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# Internal migration in Brazil using circular visualization

Emerson Augusto Baptista <sup>a</sup>, Guy J. Abel <sup>b,c</sup> and Jarvis Campos<sup>d</sup>

## ABSTRACT

In Brazil – a developing country and one that in its last census in 2010 presented a number of five-year interstate migrations of approximately 4.6 million people – the study of internal migration is a complex exercise given the size and diversity of the country. We adapted the chord diagram plot to visualize the bilateral interstate migration flows in Brazil over a five-year period of 2005–10, and the migration stocks in Brazil in 2010. The bilateral migration flows highlight some recent trends of interstate migration (observed in recent decades), in turn different from cumulative flows over a long period (migration stocks). Brazilian internal migration in the new millennium seems to be marked by the inability of destination areas to absorb migrants over long periods, by the return migration to areas of origin and by the emergence of new areas of retention of migrants.

## ARTICLE HISTORY

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## KEYWORDS

internal migration; migration flows; Brazil; circular visualization; chord diagram

In Brazil – where in the last census of 2010 there was a five-year interstate migration of approximately 4.6 million people – the study of internal migration is a complex exercise given the size and diversity of the country. The last 60 years of internal migration in Brazil are strongly related to urbanization processes and the spatial redistribution of the population, marked by intense population mobility, and inserted in the different economic stages, social and political (Baeninger, 2012).

Migration can be measured in two ways: flows and stocks. Flows are human movements between places over time, which are dynamic and difficult to define (we use five-year migration flows information). Stocks represent the number of migrants living in a place at a point in time, which are static and easy to define (we use 2010 census data).

To visualize the complex and dynamic internal migration in Brazil, where 26 states plus the Federal District contribute to 702 interstate flows in the bilateral origin–destination migration system, we use the chord diagram plot. The plot, which was created in R using the *circlize* package (Gu, Gu, Eils, Schlesner, & Brors, 2014), presents information on origin, destination, volume of movement and direction of migratory flows (arrowheads) between all states ( $Q_i$ ,

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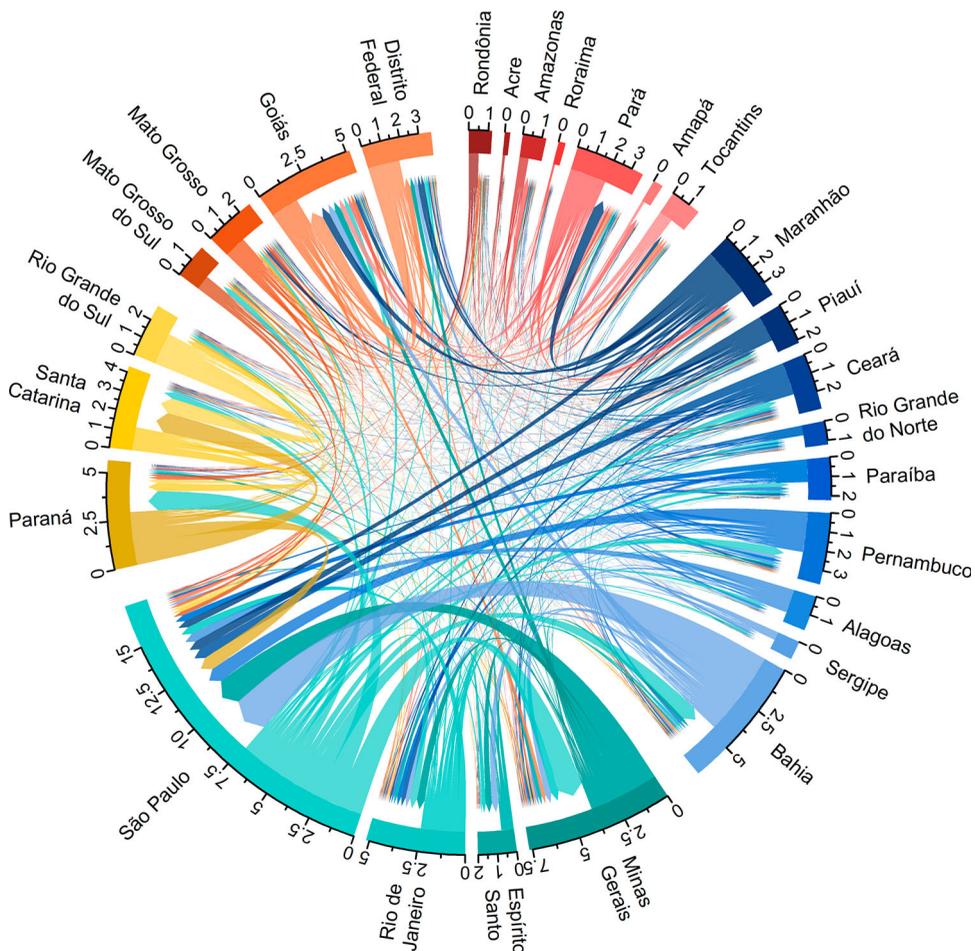
 Supplemental data for this article can be accessed <http://dx.doi.org/10.1080/21681376.2018.1526649>.

