Sectoral Linkages and Leakages in the Economy of La Reunion - An Input-Output Approach

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This article looks at the production structure and inter-sectoral links of La Reunion, a French overseas region, which presents a unique economic landscape characterized by:

- Insularity and geographical remoteness, leading to high import dependency.
- Limited industrial diversification, resulting in a concentrated export base.
- A dominant public sector, reducing private-sector contributions to GDP.
- Strong reliance on a few industries, such as tourism, agriculture, real estate, and services.

Given these structural limitations, understanding which economic sectors generate the strongest economic spillovers is critical for policymakers seeking to:

- Maximize economic growth by investing in high-multiplier sectors.
- Reduce economic leakages.
- Enhance resilience by decreasing dependence on external markets.

The goal of the paper is to find the key sectors of the economy that generate the most significant spillover effects on other sectors. The study uses input-output analysis to identify the key sectors and measure the impact of changes in final demand on the production of different sectors. We use the 2019 Symmetric Input-Output Table (SIOT) for Réunion, with 61-sector or industries and we apply Rasmussen-Hirschman linkage indices, Leontief multipliers, and the AVIONIC model (developed by INSEE) to:

- Measure sectoral interdependencies, identifying industries that are key economic drivers.
- Assess economic leakages, distinguishing between locally sourced and imported production.
- Quantify multiplier effects, evaluating how changes in demand impact total economic activity.

By integrating these analytical methods, this research provides evidence-based recommendations to optimize regional economic policy, investment, and industrial strategy. We find that the sectors with the highest multipliers are electricity, real estate, insurance, and tourism. We

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also finds that some sectors are too dependent on imports, which limits their impact on the local economy. Our article conclude that an effective economic policy should encourage the relocation of certain activities to maximize local benefits.

1 Input-Output Analysis and the Leontief Model

Input-output analysis is a mathematical tool used to study the interdependencies between different sectors of an economy (Drejer (2002), Miller et Blair (2009), Ojaleye et Narayanan (2022)). It is based on the idea that the output of one sector can be used as an input to another sector. For example, the output of the steel sector can be used as an input to the automobile sector.

Several recent studies have used the input-output approach to identify key industries in the case of Niger (Ojaleye et Narayanan (2022)), India (Sharma, Padhi, et Rath (2022)), Turkey (Gelal (2021)), Indonesia (Nugroho et Murti (2020)), Morocco (Mataoui et Faraji (2016)) and Portugal (Reis et Rua (2009)). These methods adapted to regions (Lemelin (2008)) also make it possible to analyze the participation of countries or regions in different global or regional value chains.

The Leontief model is a type of input-output model that was developed by Wassily Leontief in the 1930s. The Leontief model is based on the following equation (Miller et Blair 2009):

$$X = (I - A)^{-1}Y$$

where:

- X is a vector of the output of each sector
- A is a matrix of the technical coefficients
- Y is a vector of the final demand for each sector

The technical coefficients represent the amount of input required from one sector to produce one unit of output in another sector. For example, the technical coefficient for the steel sector in the automobile sector would represent the amount of steel required to produce one automobile.

The Leontief model can be used to measure the impact of changes in final demand on the output of different sectors. For example, if the final demand for automobiles increases, the Leontief model can be used to measure the impact of this increase on the output of the steel sector. **Leontief Multipliers** measured by **Leontief inverse matrix** $(I-A)^{-1}$ helps to dentify which sectors create the largest economic impact when their output increases. It captures both direct and indirect spillover effects from a demand shock.

The **Ghosh inverse matrix** is calculated as follows (Hambÿe 2012):

$$X = (I - B)^{-1}V \tag{1}$$

where B is a matrix of the allocation coefficients and V are primary inputs. The allocation coefficients represent the proportion of a sector's output that is used as an input to another sector.

2 Rasmussen-Hirschman Indices

The Rasmussen-Hirschman indices are used to measure the **backward** and **forward linkages** of each sector in the economy. The backward linkage of a sector measures the extent to which the sector depends on inputs from other sectors. The forward linkage of a sector measures the extent to which the sector's output is used as an input to other sectors.

