching-up periods in Brazil's economic history and presents key features of the unequal and heterogenic Brazilian economy, respectively. Section V concludes the paper.

II. Tentative Theoretical Framework

Since the Industrial Revolution, which was considered the first technological revolution, the leading country has offered a benchmark

⁷ For 2002–2010, the source is the World Bank (2018). According to World Bank data, the Y was 0.24 in 2002 and 0.30 in 2010 (Figure 3). To organize a comparison between the two databases, a simple conversion was implemented; the average of the division of the ratios (Y) according to the two databases for the years they have in common (1990–2008) was 0.7718. This value was multiplied by the ratios (Y) according to the World Bank, and the results are presented in Table 1. However, the column “Y increase” was calculated with the original values.

or moving target for followers to catch up (Braudel 1986, p. 546) through the succession of technological revolutions at the center (Freeman and Louçã 2001, pp. 139–151).

In the history of economics, descriptions of catch-up initiatives may be identified since List (1983) described Germany's catch-up with the UK. In the 1920s, there was the "great debate" regarding Soviet industrialization between Bukharin and Preobrajensky (Nove 1992, p. 126). In the 1940s, modern development economics emerged (Meier and Seers 1984), pioneered by Lewis (1984), Prebisch (1984), and Myrdal (1984), and was further elaborated by a second generation, including Furtado (1987). From List to Furtado, each generation faced the subject of development (or catch-up) with completely different conditions, technological revolutions, leading sectors, leading nations, and gradients of technological and economic backwardness.

Successful catch-up experiences meant the "overcoming of underdevelopment" for the structuralist approach (Furtado 1992). The successes of South Korea and Taiwan highlighted underdevelopment, a phenomenon which persisted even after the industrialization of countries in Latin America, Africa, and Asia. This contrast between a few catch-up countries and numerous persistently underdeveloped countries stressed that underdevelopment is a "historical trap" (Furtado 1992, pp. 37–59), which is not a new phenomenon. As revealed in Figure 2, Brazil has been in this trap since 1870.

Recently, this historical trap has received increasing attention from researchers who have renamed it the MIT. Gill and Kharas (2007) started this new literature and they present a balance of contributions to the topic in the last 10 years (Gill and Kharas 2015).⁸ A broader evaluation of this literature is beyond the scope of the present paper, but it is important to highlight the genealogy of Gill and Kharas' definition of MIT, which is descending from a "changing intellectual landscape" from the perspective of three important sources: new international trade theory (Gill and Kharas 2007, pp. 12–13), new economic growth theory (pp. 13–15), and new economic geography (pp. 15–16). It is worthwhile to note these sources because they directly or indirectly mention references utilized in this paper, suggesting

⁸ Dias (2018) organizes a comprehensive review of this literature.

theoretical overlaps that could be further discussed elsewhere.⁹ Within this intellectual context, Keun Lee (2013) presented an important elaboration on overcoming the MIT, citing South Korea and Taiwan as examples. Paus (2014) organized a literature review on Latin America on topics such as how to remain in the MIT.

Lee (2013) defined economies at the MIT as those that neither fall behind nor catch up, which is a good definition for Brazil's long-term pattern during the 20th century (see Figures 2 and 3).

The long-term approach suggested during the 26th SJE International Symposium expresses that movements occur within the trap. On the one hand, there are limited catching-up periods when the Brazilian economy approximates and reduces its gap vis-à-vis the leading economy. On the other hand, there are limited falling-behind periods which increases the gap vis-à-vis the leading economy. Therefore, the MIT for Brazil, as shown in Figures 2 and 3, is a combination of periods alternating between limited catching up and limited falling behind, a trend that characterizes the MIT.

The research objective of this study is to understand the dynamic forces that have shaped the long-term alternations. Four issues must be investigated to understand these long-term dynamic forces: first, the driving forces behind limited catching up and limited falling behind; second, the alternations between those limited processes; third, the mosaic of possible combinations between the catching-up and falling-behind processes; and fourth, the structural changes in the nature of a relatively backward economy over time, given the effects of limited catching up and its diffusion throughout the local economy.

A. Driving Forces of Limited Catching up and Falling Behind

The driving forces are investigated thoroughly by the literature.¹⁰ In the global context of growing economies, driving processes have basic differences. The approximation or gap reductions of backward

⁹ For example, Gill and Kharas (2007) cited Romer (1994), who in turn cited Nelson and Winter (1982). Furthermore, Gill and Kharas (2007) cited Bresnahan and Trajtemberg (1995) and their elaborations on general-purpose technologies that cited Rosenberg (1982). Gill and Kharas (2015) included Lee (2013) in their survey of the literature.

¹⁰ A review of neo-Schumpeterian and structuralist approaches related to this bi-dimensional dynamic was presented earlier (Albuquerque 2007, pp. 675–677).

economies are based on the domestic efforts of those economies at the periphery, whereas distancing or gap increases are the consequences of economic advances in developed economies.

In other words, from the viewpoint of backward countries, during catching-up periods, the driving forces are within, whereas during falling-behind periods, the driving forces are abroad.

a) Limited Catching-Up Periods

Two topics are discussed to investigate limited catching-up periods, namely, the driving forces of catching up and the reasons for its limitation, interruption, or decrease.

Catch-up depends on the domestic efforts of backward countries. Economic history provides extensive literature on those processes: Gerschenkron (1952) for Germany, Ohkawa and Kohama (1989) for Japan, Amsden (1989) for South Korea, and Wade (1990) for Taiwan. The literature on innovation systems was developed to deal with this subject since the study on Japan by Freeman (1987) and the chapters on Japan, South Korea, and Taiwan by Nelson (1993). Overall, all successful catching-up processes involved the formation of innovation systems, which are an outcome of structural change involving educational investments, industrial and technological policies, the formation and development of local firms, and investments in scientific infrastructure.

The basic framework for the developments is a benchmark provided by the leading economies of the UK after the Industrial Revolution and the US after the late 19th century. Innovations in the leading country and in new industrial and economic sectors provide the reference point for the catching-up processes. The active imitation, absorption of foreign technologies, and internalization of new products and processes are dependent upon the efforts triggered within the relatively backward countries.

In economies like Brazil's, those planned or unplanned efforts may be the consequences of dynamic forces that emerge within backward economies to internalize manufacturing activities or the consequence of well-designed policies to develop specific industrial sectors or the entire economy. The next sections investigate the specific domestic efforts that underlie each catching-up period in Brazil.

