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Impact techniques of modelling next-gen infrastructure investment projects to redress regional disparities using multi-regional input-output model*

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Abstract

This paper estimates the socio-economic impact of infrastructure recovery investments and resilience plan related to the Institutional Development Contract (CIS) for the city of Taranto on different categories of households, labor markets (skilled and unskilled), and private enterprises in Italy. It does so by implementing a multi-regional input-output (MRIO) model with inter-regional trade at the level of Apulia region, to estimate the intra-regional impact, and, at the national level, to estimate the inter-regional and inter-sectoral supply chain linkages and spillover effects through trade. The intra-regional effects are almost two times the inter-regional effects. Almost 51% of the inter-regional impact on value-added accrues to northern regions, 22% at the centre, while about 27% is captured by the regions in southern Italy. This evidence clearly shows a good degree of connection of the Apulia local economy with the macro region of northern Italy, while it is quite weak with the macro south in Italy. The considerable share of inter-regional spillover effects in terms of value-added, which is transferred outside the southern macro-region, over 73% reflects the persisting regional disparities in Italy, where the productive northern-regions mostly benefit from the national development policies made in the most marginal areas in southern Italy.

JEL classifications: C67, D57, F14, Q58, R13
Keywords: multiregional input-output (MRIO) model, local-NGEU investment projects, interregional trade flows, regional disparities, Taranto, Apulia, Italy

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1 Introduction

The degree of a within-country interregional trade flows and participation into the global value chains (GVCs) depends on many factors such as trade-openness, productivity gaps, and competitiveness. GVCs reflect the international division of production processes across different countries (Fabbris & Michielin, 2010; Bentivogli, Ferraresi, Monti, Paniccià, & Rosignoli, 2018).

In the case of Italy, because the country displays a substantial heterogeneity and disparities in terms of trade performance, living standards, institutional capacity, and environmental quality within and across regions (Istat, 2019), national-regional planning and development policies are especially important. For example, the southern regions (i.e., Abruzzo, Molise, Campania, Apulia, Basilicata, and Calabria) are relatively poorer and lagging economically in trade performance compared to the richer northern regions (i.e., Lombardy, Piemonte, and Veneto) where industrial production and agglomeration effects mainly take place. This "North-South Divide" has persisted since the reunification of Italy in 1861 (Menon, Perali, Ray, & Tommasi, 2021). These longstanding structural and macro-economic imbalances have been compounded by the outbreak and subsequent fallout of the COVID-19 pandemic measures undertaking by Italy (Fabbris & Michielin, 2010; Pasquini & Rosati, 2020; Svimez, 2020; OECD, 2021).

This raises questions, which assumes special relevance in the context of the implementation of the so-called "Italy in the future National Recovery and Resilience Plan" (PNRR)[1], from the COVID-19 pandemic developed under the Next Generation European Union (NGEU) stimulus package over the coming years, on the effectiveness of decentralized regional development policies versus centralized policies at the national level. To address the north-south existing disparities and the ensuing structural decline that have continually undermined the economic base and institutional capacity of Italy's southern regions, various public policies on regional development and cohesion have been designed to enhance economic growth and reduce the gap of pre-existing inequality in Italy. Within these policies, and included in the post-COVID Italian recovery plan, the 2021-2026 Institutional Development Contract (CIS) strategic recovery investment plan also known as the local-NGEU investment project of around EUR 1.097 billion by the Apulia region and the municipal administration of the province of Taranto.

The objective of this paper is to estimate the socio-economic impact at the national and multiregional level of the local-NGEU investment project on households and enterprises using a multi-regional input-output (MRIO). First, to investigate how the impact of the local investment project gets distributed within the Apulia region, and across other Italian regions exploiting the multiregional set-up. The proposed MRIO framework with micro foundation uses a novel technique for estimating multilevel internal rate of returns of the local-NGEU investment project for the Apulia region, all regions, and at the national level corresponding to the sum of the intraregional and interregional effects.

[1] The PNRR is an Italian acronym for National Recovery and Resilience Plan (NRRP) document submitted to the EU detailing how the country intends to invest the EU temporary funds worth about €222.1 billion under the Next Generation EU (NGEU) programme dedicated to member states to mitigate the social and economic crisis caused by the COVID-19 pandemic. The document also presents the structural reforms supporting green and digital transition to be implemented in the span of the next five years (2021-2026) (see,for example, Governo Italiano, 2021).

Within this context, the structure of the paper is organized as follows. Section 2 briefly reviews the methodological framework for constructing regional social accounting matrix (SAM) for the reference year of 2015, followed by details on the CIS local-NGEU strategic investment plan of the Apulia region as well as the analytical techniques of MRIO model adopted in this study. Section 3 focuses on the empirical simulation of the socioeconomic impacts of the local-NGEU investment and illustrate how the effects propagates amongst different economic agents and across Italian regions. Finally, section 4 provides concluding remarks and discusses the key policy and welfare implications aimed at redressing the persisting regional disparities in Italy and the EU. The appendix summarizes the state of implementation and the construction of the exogenous shock of the CIS local-NGEU investment plan.

2 Data and Research Methodology

2.1 Literature review on Social Accounting Matrix (SAM)

The conceptual origins and framework of SAM can be traced back to the late 1960s with the pioneering work of Richard Stone, responding to the need to integrate the famous Leontief Input-Output (I-O) model,[2] within the framework of United Nations System of National Accounting (SNA). Against this backdrop, Stone and his research team in Cambridge developed the first SAM for the United Kingdom in 1960. In fact, compared to the Leontief I-O method, SAMs represents a macro-economic equilibrium where aggregate demand equals aggregate supply.

