

BRAZIL'S HISTORICAL GDP PER CAPITA GROWTH RATES IN IPEADATA, THE MADDISON PROJECT DATABASE, AND OUR TWO PAPERS: A COMPARATIVE NOTE

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Abstract: *In two recent papers (Bacha, Tombolo, and Versiani, 2023 and 2024), we developed new estimates of Brazil's GDP growth for 1900-1980 and 1820-1900, respectively. These estimates diverge from those in the traditional sources, which are Ipeadata for 1900-1980 and the Maddison Project Database for 1820-1900. This note contains a more detailed comparison of our estimates with those of these two sources.*

Key words: *GDP growth, Brazil, Ipeadata, Maddison Project*

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

1. Introduction

In Bacha, Tombolo and Versiani (2023) (BTV-2023, henceforth), we propose new lower estimates for Brazil's GDP growth in the 1900-1980 period. We start from the generally accepted (official, henceforth) figures for real GDP in Ipeadata⁴. We propose haircuts for the GDP growth rates in successive subperiods of 1900-1980, namely, 1900-1919, 1919-1947, 1947-1966, and 1966-1980. The proposed haircuts derive from the inclusion in the GDP growth rates of estimates of slow-growing service activities that were left out of the official statistics.

In Bacha, Tombolo, and Versiani (2024) (BTV-2024, henceforth), we develop new estimates for Brazil's GDP per capita from 1820 to 1900. A table in that paper compares our estimates with those in the 2020 Maddison Project Database (MPD,

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⁴ The sources for Ipeadata are FGV/IBGE (IBGE, 1990) for 1947-1980 and Haddad (1980) for 1900-1947.

henceforth) in 2011 USD. In such comparison, we accept as valid the 1980 MPD figure for Brazil's GDP per capita in 2011 USD and use the growth rates estimated in BTV-2023 and BTV-2024 to generate new values for Brazil's per capita GDP in 1900, 1890, 1850, and 1820 (in 2011 USD), which are higher than those in MPD.

On this note, for the benefit of future researchers, we bring together these different estimates. In the next section, we make a comparison, for the 1900-2018 period, of the MPD estimates of Brazil's GDP per capita, in 2011 USD, with those in Ipeadata, in 2011 Reais. In this section, we also convert to 2011 Reais Goldsmith's (1996) real GDP per capita indexes for 1850-1900 to compare them with the MPD series in 2011 USD. In the third section, we compare the MPD estimates for the 1900-1980 period with those of BTV-2023 and Ipeadata. Conclusions are collected in section four.

2. 1850-2018: MPD compared with Goldsmith/Ipeadata

In the Excel file in the appendix, we compare the MPD series for Brazil's real GDP per capita from 1850 to 2018, in 2011 USD, with the series for the same variable derived from Goldsmith (1986) for 1850 to 1900 and from Ipeadata for 1900 to 2018, both in 2011 Reais. To make the series comparable, we use the population data for Brazil in the MPD site to compute GDP per capita in the Goldsmith/Ipeadata case.

The GDP per capita in year t expressed in constant dollars of a base year is:

$$Z_t = \frac{Y_t}{\xi_t} \quad (1)$$

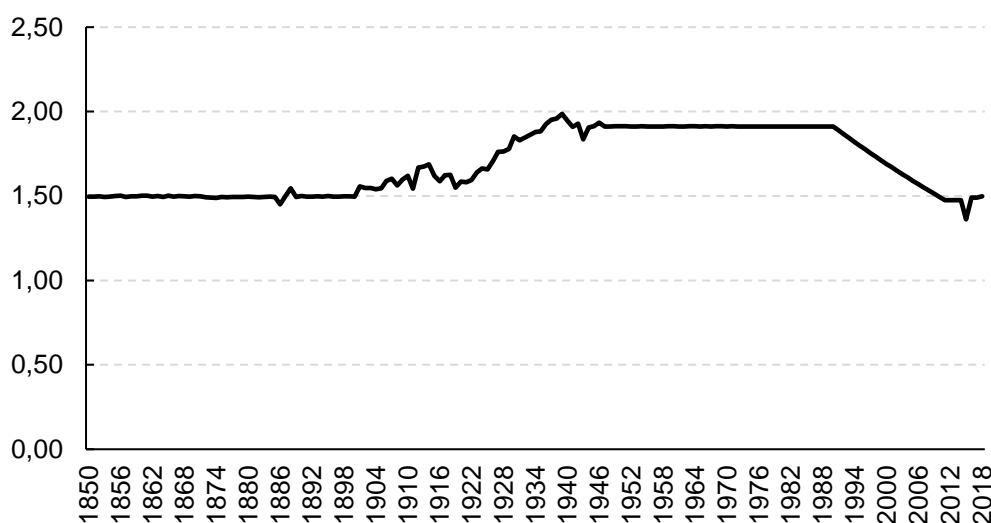
where Z_t is the GDP per capita in constant dollars of a base year, Y_t is the GDP per capita in constant national prices of the same base year, ξ_t is the purchasing power parity exchange rate.

