SECULAR STAGNATION?

A NEW VIEW ON BRAZIL'S GROWTH IN THE 19TH CENTURY

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Abstract: *Established economic historiography asserts that Brazil's per-capita GDP stagnated in the 19th century and that it grew extremely slowly in the period of the monarchy (1822–1889). We argue that these conclusions are based on inadequate methods, insufficient statistical evidence, and disregard for available historical evidence. Building on the methodology of Tombolo (2013), with the use of new databases, and a reasoned exploration of alternatives, our best estimate is that over the 1820–1900 period Brazil's per-capita income grew at a trend rate of 0.9% per year, a performance similar to Western Europe and other Latin America countries. It was only a sharp economic contraction at the end of the period that dulled Brazil's performance in the 19th century.*

Resumen*: La historiografía económica establecida afirma que el PIB per cápita de Brasil se estancó en el siglo XIX y que creció muy lentamente en el período de la monarquía (1822-1889). Argumentamos que estas conclusiones se basan en métodos inadecuados, evidencia estadística insuficiente y desconsideración de la evidencia histórica. Sobre la base de la metodología de Tombolo (2013), con el uso de nuevas bases de datos y una exploración razonada de alternativas, nuestra mejor estimación es que durante el período 1820–1900 el ingreso per cápita de Brasil creció a una tasa tendencial de 0,9% anual, un desempeño similar al de Europa Occidental y otros países de América Latina. Fue solo una fuerte contracción al final del período lo que debilitó el desempeño de Brasil en el siglo XIX.*

Key words: per-capita GDP growth, Brazil, 19th century, Maddison Project

JEL codes**:** N16, O11, O47, O54

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1. Introduction[4]

The purpose of this paper is to provide new proposed estimates of Brazil's per-capita GDP growth in the 19th century. Current statistical historiography of the period is based on successive editions of the Maddison Project Database (henceforth MPD), which gives continuity to Angus Maddison's pathbreaking estimates of global economic growth since early Christianity (Maddison, 1995; Maddison, 2001; among many others).

The latest editions of MPD for 2013, 2018 and 2020 suggest that Brazil stagnated in the 19th century, with per-capita GDP in 1900 only 0.8% higher than in 1800. The same source finds Brazil's per-capita GDP at the end of the Monarchy in 1890 only 25% higher than on the eve of Brazil's Independence in 1820—with a growth rate of only 0.3% per year.

Economic historians sometimes simply reproduce such figures or argue that their own analyses do not fundamentally diverge from those of the MPD. Thus, Abreu, Lago and Villela (2022, p. 21) assert (in our translation) that "the periodisation today consensual is that Brazil's per-capita income stagnated in the first half of the 19th century and increased only slightly in its second half".

We believe this consensus to be based on inadequate methods, insufficient statistical evidence, and disregard for available historical evidence. After a review of the relevant literature, building on an empirical analysis by Tombolo (2013), summarised in Tombolo and Sampaio (2013), with the use of new data sources and a reasoned exploration of alternatives, we propose new estimates for real per-capita GDP growth in the 19th century.

Our best estimate is that towards the end of the 19th century, Brazilians were twice as rich as in 1820. Brazil's output per-capita trend growth rate is estimated to have been 0.9% per year in the 1820–1900 period. An unimpressive performance compared to the U.S., but on par with Western Europe and other Latin American countries during the same period. This performance, we submit, is more aligned with relevant facts of the country's economic history in the period than the near-stagnation hypothesis embedded in the MPD.

The paper is organised as follows. In the next section, we review the sources of MPD for Brazil's per-capita GDP in the 19th century. In section 3, we provide

[4] We are indebted to José Murilo de Carvalho (in memoriam) for motivating us to write this paper for his 2022 seminar series on 200 years of Brazil's Independence at the Brazilian Academy of Letters. With the usual caveats, we are grateful for comments to Leslie Bethell, Thales Pereira, William Summerhill, Arno Wehling, participants in seminars at the Brazilian Academy of Letters, the Casa das Garças Institute of Economic Policy Studies, the School of International and Public Affairs of Columbia University, and two anonymous referees. We also thank Lyle Prescott for proofreading this article.

new proposed estimates of Brazil's per-capita GDP growth in that century. Section 4 explores relevant aspects of Brazil's economic history that substantiate our preferred estimates. In section 5, we convert our per-capita GDP estimates into 2011 USD dollars to compare with the MPD data from other countries and regions in the 19th century. We present our conclusions in Section 6. The Appendix contains details on data and statistical procedures.

2. MPD Brazil data reviewed

We first review the sources of MPD's data on 19th century Brazil. Angus Maddison's data on Brazil initially appeared in his 1995 book *Monitoring the World Economy*, with numbers for per-capita GDP in constant dollars for 1820, 1870 and 1900 (Maddison 1995: Table 1–3; sources in App. B, text: p. 93). For the 1850–1900 period, Maddison mentioned Goldsmith (1986: pp 22–23, 82–83) as the source; he assumed that growth in the 1820–1850 period was the same as the rate in the 1850–1913 period. His source for 1900–1985 GDP was Maddison and Associates (1992).

Maddison's *The World Economy: Historical Statistics* (2003) contains Brazil's GDP per-capita data for 1820, 1850, and all years from 1870 onward (Table 4c, p. 142). *Maddison Database 2010* reproduces the same series. However, as noted by Barro and Ursúa (2008: App. A, Table A1), Maddison's numbers show an unexplained divergence with respect to Goldsmith's. While in both authors per-capita GDP in 1900 is nearly the same as in 1850 (indicating zero growth in the second half of the century), Maddison supposes a linear trend from 1870 to 1890, a period for which Goldsmith's numbers also show zero growth. Growth rates in the two series similarly diverge for 1850–1870 and 1890–1900.

The first revision of Maddison's data, in the context of the Maddison Project, was published in 2013.[5] With respect to Brazil's data, the only meaningful change to the *Maddison Database 2010* was the assumption of zero growth in per-capita GDP in the first half of the 19th century. The reference for this new assumption was Prados de la Escosura (2009: p 301, Table 6), where "zero per capita for the early nineteenth century as suggested by Leff, *Underdevelopment and Development,* vol. 1, p. 33, was adopted".

The revision in 2018 made more substantial changes. Considering Barro and Ursúa's observation about the unexplained divergence between Maddison's and Goldsmith's data, the original Goldsmith series for per-capita GDP was now adopted in full for the 1850–1900 period, expressed in constant dollars (Bolt *et al.,*

[5] On the 2013 revision, see Bolt and van Zanden, 2013.

2018). The hypothesis of zero growth in the 1800–1850 period was maintained. This series was repeated in the 2020 revision, now converted to constant dollars by means of a different methodology (Bolt and van Zanden, 2020).

We now examine the MPD Brazil's GDP per capita estimates separately for these two periods: 1800–1850 and 1850–1900.

2.1. The 1800–1850 period

Prados de la Escosura (2009, Table 6, p. 301) explains that his figures for a stagnant Brazil in the 1800–1850 period were suggested by Leff (1982, p. 33).[6] Leff estimated growth of nominal GDP based on the quantity theory of money and an *ad hoc* hypothesis on the velocity of money. To get numbers in real terms, he used a price index composed of three parts: (i) an index of prices of tradables based on a series of wholesale prices in Great Britain and the exchange rate *mil-réis*/sterling pound, assuming purchasing power parity; (ii) an index of food prices in Rio de Janeiro prepared by Lobo et al. (1971), assumed to indicate prices of the domestic agricultural sector in the country's Southeast; and (iii) the trend in the price of a single commodity, manioc flour, extracted from a graph in an article by Mattoso (1978, p. 311), assumed to represent prices in the domestic agricultural sector in the country's Northeast. The aggregate index is a weighted average of those numbers, with a weight of 0.45 for the index of tradables and 0.55 divided equally for the two regional indices.

Leff repeatedly stressed that the data and assumptions on which he based his estimates are precarious. As to his output estimate, he wrote: "Because of the rough nature of the data and assumptions which must be used, this procedure can at best yield tentative conclusions concerning the likely magnitudes of income growth" (Leff, p. 30). Before presenting the price index, he warned: "the very notion of 'the' rate of price inflation in Brazil as a whole during the nineteenth century raises conceptual problems which are serious and perhaps insurmountable" (Leff, p. 123).

Leff's general conclusion was that "income per capita seems to have risen at only a moderate pace in Brazil during the nineteenth century" (p. 33). His favoured number is 0.1 percent per year.

[6] Prados de la Escosura mentions Maddison's (1995) estimate that Brazil's GDP yearly per-capita growth in 1820–1850 was only slightly lower than in 1850–1913, but he chooses to side with his interpretation of Leff (1982, p.33) of zero growth for the earlier period.