The fundamental purpose of a SAM is to document all the economic-wide series of transactions and transfers of incomes between different economic sectors and institutions (i.e., households, private enterprises, government, and the rest of the world) within a socio-economic system (national, regional, or sub-regional, etc.) during a specific period, usually for a year (Round, 2003b; Scandizzo & Ferrarese, 2015; Mainar-Causapé, Ferrari, & McDonald, 2018). Furthermore, SAMs represent the core economic-wide flexible and comprehensive database required for the calibration of parameters for a family of Computable General Equilibrium (CGE) models, including multiplier analysis (Defourny & Thorbecke, 1984; Golan, Judge, & Robinson, 1994; Round., 2003a; Civardi & Lenti, 2006). This implies that an aggregate SAM describes the economy's macroeconomic behavior in an initial equilibrium (Burfisher, 2011, p. 44).

In this regard, SAM technique is the proper and viable methodological approach for ex-ante socio-economic impact simulation of calibrated local, regional, and interregional infrastructure investment projects because it guides policy-makers in understanding the interdependences and structural adjustment mechanisms related to the efficiency of resource allocation, among interrelated sectors and agents within an economic system. It also provides guidance in evaluating the likely quantitative impacts and consequences of how different domestic policy options and external exogenous shocks affect society's economic welfare, in the context of sustainable development (Kemal, Jaime, & Sherman, 1982; Robinson & Liu, 2006; Hosoe, Gasawa, & Hashimoto, 2010). Understanding how

[2] The basic I-O or interindustry analysis was first developed by Professor Wassily Leontief in the late 1930s, for which he was awarded the Nobel Prize in Economics in 1973. The method is a practical means of representing the interindustry transactions and structural interdependences within a socio-economic system (see, Sraffa, 1960; Leontief W, 1986; Batten, 1983; Miller & Blair, 2009; Szabó, 2015).

households, private enterprises, government as well as various industrial sectors and their interdependencies or linkages (i.e., through trade) with GVCs across the world interact among each other is crucial for an efficient, effective, and sustainable implementation of the local-NGEU investment plan.

2.1.1 The data sources for constructing the Apulia regional SAMs

The analytical framework for the construction of SAMs for different countries and regions around the world broadly conform to the basic internationally agreed standards of the United Nations System of National Accounts (SNA). However, the classification of accounts and the degree of disaggregation can differ across countries, depending not only on the key objectives and priorities under study, but also on the availability and quality of data (Keuning & de Ruuter, 1988; Eurostat, 2008; Mainar-Causapé, Ferrari, & McDonald, 2018). For example, macro-SAMs can be constructed, using data drawn from a country's national accounts, firms and household income surveys, government budgets and balance of payments, etc. While the disaggregated micro-SAMs can be obtained by using the data in the macro-SAMs accounts as control totals.

Figure 1 below shows the macro structure for the Apulia regional SAM matrix and other 19 Italian regions for the reference year 2015. The SAM includes 63 sectors and distinguishes interprovincial, interregional, as well as international trade between Apulia and other Italian regions as well as with the rest of the world. The labor employed in each sector is distinguished in low, medium, and high skill components. Households' consumption, income and savings are disaggregated by deciles to account for the distributive impact of the CIS investment projects. The names of the industrial sectors included in the Apulia SAM are illustrated in Appendix **Table A1**. The dataset consists of 85 rows x 85 columns, including totals and provides a detailed summary of the Apulia economy.

Figure 1. The macro structure of the Apulia and Italian regional SAM

		Activity	Value added			Institutions			Direct taxation	Capital formation	Export		Total
		63 sectors	Labor (low, med,high skill)	Capital	Indirect taxation	Household income decile	Enterprises	Government	Taxes	Capital formation	Other Regions	Rest of the world	
Activity	63 sectors	Intermediate Consumption				Consumption		Consumption		Investments	Export to other regions	Export to ROW	Demand
Value added	Labor (low, med, high skill)	Wages											Gross domestic product
	Capital	Mixed income											
	Indirect taxation	Taxes											
Institutions	Household income decile		Labor income	Other income		Transfer	Capital income	Income from pensions, subsidies, contributions		Negative savings		Income from abroad	Institution incomes
	Enterprises							Contributions, subsidies		Negative savings			
	Government				Tax transfer				Tax transfer	Negative savings		Transfer from abroad	
Direct taxation	Taxes					Taxes	Taxes						Direct taxation
Capital formation	Capital formation					Savings	Savings	Savings				Capital from abroad	Saving
Import	Other Regions	Imports from other regions				Consumption							Import
	Rest of the world	Imports from ROW				Consumption							
Total		Supply	Factor outlays			Institution expenditures			Direct taxation	Investments	Export		

The pressing challenges for constructing and updating consistent SAMs for recent year involves finding not only ways to incorporate fragmented or missing datasets ranging from different sources, but also how to fix statistical inconsistencies related to the timing and adjustment of the I-O tables (Lemelin, Fofana, & Cockburn, 2013; Robinson, Cattaneo, & El-Said, 2001). In this regard, some of the commonly used statistical techniques of balancing SAMs accounts with equality between incomes and expenditures include, for example, the RAS method, cross-entropy minimization, and least squares methods. It is worth mentioning that different balancing techniques tends to yield heterogenous or slightly different SAMs.

2.1.2 Construction of the Exogenous Shock of the CIS local-NGEU investment plan

The provincial territory of Taranto will be affected in the short run by an exogenous investment shock for a total of 1.7 billion euros. Particularly, 1.1 billion euros from the CIS, about 200 million from industrial development contracts and another 400 approximately million euros for the program of the XX Mediterranean Games. The corresponding impact assessment, starting from a suitable economic modelling tool (such as a disaggregated SAM and / or a CGE applicable to it), can be carried out through the construction of specific expense vectors, which simulate both the construction phase and that of regime, also starting from the identification of the "producers" and "owners" sectors, based on the following assumptions.