Furthermore, what distinguishes those successful catching-up processes and the Brazilian case (and other underdeveloped economies)

is the continuity of the developmental processes, the structural changes, and the completion of the national innovation system's formation processes. For economies like Brazil's, Figures 2 and 3 reveal not continuity but interruptions and exhaustion of those catching-up periods. The limitations of catch-up policies and new problems related to changes in the domestic economy may trigger crises that interrupt growth trajectories. Therefore, those crises should be investigated.

b) Limited Falling-Behind Periods

For backward countries, the driving force behind falling-behind periods is the process of "creative destruction" (Schumpeter 1942, Chapter 7) abroad. This "creative destruction" is not a smooth process but an intermittent and turbulent one with a succession of technological revolutions that shape and reshape leading economies. This topic is researched extensively in neo-Schumpeterian literature. Freeman and Louçã (2001) reviewed the literature starting with Kondratiev (1998) and Schumpeter (1939).

Freeman and Louçã (2001, p. 141) presented a synthesis of five technological revolutions, starting with the "boom" of the Industrial Revolution (1780s–1815) until the boom of late 20th century with the consolidation of the "Age of the Information and Communication Technology" (pp. 301–335). Perez (2010, p. 190) presented a scheme highlighting the key innovations that triggered each of the five technological revolutions. Presently, there may be a new round of emerging technologies (OECD 2016) that may shape a sixth technological revolution.

For backward countries, this succession of technological revolutions signified the intermittent introduction of new products and processes generated abroad, such as the mechanization of textiles between the 1780s and 1815; railways and machine tools between 1848 and 1873; electrical equipment, heavy engineering, heavy chemicals and steel products between 1895 and 1918; automobiles, diesel engines, and aircraft between 1941 and 1973; and computers, software, and telecommunication equipment by the 1990s (Freeman and Louçã 2001 p. 141).

Within backward countries, the imitation process takes time and the internalization of new products is not automatic. The lags provide the background for leading countries to distance themselves from backward countries, therefore causing the falling-behind periods.

For backward countries, this succession of new products and processes from leading countries signified that import substitution processes, which have lags and are time-consuming, must be viewed dynamically. The imitation and absorption of foreign technology is time-consuming and demands investments that take time to mature. Lags create dynamics that may perpetuate backwardness. As a backward country concludes its internalization of a specific product, a new product is invented abroad, demanding a new process of imitation and absorption and generating a succession of falling-behind periods.

However, falling-behind periods are limited because backward countries may begin new imitation and absorption processes for new technologies, which will later mature and trigger new catching-up periods.

B. Alternation between Catching up and Falling Behind

Between 1870 and 2018, Brazil alternated between two processes that were neither a sustained catching up nor a persistent falling behind. This alternation may be the specific feature of countries trapped in the middle-income level.¹¹

The previous subsection (A) presented the major reasons for the alternations.

On the one hand, catching-up processes exhaust the energy of backward countries and new technological revolutions increase the gap vis-à-vis developed economies. On the other hand, falling-behind periods are limited because backward countries may take local initiatives to resume their growth trajectories.

The nature of growth in backward countries is determined by the diffusion of technology generated abroad toward the entire domestic economy. This dissemination demands structural changes within backward economies, such as new industries, educational skills, scientific infrastructure, and firms. The conclusion of this process may interrupt the growth process. The incomplete nature of the catching-

¹¹ A figure using data from Maddison (2010) for the five countries discussed in the special issue of the *Seoul Journal of Economics* reveals that the alternation between catching-up periods and falling-behind periods between 1870 and 2008 is a common feature among them. For data, refer to Appendix Figure 1. Some synchronization between all countries seems to occur during 1929–1934, 1938–1944, and 1950–1979, and these will be topics for further investigation.

up process gives rise to a phenomenon described by Furtado (1987) as polarization, modernization, and marginalization, wherein only specific parts of the economy absorb the new technologies. Growth may be correlated to the specific nature of this limited dissemination of new technologies.

The dissemination is not automatic; it is time-consuming and depends on active domestic forces and institutional changes. Over time, as the domestic dissemination of technologies continues in the backward country, new technologies emerge in developed countries, rendering recently absorbed technologies obsolete. New technologies at the center may also change the structure of trade balances, demanding new imports, destroying old exports, and causing new problems for current accounts.

C. Structural Changes Created by Limited Catching-up Periods

As each catching-up period is the process of imitation of new technologies, the absorption of foreign technologies, and their dissemination to the domestic economy, they are related to important, though limited, structural changes.

The transition from an agro-exporting economy to a limited industrialized economy is an important change and a new phase of a backward economy. The gap (Y) vis-à-vis the leading economy may be identical, but the economy is different. Each step forward in the assimilation of new technologies modernizes part of the economy and changes the modernization–marginalization polarity. The heterogeneity of those economies may increase, creating a complex process that may provide new starting points for succeeding catching-up periods.

As technological revolutions occur in the leading economies, internally backward economies acquire new starting points and may encounter broader portfolios of opportunities (additional sectors to enter, new demands to answer, and so on), given the impact of new products and processes and other consequences of the overall process of “creative destruction.”

The formation of national innovation system components is important to ground limited catching-up periods, and the succeeding steps in the formation of innovation systems may assist in absorbing technologies generated abroad during succeeding technological revolutions.

D. Different Combinations of the Driving Forces of Limited Catching up and Limited Falling Behind

Different combinations of driving forces exist during the concrete periods in the economic history of backward countries. Figures 2 and 3 empirically describe the results of those combinations for Brazil.

As revealed in subsection B, it is necessary to investigate both dimensions of the bi-dimensional process: the occurrences at the center, or in the leading country, and the occurrences at the periphery, or in the backward country. Four basic bi-dimensional combinations may occur.

The first combines boom phases of technological revolutions at the center (Freeman and Louçã 2001, p. 141) and active catch-up phases at the periphery. The boom phases of technological revolutions may offer new opportunities for backward countries because the growth of the global economy opens new demands for exports. In this combination, growth occurs at the center and the periphery, potentially resulting either in a catching-up period or in a falling-behind period, depending on the differences between the two growth rates.

In the second combination, the catching-up process at the periphery may take place during Kondratiev wave downswings or “crises of adjustment” (Freeman and Louçã 2001, p. 141), leading to catching-up periods for backward countries.

For the third combination, boom phases of Kondratiev waves at the center may combine with crises in backward countries, leading to falling-behind periods.

The fourth is a combination of downswings or adjustment crises at the center with crises at the periphery, with the results defined by differences in the negative growth rates. The relative capacity of these economies to adapt to the negative effects of crises will define whether the period is a catching up or a falling behind. If it is a catching-up period, it is merely a gap-reducing period or a “spurious” catching up without structural changes.

III. Brazilian Economic History: Alternating Catching-up and Falling-Behind Periods

After the presentation of empirical information in Section I and the tentative theoretical framework in Section II, this section focuses on the

economic history of Brazil to investigate the concrete processes that led to the seven catching-up periods and the seven falling-behind periods. On the basis of the international context presented by Freeman and Louçã (2001, p. 141), the main focus of this section is the domestic efforts and problems that shaped those periods.