Prados de la Escosura (2009) quoted this passage from Leff's book in support of his adoption of zero per-capita growth in the first part of the 19th century in Brazil—a hypothesis incorporated in the Maddison Project since 2013. However, a few pages later, Leff attempted a periodisation of income growth in the 19th century, and found that, considering five subperiods from 1822 to 1899, the growth of deflated currency stock was highest in 1822–1835 (p. 36). Leff commented on the result, asserting that "the rapid growth of the 1822–35 period is supported by the export figures for those years" (p. 37). We may conclude that there is little basis, in Leff, for the idea of zero growth in Brazilian GDP per capita during the 1800–1850 period.

Abreu, Lago and Villela point out that the money stock series for the early 19th century were precarious. They instead base their presumption of a stagnated per-capita GDP in the first half of the century on the evolution of exports. However, a recent review of Brazil's official export series in the 19th century (which most authors find unreliable at least through the early 1830s) presents a divergent view from stagnated per-capita exports in the first half of the century. Absell and Tena-Junguito (2016) conducted an accuracy test on the official statistical values of Brazilian exports and found evidence of considerable undervaluation of export prices. Once these were corrected, they concluded that Brazil's export growth was more dynamic during the post-independence decades than in any other period in the 19th century. According to their online appendix, from 1821 to 1850 Brazil's exports (in British pounds) grew 161.3% rather than the 62.5% shown in the official statistics used by Abreu, Lago and Villela.

Leff's "possible periodisation" of real money stock growth and Absell and Tena-Junguito's revision of Brazil's exports statistics lead to the conclusion that, based on these two variables, the first half of the 19th century was not one of stagnation. In Section 3 we provide our own proposed estimates of economic growth in the period, and in Section 4 we explore aspects of Brazil's economic history that give substance to these estimates.

2.2. The 1850–1900 period

We shift attention to the 19th century's second half, during which data were less scarce. Barro and Ursúa (2008)—who since 2018 have been quoted by MPD as a new source for this period—affirm that their data for 1850–1900 were from Goldsmith (1986). In the online appendix of their paper, they explain that they simply corrected Angus Maddison's (1995) estimates for 1850–1900, which he asserted to were based on Goldsmith's (1986) but in fact diverged from this data source. The implication is that the internationally accepted "bible" for the statistics

on Brazil's GDP growth in second half of the 19th century is Goldsmith (1986) to which we now turn.[7]

Goldsmith started by constructing four yearly series, namely: exports plus imports of goods, urban wage income, central government spending, and money supply. Goldsmith adopted an index-number format for each series and took a simple average of them to obtain a new series for 1850 to 1900 (and beyond) which he identified as the nominal GDP for the period.

Next, he took a simple average of four price indices (two of which were of questionable quality, as we argue in the Appendix), identifying this average as the GDP deflator for the 1850–1900 period. The result of the division of the proxy for nominal GDP by the proxy for the GDP deflator yielded Goldsmith's estimate of real GDP. Dividing real GDP by an estimate of the population, he obtained his real per-capita GDP proxy, which eventually found its way into the MPD and became the cornerstone for the presumption of a slowly moving Brazilian economy in the second half of the 19th century.

Far be it from us to depreciate Goldsmith's pioneering effort to give order to the disparate economic series then available for the Brazilian economy. His strenuous efforts to put together, by himself and in a short period, nearly all available macroeconomic information on Brazil's economy for the second half of the 19th century (and beyond) was nothing less than admirable. It is a pity that Harper & Row published only an editorially defective Portuguese-language version of his book, for an English version would have permitted a deeper historiographic critique of his approach.

With the benefit of hindsight and more recent empirical research, we submit, and further substantiate this assertion below, that Goldsmith's figures on Brazil's GDP cannot be accepted as a credible reflection of the country's economic behaviour in the second half of the 19th century. In our view, these figures should be abandoned. Yet replaced by what?

Tombolo (2013), summarised in Tombolo and Sampaio (2013), made use of the figures unearthed by Goldsmith and obtained a more acceptable proxy for the evolution of Brazil's GDP per capita in the 19th century. He constructed yearly series for population, government revenues, money supply, goods imports, and goods exports for the 1820–1946 period.

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[7] While at the University of Chicago in 1972, Contador and Haddad (1975) presented an index of real product in Brazil from 1861 to 1970. It was a pioneering paper in that context; but the results were marred by the utilisation of a flawed price index, that of Onody (1960) (as explained in the Appendix).

These series are similar to Goldsmith's, with population replacing urban wage income and government revenues replacing government spending. However, instead of taking a simple average of the series, as Goldsmith did, Tombolo first regressed them on Haddad's (1978) widely used series for nominal GDP in the 1900–1946 period. He then used the coefficients of this regression as weights to construct estimates of yearly nominal GDP from 1850 to 1900 by properly aggregating the series of population, government revenues, imports, exports, and money supply for this period.

To obtain a GDP price deflator, Tombolo first estimated a regression of five price indices on estimates of the GDP price deflators for 1889–1947. [8] He then used the estimated coefficients of this regression to generate a GDP price deflator for 1820–1900 as a composite of the five price indices. By dividing nominal GDP by the GDP price deflator, he obtained real GDP estimates, which, once divided by population, yielded a series of real per-capita GDP since 1820.

There are some problems with Tombolo's estimates. For example, population is a poor choice of a regressor in an equation purporting to represent nominal and not real GDP. In addition, his choices of the regressors for the GDP price deflator are problematic. For example, he included as regressors both the exchange rate of the *mil-réis* to the British pound and the product of this exchange rate by U.K.'s wholesale prices, which seems incongruous. Furthermore, his GDP price deflator may underestimate the course of inflation since the coefficients of his five price-index regressors add up to less than one.

Nonetheless, as acknowledged by Abreu, Lago and Villela (2022, pp. 43–44) the figures produced by Tombolo are an improvement over Goldsmith's estimates and are the best guesses that we currently have on Brazil's per-capita GDP for the 19th century. [9]

Table 1 compares the yearly GDP per capita growth rates estimated by Goldsmith and Tombolo for the Monarchy and relevant subperiods. We used Mortara (1941) population estimates for both series to make them comparable on a per-capita basis. The figures for Goldsmith figures start in 1850. For 1850–1889, Goldsmith had 0.18% while Tombolo suggested 1.02%-–five times as large a value. For the Monarchy as whole, from 1822 to 1889, Tombolo estimated a yearly growth rate of 1.03%, with roughly equal trends for 1822–1850 and 1850–1889.

[8] The deflators are Haddad's (1978), for 1909–1947, and Villela and Suzigan's (1973), for 1889–1908.

[9] Abreu, Lago and Villela (p. 44) adopted Tombolo's estimates for the second half of the 19th century but did not use them for the first half.

Table 1. Goldsmith's and Tombolo's estimates of Brazil's yearly real per-capita GDP growth in the Monarchy, 1822–1889 (%)

Period	Goldsmith	Tombolo
1822–1889	(...)	1.03
1822–1850	(...)	1.05
1850–1889	0.18	1.02
1850–1860	1.40	0.23
1860–1870	0.88	3.11
1870–1880	(-)0.27	(-)0.97
1880–1889	(-)1.42	1.81

Source: Estimated from Goldsmith (1986, p. 22) and Tombolo (2013, p. 49) using population data from Mortara (1941).

For 1850–1860 and 1870–1880, Goldsmith's figures were somewhat higher than those of Tombolo; for 1860–1870 and 1880–1889, they were substantially lower. Goldsmith's negative estimate for 1880–1889 is particularly awkward, for this was a decade in which railroads and European immigration were both growing at rapid rates accompanying the expansion of coffee production in São Paulo, the country's Northeast was recovering from the devastating droughts of the late 1870s, and the Amazon rubber boom was gaining speed.

Our conclusion is that Goldsmith (1986) underestimated Brazil's growth in the second half of the 19th century. In the next section, we develop new estimates of Brazil's economic growth in the 19th century, building on Tombolo (2013).[10]

3. Reestimating Brazil's GDP growth in the 19th century

In the following we maintain the logic of Tombolo's approach (2013) while attempting to address the problems in his empirical procedures. We start with

[10] Reference should also be made to a book-length study on the roots of Brazilian relative economic backwardness by Barros (2016). This author adopts a human capital approach to estimate Brazil's per-capita income in 1800, 1820, 1870, and 1890. He divides the Brazilian population according to origin in three ethnic groups: Indigenous, Black or Mixed, and European. Barros presumes that the incomes of Afro-Brazilians and of indigenous people remained constant while the incomes of Euro-Brazilians (around 37% of the population along the century) increased according to those in their respective countries of origin. On this basis, Barros concludes that Brazil's per-capita GDP grew 0.4% per year from 1820 to 1900.

nominal output per capita, followed by the estimation of price deflators, to conclude with new proposed estimates of Brazil's real per-capita GDP in the 19th century. We begin the analysis in 1820 since data for the earlier part of the century is particularly scant.