For the CIS, which finances a total investment amount of about € 1.1 billion, the following documents were reviewed:

- the state of implementation by sector of intervention in 2018[3], which indicates the planned expenditure amounts and the part reported for each macro-category for a total value of 1,007 million euros (see, **Table A1.2**),
- a preliminary form, still being completed, prepared by MIBACT, in which the actions and investment priorities for urban regeneration interventions are identified (which are added to the two interventions[4] that have in fact been concluded in the CIS); for these new interventions, an additional 90 million euros will be allocated, concentrated in the recovery of some historical-cultural sites and the neighbouring streets of the Old City (Città Vecchia) of Taranto.

Table 1 and **Table 2** summarize this analytical presentation of the CIS local-NGEU investment project in a final vector representing both the vector of exogenous shocks applied to the local economy to evaluate the impact of the investment plan and the cost flow of the project as it is traditionally modelled in project analysis.

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3. The Governance of the CIS, supported by the related Mission Structure, had a setback in 2018, a critical issue that does not yet seem to have been resolved due to the resumption of construction sites and acceleration of spending; for these reasons it can probably be assumed that the actual progress is very similar to that recorded about two years ago.

4. Restoration works of the former Convent of S. Antonio and restoration and enhancement of the Compendium of Santa Maria della Giustizia.

Table 1. Project List of the CIS local NGEU investment Plan

Instrument	**Related sectors**	**Project**	**Project cost** (Mln euros)
CIS	Environment	Drainage Mar Piccolo	55.0
CIS	Environment	Platform riqualification	20.8
CIS	Environment	Ex Cemerad	10.0
CIS	Environment	Statte Aquifers	37.0
CIS	Environment	Environmental Centre	1.0
CIS	Environment	Waste water Ilva	14.0
CIS	Environment	Cimitery San Brunone	11.0
CIS	Environment	Restoration Statte Municipality	0.2
CIS	Environment	Water collection Crispiano	3.0
CIS	Environment	Environmental Riqualification Montemesola	3.0
CIS	Environment	Water collection Massafra	3.0
CIS	Environment	Environmental Riqualification Statte	3.0
CIS	Military Arsenal	Installations Military Arsenal	37.2
CIS	Military Arsenal	Enhancement Military Arsenal	5.7
CIS	Health	San Cataldo Hospital	207.5
CIS	Health	Medical equipments	70.0
CIS	Ports	Logistic plate Taranto	219.1
CIS	Ports	Riqualification Peer	75.0
CIS	Ports	Dredging	83.0
CIS	Ports	Taranto RFI Railroad	25.5
CIS	Ports	Foranea Dam	14.0
CIS	Education	Schools Riqualification	8.2
CIS	Education	School neighborhoods	1.2
CIS	Education	Risk Analysis of School Projects	0.1
CIS	Tourism and culture	Restoration Convento	5.1
CIS	Tourism and culture	Restoration Compendio	2.0
CIS	City Development	Soil remediation	2.0
CIS	City Development	Urban Forest	6.9
CIS	City Development	Carducci Palace	2.1
CIS	City Development	Residential construction	20.0
CIS	City Development	Restoration Via Garibaldi	2.1
CIS	City Development	Housing Sociale	15.2
CIS	City Development	Restoration Palazzo Troilo	3.6
CIS	City Development	Lungomare, Tamburi, sport facilities	40.0
CIS	MIBACT	Riqualification Città Vecchia	90.0
		TOTAL	**1096.3**

Table 2. Project costs by year and sectors (values in M€)

	Costruction year						
	1y	**2y**	**3y**	**4y**	**5y**	**6y**	**Total**
Agriculture	2	2	0	0	0	0	**3**
Manufacture of non-metal products	9	9	8	8	6	4	**45**
Manufacture of metal products	9	5	4	4	4	2	**28**
Computer and electronic products	14	5	5	5	5	4	**38**
Electrical equipment	26	6	5	5	4	2	**48**
Machinery & equipment	16	12	11	11	7	4	**61**
Other transport equipment	9	9	9	9	9	9	**55**
All utilities & waste	5	5	5	5	0	0	**21**
Construction	129	125	113	107	59	40	**572**
IT services	1	1	1	1	1	0	**5**
Business services	0	0	0	0	0	0	**1**
Rest of the world	73	37	34	34	26	16	**220**
Total	**292**	**217**	**196**	**190**	**121**	**80**	**1096**

2.2 Multi-regional Input-Output (MRIO) models

MRIO models are modified extensions of the Isard's interregional input-output (IRIO) model with feasible real-world empirical implementation with less restrictive data requirements (Bon, 1975, p. 5; Hyland et al. 2012, p. 153; Többen et al. 2015, p. 1). Unlike the IRIO model, trade flows among regions are captured differently in MRIO models. Particularly, interindustry transaction flows denoted by $t_{ij}^{\bullet s}$ are estimated by sector in multiregional models lacking inputs regional origins, where the dot superscript indicates all possible geographical locations of sector i. Put differently, similar commodities are no longer distinguished by their regional origins (Toyomane, 1988, p. 17; Miller et al. 2009, p. 90; Polenske et al. 2004). Similarly, the corresponding technical coefficients for each receiving region in the MRIO model indicated by $a_{ij}^{\bullet s}$ is a ratio measuring the quantity of commodity i required to produce one unit of sector $j's$ total output located in region s

$$a_{ij}^{\bullet s} = \frac{t_{ij}^{\bullet s}}{x_j^{s}} \qquad where, \qquad \mathbf{A}^{s} = [a_{ij}^{\bullet s}]_{s=1,\cdots m} \tag{1}$$

By re-expressing equation (1) we obtain the structural equation $t_{ij}^{\bullet s} = (a_{ij}^{\bullet s} x_j^{s})_{s=1,\cdots m}$, that relates the interindustry multiregional intermediate transactions to total output. In general, depending on the specifications of the missing regional origins and accounting scheme for spatially differentiated interregional trade, MRIO models can then be classified into three major groups: column coefficient (Chenery-Moses) model, row, and gravity coefficient models (see, e.g., Polenske, 1970; Bon, 1975, p. 7, 1984; Toyomane, 1988, p. 17).