The Rasmussen-Hirschman indices are calculated as follows:

$$BL_j = \sum_{i=1}^{n} l_{ij} \tag{2}$$

$$FL_i = \sum_{j=1}^{n} g_{ij} \tag{3}$$

where:

- BL_j is the backward linkage of sector j
- FL_i is the forward linkage of sector i
- l_{ij} is the element in the Leontief inverse matrix for sector i and sector j
- g_{ij} is the element in the Ghosh inverse matrix for sector i and sector j

3 Import Content of Final Demand and leakages

The import content of final demand measures the extent to which the final demand for a good or service is satisfied by imports. The import content of final demand can be calculated using the following equation (Bourgeois, Briand, et al. 2019):

$$M^f = \underbrace{A^m(I - A^d)^{-1}DF^d}_{\text{indirect content}} + \underbrace{DF^m}_{\text{direct content}} \tag{4}$$

where:

- M^f is the import content of final demand
- A^m is a matrix of the import coefficients

- A^d is a matrix of the domestic coefficients
- DF^d is a vector of the domestic final demand
- DF^m is a vector of the import final demand

The import coefficients represent the amount of imports required to produce one unit of output in a sector. The domestic coefficients represent the amount of domestic inputs required to produce one unit of output in a sector. The import content of final demand can be used to measure the extent to which a sector is dependent on imports. .

The responses of imports following an exogenous variation in final demand are defined:

$$\Delta M = A^m.(I - A^d)^{-1}.\Delta DF^d + \Delta DF^m \tag{5}$$

and then :

$$\Delta M = \underbrace{A^m.\Delta DF^d + \Delta DF^m}_{\text{Direct effect}} + \underbrace{[A^m.(I - A)^{-1} - A^m].\Delta DF^d}_{\text{Indirect effect}} \tag{6}$$

Bakward leakages are determined by elements (i, j) of the inverse matrix related to Leontief Matrix A on $(I - A^d)^{-1}A^m$. By analogy with Forward linkages, **Forward leakages** are determined by elements (i, j) of the inverse matrix related to Gosh Matrix B on $(I - B^d)^{-1}B^m$.

4 Results and Analysis

4.1 Overview of Economic Structure

Reunion's GDP in 2019 was approximately €25 billion, with the economy dominated by public administration, services, and selected industrial sectors.

Largest contributors to GDP are:

- Public sector (education, healthcare, administration) – 17.5%
- Manufacturing – 11.4%
- Real estate – 10%
- Construction – 9.2%
- Transport – 5.6%
- Tourism (hotels, restaurants) – 2.5%

Export sectors are highly concentrated in a few industries which are :

- Agri-food processing – 26.8%
- Transport – 23.7%
- Manufacturing – 17.4%
- Sugar and rum – 17.4%

This high level of export concentration exposes La Reunion's economy to external shocks, reinforcing the need for diversification strategies.

4.2 Key Economic Sectors Based on Multipliers

High-Multiplier Sectors (Multipliers > 2)

- Electricity : 3.08
- Tourism and Travel Services : 2.69
- Real Estate : 2.57
- Insurance : 2.27

These sectors have high economic spillovers, meaning investments in these industries stimulate broader economic activity.

Medium-Multiplier Sectors (Multipliers between 1.5 and 2)

- Construction : 2.01
- Manufacturing : 2.07
- Education & Healthcare : 1.98
- Hospitality : 1.83
- Transport : 1.63

These industries play an important role but do not act as primary economic drivers.

Low-Multiplier Sectors (Multipliers < 1.5)

- Oil Refining : 1.00
- Pharmaceuticals : 1.00
- Extractive Industries : 1.21

These industries contribute little to local economic growth due to high import dependency.

4.3 Leakages and Import Dependence

High-Leakage Sectors (Import-Dependent)

- Oil Refining : Over 90% imported inputs
- Pharmaceuticals : Highly reliant on imported raw materials
- Transport Equipment : 80% import dependence

These sectors limit local economic benefits as they do not create strong domestic value chains.

Low-Leakage Sectors (Locally Integrated)

- Real Estate
- Tourism
- Construction

These sectors have strong local economic effects, making them ideal candidates for investment.

5 Policy Implications

The findings of this study have several policy implications. First, the government should encourage the development of the key sectors identified in this study, which have high backward and forward linkages and low import content. By developing these sectors which high-multipliers, the government can maximize local benefits. The government may encourage to invest in local production for import-dependent industries and hence to promote domestic sourcing policies in construction, manufacturing, and energy. It can also provide tax incentives and subsidies for real estate, tourism, and electricity.

Second, the government should reduce the dependence of the economy on imports by encouraging the relocation of certain activities to La Reunion and can make the economy more resilient to external shocks. Hence, it can support local manufacturing to replace high-leakage imports in promoting value-added transformation (e.g., agri-food processing instead of raw exports).

Third, the government should adopt a holistic approach to economic development. This means that the government should consider the interdependencies between different sectors of the economy. By adopting a holistic approach, the government can ensure that economic development is sustainable and inclusive.

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