The starting point of this investigation, that is, the Brazilian position in 1870, is emblematic. According to the data from Maddison, the Brazilian ratio vis-à-vis the American ratio was nearly identical to the Japanese at $Y = 0.29$. From 1870 and 1900, the Brazilian position further deteriorated, reaching $Y = 0.17$.¹² The deteriorations of the Brazilian position from $Y = 0.87$ in 1700 and from $Y = 0.51$ in 1850 were the consequence of the very limited development of manufacturing activities in Brazil while revolutionary changes were occurring in the US industry and economy [see Chandler (1977) for a historical account of the periods between 1866 and 1922]. Among the main features of this historical period in Brazil was the late beginning of the construction of a national economy in 1808 and the very late abolition of slavery in 1888 (Paula 2012). This feature contrasts the processes between the US and Brazil and establishes the technological backwardness of the latter during the second half of the 19th century. Slavery was still prevalent in Brazil, while a second technological revolution was occurring in the UK and in the US.

The following sections organize the investigation by catching-up periods (Table 2, Section A) and falling-behind periods (Table 3, Section B)

A. *Catching-up Periods*

Table 2 compares GDP per capita of Brazil and the US during the initial and last years of each catching-up period.

Table 2 presents two features of catching-up periods.¹³ The first feature involves catching-up periods during crises and/or negative

¹² In 1900, the US had a GDP per capita 1.67 times greater than in 1870 while Brazil's had shrunk 0.95 times during the same period.

¹³ Although those periods are well defined in Figures 2 and 3 and in Table 2, they were interconnected during the history of the Brazilian economy. For instance, Suzigan (1986, p. 75) suggests links between different phases in 1900 and 1950, that with different dynamics, organized a long transition in Brazil's economy from agrarian to industrial (p. 366).

TABLE 2

RATIO BETWEEN THE GDP PER CAPITA OF THE FIRST YEAR AND THE LAST YEAR OF EACH CATCHING-UP PERIOD FOR THE US AND BRAZIL (1870–2016)

Catching-up period	United States	Brazil
1918–1922	0.98	1.25
1929–1933	0.69	0.94
1944–1949	0.73	1.20
1956–1961	1.04	1.28
1967–1976	1.18	1.75
1978–1980	1.01	1.11
2002–2010	1.06	1.25

Source: Maddison (2010), World Bank (2018) for 2014–2016. Author's elaboration. (Between 1922 and 2003, the GDP per capita in 1990 International Geary–Khamis dollars. After 2008, the GDP per capita, PPP, in constant 2011 International Geary–Khamis dollars)

growth in the US, such as during the three initial catching-up periods from 1918–1922, 1929–1933, and 1944–1949. From 1929–1933, the Brazilian economy shrank, as presented in Table 2, but less than the US economy, signifying a gap-reducing period or a “spurious” catching-up period. The second are catching-up periods wherein both economies grew but the Brazilian economy grew more. However, note that during the last catching-up period, the US suffered the 2007–2008 crisis, which blocked sustained growth.

Between 1918 and 1922, the first catching-up period corresponded to important changes in the Brazilian economy. Before the First World War, the market for industrial products was “created by the expansion of exports of the agrarian sector” especially through “linkages of consumption and production” (Suzigan 1986, p. 366). This dynamic force in industrial investments, induced by the expansion of the agro-exporting economy, may be one of the reasons the falling behind was mitigated after the initial years of the 20th century. Since 1900, “the incipient domestic industrial sector was already stimulating investments in other activities through backward and forward linkages” (Suzigan 1986, p. 75). In Chapter 3, Suzigan describes the specific industries that developed before 1914–1918, such as textiles (cotton, jute, and wool), hats, footwear, wheat milling, sugar, beer, matches, and a few branches of the metalworking sector, all utilizing imported steel and iron (p. 248).

The First World War represented a change in the dynamics, as

the performance of exports from the agrarian sector still influenced, albeit decreasingly, the growth of the market for industrial products. Institutional changes occurred after the First World War, such as limited protection for manufacturing activities and governmental assistance for specific industries (Suzigan 1986, pp. 368–369).

The year 1919 marks a boom for economies at the center, which “translated to a great and generalized rise in the price of commodities,” with impacts on coffee exports large enough to sustain the fast recovery of imports (Fritsch 1990, p. 46). Industrial expansion from 1919–1920 was explained by the demand to replace obsolete machinery, owing to the adverse shock of war (p. 91).

The industries that developed after the First World War represented “the beginning of diversification of industrial investment and also of the beginning of transition towards an economy ruled by the industrial capital” (Suzigan 1986, p. 261). Moreover, an important change in the dynamics of the economy was occurring, as “the industrial investment did not concentrate anymore only in sectors complementary to the export economy, increasingly focusing the production of intermediary goods such as cement, steel and iron, chemical products, fertilizers, paper and pulp *etc.*, and capital goods, including machines and equipment” (pp. 261–262).

The second catching-up period indicated in Table 2 combines the profound and long crisis at the leading country with Brazil’s fast recovery. This catching-up period corresponds to an important structural change in Brazilian industries. In the 1930s, the relationship between the performance of the agrarian-exporting sector and industrial investments was no longer significant (Suzigan 1986, p. 261, p. 369).

The 1929 crisis had important consequences for the changes in Brazil. Initially, the impact of the crisis was large, causing a 13.3% decrease in the GDP between 1928 and 1931. Brazilian political life was divided in 1930, when the agrarian elites no longer ruled the country, giving room for economic policies favoring industrial development. Abreu (1990a, p. 78) reviews the debate on the economic implications of that political change, concluding that, “in practical terms, Vargas adopted policies that tended to favor the industry.”

During the Great Depression of 1929 and the coffee crisis experienced by the exporting sector, the previous pattern of “industrial investment induced by the expansion of the export economy was broken” and new dynamics emerged (Suzigan 1986, p. 365). The 1930s represented a

“turning point in the transition towards an industrial economy” (Suzigan 1986, p. 366). Abreu (2008a p. 316) evaluates that “[t]o the conventional expenditure-switching policies ... must be added the reinforcing effects of exchange and import controls. It was of crucial importance that there was a considerable existing industrial capacity already installed so that recovery could take place led by an extremely good industrial performance after 1932.”

Suzigan (1986) presents further qualitative changes during the 1930s; 42 new firms in the metal-mechanical industries (p. 295) distributed into branches, such as agricultural machinery, machines for textiles, machines for woodwork, machine-tools, printing machines, elevators, and so on (p. 297).

In the 1930s, a “more persistent and increasingly articulated action, deliberated and comprehensive aiming at the industrialization” (Suzigan and Vilela 1997, p. 32) started, with elements of industrial policies targeting sectors such as steel making and paper and pulp, as well as utilizing specific instruments such as exchange rate devaluation, revision of customs duty rates, and administrative restrictions to imports (Suzigan and Vilela 1997, p. 45).

