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decompr: GVC Decomposition in R

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Abstract

Global Value Chains have become a central unit of analysis in research on international trade. However, the complex matrix transformations at the basis of most Value Chain indicators still constitute a significant entry barrier to the field. The R package decompr solves this problem by implementing the algorithms for the analysis of Global Value Chains as R procedures, thereby simplifying the decomposition process. Two methods for gross export flow decomposition using Inter-Country Input-Output tables are provided. The first method concerns a decomposition based on the classical Leontief (1936) insight. It derives the value added origins of an industry's exports by source country and source industry, using easily vailable gross trade data. The second method is the Wang-Wei-Zhu algorithm which splits bilateral gross exports into 16 value added components. These components can broadly be divided into domestic and foreign value added in exports. Using the results of the two decompositions, decompr provides a set of Global Value Chain indicators, such as the now standard Vertical Specialisation ratio. This article summarises the methodology of the algorithms, describes the format of the input and output data, and exemplifies the usefulness of the two methods on the basis of a simple example data set.

Keywords: trade, global value chains, decomposition, R.

1. Introduction

Global Value Chains (GVCs) refer to the quickly expanding internationalization of production networks. Most goods we use nowadays consist of parts that are sourced from different corners of the planet and are assembled across different continents. A popular example of this development is the iPhone, which uses inputs from at least five countries (USA, China, Germany, Taiwan, South Korea) and is assembled in two (USA and China). This has made GVCs a central topic in research on trade and development policy. Both policy makers and academia increasingly value the growth opportunities GVCs offer to global trade and, especially, to developing countries. However, analysing this phenomenon empirically requires

complex matrix manipulations, since the relevant data is only available in the form of gross flows. The decompr package enables researchers with little background in matrix algebra and linear programming to easily derive standard GVC indicators for statistical analysis.

The package uses Inter-Country Input-Output tables (ICIOs), such as those published by the OECD and WTO (TiVA), the World Input Output Database (Timmer, Erumban, Gouma, Los, Temurshoev, de Vries, and Arto 2012), or national statistics bureaus, as input. These tables state supply and demand relationships in gross terms between industries within and across countries. For instance, let us look at the example of the leather used in German manufactured car seats. The ICIOs quantify the value of inputs that the Turkish leather and textiles industry supplies to the German transport equipment industry. The problem of these tables measuring gross trade flows, is that they do not reveal how much of the value was added in the supplying industry, and how much of the value was added in previous stages of production, performed by other industries or even countries.

The Leontief decomposition of gross trade flows solves this problem by reallocating the value of intermediate goods used by industries to the original producers. In our example, the use of Argentinian agricultural produce (raw hides) is subtracted from the Turkish leather industry and added to the Argentinian agricultural industry. The Wang-Wei-Zhu (henceforth WWZ) decomposition goes a step further by not only revealing the source of the value added, but also breaking down exports into different categories, according to final usage and destination. It implements the theoretical work of Wang, Wei, and Zhu (2014). The main categories in this framework are listed below.

1. domestic value added in exports
2. foreign value added in exports
3. pure double counted terms

1.1. Package Details

The decompr package implements the algorithms for these decompositions as R procedures and provides example data sets. We start by loading the package and listing the functions.

```
# load package
library(decompr)

# list functions in package
ls('package:decompr')

## [1] "decomp"              "leontief"            "load_tables"
## [4] "load_tables_vectors" "wwz"
```

The R procedures are implemented as functions, the included functions are listed below.

- `load_tables_vectors()`; transforms the input objects to an object used for the decompositions (class: `decompr`)

- `leontief()`; takes a decompr object and applies the Leontief decomposition
- `wwz()`; takes a decompr object and applies the Wang-Wei-Zhu decomposition
- `decomp()`; a wrapper function which integrates the use of load_tables_vectors with the various decompositions, using an argument *method* to specify the desired decomposition (default leontief)

For legacy purposes, one depracated function is also available under their original names (`load_tables()`). In addition to this, one example data sets is included.

- `leather`; a fictional three-country, three-sector data set [1]

Trade flow analysis often involves studying the development of a certain variable (set) over time, thus taking the panel form. However, at the decomposition level, the panel dimension is essentially a repeated cross-section. Therefore, as a design decision, the time dimension is not implemented in the package itself. Instead, we provide examples of how this repetition can be implemented using a `for-loop`.

Section **??** introduces the data as it is used by the package as well as two example data sets, after which Section **??** and Section **??** summarise the theoretical derivations for the two decompositions, and show how these can be performed in R using decompr. We conclude with a discussion of potential uses and further developments of GVC research.

Acknowledgments

Here you can write some acknowledgments.

References

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Wang Z, Wei SJ, Zhu K (2014). "Quantifying international production sharing at the bilateral and sector levels."

A. This is the first appendix section

A.1. A subsection

A subsubsection

some text

[1] load using: `data(leather)`

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