2.2.1 The Chenery-Moses' column coefficient MRIO model

The Chenery-Moses MRIO model assumes that the purchasing sectors decides the compositions of each inputs' regional origins. In other words, every purchasing industrial sector including the final demand sector of commodity i, in region s, would purchase commodity i, both from domestic and imported sources in the same proportions among the selling regions (Moses, 1955; Ungsoo, 1974, p. 9; Toyomane, 1988, p. 17). The overall commodities traded between selling and purchasing regions can be illustrated in **Table 3**. Then, let $t_{ij}^{rs} = t_i^{rs}$ for all j, represent a flow or purchases of commodity i from region r to the producing and final demand sectors in any other region s, regardless of the destination sector in the purchasing regions

Table 3. Interregional Trade of Commodity i

	Importing Region					
Exporting Region	*1*	*2*	...	*s*	...	*m*
1	t_i^{11}	t_i^{12}	...	t_i^{1s}	...	t_i^{1m}
2	t_i^{21}	t_i^{22}	...	t_i^{2s}	...	t_i^{2m}
⋮	⋮	⋮	...	⋮	...	⋮
r	t_i^{r1}	t_i^{r2}	...	t_i^{rs}	...	t_i^{rm}
⋮	⋮	⋮	...		...	⋮
m	t_i^{m1}	t_i^{m2}	...	t_i^{ms}	...	t_i^{mm}
Total	T_i^1	T_i^2	...	T_i^s	...	T_i^m

Each column sums in **Table 3** represents the total shipments (supplies) of commodity i into region s that came from all other regions, including the amount supplied from within the region, (i.e., t_i^{ss}) itself. In other words, T_i^s is the total amount of commodity i, consumed in region s. Furthermore, since the total supplies for each commodity i, regardless of regional origins must be equivalent to intermediate demands and final demands for each commodity i in region s, we have (see, Miller et al. 2009, p. 107).

$$T_i^s = t_i^{1s} + t_i^{2s} + \cdots + t_i^{rs} + \cdots + t_i^{ms}$$

$$= \sum_{r=1}^{m} t_i^{rs} = \overbrace{\sum_{j=1}^{n} a_{ij}^{\bullet s} x_j^s + f_i^s}^{T_i^s} \qquad \begin{matrix}(r = 1, 2 \ldots, m)\\(i = 1, 2 \ \ldots, n)\end{matrix} \qquad (2)$$

By dividing each element in the column (see, **Table 3**) of a particular region s, by the column total T_i^s, of the receiving region, we obtain the fraction of total supply of commodity i used in region s that came from within and other regions r, for $(r = 1, \ldots, m)$. These trade or supply coefficients in any column denoted by c_i^{rs} must add up to unity when summed over the selling regions as stated below

$$c_i^{rs} = \frac{t_i^{rs}}{T_i^s} \quad where, \quad \sum_{r=1}^{m} c_i^{rs} = 1 \quad (all\ i) \tag{3}$$

The structural equation obtained from equation (3), $t_i^{rs} = (c_i^{rs} T_i^s)$ states that the shipments of a given commodity i from regions r into region s, is directly proportional to the total consumption of commodity i in region s (see, Bon, 1984, p. 795; Polenske et al. 2004, p. 271). Note that, the trade coefficients assume identical or fixed regional supply patterns of any given inputs among all purchasers, including the final users of each commodity i in a specific region (Ungsoo, 1974, p. 9). And by substituting the structural equation into the right-hand side of (2), the Chenery-Moses MRIO model for m-regions and n-sectors of industries can be represented by the set of linear equations (see, Moses, 1955; Toyomane, 1988, p. 17)

$$x_i^r = \sum_{s=1}^{m} \overbrace{c_i^{rs} T_i^s}^{t_i^{rs}} = \sum_{s=1}^{m} c_i^{rs} \overbrace{\left(\sum_{j=1}^{n} a_{ij}^{\bullet s} x_j^s + f_i^s \right)}^{T_i^s} \qquad \begin{matrix} (r = 1, 2 \ldots, m) \\ (i = 1, 2 \ \ldots, n) \end{matrix} \tag{4}$$

$$= \sum_{s=1}^{m} \sum_{j=1}^{n} c_i^{rs} a_{ij}^{\bullet s} x_j^s + \sum_{s=1}^{m} c_i^{rs} f_i^s$$

where x_i^r is the total production (supply) of commodity i in region r, while f_i^s denotes the total exogenous final demand for commodity i in region s. From equation (4)[5], we can express the set m matrix equations for the entire multi-regional economy (see, Miller et al. 2009, p. 108), one for each region r, for $(r = 1, \ldots, m)$

$$\mathbf{x}^r = \sum_{s=1}^{m} \mathbf{C}^{rs} (\mathbf{A}^s \mathbf{x}^s + \mathbf{f}^s) = \sum_{s=1}^{m} \mathbf{C}^{rs} \mathbf{A}^s \mathbf{x}^s + \sum_{s=1}^{m} \mathbf{C}^{rs} \mathbf{f}^s \qquad (r = 1, 2 \ldots, m) \tag{5}$$

the matrix form becomes

[5] The balance equation of the Chenery-Moses MRIO column coefficient model states that the total production of each commodity i, in region r, is equivalent to the shipments (supplies) of commodity i to all other regions s, including the amount supplied within the region (i.e., t_i^{rr}) itself. Furthermore, the product between interregional trade and technical coefficients of the Chenery-Moses model is equivalent to the technical coefficient of the Isard IRIO model, $a_{ij}^{rs} = c_i^{rs} a_{ij}^{\bullet s}$ (see, Ungsoo, 1974, p. 8; Toyomane, 1988, p. 20; Miller et al. 2009, p. 107). This decomposition into separate components by (Moses, 1955) implies that both interregional trade and technical coefficients are both independently estimated and easily updated periodically.

