Interregional capital flow tables for Brazil: A data-driven approach using electronic invoices

Topic: Input-Output Accounts and Statistics
Author: Lucas Ferraz Vasconcelos
Co-Authors: Joao Maria de Oliveira

Investment dynamics is a cornerstone of economic activity and growth analysis. Capital flow tables, which detail purchases of capital goods by industry, provide crucial insights into the structure of investment, showing its sectoral patterns while allowing more accurate simulations of alternative policies to stimulate investment, promote sustainable growth, and improve the productive structure.

These tables, conceived by Wassily Leontief as an integral part of the input-output framework but not implemented by him, have often lagged behind standard input-output tables in development due to data constraints. The scarcity of prior studies estimating and analyzing capital flow tables for Brazil, which have relied on harmonizing diverse and often limited data sources, further confirms these data limitations.

This research addresses a significant gap by developing an interregional capital flow table for Brazil, disaggregated by Brazilian states and consistent with the System of National Accounts. It builds on a recent trend of producing estimates based on official administrative records, which provide a more accurate representation of economic reality. The research pioneers a novel approach by using the comprehensive data from Brazil's electronic invoices (Nota Fiscal EletrÃ´nica, NF-e).

The NF-e system captures the majority of business-to-business transactions, offering unparalleled granularity. This allows us to address key research questions: How can NF-e data be used to construct a detailed and accurate capital flow table? What is the structure of industry capital flows in Brazil, as revealed by the NF-e data, and how does it differ from previous estimations? How can this table be integrated into the Brazilian SNA for a more complete picture of investment? And, what is the distribution of capital goods in terms of sales and purchases among the 27 Brazilian states?

Our methodology involves cleaning and adapting a comprehensive extraction of the NF-e database for 2018. Although standardized, the NF-e requires some data cleaning and pre-processing to ensure data quality. We then used the Mercosur Common Nomenclature (NCM) product code, which is compatible with the International Harmonized System (HS), along with seller and buyer sector codes derived from the International Standard Industrial Classification (ISIC), and a tax code of the operation to classify transactions. A critical step is to use the Broad Economic Categories (BEC) classification to determine which products should be categorized as gross fixed capital formation and, in some cases, in what proportions. The data were then used to construct a capital flow matrix, which represents the flow of capital goods from producing to investment-consuming activities. This matrix is disaggregated by industry and by the 27 Brazilian states, providing a regional dimension. The resulting table is designed for seamless integration into the Brazilian System of National Accounts.

The primary data source is an extraction of the Brazilian NF-e database for the year 2018. Key variables include NCM/HS product codes, seller and buyer sector codes, legal classification (public and private), transaction values, product tax information, fiscal classification of the transaction, and geographic information (origin and destination states).

This research offers several key contributions. It provides an unprecedented level of granularity compared to previous studies, enabling a finer-grained analysis of capital flows. The NF-e system

allows for potentially more frequent updates than survey-based methods, facilitating timely analysis. The regional disaggregation provides insights into regional disparities. Furthermore, this research develops a new methodology for constructing capital flow tables from electronic invoice data, potentially applicable to other countries with similar systems.

The research will provide a comprehensive and detailed picture of capital flows in Brazil, revealing intricate inter-industry and inter-regional relationships. We will compare the findings with existing estimates to assess the impact of using the more granular NF-e data. The resulting capital flow table will be a valuable resource for researchers and policymakers, offering a powerful tool for analyzing investment, economic growth, and structural change, and supporting evidence-based decision-making in economic development, industrial policy, and the reduction of regional disparities. We will also discuss challenges, limitations, and potential future research directions.

Keywords: Capital Flow Table, Input-Output Analysis, Electronic Invoices, Brazil, Nota Fiscal EletrÃ´nica, Investment, System of National Accounts, Regional Analysis, Big Data.