Despite the lack of a general industrial policy, Suzigan and Vilela (1997, p. 45) describes important elements of industrial policies during the Second World War and in the 1940s, targeting sectors such as steel making, heavy engines, iron ores, and alkalis; utilizing specific instruments such as exchange rate overvaluation, administrative controls, quantitative restrictions, and licensing regime; and implementing state investments in infrastructure such as electric power and transportation.

In 1946, a state-owned steel plant—Companhia Siderúrgica Nacional (CSN)—began its operation in the framework of agreements with the US regarding the Brazilian entry during the Second World War. In 1948, a plan for industrialization (Plano Saúde, Alimentação, Transporte e Energia - SALTE) was prepared, but it was only approved by the Brazilian Congress in 1950 and its implementation was abandoned in 1951. Viana (1990, p. 114) describes the use of import control after 1946, including its different phases and its increasing use for industrial promotion. For Viana, this period shows a transition to a new phase of industrialization, that is, the creation of industries of electric appliances and other durable consumer goods (p. 115).

During this third catching-up period between 1944 and 1949, the

Brazilian economy completed its transition to an industrial economy (Suzigan 1986, p. 366). In 1947, agriculture and industry represented 20.72% and 25.20% of the GDP, respectively (Bonelli 2003, p. 375).

Between 1950 and 1956, a new set of elements of industrial policies was created that included important institutional initiatives (Suzigan and Vilela 1997, p. 45). Abreu (2008a, p. 319) describes the period between 1946 and 1955 as “removing infrastructure bottlenecks.” A national development bank, the Banco Nacional de Desenvolvimento (BNDE), was created in 1952; it is another one of those distinctive institutions differentiating Amsden’s “rest” from her “remainder” (2001, p. 132). Other institutions’ key for the later deepening of development included the Conselho Nacional de Pesquisas (CNPq, in 1951) and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, in 1951). In 1953, Petrobrás was also created. Those initiatives taken during the second Vargas administration represent “the creation of an institutional planning basis” (Suzigan and Vilela 1997, p. 33).

The fourth catching-up period (1956–1961), known as the “Golden Years” for Abreu (2008a, p. 337) (Table 2), was the first with positive growth in the US. After 1956, an exchange rate reform occurred in 1957 with implicit content to stimulate an acceleration of the “substitution of capital goods, reducing previous emphasis on the substitution of consumer goods” (Orenstein and Sochaczewski 1990, pp. 173–174). This reorientation was in line with the “stage that the process of substitution/industrialization had reached.” (Orenstein and Sochaczewski 1990, p. 175). This reform meant “a deepening in the process of substitution, as it reached more advanced levels of industrialization” (Orenstein and Sochaczewski 1990, p. 175). In 1959, the domestic production of capital goods covered 63% of the local demand (Lago *et al.* 1979 p. 459).

Suzigan and Vilela (1997) identify the Target Plan as “the first effective experience of industrial development planning as the central element of a comprehensive strategy of economic development” (p. 33), the first case of industrial policy “in wide sense” (p. 37).¹⁴ Targeted sectors included steel making and metallurgy, heavy chemicals, heavy

¹⁴ For Suzigan and Vilela (1997, p. 37), industrial policy “in wide sense” demands “an indicative plan and formal mechanisms of coordination of instruments and auxiliary policies between themselves and with macroeconomic policy.”

mechanical and electric machinery, motor vehicles and auto parts, shipbuilding, paper and pulp, cement; instruments and auxiliary policies included simplified multiple exchange rates, 1957 tariff, law of national similar, exchange rate bonus to manufacturers; financing through BNDE, *Banco do Brasil* and regional banks; and state investments in infrastructure; energy included electric power generation, nuclear, coal, refining of oil; and finally, transportation (Suzigan and Vilela 1997, p. 46).

This period establishes a pattern of tripartite structure of capital ownership, namely, foreign capital, private domestic capital, and state-owned firms. With quantitative changes in the relative share of those three forms of ownership, this pattern is preserved until today.

The fifth catching-up period was related to the so-called Brazilian miracle (Lago 1990) or the “years of high growth” (Abreu 2008a, p. 370). Important institutional change took place with a new dictatorship initiated with the 1964 coup d’état. Attempts were made to establish industrial policies, such as the Plano Estratégico de Desenvolvimento (PED, in 1967) and the I Plano Nacional de Desenvolvimento (PND, in 1972, for 1972–1976) (Lago 1990, pp. 236–237). During these important institutional changes, a new political regime after the military coup of 1964 was integral to the preparation of this phase. Consequently, various changes reshaped the state, including new wage legislation, new tax structure, and bank reform. Those changes were a political answer to the stalemate related to the end of growth of the previous period. Figure 1 shows that the GDP per capita was greater than the level achieved in 1962 only in 1966; specifically, industry’s initial growth was based on the considerable idle capacity available (Lago 1990, p. 239).

According to Suzigan and Vilela, elements of industrial policies were used during the “cycle of expansion 1968–1973”: targeted sectors included steel making, non-ferrous metals, petrochemicals, shipbuilding; instrument and auxiliary policies included devaluation, raise in tariff rates, import requests, similarity tests, national participation agreements, tax exemptions, fiscal credit; and state investments in infrastructure included energy, transportation, urbanization/sanitation (Suzigan and Vilela 1997, p. 47–48).

The sixth catching-up period (1978–1980) (Table 2) was related to a relative stagnation of the US economy, namely, the second oil crisis. This catching-up period is related to a second industrial policy in a wide sense (Suzigan and Vilela 1997, p. 33). Targeted sectors were

capital goods, basic inputs, telecommunications, aircrafts, armaments, nuclear energy, and informatics. Huge public investments were made in infrastructure, including energy, transportation, warehousing, telecommunications, and urbanization/sanitation (Suzigan and Vilela 1997, p. 47–48).

Carneiro (1990, p. 313) evaluates that “the overall restructuring objectives have been achieved, albeit in longer deadlines than scheduled,” and “to the sectors most favored by industrial policy, performance can be illustrated by the fall ... in the share of imports between 1973 and 1979.”

In this catching-up period, another structural change occurred. According to *Conjuntura Econômica* (1984), the value of exports of manufactured products overtook the value of non-manufactured products in 1978. Chami (2003, p. 419) notes that the exports of manufactured products in 1981 comprised 50% of Brazilian exports, reaching 59.8% in 2000.

The seventh catching-up period (2002–2010) is combined with another important crisis in the US economy (2007–2008). This period has a very peculiar nature: a change occurred in the pattern of exports. In 2008, natural resources became the main sector of exports from Brazil, ahead of other industrial sectors (by intensity of technology).