3.1 Estimating nominal output per capita

Our aim is to construct an index number representing nominal GDP from three macroeconomic variables at current prices: an arithmetic mean of goods exports and imports in national currency (which we denominate as "foreign trade index"), an arithmetic mean of central government's revenues and expenditures (which we denominate as "government budget"), and a money supply series. All variables are expressed in per-capita terms. We choose these variables both because of their direct association with nominal GDP and their availability for most of the 19th century. The Appendix details the data sources for these series.

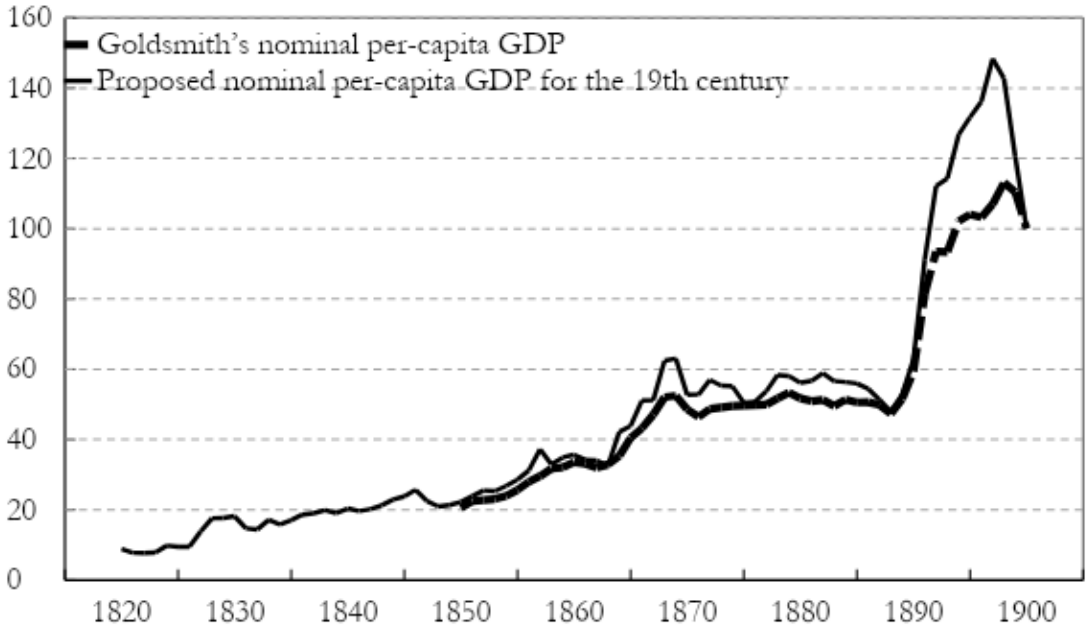
Our first task is to determine the weights with which these three variables enter the construction of nominal GDP. We obtain these weights with a regression of nominal GDP on the three variables in the 1900–1947 period. For this purpose, we use Haddad's (1978) nominal output estimates for 1900-1947. The results of this regression are in the Appendix. Applying the weights obtained in the regression to the values of the independent variables along the 19th century, we built a nominal output per capita series from 1820 to 1900, using a Laspeyres index based in 1900:

$$Y_t^n = 100\times\left(0.461783\times\hat{FT}_t + 0.179754\times\hat{GB}_t + 0.387892\times\hat{M}_t\right)$$

where the hats on top of the variables indicate the (gross) percentage change between year t and year 1900; Y_t^n is nominal GDP, FT_t is a foreign trade index obtained by the arithmetic mean of exports and imports in domestic currency; GB_t is a government budget index obtained by the arithmetic mean of government expenditures and revenues; and M_t refers to a money supply series. All variables are in per-capita terms[11]. Figure 1 compares our series of nominal per-capita output for 1820–1900 with Goldsmith's for 1850–1900.

[11] In the interval between 1890 and 1892 we excluded money supply from the construction of nominal output to avoid the undesirable effects of the huge monetary expansion in the transition from Monarchy to Republic (a period known as the *Encilhamento,* a term related to the strong speculative bubble that occurred at the time), and adjusted the weights for the other variables accordingly in this interval.

Figure 1. Probable level of Brazilian nominal per-capita GDP in the 19th century (1900 = 100)



Source: Goldsmith's nominal per-capita GDP series uses Goldsmith (1986) and Mortara (1941) for population estimates. For our nominal per-capita output, see the Appendix.

Figure 1 makes it clear that except in the 1890s the general tenor of our series is like that of Goldsmith's, and even in this last decade the cumulative growth rates of the two series are similar. We conclude that the exclusion of the payroll series and the introduction of government taxes do not change much our nominal GDP series from that obtained by Goldsmith over the 1850–1900 period. The main difference between our results and Goldsmith's is the choice of deflators to obtain real output, as we explain in the following.

3.2 Estimating the output deflator

The next step is to select a deflator to obtain a real output series. In Appendix we provide a detailed explanation of the construction of the deflator. Briefly, the only methodologically sound price index for (part) of the period is the wholesale price index of Catão (1992). Unfortunately, it is available only from 1870. For the previous decades, the next best choices are the cost-of-living index of Lobo et al. (1971) and a general price index of Buescu (1973). For the 1820–1870 period, we constructed a Laspeyres index from these two indices, based in 1870, with weights

given by a regression of the Catão index on log first differences of these two series in the 1871–1887 period, as follows:

$$P_t = 100 \times \left(0.716484 \times \hat{B}_t + 0.283516 \times \hat{L}_t \right)$$

where the hats on top of the variables indicate the (gross) percentage change between year t and year 1870; P_t is our proposed output deflator, B_t is the Buescu price index and L_t is the Lobo price index. This weighted average is then spliced into the Catão index in 1870 which is thus extended back to 1820. This is the price index that we use as deflator of nominal per-capita GDP from 1820 to 1900. This index is in Figure 2, where we also display Goldsmith's output deflator for 1850 to 1900.

Figure 2. Goldsmith's and our proposed deflator (1900 = 100)

Source: Goldsmith's deflator from Goldsmith (1986). For our deflator, see the Appendix.

Goldsmith constructed his deflator as a simple average of four price indices: Buescu (1973), Lobo et al. (1971), Onody (1960), and Vieira (1947).[12] We did not include either Onody's or Vieira's price indices in our equation because of their

[12] The Portuguese version of Goldsmith book (the only one that is available as Goldsmith's English original has apparently been lost) wrongly attributes to Randall (1977) the Vieira index when she only transcribes it in her book.

shortcomings, as we explain in the Appendix. Furthermore, we used appropriately weighted Buescu's and Lobo's indices as proxies to Catão's index.

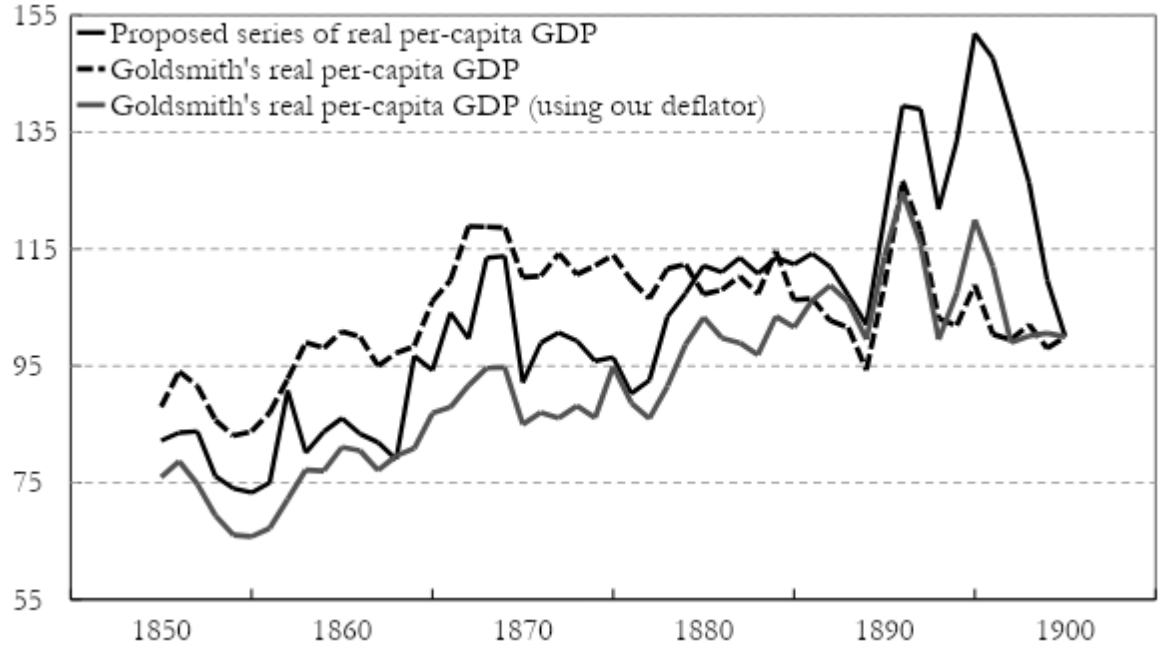
Goldsmith's and our index exhibit nearly the same yearly inflation rate for 1850 to 1879 (2.5% vs. 2.4%). From 1879 to 1887, our index shows a deflation of about 2.0% per year. In the same period, Goldsmith's index displays a yearly inflation rate of 0.3%. The index used by Goldsmith fails to capture the deflation particularly evident in import prices in these years. From 1888 to 1900, the yearly inflation rate is 5.7% for the Goldsmith deflator and 6.2% for ours.

