

# The relative importance of total factor productivity and factors of production in income per worker: Evidence from the Brazilian states

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## Abstract

Income per worker gap in different regions of Brazil is stunning. To assess the relative importance of factor of production and total factor productivity (TFP) in those income per worker disparities, development accounting exercises were carried out for the 1970, 1980, 1990, 2000 and 2010 years. In 1970, both types of capital stocks and TFP gaps were associated with the Brazilian states lower relative income in comparison to São Paulo state. Over the decades up to the year 2000, the Brazilian states have experienced a relevant capital deepening process, which account for income per work catching-up. However, the TFP gaps in relation to the reference state remain almost stable and their reduction is fundamental to the maintenance of the Brazilians states income per worker catching-up process. The conclusions remain similar when the analysis is conducted by means of distinct *proxies* of physical capital. When considering the human capital qualitative aspect, we noticed a greater human capital gap among the Brazilian states in relation to São Paulo State and, as a consequence, a reduction in the TFP relative gap.

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## Resumo

O diferencial de renda por trabalhador em diferentes regiões do Brasil é impressionante. Para avaliar a importância relativa dos fatores de produção e da produtividade total dos fatores (PTF) na disparidade de renda por trabalho, exercícios de contabilidade do desenvolvimento foram realizados para 1970, 1980, 1990, 2000 e 2010. Em 1970, a renda por trabalhador dos estados brasileiros em relação ao paulista era inferior devido às defasagens existentes em ambos os tipos de capital e da PTF. Ao longo das décadas até 2000, os estados brasileiros experimentaram um processo relevante de aprofundamento de capital físico, que acabou levando a um processo de “*catching-up*”. No entanto, as defasagens da PTF em relação ao estado de referência permaneceram praticamente estáveis em todo o período, sendo que a sua redução é fundamental para que os estados brasileiros mantenham o processo de

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“catching-up” da renda por trabalho. As conclusões são semelhantes quando a análise é feita com distintas *proxies* de capital físico. Ao considerar o aspecto qualitativo do capital humano, notamos uma maior defasagem de capital humano dos estados brasileiros em relação ao Estado de São Paulo e, como consequência, uma redução nos diferenciais da PTF.

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*Palavras-chave:* Contabilidade do desenvolvimento; Crescimento Econômico; Produtividade total dos fatores; Estados brasileiros

## 1. Introduction

In 1970, the average citizen of the richest state of Brazil – São Paulo – was 10.5 times richer than the average citizen of Piauí, its poorest state. In 2010, regional dispersion in Brazil has declined: per capita income in the state of São Paulo was 4 times higher than in Maranhão, which is now poorer than Piauí.

Despite the strong decrease in regional income inequality, it is still higher than among regions of developed countries, while lower than among regions of poor countries. As examples, the richest state of India (Goa) was seven times richer than its poorest state (Bihar), in 2014. On the other hand, among the US states, the maximum difference in per capita income was 2, in 2014 (Alaska and Mississippi).

Why has this difference decreased from 1970 to 2010? Is the decline in income inequality sustainable? These are important questions that motivated the present study. The main objective was to decompose the Brazilian states product per worker in the following components: capital-output ratio, human capital per worker, and total factor productivity (TFP).

The product decomposition exercise was crucial to assess the contribution of each factor of production into the fall of income inequality among the Brazilian states. Understanding their roles in the evolution of income per worker is crucial to guide economic policies aimed to foster growth and improve interstate income distribution. Taking into account various measures of physical capital and *proxies* to capture human capital qualitative aspect was important to give more reliability to the product decomposition results.

It had been challenging to perform the level accounting exercises due to the lack of physical capital estimates for the Brazilian states in the national accounts. The stock of physical capital at the state level is only available for 1970, 1975, 1980 and 1985 (Reis et al., 2005), based on the industrial census, which was interrupted. Our second motivation was to construct *proxies* for 1990, 2000 and 2010 that could help to understand the recent period of the Brazilian economic history.<sup>2</sup>

The third motivation was to improve the empirical estimation of the human capital *proxy*, which is our concern since 2005, and now has a widespread recognition with the study of Hanushek and Wößmann (2007). According to the authors' knowledge there are no development decomposition studies for the Brazilian states that capture human capital qualitative aspect. To accomplish this aim it was employed a *proxy* for the Brazilian states human capital elaborated by the Brazilian Institute of Applied Economics (IPEA) available for 1980, 1991 and 2000. This variable was developed based on the annual income expected values associated with education and experience. The advantage in using such *proxy* is that it already captures the real return of the market for the educational system quality since it is based on the actual wages return. The second *proxy* was a multiplicative term between years of schooling of the population over 24 years and each state Basic Education Development Index (IDEB) score in 2005. Here is made an assumption that quality and quantity are perfect substitutes since state A with the same quantity as state B, but twice its quality has twice of state B human capital. This assumption is the same as in Lucas (1988) and it seems to be reasonable as a first approximation.

The development (or level) accounting exercises were based on Solow (1957) and Hall and Jones (1999), applied to study the evolution of output per worker, production factors and TFP, in the case of the Brazilian states with respect to São Paulo state (reference state). The study employed data available on the censuses years: 1970, 1980, 1991, 2000 and 2010.

<sup>2</sup> Those physical capital *proxies* were partially elaborated by Figueiredo and Resende (2013) to study economic growth process of Minas Gerais state.

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