$$\mathbf{x} = \begin{bmatrix} \mathbf{x}^1 \\ \mathbf{x}^2 \\ \vdots \\ \mathrm{x}^m \end{bmatrix};\ \mathbf{f} = \begin{bmatrix} \mathbf{f}^1 \\ \mathbf{f}^2 \\ \vdots \\ \mathbf{f}^m \end{bmatrix}\ ;\ \mathbf{A}^\star = \begin{bmatrix} \mathbf{A}^1 & 0 & \cdots & 0 \\ 0 & \mathbf{A}^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \mathbf{A}^m \end{bmatrix} \mathit{where,}\ \mathbf{A}^r = [a_{ij}^{\bullet r}]_{r=1,\cdots m} \tag{6}$$

and

$$\mathbf{C}^\star = \begin{bmatrix} \mathbf{C}^{11} & \mathbf{C}^{12} & \cdots & \mathbf{C}^{1m} \\ \mathbf{C}^{21} & \mathbf{C}^{22} & \cdots & \mathbf{C}^{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{C}^{m1} & \mathbf{C}^{m2} & \cdots & \mathbf{C}^{mm} \end{bmatrix},\ \text{where,}\ \mathbf{C}^{r s} = \begin{bmatrix} c_1^{r s} & 0 & \cdots & 0 \\ 0 & c_2^{r s} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & c_n^{r s} \end{bmatrix}$$

$$\text{and} \qquad \mathbf{C}^{s s} = \begin{bmatrix} c_1^{s s} & 0 & \cdots & 0 \\ 0 & c_2^{s s} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & c_n^{s s} \end{bmatrix} \tag{7}$$

From equation (5), (6) and (7), the solution equation yields

$$\begin{aligned} \mathbf{x} &= \mathbf{C}^\star\mathbf{A}^\star\mathbf{x} + \mathbf{C}^\star\mathbf{f} \\ (\mathbf{I} - \mathbf{C}^\star\mathbf{A}^\star)\mathbf{x} &= \mathbf{C}^\star\mathbf{f} \\ \mathbf{x} &= (\mathbf{I} - \mathbf{C}^\star\mathbf{A}^\star)^{-1}\mathbf{C}^\star\mathbf{f} \end{aligned} \tag{8}$$

Here, $\mathbf{x}$ and $\mathbf{f}$ represents the vectors of regional total outputs and final demands respectively. Furthermore, $\mathbf{C}^\star$ is a block of interregional trade coefficients matrix, with each of the submatrices (i.e., $\boldsymbol{C}^{r s}$ and $\boldsymbol{C}^{s s}$) containing the trade coefficients for n-*traded* commodities, while the off-diagonal elements equal to zero. The matrix, $\mathbf{A}^\star$ is a block of diagonal-matrix of regional IO technical coefficients in all regions, with each of the submatrices $\mathbf{A}^r = [a_{ij}^{\bullet r}]_{s=1,\cdots m}$ along the principal diagonal and the elements on the off-diagonal equal to zero.

3 Empirical Findings

3.1 Estimation of interregional trade flows

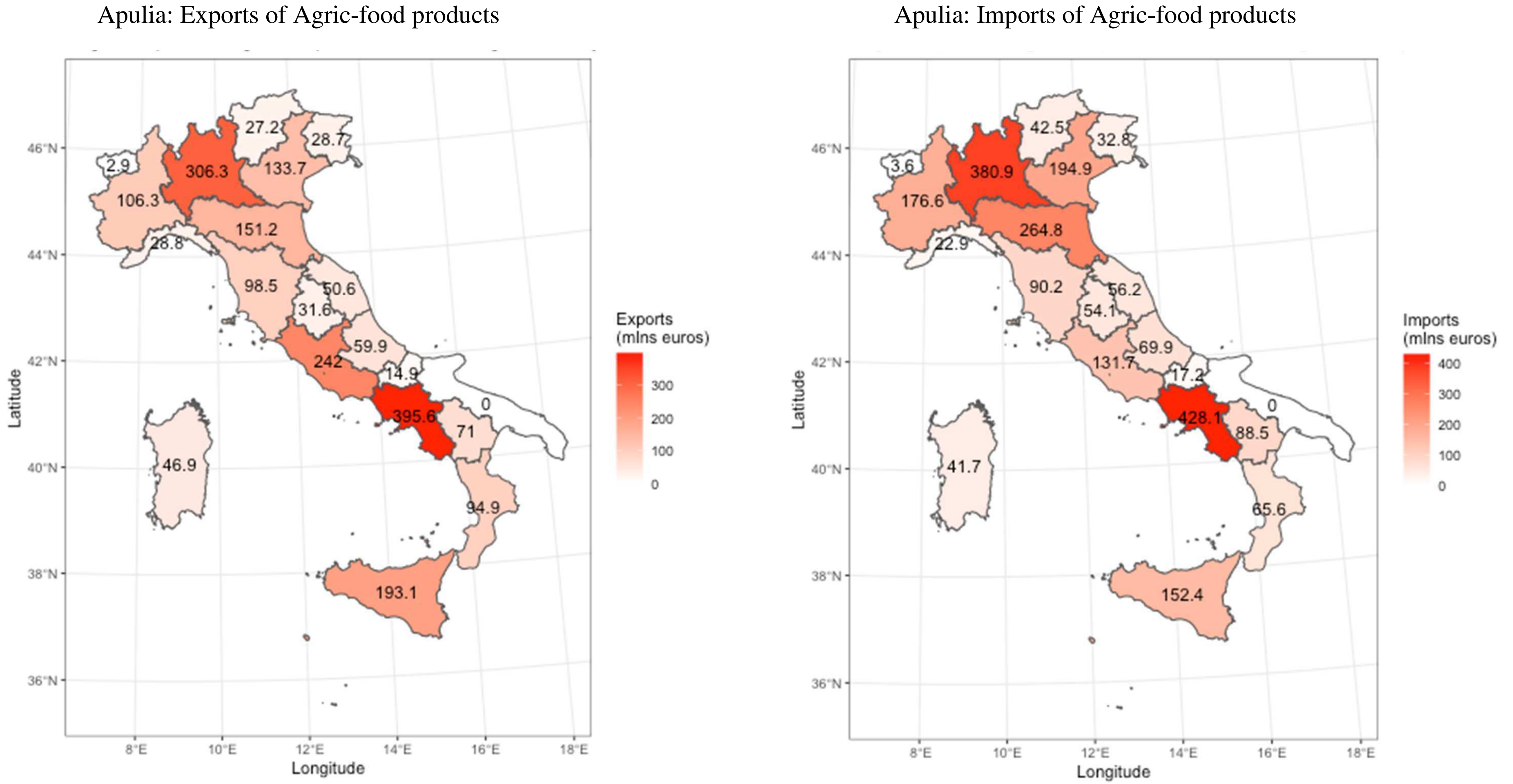
The starting point for the construction of the MRIO model for the 20 Italian regions is constituted by the regional SAMs in which the interregional trade flows was estimated, adopting a non-survey methodology. This approach was dictated by cost-related issues and the fact that there is no information on interregional trade flows for different sectors either at national or regional level. (Huang & Koutroumpis, 2023). Cross-hauling in interregional trade is the process in which each region simultaneously exports and imports the output of a generic sector i (Fujimoto T. , 2019). Here, interregional trade was estimated using the cross-hauling adjusted regionalization method (CHARM) model proposed by Kronenberg (2009) and subsequently refined by (Többen & Kronenberg, 2015) with some adaptations. The model assumes that cross-hauling in interregional trade is proportion to the cross-hauling potential determined by the amount of output or demand. Particularly, interregional import-export is zero-sum at the national level, the sum of regional exports by branch corresponds to the sum of regional import.