We take the Z 's from MPD (2020) and we derived the Y 's from Ipeadata and Goldsmith, the Z 's are in 2011 constant dollars, and the Y 's are in constant 2011 reais. Applying the Z 's and the Y 's of the 1850-2018 period to equation (1) and solving for ξ_t , we find three distinct implicit purchasing power parity exchange rates or three

benchmarks in the terminology of Bolt and van Zanden (2020): 1.50 for 1850 to 1900, 1.91 for 1947 to 1990, and 1.48/1.50 for 2011 to 2018, as indicated in Graph 1 below.

Graph 1 shows that the benchmark rate for the 2011-2018 period varies around 1.48/1.5, which may derive from numerical approximations (except for 2016, when the ratio drops to 1.36—we did not find an explanation for this discrepancy).

Graph 1: Implicit PPP Exchange Rate in MPD Brazil's data



Source: authors' calculation as indicated in the text.

MPD considered two international purchasing power price surveys from the International Comparison Program (ICP), one for 2011 and the other for 1990. This explains the implicit exchange rate shift from 1.91 in 1990 to 1.5 (1.48) in 2011. Between 1991 and 2010, the MPD adopted a procedure such that, to the growth rate of each year according to the national accounts, they added a correction (which is constant for all years between 1990 and 2011) to make it consistent with the two benchmarks in 1990 and 2011 (Bolt and van Zanden, 2020, pp. 27-28). This explains the (log) straight line between these two end-points.

We could not find out why the MPD adopted the 1.5 benchmark used in the 2011-2018 period for 1900. What we found is that if they had adopted the benchmark of the 1947-1990 period (1.91), they would have obtained a GDP per capita lower than their assumption of a subsistence level (\$700 in 2011 USD) for 1900. With the 1.5

benchmark, they obtained a GDP per capita higher than their estimated subsistence level for 1900.

For the 1900-1947 period, the MPD used Maddison's GDP per capita growth rates (1992). These do not perfectly coincide with the rates in Haddad (1980), which are used by Ipeadata. Maddison cites as sources Haddad (1978), Haddad (1980), Zerkowski and Veloso (1982), Veloso (1987). These multiple sources may explain why the implicit exchange rates fluctuate so much between the benchmarks for 1947 (=1.91) and 1900 (=1.50), not obeying a straight line as between 1990 (benchmark=1.91) and 2011 (benchmark=1.48/1.50).

We express equation (1) in percentage change terms to obtain equation (2):

$$\hat{Z}_{t,t-n} = \hat{Y}_{t,t-n} - \hat{\xi}_{t,t-n} \quad (2)$$

where the accent “^” indicates the mean growth rate (in logs differences) between years t and $t - n$, and the variables Z , Y e ξ are as in equation (1). So, the GDP per capita growth rate in constant dollars, $\hat{Z}_{t,t-n}$, is equal the GDP per capita growth rate in constant national prices, $\hat{Y}_{t,t-n}$, minus the benchmark growth rate, $\hat{\xi}_{t,t-n}$.