The growth of Y between 2002 and 2010 may be under a predominantly passive insertion in the international division of labor, with structural adjustments determined by an expansive global economy. This phenomenon could mean a strange combination of a catching-up period and regressive structural change.

The main point of this review on the seven catching-up periods in Brazil is the correlation of structural change in the economy and limited catch-up vis-à-vis the US economy, except in the seventh period. Even when the limited catch-up was associated with the US crises (the case of the three first periods, according to Table 2), domestic changes were important to disconnect the domestic dynamics of the Brazilian economy from the problems of the international economy. Regularity seems to be in place; that is, each approximation is generally related to structural changes within the Brazilian economy. Each of the most important domestic structural changes—transition from an agricultural economy to an industrial economy, transition from consumer goods industries to intermediary and capital goods industries (limited)—was related to a catching-up period.

This regularity explains a difficult side of this middle-income status: the need for domestic change to achieve and preserve a middle-income status. Although no direct relation exists between industrial policies in a “wide sense” in those catching-up periods (Suzigan and Vilela 1997), in each approximation (with one exception, the 2003–2010 period) (Suzigan 2017) underwent an implementation of the elements of industrial policies (Suzigan and Vilela 1997).

Those structural changes were combined with waves of institutional building (Suzigan and Albuquerque 2011) in 1808, 1870–1900, 1930–1934, 1948–1952, and 1964–1980 that may be interpreted as a discontinuous formation process of key institutions in the Brazilian system of innovation. Despite the mismatches during the catching-up-periods, those waves of institutional building might prepare conditions for growth for successful industries, sectors, and/or regions.

B. Falling-Behind Periods

The falling-behind periods are 1922–1926, 1934–1944, 1949–1953, 1961–1966, 1976–1978, 1980–1992 (Figure 2), and 2014–2016 (Figure 3). Table 3 organizes a comparison between the last and initial year GDP per capita (US and Brazil) in each falling-behind period.

Table 3 shows that falling-behind periods were not only the consequences of negative growth in Brazil (*e.g.*, the numbers less than 1.00 in Table 3). Negative growth helps to explain the three falling-behind periods (the first period is from 1922–1926, and the last two are from 1980–1992 and 2014–2016). Other three falling-behind periods were related to positive growth, although small, and another was related to a relatively strong growth (1933–1944). As discussed in Section III, growth at the center, the maturing and diffusion of a succession of technological revolutions, and the structural changes they bring explain how the US grows and expands the gap vis-à-vis the Brazilian economy. The entire Section III highlights the persistence of relative technological backwardness after each domestic upward structural change, that is, the Brazilian economy was constantly one or two technological revolutions behind the capitalist center.¹⁵

¹⁵ The systematization of those delayed incorporation of technological revolutions may be beyond the scope of the current paper, but Section A presents a few illustrations. One example is the steel industry. According to

TABLE 3
RATIO BETWEEN THE GDP PER CAPITA OF THE LAST YEAR AND THE FIRST YEAR OF
EACH FALLING-BEHIND PERIOD OF US AND BRAZIL (1870–2016)

Falling-behind Period	United States	Brazil
1922–1926	1.19	0.99
1933–1944	2.58	1.29
1949–1953	1.19	1.08
1961–1966	1.24	1.04
1976–1978	1.08	1.06
1980–1992	1.25	0.92
2014–2016	1.12	0.98

Source: Maddison (2010), World Bank (2018) for 2014–2016. Author's elaboration. (Between 1922 and 2003, GDP per capita in 1990 International Geary-Khamis dollars. After 2008, GDP per capita, PPP, constant 2011 International Geary-Khamis dollars)

The first falling-behind period was part of an international recession beginning in the early 1920s and an exchange rate crisis (*i.e.*, currency depreciation) that blocked the necessary imports of machine tools (Suzigan 1986, p. 91). Fritsch (1990, p. 46) describes the commodity boom and a large trade balance in 1919 which collapsed in 1920. Later, it implemented a monetary shock in 1922–1926 as an adjustment policy. In 1926, the GDP per capita was at the level of that in 1922. As the US economy recovered and grew from 1922 to 1929, the combination of stagnation in Brazil and growth in the US explains this falling-behind period.

The second falling-behind period (1933–1944) was related (see Table 3) to an important increase in Brazilian GDP per capita: 29% between 1944 and 1933. Although a positive growth occurred for the entire period, it was limited within Brazil by two negative growth periods in 1939 and 1942, both related to exchange rate crises in 1938–1940 (IBGE 2003, p. 444) and 1941–1942 (Abreu 1990a, p. 93). In 1938–1940, triggered by the external shock from the recession in the US (1937), a

Freeman and Louçã (2001, p. 141), it is an industry of the third technological revolution (1895–1918). However, it was only introduced in Brazil after the Second World War during the fourth technological revolution, with the inauguration of CSN in 1946.

retraction occurred in the Brazilian exports (not coffee). This retraction led to a shortage in international currencies that combined with the increase in imports and subsequently led to exchange-rate problems. The answer was exchange rate control and import control after 1937. In 1941–1942, the beginning of the Second World War led to the closure of traditional European markets to Brazilian exports, resulting in a decrease in the trade balance (Abreu 1990a, p. 93).

Table 3 shows an important growth that is greater than nearly all catching-up periods, except 1967–1976 (Table 2). The dominant force in this falling-behind period was the recovery of the US economy (stabilization from the implementation of *New Deal* policies) and growth related to the Second World War (see Kennedy 1999, especially Chapter 18: The War of Machines).¹⁶

In the third falling-behind period between 1949 and 1953, the Brazilian GDP per capita (Table 3) did not fall. However, the growth was limited by an exchange rate crisis in 1952. For Bastos (2001, p. 401), this crisis reflected the persistent dependence on exports of primary goods and the lack of investments in capital goods and intermediary goods, which heavily affected the need for imports. Viana (1990, pp. 125) presents the global context of the Korean War and its relation to a new mismatching (p. 128) between increase in imports and reduction of exports (especially of cotton) as a cause of this exchange rate collapse.

This limited domestic growth (Table 3) is contrasted with the US resuming growth, which is associated with an expansion of industries related to the fourth long wave, namely, the long post-war expansion. Therefore, this falling-behind period is explained by a contrast between strong growth in the US and limited but positive growth in Brazil.

The fourth falling-behind period was related to a deep political crisis connected to a GDP per capita decrease between 1962 and 1965, resuming the level of that in 1962 in 1966. Therefore, the data in Table 3 reflect near stagnation between 1961 and 1966. This deep crisis may be related to an exhaustion of the investments of the Target Plan and an indication of the need for further structural change. During the initial years of the military government's implementation of an adjustment plan (PAEG), changes were introduced to answer those

¹⁶ Figure 2 shows 1944 as the largest gap vis-à-vis the United States in the 20th century ($Y = 0.112$).

limits of previous growth patterns—changes in banking structure, taxation, labor relations, wage policies, and so on. Those adjustment policies changed the pattern of economic growth that became typical of the military regime, especially in relation to income concentration.