Figure 2 below reproduce the values of the interregional exports and imports of agri-food products between the Apulia region and other 19 Italian regions estimated with the CHARM model. As illustrated in **Figure 3**, the Apulia region records an active interregional trade balance in terms of agri-food products with respect to the regions of Lazio (+110.30 M€), Sicily (+40.70 M€), Calabria (+29.29 M€), and the a negative interregional trade balance relative to Emilia-Romagna (-113.55 M€), Lombardy (-74.58 M€), Piedmont (-70.34 M€), and the Veneto region (-61.19 M€). The total interregional trade relative to all sectors between Apulia with the rest of Italy is illustrated in the Appendix **Table A1.1**.

Furthermore, a gravity econometric model was used to determine how the outflows from each region are divided among the remaining regions. Gravity model holds that the volumes of bilateral trade flows between regions is directly proportional to the economic sizes, and inversely proportional to the distances between both regions, reflecting transportation costs (Leontief. & Strout, 1963; Polenske., 1969). The interregional flows were subsequently calibrated with a spatial interaction procedure (Wilson, 1971; Fotheringham, 1983a; Fotheringham A. , 1983b; Dennet, 2012), which made it possible to respect the total of outgoing and incoming flows for each region. The fixed supply form of the static MRIO model is formulated using the following four assumptions:

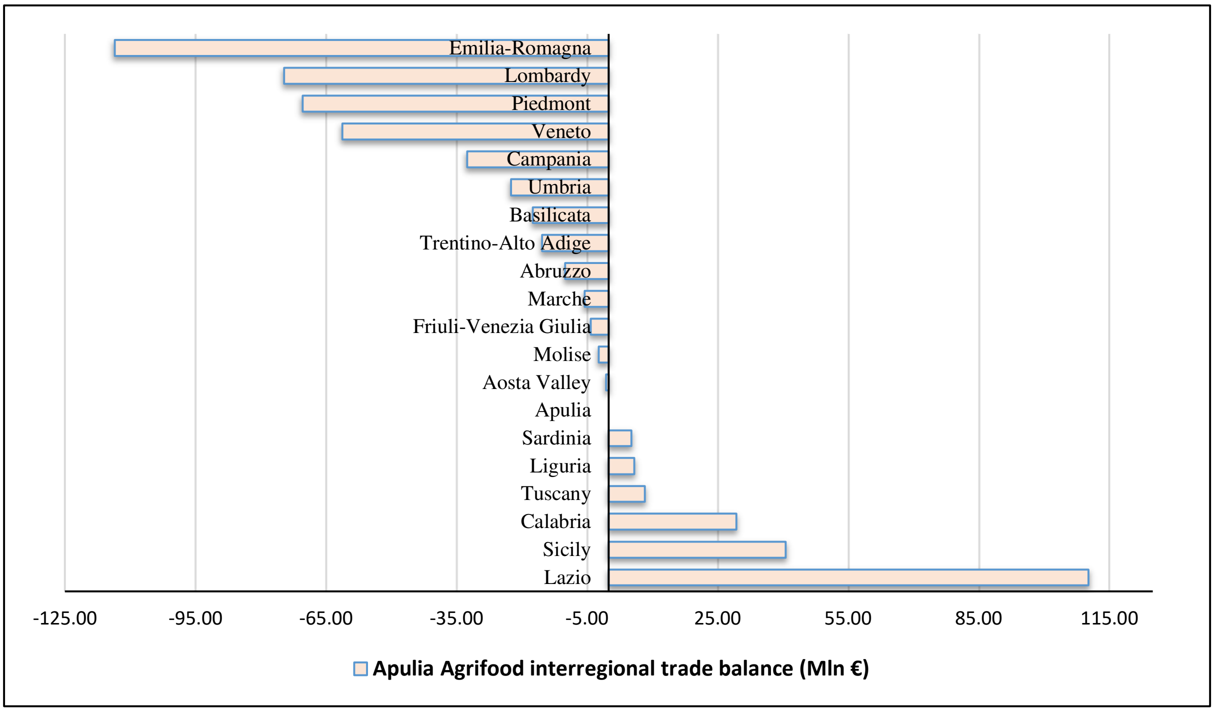
1. Constant technology coefficients. No substitution among inputs is allowed to occur.
2. Constant trade coefficients. No substitution among supplying regions is allowed to occur. Thus, a region is assumed to continue supplying a given fraction of the consumption of another region over time. No empirical verification of this assumption has been possible because of the lack of data.
3. Constant industrial shares. Each industry in a given region is assumed to continue purchasing a fixed share of the total amount of a given good supplied to the region. Again, because of the lack of data, no empirical testing of this assumption has been made. By incorporating this assumption, however, the amount of data required to implement the model is drastically reduced.
4. Excess capacity. All producers and transportation facilities are assumed to be operating at less than full capacity.