The implication is that, in 1850-1900, 1947-1990, and 2011-2018, MPD and Goldsmith/Ipeadata exhibit nearly the same output growth rates (because $\hat{\xi}_{t,t-n} \approx 0$ in these periods).⁵

These results are as expected. For 1850-1900, the two series had Goldsmith (1986) as a source⁶. For 2011-2018, Bolt and van Zanden (2020, p. 28) explicitly state that MPD adopted the same growth rates as the national accounts⁷. Finally, for 1947-1990, the MPD also used Brazil's national accounts (v. Bolt et al., 2018, p. 36).

Table 1 indicates the GDP per capita levels and annual growth rates in relevant periods in MPD and Goldsmith/Ipeadata. According to both sources, there was practically no growth in 1850-1900 (0.02% per year). For 1900-2018, both series yield approximately the same 2.4% annual GDP per capita growth rate. In these

⁵ The implicit benchmark in 2011 was 1.48, and in 2018, it was 1.5; hence, there are small differences between the two growth rates in 2011-2018.

⁶ Bolt et al. (2018, p. 36) refer to Barro and Ursúa (2008) who use Goldsmith data.

⁷ Hence, the implicit benchmark of 1.48 that we obtained for 2011-2014 may be due to an approximation error.

comparisons, the endpoints display the same purchasing power of 2011 Reais in 2011 USD, 1.5. Relevant differences between the two series appear in subperiods since 1900.

Table 1: Brazil's GDP per capita, Goldsmith/Ipeadata vs. MPD

Year	GDP per capita			Period	Compound annual growth rates (%)		
	Goldsmith/Ipeadata (2011 R\$)	Benchmark (R\$/USD)	MPD (2020) (2011 USD)		Goldsmith/Ipeadata (2011 R\$)	Benchmark (R\$/USD)	MPD (2020) (2011 USD)
1850	1,297	1.50	867	1850-1900	0.02	0.00	0.02
1900	1,307	1.50	874	1900-2018	2.35	0.00	2.38
1947	3,738	1.91	1.956	1900-1947	2.26	0.52	1.73
1990	14,995	1.91	7.842	1947-1990	3.28	0.00	3.28
2011	21,890	1.48	14.831	1990-2011	1.82	-1.21	3.08
2018	20,162	1.50	14.034	2011-2018	-1.17	0.19	-0.79

Source: Authors' calculation as indicated in the text.

From 1900 to 1947, according to Ipeadata, Brazil's GDP per capita annual growth rate was 2.3%, but according to the MPD, it was only 1.7%. The difference is because, from the beginning to the end of this period, the implicit exchange rate of Brazil's currency vis-à-vis the USD depreciated from 1.5 to 1.91 (0.5% yearly). This depreciation reduces the GDP per capita growth rate in the MPD series vis-à-vis that in Ipeadata.

From 1947 to 1990, the same 3.3% cumulative annual GDP per capita growth rate appears in both series. This is so because the same exchange rate applies at these endpoints, that is, 1.91.

From 1990 to 2011, the MPD shows a cumulative annual GDP per capita growth rate of 3.0%, contrasting with a much lower 1.8% in Ipeadata. The reason is that at the beginning of the period, in 1990, the benchmark was 1.91, whereas at its end, in 2011, it was 1.48 (-1.2% change yearly).

Finally, from 2011 to 2018, the cumulative annual GDP per capita growth rates diverged slightly: 1.2% in Ipeadata vs. 0.8% in MPD. The difference is explained by an approximation irregularity in 2011 in the conversion to 2011 USD of the output per capita in 2011 Reais (1.48 instead of 1.5).

3. 1900 to 1980: MPD, BTV-2023 and Ipeadata compared

In BTV-2023, we compare our (lower) estimates for Brazil's annual GDP per capita growth rates in 1900-1980 with those in Ipeadata. The figures for Ipeadata are slightly different from those in Table 1 above because we used somewhat different population data in BTV-2023⁸. That comparison is replicated in the upper part of Table 2 below for the periods between 1900 and 1980 considered in BTV-2023.

The upper part of Table 2 also displays Brazil's annual GDP per capita growth rates from 1900 to 1980, according to the MPD⁹.