Having established a deflator, we proceeded to estimate Brazil's real output per capita from 1820 to 1900, first comparing our results with those of Goldsmith for the 1850–1900 period.

3.3 Probable evolution of Brazil's real per-capita GDP from 1850 to 1900

We obtain an estimate of Brazil's real per-capita output from 1820 to 1900 dividing per-capita nominal GDP by the deflator developed in the previous section. Figure 3 compares the evolution between 1850 and 1900 of our real per-capita output series (the continuous black line) with that of Goldsmith (the black dashed line). The figure also shows the behaviour of Goldsmith's nominal output estimates deflated by our price index (the grey line). All series are in index number form with 100 in 1900.

Figure 3. Probable levels of Brazilian real per-capita GDP in the second half of the 19th century (1900 = 100)



Source: Goldsmith's real per-capita output is estimated from real output data in Goldsmith (1986) using Mortara's population series (1941), the same that we use for our series.

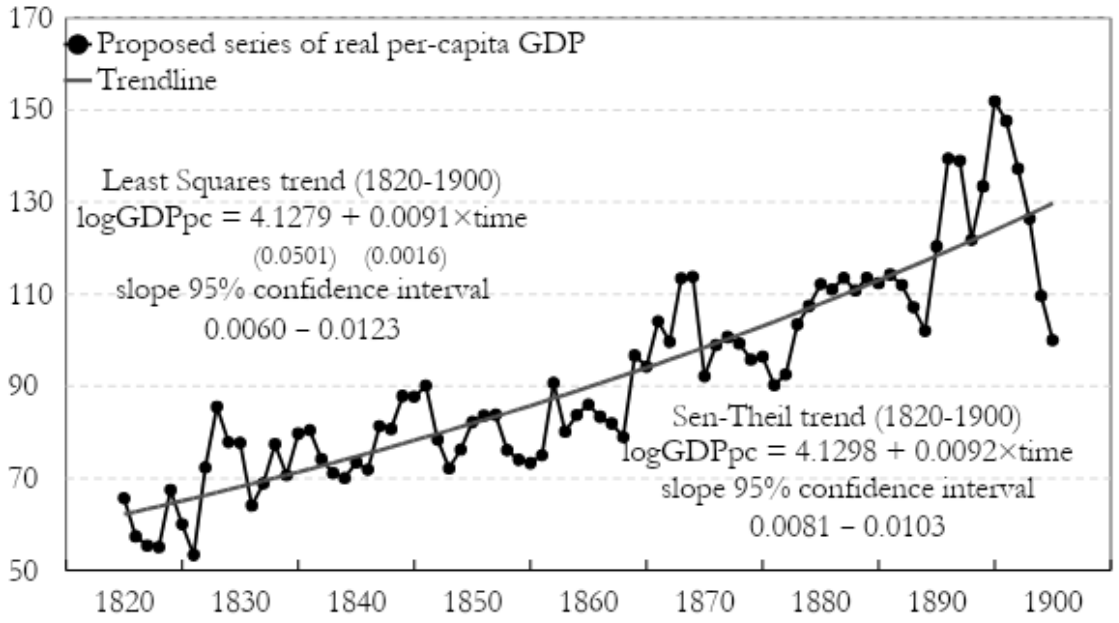
Overall, our series displays a higher per-capita output growth rate, which is the reason why most of the time it lies below Goldsmith's series (all series are equal to 100 in 1900). The difference is mostly due to the deflators, since when Goldsmith's nominal series is adjusted by our deflator, the growth pattern of his inflation-corrected series is similar to ours. Our series diverges from Goldsmith's in growth rates mainly between 1878 and 1887 when the inflation rates of the two deflators differ sharply. In this period, the yearly growth rate of real per-capita output in our series is 0.9%, whereas Goldsmith's calculated a negative rate of −0.9%. In the last decade of the century, our series displays sharper fluctuations than Goldsmith's, but both overall growth rates are similar.

Having argued that the differences between our results and those of Goldsmith for the second half of the century are mostly due to the price deflators, we proceed to a more detailed analysis of our series for the entire 1820–1900 period.

3.4. Per-capita GDP growth in the 19th century

The black dotted line in Figure 4 displays the evolution of our estimated real per-capita output series from 1820 to 1900. Two features are apparent. First, the trend is clearly positive. Second, the series is highly volatile, with periods of expansion alternating with periods of contraction of varying magnitude and duration.

Figure 4. Our estimate of Brazil's real per-capita GDP from 1820 to 1900 and its trendline



Source: Our own estimates.
Note: *OLS trend with HAC (Newey-West) standard errors and covariance (prewhitening with lags = 1, quadratic-spectral kernel, Andrews bandwidth = 3.2136); standard errors in brackets.

Because of this high volatility, we decided to fit a log linear trend to the series using both Least Squares and the Theil-Sen estimator. The latter, unlike Least Squares, is robust to outliers,[13] which are particularly evident in the last decade of the 19th century. In Figure 4, the black trend line of the Theil-Sen estimator has a slope indicating an annual growth rate of 0.9% between 1820 and 1900.[14]

The point estimate of the slope by the two methods is the same, 0.9% per year, but the 95% confidence interval is bigger for Least Squares (0.60%-1.23%) than for the Theil-Sen estimator (0.81%-1.03 %). If for prudence we accept the

[13] The Theil–Sen estimator (Theil, 1950; Sen, 1968) is a method for fitting a line to sample points by choosing the median of slopes among all pairs of points. It is resistant to outliers, with a breakdown point of 0.29 (Wilcox, 2001, p. 208). The estimator is nonparametric, i.e., it does not depend on a probability distribution. It is an alternative to the parametric Least-Squares regression line. Least Squares use a weighted mean to estimate the slope; Sen's uses a median.

[14] As a check on our estimates, we redid the computation of real per-capita output using the official trade series instead of the revised series of Absell and Tena-Junguito. The point slope is 0.91% per year for the series using the Absell and Tena-Junguito foreign trade data, and 1.00% for the series using the official data. However, the confidence interval (by OLS) of the slope for the series using the official foreign trade data (0.78–1.22%)** is within the range of the series using the Absell and Tena-Junguito foreign trade data (0.60–1.23%) The alternative estimates are displayed in the Appendix.

bigger interval, we have a range from 0.6% to 1.2% for the average annual growth of the Brazilian economy between 1820 and 1900.

Searching for possible multiple breakpoints in the series, we applied Bai-Perron (2003) tests, as explained in the Appendix. None of these tests suggested the existence of breakpoints in the series, supporting the adoption of the same trend growth rate for the whole 1820–1900 period, meaning that Brazil's per-capita output trend-growth was 0.9% per year with a range of 0.6% to 1.2%.[15]

These results are in sharp contrast to previous studies on the behaviour of Brazil's economy in the 19th century. Leff (1982, pp. 33–34) claimed that "income growth in nineteenth-century Brazil probably did not exceed the country's rate of population increase." Furtado (1963, Ch. 19) asserted that real per-capita income declined in the first half of the century, while Prados de la Escosura (2009, p. 301) assumed that the Brazilian economy stagnated in the same period. Also, our suggested range for the yearly trend growth rate of real output from 1820 to 1900 (0.6% to 1.2%) is well above the 0.2% to 0.5% range that Abreu, Lago and Villela (2022, p. 65) hypothesised for the mean growth rate of real per-capita output during the Monarchy (1822–1889).

In the face of these differences, we should stress the tentative nature of our results. We used indirect methods to estimate output growth—we have no observations on production volumes, only monetary series deflated by price indices. The margin for measurement error is large indeed[16].