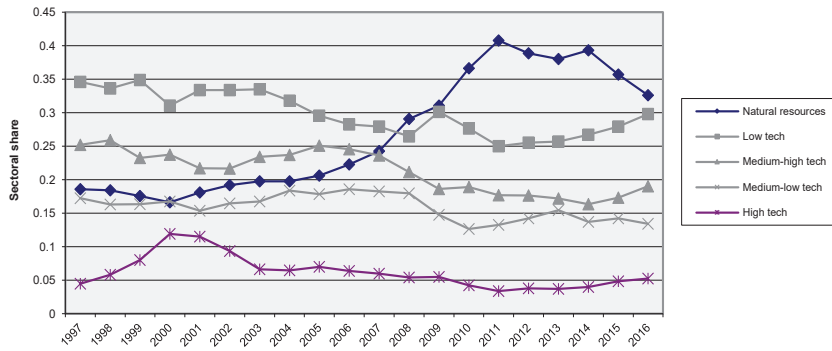
This stagnation in Brazil contrasted with the steady growth of the US economy which remained in the long post-war expansion—related to the expansive phase of the fourth long wave—and the outcome is an increase in the gap (Figure 2).

The fifth falling-behind period (1976–1978) was a child of the contradictions of the “miracle” (especially the intensification of problems related to income distribution, probably problems derived from attempts to proceed with policies previously completed, such as more import substitution in relatively backward industries), problems in the balance of payments derived from the international oil crisis of 1974, end of Bretton Woods, and the end of the expansive phase of the fourth long wave, all of which contributed to the deceleration in growth rates of the previous period. The deceleration of Brazilian growth rates that remained positive (Table 3) was greater than the deceleration of US rates that determined the increase in the gap shown in Figure 2.

The sixth falling-behind period (1980–1992) had a strong domestic determinant: Figure 1 shows the deep crisis in this period as the GDP per capita in 1980 was reached again in 1987 and 1996 and was only overcome after 1997. Negative growth in Brazil explains this important falling-behind period (Table 3).

The economic model of the military regime manifested exhaustion, probably as a consequence of wrong choices in II PND, including the conclusion of industries related to the second and third technological revolutions, some industries of the fourth, and no effective policies for the then-emerging technologies, especially TICs. Those policies may be compared with the Korean initiatives, among which KIET, a research institute for electronics and informatics, was created in 1976 (Kim 1993, p. 228, p. 214).

After II PND, a sequence of policies were in place that included in the 1980s what Suzigan and Vilela (1997, p. 49) qualify as “an implicit negative industrial policy” that “resulted from macroeconomic adjustment measures affecting industry in the first years of the decade” (p. 49). Furthermore, Suzigan and Vilela stress that “the late 1980s would be characterized by persistent macroeconomic instability, anti-inflationary measures and stabilization plans predominated, precluding



Source: Author's elaboration, data from MDIC (2016)

FIGURE 4

SHARE OF BRAZILIAN EXPORTS ACCORDING TO ECONOMIC SECTORS, NATURAL RESOURCES AND OTHERS VERSUS MANUFACTURING SECTORS, BY INTENSITY OF TECHNOLOGY (1997–MARCH 2016)

industrial policies actions almost entirely” (p. 61).

A key determinant of the seventh and last falling-behind periods (2014–2016) is the end of a commodity boom. The slowdown in the growth rates of the Chinese economy that still persisted in 2015 (IMF 2016) were transmitted through “spillovers to other economies through trade channels and weaker commodity prices” (IMF 2016, p. 1). Given the dependence of Brazilian economy on the exportation of natural resources (Figure 4), the impact of this Chinese deceleration was very important. This change in the global scenario, that is, the end of the commodity boom, together with an important political crisis related to an exhaustion of the policies from *Partido dos Trabalhadores* (PT) governments (in the central government between 2003 and 2016) determined an important recession comparable to that in the 1929–1930 period.

This falling-behind period can be interpreted as a consequence of the negative structural change of the last catching-up period (2002–2010), with the increase in the dependence on natural resources in exports and important implications in relation to external vulnerability.

This survey on falling-behind periods shows an empirical regularity: the relationship between them and exchange rate crises and adjustment programs (or restrictive government policies, *i.e.*, monetary shocks).

Exchange rate crises occurred¹⁷ in 1890–1892 (IBGE 2003, p. 439; Franco 1990, p. 14, for 1891), 1920–1922 (IBGE 2003, p. 439), 1929–1931 (IBGE 2003, p. 444), 1938–1940 (IBGE 2003, p. 444), 1952–1953 (IBGE 2003, p. 440; Viana 1990, p. 133), 1954 (Pinho Neto 1990, p. 152), 1999 (Werneck 2014, pp. 347–349); deterioration in the balance of payments in 1962–1963 (Resende 2005, p. 39), in 1974–1975 (Resende 2005, p. 43), and in 2002; and a sequence of crises related to the external sector, especially to foreign debt during the late 1970s and the late 1990s—in 1979, 1982, 1983, and 1999 (IBGE 2003, p. 441).¹⁸

Adjustment plans or restrictive government policies emerged in 1898 (Franco 1990, p. 12, p. 28), 1924 (Fritsch, p. 54), 1946–1949 (Viana, p. 119), 1951–1952 (Viana, p. 121), 1953 (Viana, p. 136), 1961 (Abreu, p. 198), 1962 (Abreu, p. 206), and 1964–1965 (Resende 1990, p. 222); and a sequence of adjustment plans were negotiated with the IMF and/or stabilization plans for inflation control in 1982, 1986–1989, 1991, 2015, and 2016–2018.

Exchange rate crises are consequences of the limits of the growth process in underdevelopment. Resende and Torres (2016) articulate the limits of the formation of national systems of innovation with the endogenous process that leads to those crises. The lack of technological dynamism is related to the crises in the current account as the “tendency to show external crises due to recurrence of its CA deficit” (Resende and Torres 2016 p. 750). Adjustment plans and restrictive policies may not be the causes of trajectory interruptions, but they may aggravate and intensify the increase in the gap. The prevalence of adjustment plans, 10 plans according to Abreu (1990), over industrial policies in the wide sense, two plans according to Suzigan and Vilela (1997), during the 20th century in Brazil might be a component of the long-term macroeconomics of the MIT.

¹⁷ Exchange rate crises are related to strong movements in the value of key foreign currencies. Depreciation of the Brazilian currency leads to problems in import, lack of foreign reserves, and difficulties related to external debts, for example. Those problems strongly affect the macroeconomic stability.

