

A NOTE ON BRAZIL'S HISTORICAL GDP PER CAPITA GROWTH RATES

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

Resumo: *Em dois artigos recentes (Bacha, Tombolo e Versiani, 2023 e 2024), desenvolvemos novas estimativas do crescimento do PIB per capita do Brasil para 1900-1980 e 1820-1900, respectivamente. Essas estimativas divergem das fontes tradicionais: Ipeadata para 1900-1980 e o Maddison Project Database para 1820-1900. Esta nota contém uma comparação detalhada de nossas estimativas com as dessas duas fontes.*

Keywords: *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 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 national account statistics.

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

In Bacha, Tombolo, and Versiani (2024) (BTV-2024, henceforth), we develop new estimates for Brazil's GDP per capita from 1820 to 1900. The paper compares our estimates with those in the 2020 Maddison Project Database (MPD, henceforth) in 2011 USD. In such comparison, we accept as valid the MPD estimate for Brazil's 1980 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 1820, 1850, 1890, and 1900 (in 2011 USD), which are higher than those in MPD.

In this note, we bring together these different estimates. In the next section, we compare the MPD estimates of Brazil's GDP per capita, in 2011 USD, with those in Ipeadata, in 2011 Reais, for the 1900-2018 period. In the same section, we convert to 2011 Reais Goldsmith's (1996) real GDP per capita indexes for 1850-1900 and compare them with the MPD series in 2011 USD. These comparisons unveil the implicit exchange rates used by MPD to convert to 2011 USD the estimates of Ipeadata and Goldsmith, expressed in 2011 Reais.

In the third section, we compare the GDP per capita growth rates across MPD, BTV-2023, and Ipeadata for the period 1900–1980. Additionally, we compare their estimates of Brazil's GDP per capita evolution during this time, expressed in 2011 USD. Conclusions are collected in section four.

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

In the Excel file in the online appendix, we compare the MPD series for Brazil's real GDP per capita from 1850 to 2018, in 2011 USD, with the series 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.

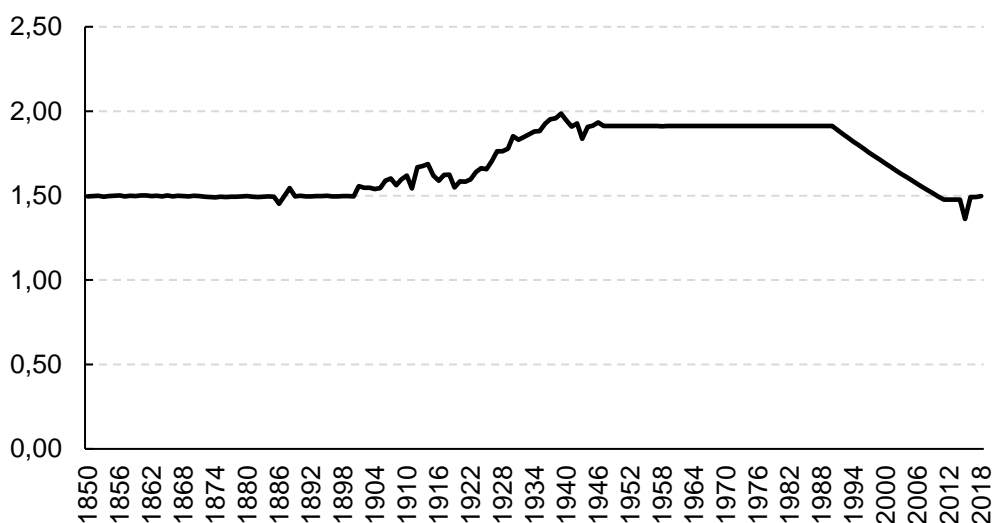
The GDP per capita in year t expressed in constant dollars of a base year is:

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

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): 1.5 for 1850 to 1900, 1.91 for 1947 to 1990, and 1.48/1.5 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 were unable to trace the origin of the 1.5 benchmark that MPD used for 1850-1900, the same value applied for the 2011–2018 period. However, our analysis indicates that if they had used the benchmark from the 1947–1990 period (1.91), their estimate for GDP per capita in 1900 would have been lower than their assumed subsistence level of \$700 (in 2011 USD). By applying the seemingly arbitrary 1.5 benchmark, they arrived at a GDP per capita for 1900 that exceeded their estimated subsistence level. Moreover, by using this benchmark—the same applied for the final year of their series (2018)—they achieved cumulative GDP per capita growth rates for the entire 1900–2018 period that matched those of Brazil's national accounts.