One possible source of upward bias in our estimates is the inclusion of only market-related variables in the nominal GDP regression, as these variables would not capture the evolution of the slow-moving subsistence sector[17] (this criticism,

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[15] The trend growth rate is the same if the series is smoothed with moving averages. We applied a 10-year moving average to the data and then re-estimated the trend slope by OLS—the sample now starts in 1829 and the number of observations is 72 (1829–1900). The results are (standard errors in brackets): intercept 4.1789 (0.1054), slope 0.0089 (0.0040). The slope is similar to that obtained in the original series.

[16] Our composite for nominal GDP gives a high weight of 0.39 to the money supply series, which as pointed out by Goldsmith (1986, pp. 43-50) and Villela (2020, pp. 137-142), is of dubious quality, as it does not include banking houses notes and metallic coins which were important in parts of the century (on metallic coins, see Calógeras (1960[1910]). But this is the only series available for the whole period, and both Goldsmith and Villela, after listing their caveats, proceed to use it in their statistical analyses. As a check on our findings, we tested an alternative specification for the composition of nominal GDP in which – following on Goldsmith – we gave the same weight of 0.2 for each of the five variables: money supply, government spending, government taxes, exports, and imports. That is, we reduced the weight of money supply to practically one half. This variant generated the same trend real GDP per capita growth rate of 0.9% both for 1820-1890 and for 1820-1850, as in our preferred estimate.

[17] We are indebted to an anonymous referee for this observation.

incidentally, would apply to all previous studies as they also considered only market-related activities).

It is however our understanding that production of subsistence food for the predominant rural population had, by and large, very low activity levels; in the words of Furtado (1963, pp. 130-131): "because it was based on cattle breeding and on farming with the most rudimentary techniques, its economic density was reduced to a minimum". On the other hand, the production level of the commercially oriented subsistence sector was related to that of the export sector. In the case of Bahia, for instance, Barickman (1998, pp. 79–80) shows that the ups and downs of the price of cassava flour (a staple food in the region), sold by small farmers to sugar estates, and also to Salvador, the provincial capital, followed closely the export price of sugar (in other words, production of this sector would be taken care of by the export series that we used).

The presumption of the smallness of the subsistence sector is substantiated by the estimate of Brazil's per capita income in 1872 by Bertola et al. (2012, p. 8). This paper estimates GDP per capita from the income side, using information from the 1872 Census and other administrative records, and it includes an imputation for enslaved persons' incomes. It thus supposedly captures the income generated in the subsistence sector. Notwithstanding, the figure that the authors obtain for Brazil's GDP per capita in 1872 is 118 mil-réis, practically the same as the 119 mil-réis estimated by Goldsmith (1986, p. 23) who used a methodology similar to ours, that is, considering only market-related activities.

In view of the weakness of the available data, our results can only be considered as provisional. Our claim is the use of series similar to those of previous studies. The differences are that our monetary series are newer and aggregated according to a methodology respectful of their relationships with nominal output in the 20th century. In addition, our price deflator series used the only truly reliable price index for the later part of the 19th century (Catão, 1992) while estimating the inflation rate in the rest of the century with a combination of the two next-best indices (Lobo, 1971; and Buescu, 1973), which is respectful of their relationships with the Catão index in the 1871–1897 period. In the Appendix we discuss in detail the construction of our series and make them available for future researchers who may want to test their robustness.[18]

[18] The Brazilian economic historian Thales Pereira is constructing a new price series for the 1824–1870 period, using methods similar to those adopted by Catão (1992) for the 1870–1913 period. Once this series is published and subjected to peer evaluation, it may lead to a revision of Brazil's output performance in the 19th century. Preliminary figures of this series that Pereira made available to us suggest that our results by and large will be sustained.

Ours is certainly not a perfect proposal, but under a reasoned exploration of alternatives it seems to us to be the best one according to our research. More importantly, our quantitative findings are backed up by historical and historiographic evidence that we present in the following section.

4. Historical and historiographic evidence

In this section, we review relevant historical and historiographic material on Brazil's economy in the 19th century.[19] First, we deal briefly with the second half of the century because our findings for this period do not diverge substantially from those in the literature. There follows a deeper analysis of the country's economy in the first half of the 19th century, where our statistical findings do not conform to the current historiographic consensus.

4.1. The second half of the 19th century

Furtado (1963, Ch. 25) asserted that the second half of the 19th century was one of significant growth. It was only Leff (1982) who challenged this evaluation, based on the disputable quantity theory of money and on the use of inadequate price deflators. Goldsmith (1986) arrived at a lower output growth rate than ours for the 1850–1900 period, but this, as we hope to have convincingly shown, is only because of his use of inappropriate price deflators to generate the real output series.

Several studies, moreover, document relevant sources of growth in the second half of the century. The extraordinary expansion of coffee cultivation in São Paulo is described in Bacha (1992, pp. 18–28). The positive effect of this expansion on income and production diversification, especially when free labour became predominant in the coffee sector, has been emphasised since Furtado (1963, Ch. 25, 26). The favourable impact of the railroad expansion from 1850 onward—essentially financed by British capital—is analysed in Summerhill (2003); see also Herranz-Locán (2014). It may also be noted, as mentioned by Franco (1991, Ch. 4), that the country's financial relationship with the rest of the world improved in the last two decades of the century, opening the way for better access to international finance.

After 1870, there are indications that mass immigration, stimulated by coffee expansion, brought a significant contribution in terms of human capital (see Hall, 1969; Holloway, 1974; Barros, 2016). The number of immigrants arriving from 1871 to 1900 was 1.86 million, an impressive number when compared to the total

[19] For historical accounts of the 1822–1889 period, see the chapters by L. Bethell and J. M. Carvalho (on 1822-1850), R. Graham (on 1850-1870), and E. Viotti da Costa (on 1870-1889) in Bethell, 1989.

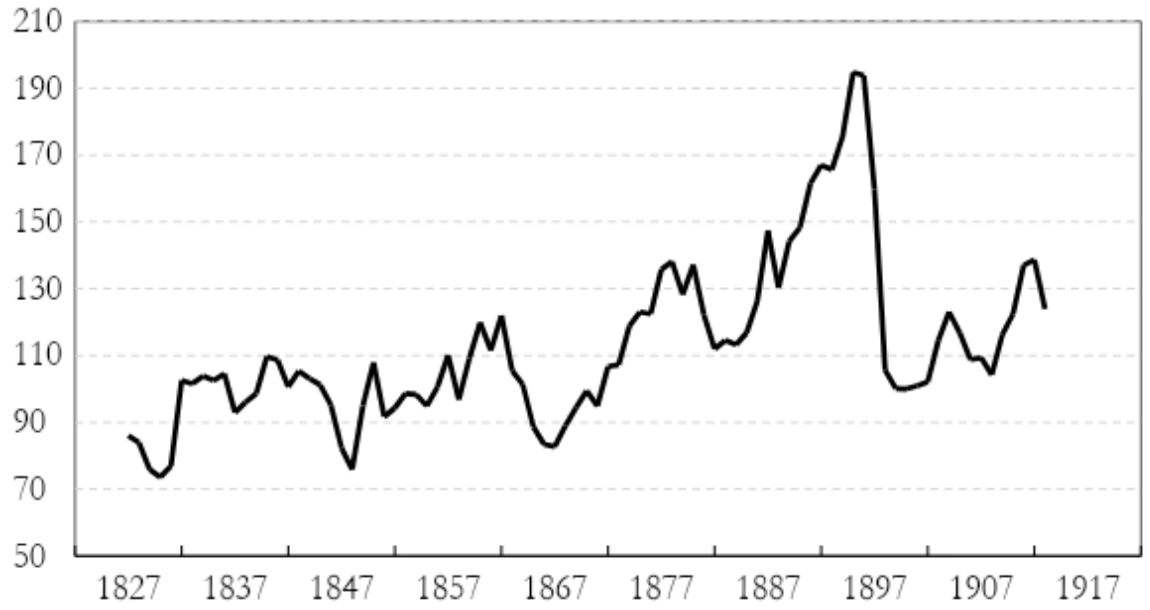
population of 10.1 million in the 1872 census (Merrick and Graham, 1979: p. 37). In those three decades, the proportion of foreign-born male workers in the labour force doubled, to 10% in 1900. In the São Paulo province, this proportion was 22% in agriculture and 47% in non-agricultural activities (57% in industry). Data for 1900 are a strong indication of the educational superiority of the foreign-born: their literacy rate was 43%, compared to 23% for the native-born. The proportion of the foreign-born with primary education was twice as high as that of the native-born; a proportion close to three times as high, in the case of secondary or college education (Merrick and Graham, pp. 105–111).

The 1870s also witnessed the beginnings of an industrialisation drive, especially in cotton textiles. Tariff protection for this sector increased in the following decades, favoured by the growing influence of pro-industry interests, and by investments from the importing business (Versiani, 1979; Versiani, 2023; Dean, 1969: Part One).