¹⁸ See <https://seculoxx.ibge.gov.br/economicas/setor-externo/graficos.html>. According to IBGE (2003), “The declines and low values exported in the periods of the exchange rate crises of 1914, 1921, 1932, 1940, 1952, 1962, 1982, 1986, 1999 and the tendency to decline in exports between the mid-1920s and 1940s, and between 1951 and the early 1960s, can be easily identified” (p. 438).

IV. Cause and Consequence: Unequal Development in Brazil and Four Vicious Cycles

Why did the alternation occur between the catching-up and falling-behind periods?

The main issue is to understand what regularly interrupts catching-up periods which block further advances in the formation of the Brazilian system of innovation. A specific structural phenomenon might exist that imposes this alternation, breaks the catching-up periods, and repeats the falling-behind periods.

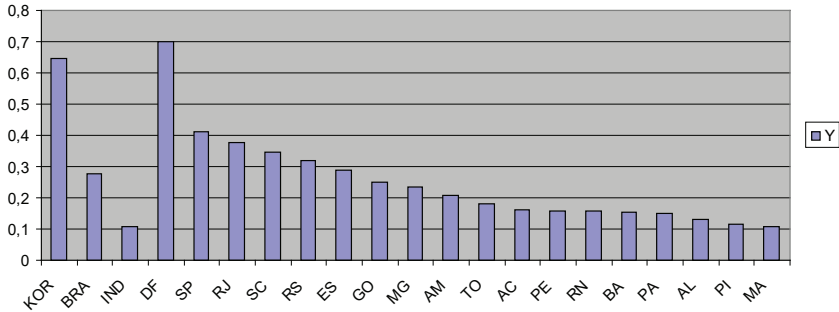
The conjecture of the present study is that inequality may have a key role in preserving the MIT or the “historical trap,” that is, underdevelopment (Albuquerque 2007, pp. 682–683). Inequality may be a strong force causing catching-up processes to lose steam and exhaust themselves. A specific pattern of path dependence and lock-in probably exists, historically and politically conditioned outcomes of political projects, actions, and struggles that shape the pattern described in Section III.

Inequality might be both a cause and a consequence because when a broad picture of the Brazilian economy is taken, the images will consistently show inequalities. Using the basic variable of this paper, that is, the ratio of GDP per capita vis-à-vis the US (Y), Figure 5 shows how different Brazilian states are in this regard. The leading state in Brazil (São Paulo), with $Y = 0.41$, is between the Brazilian average and the Korean position. São Paulo is nearly four times closer to the US GDP per capita than Maranhão ($Y = 0.11$).¹⁹

Those inequalities in income are related to inequalities in the distribution of economic and industrial activities and science and technology resources (Fapesp 2005, p. 6–26 and p. 6–6).

Those inequalities are present within states as well, as reflected in the reports from the United Nations Development Program (UNDP). PNUD, FJP (2013, p. 42) present a map with levels of UNDP’s index of human development (IHD) by municipality. This map for 2010 shows how inequality is distributed throughout Brazil and within states. For

¹⁹ Figure 5 shows Brasília, Distrito Federal (Brazilian federal capital: DF in the Figure) as richer than South Korea. However, it is a very peculiar city, with a concentration of above-the-average wages of top public servants (Judiciary, Legislative, and Executive branches).



Source: IBGE (2017), World Bank (2018), author's elaboration.

FIGURE 5

RATIO OF GDP PER CAPITA AMONG SELECTED COUNTRIES (KOREA, BRAZIL, AND INDIA), SELECTED BRAZILIAN STATES, AND THE US (Y) (2015)

example, within São Paulo, three levels exist: medium, high, and very high IHD. Minas Gerais has those three plus low and very low. A clear division exists between Northern states with worst IHD and Southern states with better IHD. If we zoom in on those data, strong inequality will be shown even at the city level: São Paulo is a city of both luxury homes and *favelas*.

According to recent research on income and wealth concentration (Souza 2016), the Brazilian inequality is a structural phenomenon, surviving economic and political changes. With data from 1926 to 2013, Souza (2016, p. 221) shows how the richest (wealthier) 1% in Brazil has an income share that oscillates between 20% and 30%. Souza's data also show that the richest 10% have an income share greater than 50% in 2010; this share was more than 60% in the early 1970s (2016, p. 221).

Income concentration shapes other features of the Brazilian economy. Probably the most important is the permanent blocking effect on Adam Smith's dynamics between the market growth and the sophistication of labor division (one of the major determinants of technological progress). No less important is the impact on education, given that the latter is another key feature of an innovation system. Braga (2015, pp. 31–32) shows the prevalence of illiteracy among people older than 15 years as follows: 65.3% in 1900, 50.6% in 1950, and 9.6% in 2010. In a dynamic approach, those data show that Brazil is nearing what Japan did by the 1900. However, literacy in Portuguese is not only necessary now

but also in mathematics, English, computer programming, and so on. The persistence of income concentration limits in the spread of high-quality public and universal education is likewise very important, with profound consequences for science and technology dynamics.

Given the high prevalence of illiteracy until the early 1970s, very quickly meeting economic growth with important limits to catch up further was understandable.

The alternation between catching-up and falling-behind periods that characterize the MIT may be a consequence of the vicious cycles shaped by the income concentration.

The first vicious cycle articulates income concentration and the size of domestic markets. Income concentration limits the growth of a domestic market and the size of the domestic consumer market. Since Adam Smith, the size of markets is understood as one key determinant of technological progress. This concept limits the scope of economic growth, evaporating the energies that would otherwise open room for economies of scale and other economic dynamic forces that increase the output and reduce costs of production. Given the stability of income concentration, this element might be the key of MIT. This income concentration is directly related to old and persistent problems related to literacy and education, another strong blocking factor for economic development. The combination of income concentration and limits to quality universal education may be important determinants of the difficulties of entering new and more sophisticated industries. As discussed earlier, income concentration shapes a very peculiar orientation of technological progress that might be typical of innovation systems at the periphery (Albuquerque 2007, pp. 682–683).

Those limitations of the first set of vicious cycles lead to a second set of vicious cycles: the lock-in in natural resources and less developed industries or relatively backward industries, given the continuity of technological revolutions at the center, are important to shaping the incomplete nature of the Brazilian innovation system. This incomplete formation is a structural source of external vulnerability, including the relative technological backwardness. The persistence in lagging behind one or two technological revolutions has implications for the current account because the need to import new products and processes from the last technological revolutions constantly exists. Therefore, current account and exchange-rate crises repeatedly appear. Without institutions to push the entry in new sectors, with higher

technological content at each specific time related to contemporary technological revolution, the exports are in products with low-demand elasticity, whereas imports are in products with high-demand elasticity. Periodically, structural external constraints to growth take place. As a structural phenomenon, external vulnerability leads to repeated current account (CA) and exchange-rate crises. Section IV shows that these crises are turning points for many catching-up periods.