Abel, Muttarak, & Liu, 2017). In the plot diagram, states of a same geographical region have similar colour palettes, while they are positioned side by side in an approximate geographical order.

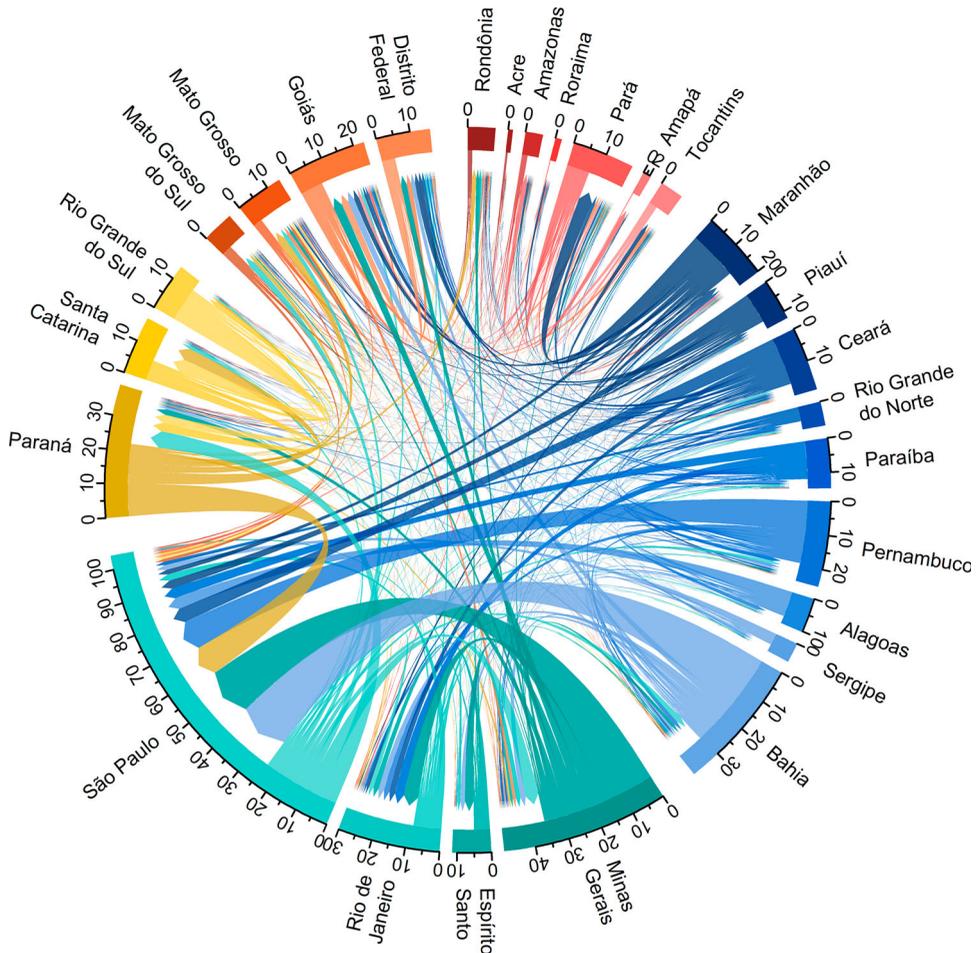
Figure 1 show that the largest migration flows in Brazil between 2005 and 2010 are destined for the state of São Paulo, with greater relevance for immigrants from the states of Bahia, Minas Gerais, Paraná, Pernambuco and Ceará, although the number of immigrants to São Paulo decreased over the past decades. At the same time, the flows from São Paulo to the states of Minas Gerais, Paraná and Bahia are also significant, which is a result of return migration (Baptista, Campos, & Rigotti, 2017). The migration from the Paraná and Rio Grande do Sul to Santa Catarina, Federal District to Goiás and Maranhão to Pará are worth consideration.

The migration stocks (Figure 2) make apparent the significance of São Paulo's influence on the fluctuation of spatial redistribution of the Brazilian population. Considering inflows and outflows, São Paulo contributes to 39.6% of the interstate migration stocks. The main origins of these flows are states that have historically served as reservoirs of labour for São Paulo, such as Minas Gerais, Bahia, Pernambuco and Paraná.

The Northeast states, such as Minas Gerais, portray the prevalence of population losses, even considering the recent reduction in population losses and an increase in return migration. Already



**Figure 1.** Bilateral migration flows in Brazilian states, 2005–10 (thousands).



**Figure 2.** Migration stocks in Brazilian states, 2010 (thousands).

the North and Centre–West regions are notable, with respect to migration stocks, for the prevalence of immigration. This phenomenon is consistent with the historical process of occupation that these regions experienced, due to the expansion of the agricultural frontier. Finally, the South Region is marked by the population losses of Rio Grande do Sul and Paraná, in part related to the exhaustion of the agricultural frontier and strong immigration to the state of Santa Catarina.

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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