A less-emphasised but important factor boosting economic growth was the huge improvement in the country's terms of trade (price of exports relative to the price of imports) in the second half of the 19th century, as shown in Figure 5, derived from the online appendix of Absell and Tena-Junguito (2018). Indeed, measured from its trough in 1867 to its peak in 1895, Brazil's terms of trade more than doubled during the second half of the century, increasing at an extraordinary rate of 3.1% per year.

Bacha and Bonelli (2016, pp. 163–165) demonstrate the critical role that the terms of trade had on Brazil's total factor productivity growth in the 1980–2014 period. Greater volumes of efficiency-improving imported intermediate goods would be the transmission mechanism leading from better terms of trade to higher domestic productivity growth. It stands to reason that productivity growth would be even more dependent on the purchasing power of exports in 19th-century Brazil.

Figure 5. Brazil's terms of trade, 1827–1913 (1900 = 100)



Source: Online appendix of Absell and Tena-Junguito (2018): Supplementary Material, price indices. Available at https://doi.org/10.1017/S0212610917000143.

4.2. The first half of the 19th century

In his influential book on Brazilian economic history, Celso Furtado argued that the country's per capita GDP did not increase in the first half of the 19th century. He thought, in fact, that it would have probably decreased. His argument is based on the idea that GDP growth at the time depended entirely on the growth of exports; with then available data, he supposed that the sterling value of exports had grown at a yearly rate of 0.8% in the 1800–1850 period, while the rate of population growth was 1.3%. Furthermore, terms of trade would have fallen close to 40% between 1821–1830 and 1841–1850 (Furtado, 1963: Ch. 19). Leff (1982: pp.39–40) also mentioned the slow growth of exports, in support of his thesis of near stagnation in the 19th century.

As we have already stressed, in a recent review of Brazilian trade statistics for the 1821–1913 period, Absell and Tena-Junguito (2016, 2018) showed, on the contrary, substantial export growth in the 1821–1850 period, averaging 3.5% per year, while the population was growing at 1.5% (IBGE, 1990: p. 30). In the entire 1821–1900 period, the average rate of export growth was 2.7%. From 1827–1831 to 1846–1850, the terms of trade increased about 15%, a yearly average of 0.8%.[20]

There are also indications that the rapid expansion of coffee, in the period, brought about significant productivity gains. The proportion of coffee exports in total export value jumped from 21% in 1821 (when sugar was the main export

[20] Rates derived from trade series in current sterling in Absell and Tena-Junguito (2018: Supplementary Material).

item), to 44% in 1850–1851, with sugar now in a distant second, making up only 23% of total export value (data from Absell and Tena-Junguito, 2016, Supplemental Material). Such inversion probably had a positive effect on output value per capita, as suggested by data from a large sample of farms in São Paulo province—where coffee spread rapidly along the Paraíba Valley, in the period—showing that the value of production per worker was 52% higher in coffee than in sugar (cf. Luna and Klein, 2018, Table 1.1). All things considered, it can be said that external trade favoured income growth in the first half of the century.

Moreover, the idea that income growth in the period could only derive from the export sector is no longer tenable. In recent decades, there has been growing evidence of important flows of domestic trade, especially toward Rio de Janeiro city. In the 18th century, Rio, the only important port in the Central South, had become an export and import trade hub after the discovery of gold, and later diamonds, in the neighbouring province of Minas Gerais. The transfer of the colonial capital from Bahia to Rio in 1763 probably enhanced economic activity in the city.

The importance of export trade via Rio increased with the "agricultural renaissance" of the last decades of the 18th century, favoured by increased prices for agricultural commodities as a result of interrupted supplies from North and Central America, caused by the destructive 1791–1804 revolution in Haiti—a major supplier of sugar and other agricultural products—and the United States war of independence (Alden, 1984: p.627ff). There was a revival of Brazilian exports of sugar, rice, cotton, and other agricultural products in this period. Especially important for the Rio export trade was the growing production of sugar in the northern part of the Rio de Janeiro province.

On the other hand, supply of basic food items to the city of Rio, such as beans and manioc, fell significantly, as planters in the neighbouring area turned to production of more lucrative exportable items such as rice and indigo. Consequently, provision of agricultural production from Minas Gerais became important (Brown, 1986: p. 56).

As Martins (2018) observed, the gold and diamond boom in Minas Gerais in the 18th century diverted many historians' attention from the fact that, as mining prospered, agricultural production in the province increased significantly. Mining activity caused an intense flow of migrants into the province. The rapid rise in demand, especially for food products, was met, as stressed in the literature, by trade from other regions in Brazil (for instance, Furtado, 1963: Ch. 3).

But more recent research on the sources of supply for the mining region, as Zemella (1990) has shown, indicates that it increasingly came from inside the

region itself. Prado Jr. (1971[1942]: Ch. 3, 10) had already noted that as early as the 1760s, Minas sent food commodities to Rio de Janeiro and São Paulo. A long-held belief that mining and agriculture were incompatible (Antonil, 1982[1711]: p.169; Furtado, 1963: Ch. 15) proved to be incorrect: Costa Filho (1963: pp.159 ff), for instance, mentioned various "mixed farms" in Minas Gerais, where mining, agriculture, and cattle-raising coexisted in the 18th century.

As noted by Maxwell (1973: p. 88), such coexistence was made easier by the mining rights concession system of the Portuguese Crown; those rights were frequently granted in land tracts previously given for free for agricultural purposes (the so-called *sesmarias).* Many authors have documented the diversity of productive activity in 18th-century Minas Gerais (see references in Martins, 2018: pp. 508 ff). Such development of non-mining production was made easier by the fact that the Portuguese authorities, while strictly controlling and regulating everything related to gold and diamonds, gave considerable unregulated freedom to other activities—in which the major part of the population was engaged (Holanda, 1985: pp. 289, 294–95).

In a pathbreaking paper, Martins Filho and Martins (1983) argued that Minas Gerais in the 19th century was a slave-based economy producing essentially for the domestic market, in mostly small or mid-sized farms—arguing also that it would be the sole example of such a productive structure in the Americas. The important point is that Minas Gerais at the time was certainly a major supplier of consumer goods for the domestic market.

Such supply gained importance after 1807, when, fleeing from the Napoleonic invading troops, the Portuguese court moved to Rio de Janeiro, accompanied by a large entourage (close to fifteen thousand people), mostly wealthy aristocrats, bureaucrats, and merchants. The city of Rio was transformed into "the most important consumption center of south-central Brazil [and] the center of an internal trade network in which hinterland areas produced for the city's population consumption" (Brown, 1986: pp. 61–62). As shown in detail in Brown's study, Minas Gerais was Rio's main source of supply in the following years. The vast network of commerce between the interior and the capital then developed, "most [of it] in commodities intended for the domestic market" (Brown, p. 476), would also eventually involve, to some extent, more distant localities in Goiás, São Paulo and Rio Grande do Sul provinces.

Such long-distance trade was based on credit, furnished mostly by Rio de Janeiro merchants; but some Minas cities were also intermediary trading centres, which led to capital accumulation and sources of credit supply outside Rio. It also led, incidentally, to the rise of an interior elite with roots in domestic trade—sometimes very active in the politics of the agitated period around the time of the

Independence in 1822 (Brown, p. 507 ff; Lenharo, 1979). Some of the Rio merchants became extremely wealthy and influential in the colonial administration—and, after Brazilian independence in 1822, also influential in the first monarchical government up to 1831 (Gorenstein, 1993; Fragoso, 1992).[21]

Some of the domestic trade toward Rio involved large investment, such as the supply of some 20,000 head of cattle consumed in the city every year. Cattle traders frequently had to wait for up to two years to realise their profits: animals were herded in journeys of hundreds of kilometres, after which they were kept in pastures for long periods, to rest and fatten before being sold in Rio, "the only market which could draw large number of animals from great distances" (Brown, 1986: p. 505). The accounts of one of the big São Paulo cattle traders, the Baron of Iguape, were preserved, which allowed a detailed look at the activities of those merchants in the 1820s and the large investments involved in this business (Brown, pp. 500–504).

Another factor significantly impacting Brazil's economy was the Napoleonic Wars, which triggered a sudden increase of British traders' interest in the Brazilian market. Immediately after his arrival in Brazil, the Portuguese Prince Regent decreed in January 1808 the opening of Brazilian ports to all friendly nations, ending the Portuguese monopoly of trade with Brazil. At this time, British exports were severely limited by restrictions arising from the war with France; accordingly, many British merchants saw the opening of Brazilian trade as a welcome opportunity.[22]

In June 1808, the Portuguese ambassador in London called a meeting of merchants who intended to do business with Brazil; 113 London merchants joined the Association of English Merchants Trading to Brazil, organised at the meeting. In the second half of this year, the number of British merchants in Rio was larger than 100, perhaps reaching 200; the eagerness to trade was such that some of the goods brought to sell in the local market were totally inappropriate, such as ice skates (Manchester, 1972: p. 75; Pantaleão, 1993: pp. 73–76).