Figure 2. Apulia Interregional Exports and Imports of Agric-food products to other regions in Italy



Note: Figure 2, shows the total values in terms of interregional trade (exports and imports) of approximately (+ 2084.28 M€) and (- 2314.69 M€) respectively in Agri-food products between the Apulia and other 19 Italian regions, corresponding to a trade balance of (- 230.41 M€). Here the Apulia intra-regional exports and imports of is set to zero by construction to better reflect the trade flows in the diagram.

Figure 3. Apulia Interregional trade balance for Agri-food products (Mln €)



3.2 Empirical results: Intra and Interregional Impacts

The impact on the local economy is obtained by applying the exogenous shock vector in **Table 4** to the regional local SAM illustrated below. About 65% of the total investment shock is allocated to the construction sector.

Table 4. Vector of CIS investment shock allocated to key sectors in Apulia region

Ref. #	Sector Description	CIS inv (mln euros)	Share (%)
-	Construction	571.90	65.26
-	Manufacture of machinery and equipment	60.72	6.93
-	Manufacture of motor vehicles, trailers, and semi-trailers	54.79	6.25
-	Manufacture of basic metals	44.71	5.10
-	Manufacture of computer, electronic and optical products	43.30	4.94
-	Manufacture of electrical equipment	43.30	4.94
-	Manufacture of fabricated metal products, except machinery and equipment	27.85	3.18
-	Water collection, treatment, and supply	10.43	1.19
-	Management of sewer networks; waste collection, treatment, and disposal	10.43	1.19
-	Software, computer consulting and related activities; information service activities	5.20	0.59
-	Agricolture and hunting	3.08	0.35
-	Other technical, scientific professions; Veterinary services	0.55	0.06
-	Manufacture of chemicals and chemical products	0.10	0.01
Total CIS recovery investments		**876.35**	**100**

3.2.1 Intra-regional impact of CIS local-NGEU investments on the Apulia region

As illustrated in **Table 5**, the intraregional impact calculated with the MRIO model have been grouped into Total impact: Intermediate consumption, and Value added (Low income, Mid income, High income, Capital income and Indirect taxes), and Impact on Institutions (Households, Government and Enterprises). The CIS local-NGEU investments of € 876.35 M in the construction period generates an overall interregional impact on the Apulia economy of € 3353.73M, in terms of inter-sectorial purchases from intermediate input suppliers in the production process (€ 2242.44M), of which € 1079.55M deriving from the direct effects in intermediate input expenditures, € 1334.93M from the indirect intermediate input increases, and € 1111.29M of value-added, 33.14% of the total interregional impact. The intra-regional value-added in **Table 5** divided by the total investment costs as shown in **Table 4** produces a value-added benefit/cost ratio of 1.27, reflecting the low values of multipliers related to the value-added sectors affected by the recovery investments. The total sector multiplier reproduces the intensity with which a sectoral investment spreads over the entire domestic economy. The induced consumption effects on potential household spending on goods and services from employees' earnings of direct and indirect business expenditures is about € 974.27M.

Table 5. Intraregional impacts Apulia region of CIS (millions of Euros)

Sectors	**Impact (€ Mln)**	**Impact/Total (%)**
Intermediate Consumption	**2242.44**	**66.86**
Direct effects	*1079.55*	*27.06*
Indirect effects	*1334.93*	*39.80*
Value-added (VA)	**1111.29**	**33.14**
Income (Low)	*210.29*	*6.27*
Income (Mid)	*189.00*	*5.64*
Income (High)	*69.40*	*2.07*
Capital Income	*505.88*	*15.08*
Indirect Taxes	*139.72*	*4.08*
Impact on institutions (*) or Induced effects (**)	**1987.16**	**100%**
Households	*974.27*	*49.03*
Government	*653.85*	*32.90*
Enterprises	*359.03*	*18.07*
Total impact (TI)	**3353.73**	**100%**

Note: Total impact (TI) is the sum total of Intermediate consumption and Value added

(*) Institutions measures the impacts on the income of Households and Enterprises which include:

- *Household total income*: Factor income distribution to households, Inter Households transfers, Distribution of corporation's income to households, Government transfers to households, Transfers to Households from RoW;
- *Enterprise total income*: Factor income distribution to enterprises, Government transfers to enterprises, Transfers to Enterprises from RoW.
- *The Government is included given its role as a significant economic agent in the local economy of Taranto (Apulia)*

(**) An example of the source of induced effects is the link from regional wages to labor and household spending. This link is an expression of endogenous consumption – money earned in the region that is also spent in the region. A sector's export demand typically creates the combined effects of induced along with the direct and indirect effects. Interestingly, a source of pure induced effects happens when outside-the-region payments, e.g., social security payments from the federal government, are made to households. Regional household spending from outside sources of income can have a strong induced effect, but it does not have any direct or indirect effect.