For the 1900-1947 period, the MPD used Maddison's (1992) GDP per capita growth rates. These do not perfectly coincide with the rates in Haddad (1980), which Ipeadata uses. Maddison cites as sources Haddad (1978), Haddad (1980), Zerkowski and Veloso (1982), and 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 is the case between 1990 (benchmark=1.91) and 2011 (benchmark=1.48/1.50).

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

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

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). The GDP per capita growth rate in constant dollars, $\hat{Z}_{t,t-n}$, is equal to 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 identical 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

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

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 (Bolt et al., 2018, p. 36).

Table 1 indicates the GDP per capita levels and annual growth rates in relevant periods according to MPD and Goldsmith/lpeadata. Both sources display 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. The reason is that the endpoints of these periods display the same purchasing power of 2011 Reais in 2011 USD, which is 1.5. Relevant differences in the two series appear in subperiods since 1900.

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

Year	GDP per capita			Period	Compound annual growth rates (%)		
	Goldsmith /lpeadata (2011 R\$)	Benchmark (R\$/USD)	MPD (2020) (2011 USD)		Goldsmith /lpeadata (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, Brazil's GDP per capita grew at an annual rate of 2.3% according to lpeadata, but only 1.7% according to MPD. This difference arises because, over this period, the implicit exchange rate of Brazil's currency against the USD depreciated from 1.5 to 1.91 (an average annual depreciation of 0.5%). This depreciation lowers the GDP per capita growth rate in the MPD series compared to lpeadata.

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

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

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

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 diverge slightly from those in Table 1 because in BTV-2023 we used different population data⁸. The comparison is replicated in the upper part of Table 2.

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 the three sources (MPD, BTV-2023, and Ipeadata). 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 disregard the benchmarks MPD used to convert Ipeadata's GDP per capita in 2011 Reais into 2011 USD. The rationale is as follows: if the BTV-2023 data were adopted as the official figures for Brazil's national accounts, we presume that MPD would reassess the implicit exchange rates used for converting the Ipeadata figures into 2011 USD. Under these new conditions, with an implicit exchange rate of 1.91, Brazil's GDP per capita in 1900 would no longer fall below the subsistence level, eliminating the need to lower the benchmark from 1.91 to 1.5, as MPD did.

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 are different.

For the 1900–1980 period, Ipeadata shows the highest annual GDP per capita growth rate at 3.2%, BTV-2023 the lowest at 2.5%, and MPD an intermediate rate of 2.9%. As a result, Ipeadata reports the lowest GDP per capita for 1900 at \$684, BTV-2023 the highest at \$1,159, and MPD an intermediate value of \$874.

The significance of these figures is that Ipeadata leaves no room for Brazil to have experienced economic growth in the 19th century. With a per capita income of \$684 in 1900, Brazil would already have been below the subsistence level of \$700 (in 2011 USD) set by MPD. Additionally, using MPD's estimate for GDP per capita in 1900, Brazil could not have grown at the rates suggested by BTV-2024, as this would imply a GDP per capita below subsistence in 1800. Only with the 1900 GDP per capita estimate from BTV-2023 does the 19th-century growth postulated in BTV-2024 become consistent with per capita incomes above subsistence in both 1900 and 1820.

There is another consequence of MPD estimating a lower cumulative annual GDP per capita growth rate than Ipeadata for the 1900-1980 period. Namely, 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 both that of Ipeadata (2.3%) and that of BTV-2023 (1.9%). For the 1947-1980 period, at 3.5%, the cumulative annual growth rates are the same in MPD and Ipeadata. 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 aims to assist future researchers comparing GDP data from BTV-2023 and BTV-2024 with figures from Ipeadata and MPD.

From 1900 to 1980, BTV-2023 reports a cumulative annual GDP per capita growth rate that is 21.5% lower than what is depicted in Ipeadata. This suggests that while Brazil's GDP per capita growth was above the global average, it did not rank among the fastest-growing countries worldwide, as Haddad (1980) indicated. This perception became so widespread that it even reached introductory economics textbooks. In his popular *Principles of Economics*, Mankiw (2018, p. 517) asserts that Brazil was the growth champion between 1900 and 2014, surpassing both Japan and China.

For the period 1820-1900, BTV-2024 asserts that Brazil's annual GDP per capita trend growth rate of 0.9% was comparable to that of Latin America and Europe. In contrast, estimates from MPD, widely referenced in historiography, indicate that Brazil experienced secular stagnation during the 19th century.

With advancements in machine learning and the emergence of new datasets, future research is likely to refine the estimates in BTV-2023 and BTV-2024. In the meantime, we hope this note clarifies the complexities and statistical nuances of our revisions to Brazil's historical GDP per capita growth rates.

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