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[21] According to the well-known Brazilian historian S. Buarque de Holanda, it is an erroneous notion, although frequently found in the literature, that big landowners had a major influence in the early decades of the 19th century. It was the wealthy merchants who dominated Brazilian politics in the period (Holanda *apud* Gorenstein, 1993: pp. 129–130).

[22] A series of trade prohibitions imposed by France and Britain in 1806–1807 (the so-called Berlin and Milan decrees by Napoleon, the British 1807 Orders in Council) also applied to the ships of neutral countries. These restrictions had an extremely adverse effect on U.S. exports and shipping; the U.S. government retaliated with a general trade embargo in 1807, and other restrictive measures in the following years. Such economic warfare culminated in the British–U.S. war of 1812–1815. Already excluded from France-dominated European countries, British exporters had access to few markets. See, for instance, Bickham (2012) and Frankel (1982).

In the following years, Great Britain dominated Brazil's imports, which was made easier by an 1810 commercial treaty signed by Portugal and Britain, largely favourable to the latter. Brazil became an important market for English manufacturers; in 1820, Brazilian purchases of British goods, mostly in Rio de Janeiro, were nearly 60% of those by the United States (Britain–U.S. trade was by then back to normal). Exports to Britain also increased, mostly of cotton, but much less; there were big trade surpluses in favour of Great Britain (Manchester, 1972: pp. 96–98).

The abolition of the British slave trade in March 1807 also had far-reaching consequences for the Brazilian economy. Prior to 1807, British traders largely dominated the African slave trade, an activity highly dependent on credit and vulnerable to delayed returns. The British had the great advantage due to their access to London financial and commercial institutions. After abolition, British merchants tried various expedients to maintain their presence in the slave trade; some even moved to foreign countries; but always present was the danger of intervention by the British Navy and courts (Eltis, 1987: p. 51 ff.). However, "the supply of British goods and credit proved to be beyond the power of law to control" (Eltis, p. 58).

As stressed by Miller (1988), the abundance of British capital was instrumental in furthering the intense flow of forced migration of Africans to Brazil in the 1810s and 1820s. Some British merchants participated in the slave trade as part of their import business in Brazil. Also, some Lisbon merchants formerly engaged in the slave trade, and having moved to Rio de Janeiro along with the royal family, became agents for the British, who supplied them with credit and trade goods to be used in slave trade with Angola (this Portuguese colony was the main source of chattels sent to Brazil). Angola-based traders, who formerly controlled the bulk of the Brazilian slave trade, were now marginalised by the Anglo-Portuguese merchants; Brazilian traders faced a similar fate (Miller, 1988: p. 505 ff; Klein, 1978: pp. 82–83).

Recently published data on the slave trade allow a more precise evaluation of the extraordinary flow of enslaved Africans to Brazil, in the first half of the 19th century.[23] From 1800 to 1850 (when slave trade was abolished in Brazil), close to 2.1 million forced migrants from Africa entered the country, more than 40% of the total registered during the three centuries of slave trade into Brazil (4.9 million). In the 1810s and 1820s, when close to fifty thousand coerced labourers entered the country each year, trade was especially profitable, which explains "the eagerness of

[23] Data available on *SlaveVoyages* website: https://www.slavevoyages.org, the source of the slave trade numbers quoted hereafter.

Brazil-based metropolitan traders to gain ownership of the slaves in those decades" (Miller, 1988: p. 513).

The monetary significance of such a large inflow may be gauged by ascribing an average price to the forced migrants. In the 1820s, when slave trade brought to Brazil reached its peak (close to 524,000 Africans), an average of 210 *mil-réis* is suggested in Bergard (1999, pp. 268–69).[24] At this price, the total value of the 524,000 forced migrants, converted into sterling pounds (£ 17.3 million), is a sizeable proportion (29.6%) of total merchandise imports in the decade (£ 58.4 million).[25] It is clear that investment in slave trade toward Brazil was considerable in the period (and also that a large portion of the total import trade went unrecorded).

Which activity demanded so many enslaved workers in the first half of the 19th century? Coffee cultivation was rapidly expanding in the period, especially after 1820 (Bacha, 1992); this could suggest that coffee farms were the main destination of those workers. A suggestion possibly reinforced by the fact that Rio was the port of entry for most incoming chattels at the time, and Rio de Janeiro province was, then, the main coffee-producing region. In fact, Brazilian slave trade in this period is often related to coffee in the literature (Miller, 1988: pp. 459, 493; Klein, 1999: p. 41).

However, official registers of domestic slave trade between Rio de Janeiro city and the provinces, for the 1809–1833 period, tell a different story.[26] In the 1821–1830 decade, the main destination was the province of Minas Gerais (41% of the total); 34% went to the Rio de Janeiro province, 15% to São Paulo province, and 10% to other provinces. Taking the two decades together (1811 to 1830), Minas and Rio provinces together received approximately 80% of the arriving slaves (equally divided between the two), while 12% went to São Paulo.

Those numbers seem to substantiate the early contention, in Martins Jr. and Martins (1983), that the Minas Gerais province was a large importer of enslaved Africans in the first half of the 19th century, and a significant supplier of agricultural goods to the domestic market. Contrary to a then-prevailing notion, according to which Minas was, in the period, an exporter of forced labour to the

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[24] Bergard researched slave prices in decedents' inventories from Minas Gerais; 210 *mil-réis* is the average price in the 1820s for enslaved men and women, 15–40 years of age—a reasonable approximation of the average age of the arriving enslaved. An independent source, Miller (1986: p. 63), gives nearly the same average for Brazilian slave prices in the 1820s: 240 *mil-réis*.

[25] Exchange rates from IBGE (1986: p. 68); merchandise import data from Absell and Tena-Junguito (2018: Supplementary Material).

[26] Those registers were first researched by J.L. Fragoso and R.G. Ferreira, and reviewed by R.B. Martins; cf. Martins (2018: pp. 418-19, 554-67)

coffee-growing areas, as the ending of the mining boom would have caused the province to have an "excess" of enslaved workers (cf. Furtado, 1963: Ch. 20).

It is thus clear that production and trading activity geared to domestic consumption, especially after 1807, was very significant. Rio de Janeiro was a major source of demand for this production, and Minas Gerais probably a major source of supply.

In conclusion, there is much evidence of a favourable climate for economic growth in the first half of the 19th century. According to Absell and Tena-Junguito, exports showed a healthy increase, especially in the 1821–1840 period (4.2% per year, in sterling value). Such increase was probably associated with productivity gains. There was heavy investment in the African slave trade, probably financed by British traders, and a large proportion of the increase in the enslaved labour force was apparently linked to an expansion of goods produced not for export but for the domestic market. There are no signs of stagnation, as most of the literature, until now, has supposed.

5. Comparison of Brazil's performance with other countries in the 1800s

In Table 2 we compare the evolution of Brazil's per-capita GDP with other countries/regions in the 19th century. For Brazil, we list the MPD estimates and our own-–the latter converted into 2011 US dollars with the per-capita GDP value of the MPD in 1900 corrected according to Bacha, Tombolo and Versiani (2023) (henceforth, BTV)[27].

According to the MPD, the value of Brazil's per capita GDP (in 2011 USD) was $1,585 in 1980. Taking this value as given and using the yearly growth rate from 1900 to 1980 calculated by BTV, we conclude that Brazil's per capita GDP (in 2011 USD) was $1,159 in 1900, a value 32.6% higher than the MPD's estimate of $874.

[27] BTV argue that the national accounts overestimate Brazil's GDP growth from 1900 to 1980. The reason is the exclusion in official statistics of slow-growing service activities, the growth rates of which are presumed to follow those of the higher-growth activities included in the real GDP estimates. BTV develops and applies methods to introduce such excluded services in the real output series. As a result, it suggests haircuts in the official statistics that reduce Brazil's per-capita GDP yearly growth rate from 3.25% to 2.48% in the 1900–1980 period. In the same period, according to MPD Brazil's per capita GDP yearly growth rate was 2.85%, lower than the official statistics, but higher than the BTV estimates.