The lower part of Table 2 displays the evolution of Brazil's GDP per capita in 2011 USD estimated from these three sources (MPD, BTV-2023 and Ipeadata). In an approach similar to that in BTV-2024, this set converts the Ipeadata and the BTV-2023 index number series into 2011 USD, assuming for 1980 the same GDP per capita in 2011 USD as in MPD, that is, \$8,249.

For the BTV-2023 estimates, we ignore the benchmarks the MPD used to convert into 2011 USD the GDP per capita in 2011 Reais from Ipeadata. The reason is as follows. Suppose the BTV-2023 data is adopted as the official Brazil national account figures. The MPD would have to reconsider the implicit exchange rates used to convert the Ipeadata figures into 2011 USD. In fact, under these new circumstances, with the 1.91 implicit exchange rate, the 2011 USD value of Brazil's GDP per capita in 1900 would no longer be below subsistence; hence, there would be no need to change the 1.91 benchmark to 1.5 as the MPD did.

For the 1900-1980 period, Ipeadata shows the highest annual GDP per capita growth rate, 3.2%; BTV-2023, the lowest, 2.5%; and MPD, the middle, 2.9%. Consequently, the level of GDP per capita in 1900 is the lowest in Ipeadata, \$684; the highest in BTV-2023, \$1,159; and the middle in MPD, \$874. The relevance of these figures is that Ipeadata has no space for Brazil to have grown in the 19th century. For, at \$684, the country's per capita income in 1900 would already have been below the \$700 (in 2011 USD) subsistence level adopted by MPD. Also, with the MPD level of

⁸ In BTV (2023), the population data embedded in the GDP per capita estimates (both ours and Ipeadata's) are from Mortara (1941) for 1900 to 1915 and from Ipeadata (as of 2021) for 1916 to 1980.

⁹ These are not strictly comparable with the other two series because the population estimates differ.

GDP per capita in 1900, Brazil's could not have grown in the 19th century at the rates postulated in BTV-2024, as these would imply a GDP per capita below subsistence in 1800. It is only with the 1900 GDP per capita derived from BTV-2023 (in 2011 USD) that Brazil's 19th-century growth rates calculated in BTV-2024 would be consistent with above subsistence GDPs per capita both in 1900 and 1820.

Another consequence of the fact that, for the 1900-1980 period, MPD estimates a lower cumulative annual GDP per capita growth rate than Ipeadata is that the haircuts that BTV-2023 applies to the Ipeadata series cannot be replicated in the case of the MPD. This is specifically the case of the 1900-1947 period, in which, at 1.7%, the MPD estimate is lower than Ipeadata (2.3%) and BTV-2023 (1.9%). For the 1947-1980 period, at 3.5%, the cumulative annual growth rate is the same in MPD and Ipeadata; hence, in this case, the same haircut proposed in BTV-2023 (down to 2.6%) would apply to both series.

Table 2: Brazil's GDP per capita - Ipeadata, MPD and BTV-2023

Period	MPD	BTV-2023	IPEADATA
	Compound annual GDP per capita growth rates (%)		
1900-1980	2.85	2.48	3.16
1900-1947	1.73	1.90	2.26
1900-1919	1.47	1.01	1.66
1919-1947	1.90	2.51	2.67
1947-1980	4.46	3.32	4.46
1947-1966	3.48	2.61	3.48
1966-1980	5.80	4.29	5.79
Year	GDP per capita in 2011 USD		
1900	874	1,159	684
1919	1,154	1,403	935
1947	1,956	2,810	1,956
1966	3,747	4,584	3,749
1980	8,249	8,249	8,249

Source: Authors' calculation as indicated in the text. Population data from MPD.

4. Conclusions

This note's objective is to facilitate the work of future researchers who may want to compare the GDP data in BTV-2023 and BTV-2024 with those in Ipeadata and MPD.

BTV-2023 reduces by 21.5% the high cumulative annual GDP per capita growth rate in the 1900-1980 period pictured in Ipeadata. BTV-2024 maintains that in 1820-1900, at 0.9%, Brazil's GDP per capita annual trend growth rate was at par with those in Latin America and Europe. The figures in MPD, which are amply adopted in the historiography, suggest, in contrast, that the country experienced a secular stagnation in the 19th century.

We hope to have clarified many intricacies and statistical details in these comparisons in this note.

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