A third vicious cycle probably exists, which is related to the strong natural resource base of a country such as Brazil. Those resources may be used in a “predatory” way, opening room for the predominance of a predatory economic dynamics over an innovative economic dynamics. In this innovative dynamic, the use of natural resources would certainly be non-predatory. The vicious cycle here would lie in the natural resources still open to easy capital accumulation, which combined with the income concentration pattern described above, block land reform as implemented in South Korea, Taiwan, Japan (Amsden 1989, p. 147), and China (Drèze and Sen 2002, p. 260) and does not push capital toward industrial and economic investment. As Amsden (1989 p. 37) puts forward, land reform in Korea was a tool for directing “idle capital away from land speculation to manufacturing.” Lacking political conditions to organize this way to capital accumulation, the predatory use of “natural resources” becomes a repeated temptation to avoid industrial investment and innovation. Therefore, a very difficult transition is expected from a “predatory capitalism” trajectory toward an “innovative capitalism” trajectory.

Finally, a fourth vicious cycle might exist that links those repeated exhaustion of specific patterns of limited growth (*i.e.*, the catching-up periods described in Section III) with political tensions and crises that provoke social and economic stalemates that freeze economic development while they last. Conservative backlashes might occur against minor reductions in the income concentration and actions of established firms against the creative destruction that follows innovation; this possibility may be another source of lock-ins that populate the MIT. Those political stalemates are periods of difficult democratic discussions and elaborations. Thus, defining priorities and creative policies for development is necessary.

This fourth vicious cycle, representing economic slowdowns and political stalemate, might have caused the repeated failures in industrial policies since the early 1980s (Suzigan and Vilela 1997, pp. 49–140;

Suzigan 2017).

The end result of those four vicious cycles is permanent technological backwardness. The Brazilian economy is frequently absorbing technologies of the previous technological revolutions. Technological backwardness is consistently renewed but never capable of jumping to technologies related to contemporary GPTs. This condition may be graphically illustrated by the “Red Queen Effect” (Chaves *et al.* 2017). Although Brazil between 1974 and 2014 moves upward in the global science and technology scenario, it basically preserves the distance from the moving threshold that divides the center and the periphery.

V. Conclusion: Understanding the Trap and How to Overcome It

A long-term view of the trajectories of countries within the MIT enables a qualification of its definition: it is an alternation between catching-up and falling-behind periods. This alternation shows economies oscillating around 20%–25% of the US GDP per capita throughout the entire 20th century.

This alternation between catching-up and falling-behind periods has two major driving forces for backward countries. Internationally, existing technological revolutions generate new products and processes and reshape global conditions. Those technological revolutions may increase the gap between the backward and leading economies. Domestically, local efforts are in place to imitate and absorb foreign technologies, policies for industrial and technological development, as well as planned and unplanned efforts of firms and institutions to connect to international flows of knowledge; in sum, policies for the formation of innovation systems to feed catching-up processes. Those two driving forces are connected, and the process as a whole is bi-dimensional.

This defining feature of a MIT, namely, the alternation, may be caused by the pattern of income concentration that exhausts energies of the catching-up processes by blocking the formation of a huge domestic market as a source of economies of scale and scope for dynamic firms and blocking the maturing of innovation systems extremely dependent on educational and scientific institutions to feed the catching-up processes. As discussed in SECTION IV, income concentration is connected with four vicious cycles that cause this alternation.

The question requiring solution is how to transform those four vicious cycles that cause the alternation between catching-up and falling-behind periods in positive feedback that preserves the catching-up process.

It is not an easy question and is certainly a multidimensional task. A new book prepared within the Cedeplar-UFMG (Andrade and Albuquerque 2018) might be one introduction to those various dimensions. Its 23 chapters are prepared by researchers from different fields of economics and demography. They discuss topics such as inequality, demographic and climatic changes, taxation, macroeconomics, exchange rate, labor markets, pension and health systems, industry and development, and science and technology.

The answer for this issue is beyond the scope of the current paper, but it articulates three topics.

First, lessons from successful catching-up processes: each successful catching-up process has lessons of mechanisms, policies, and institutional building that shape development.

Second, a diagnosis of today's starting point for a catching-up process in Brazil: a very heterogeneous economy, with a polarity between modernization and marginalization, shaped by income concentration that combines high-tech industries with nearly predatory exploration of natural resources.²⁰

Third, a set of policies that would be part of policies for active insertion in the global economy. The institutional innovation that would probably characterize the Brazilian catching-up process will be a process that combines the formation of innovation and welfare systems. The welfare system is strategic to improve the income distribution in Brazil, and it is a bridge between the innovation and health systems through the strategic development of health-related industries and sectors. Active insertion in the global economy would require an understanding of opportunities that the emerging technological revolution (OECD 2016) might be opening now to a country, such as Brazil. Notably, biotechnology, nanotechnology, solar energy, big

²⁰ This polarization may be seen in the data on trade balance (<http://www.mdic.gov.br/balanca/SH/ISIC.xlsx>), which show Brazil with positive balance in products related to natural resources, low- and medium-tech industries, and negative balance in products of high-tech industries. As shown in Figure 4, Brazil has exports in high-tech industries as well.

data, and robotics are emerging sectors that previous scientific and technological developments in Brazil may provide levers for entry in those new sectors.²¹

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²¹ Those topics were developed in Albuquerque (2018).

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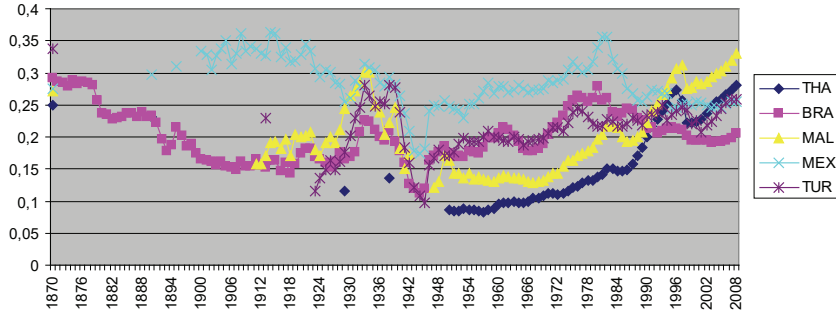
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APPENDIX



Source: Maddison (2010), author's elaboration

APPENDIX FIGURE 1

RATIO OF GDP PER CAPITA AMONG SELECTED COUNTRIES (THAILAND, MALAYSIA, MEXICO, TURKEY, AND BRAZIL) AND THE UNITED STATES (Y)
(GDP PER CAPITA IN 1990 INTERNATIONAL GEARY-KHAMIS DOLLARS)
(1870–2008)