Table 2. Per-capita output in the 1800s: Brazil and other countries (2011 USD)

Year	Brazil: Maddison	Brazil: Our estimates	Other Latin America countries	Western Europe	United States
1820	867	[720] 761	978	2307	2674
1850	867	[949] 953	1150	2678	3632
1890	1084	[1371] 1395	1894	4079	6665
1900	874	[1503] 1159	2117	4724	8038
Cumulative annual growth rates (%)					
1850/1820	0.0	[0.9] 0.8	0.5	0.5	1.0
1890/1820	0.3	[0.9] 0.9	0.9	0.8	1.3
1900/1820	0.0	[0.9] 0.5	1.0	0.9	1.4

Source: Brazil/Maddison, W. Europe, and US: MPD (2020). Other L.A., estimated from L.A.'s and Brazil's GDP per capita and population in MPD (2020). Brazil/Our estimates: in 1900, $874 from MPD (2020) plus 32.6%; in brackets: trend values according to the Theil-Sen estimator.

The countries/regions of comparison are other Latin America countries, Western Europe, and the U.S.—with data from the MPD.[28] The table lists estimates for 1820, 1850, 1890, and 1900. In the case of our estimates for Brazil, we list both our point estimates and, in brackets, the values along the trendline, according to the Theil-Sen estimator. The last three rows present the cumulative annual growth rates for relevant subperiods.

The figures in the table confirm the exceptionalism of US growth, particularly in the second half of the 19th century. Brazil's performance, according to our estimates, is on par with other Latin American countries and with Western Europe prior to 1890. That is, our series of real per-capita output is consistent with the performance of Latin America in the 19th century according to the Maddison Project database. Our economic history arguments suggest that it is implausible that the performance of Brazil's economy was so discrepant from the rest of Latin America as the Maddison Project indicate.

According to our proposed figures, Brazil performed only slightly worse than the US in 1820–1850. This finding contrasts with previous studies asserting that Brazil's economy stagnated in the first half of the century. But our figures conform to regional economic trends in the US itself: economic historians there agree that the U.S. South's slave-based economy grew like the rest of the countryin

[28] In the case of other Latin America countries, the figures are ours, but directly derived from those in MPD for Brazil's and Latin America's population and per-capita GDP.

the 19th century before the Civil War.[29] In both these slave-based societies—Brazil's and the U.S. South's—the robust economic growth in the early 19th century seems related to the interplay between the vigour of world demand and the sluggishness of alternative supply sources for the agricultural goods they produced. In the U.S. South, productivity growth was associated to innovations in the technology of cotton production and processing. In Brazil, we believe productivity growth to have been driven by the shift from sugar to coffee production.

It may be said that Brazil was subject to a perfect storm in the last decade of the 19th century. First, there was an inflation-burst, a consequence of the erratic monetary policies adopted in the first years of the Republican period, started in November 1889. A sharp fall in the exchange rate followed, aggravated by the sudden stop of capital inflow caused by the international Panic of 1890; the average sterling value of the mil-réis in 1892 was less than half what it had been in 1889 (IBGE, 1990: pp. 592-3). This increased the burden of external debt payments on government expenditures; the federal budget was further burdened by heavy military expenses related to rebellions occurred in the states of Rio Grande do Sul (1893–95) and Bahia (1896–97). The government difficulties, and the collapse of the coffee market in 1896, led to a foreign debt restructuring in 1898, followed by the highly contractionary monetary policies of finance minister Joaquim Murtinho in the last two years of the century (cf. Franco 2014).

This perfect storm generated a sharp aggregate demand shortfall; however, there are various indications that the real economy was expanding fast, in the period. In 1894, after the end of the speculative bubble, it was already noted "the obvious disparity between the poor situation of the Treasury and of monetary management, and the economic situation of the country […]. In spite of all wild speculation in the stock exchange, Brazilian productive activities kept progressing" (Calógeras, 1960[1910], p. 279, our translation). And the factors that favoured Brazilian economic growth in the second half of the nineteenth century were conspicuously present in the last decade: from 1891 to 1900, 1.1 million immigrants entered the country (Merrick and Graham, 1979, p. 37); the extension of the railroad network increased 45% (IBGE, 1986, p. 41); industrial machinery imports were 61% greater than in the previous decade (Suzigan, 1986, app. 1); twenty-two new cotton textile mills were established (Versiani, 1979, app. A); installed capacity of the (nascent) waterpower-generated electricity increased tenfold (Dean, 1997, p. 255).

These are the reasons why in Table 2 our estimates display a marked difference in 1900 between trend (or potential) per-capita GDP of US$ 1,503 and

[29] See, for example, Engerman (1975, p. 350) and Wright (2022, p. 132).

actual per-capita GDP of US$1,159. The sharp acceleration of Brazil's economy in the subsequent decades suggests that the trend estimate is not a statistical artefact (cf. Haddad, 1980).

6. Conclusions

"I tried to trace the history in quantitative terms, whenever possible, and I hope that many proxy estimates that I had to use will be improved by Brazilian specialists". These were the words of Raymond W. Goldsmith in the preface to his solitary *tour de force* to provide a year-by-year quantitative analysis of Brazil's economic growth since 1850 (Goldsmith, 1986, *Preface*; our translation). Goldsmith's estimates became the basic reference for the estimation of Brazil's GDP growth in the second half of the 19th century and was adopted by the MPD.

For 1800, 1820 and 1850, the Maddison Project continued to adopt a proposal by Prados de la Escosura (2009, p. 301, Table 6), that Brazil's per-capita income was constant in the first half of the 19th century. This stagnation hypothesis became consensual in the literature, as exemplified by Abreu, Lago and Villela (2022, p. 21).

This paper builds on Tombolo (2013), summarised in Tombolo and Sampaio (2013), to provide new estimates for Brazil's per-capita GDP growth from 1820 to 1900. The basic method follows that of Goldsmith (1986): lacking information on production volumes, the alternative is to aggregate yearly monetary series related to nominal per-capita GDP (namely, money supply, government income and expenditure, exports and imports of goods) and deflate the aggregate by available price indices, to obtain proxies for real per-capita GDP.

Our series are similar to those used by Goldsmith. The basic differences in the monetary series are that ours extend back to 1820 and are newer—particularly for exports and imports of goods (from Absell and Tena-Junguito, 2016 and 2018) and central government income and spending (from Carrara, 2022). Furthermore, they are aggregated according to a methodology developed by Tombolo, respectful of their relationships with nominal GDP in the 20th century.

Our price deflator series also used a new and only truly reliable price index for the latter part of the 19th century (Catão, 1992), while estimating the inflation rate for the rest of the century with a combination of the two next-best indices (Lobo, 1971; Buescu, 1973), which is respectful of their relationships with the Catão index in the 1871–1897 period.

The alternative that we consider best for Brazil's real per-capita GDP from 1820 to 1900 has two characteristics. First, the trend is clearly positive. Second, the

series is quite volatile, with periods of expansion alternating with periods of contraction of varying magnitude and duration. This volatility makes it difficult to distinguish signal from noise on a year-to-year basis, which is why we focus on the trend line. This line has a slope indicating an annual growth rate of 0.9% for Brazil's per-capita GDP between 1820 and 1900, with a 95% confidence interval ranging from 0.6% to 1.2%. We identified no structural breaks in the series, which means that the same trend growth rate applies for 1820–1850 and 1850–1900.

Our results are less surprising for the second half of the 19th century than they are for the century's first half, for Furtado (1963, Ch. 25) had long claimed that Brazil grew handsomely from 1850 onward. In the paper we show that it was only because of the choice of inappropriate price deflators that Goldsmith found lower growth rates for this period than our own estimates. For the first half of the century, however, Furtado presumed that the country's economy stagnated if not shrunk in absolute terms. This, we argue, was because Furtado inferred GDP's growth from the stagnant behaviour of per-capita exports, a series that has recently been subject to substantial upward revision (Absell and Tena-Junguito, 2016).

To back up our proposed estimate for Brazil's per-capita GDP growth rate in the first half of the 19th century, we provide historical evidence not only of substantial export-oriented growth but also of domestic commerce as a significant source of income growth in the period. There was heavy investment in the African slave trade, and a sizable proportion of the net increase of the enslaved labour force was linked to production for the domestic market.

The paper concludes with a comparison of Brazil's economic performance in the 19th century with those of other Latin American countries, Western Europe, and the US. The figures confirm the exceptionalism of US growth, particularly in the second half of the century. But Brazil's per-capita GDP growth performance was on par with other Latin American countries and Western Europe up to 1890. It was only a sharp, albeit temporary, contraction in the late 1890s that dulled Brazil's performance at century's end.

Did Brazil stagnate in the 19th century? Our proposed answer is: No, it did not. The rhythm of Brazil's per-capita GDP growth was apparently quite normal for the general pattern of the century.

We reiterate this to be far from a perfect proposal; only that it is the result of a reasoned exploration of alternatives, based on which we offer the best one according to our research. We consider our new series to be important because it indicates positive economic growth particularly in the period through 1850, in better agreement than previous studies with the indications provided by the economic history of the period. With this approach we hope to contribute to

enhancing our existing knowledge and exploring novel avenues of research on Brazil's economy in the 19th century.

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