Note: Totals may not sum due to rounding.

3.2.2 Interregional impact of CIS local-NGEU investments on the other Italian regions

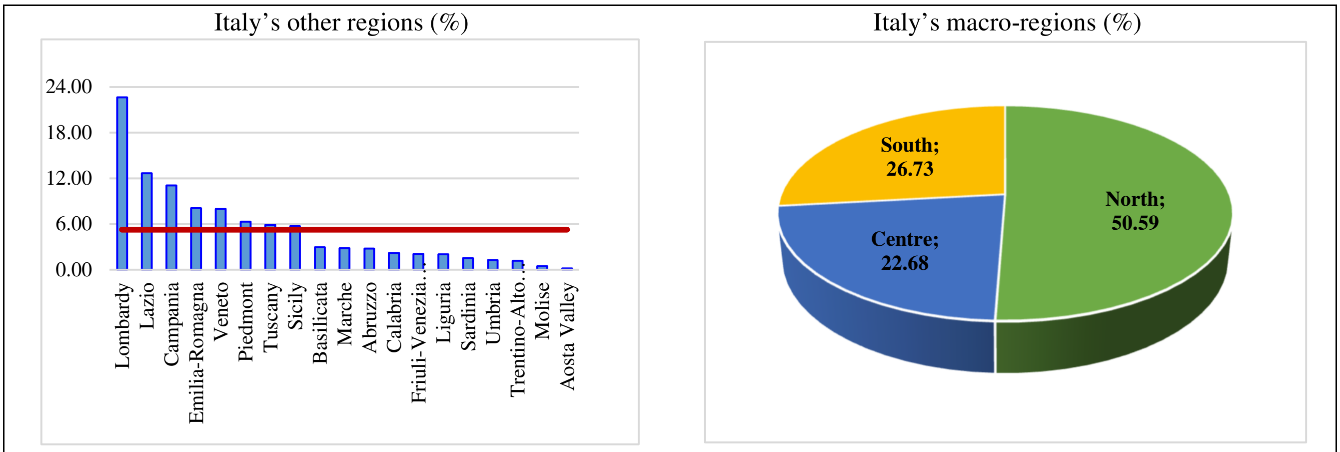
As illustrated in **Table 6** the total interregional impact on rest of Italy region estimated with the MRIO model is € 2498.19M, while the impact on intermediate consumption in the production process is € 1733.98M, equal to 69.41% of the total. The impact on inter-regional value added is equal to € 764.21M, 30.59% of the total impact. As shown in **Figure 4** considerable share of inter-regional spillover effects in terms of value-added, which is transferred outside the southern macro-region, over 73% reflects the regional disparities in Italy, where the productive northern regions mostly benefit from the national development policies made in the most marginal areas in southern Italy. Total impact and the induced interregional consumption effects on potential institutional spending on goods and services are reported graphically on the regional map shown in **Figure 5**.

Table 6. Interregional impact of CIS (in millions of euros)

Sectors	Impact (€ Mln)	Impact/Total (%)
Interm. Consumption	**1733.98**	**69.41**
Direct effects	*528.96*	*21.17*
Indirect effects	*1205.01*	*48.24*
Value-added (VA)	**764.21**	**30.59**
Income (Low)	*95.58*	*3.83*
Income (Mid)	*141.28*	*5.66*
Income (High)	*62.14*	*2.49*
Capital Income	*366.68*	*14.68*
Indirect Taxes	*98.52*	*3.94*
Impact on institutions	**1380.92**	**100%**
Households	*652.16*	*47.23*
Government	*461.93*	*33.95*
Enterprises	*266.83*	*19.32*
Total impact (TI)	**2498.19**	**100%**

Note: Total impact (TI) is the sum total of Intermediate consumption and Value-added.

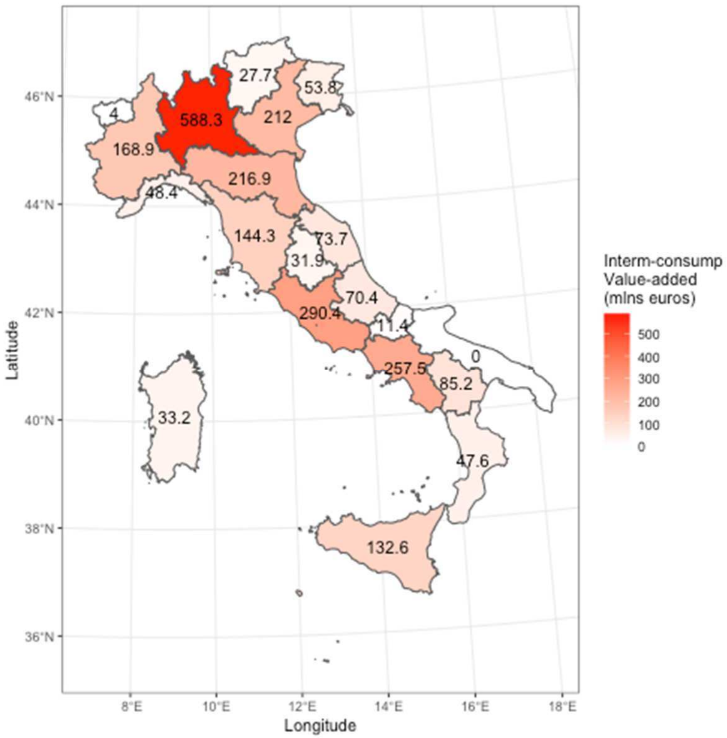
Figure 4. Inter-regional value-added share by Italy's regions and macro-regions



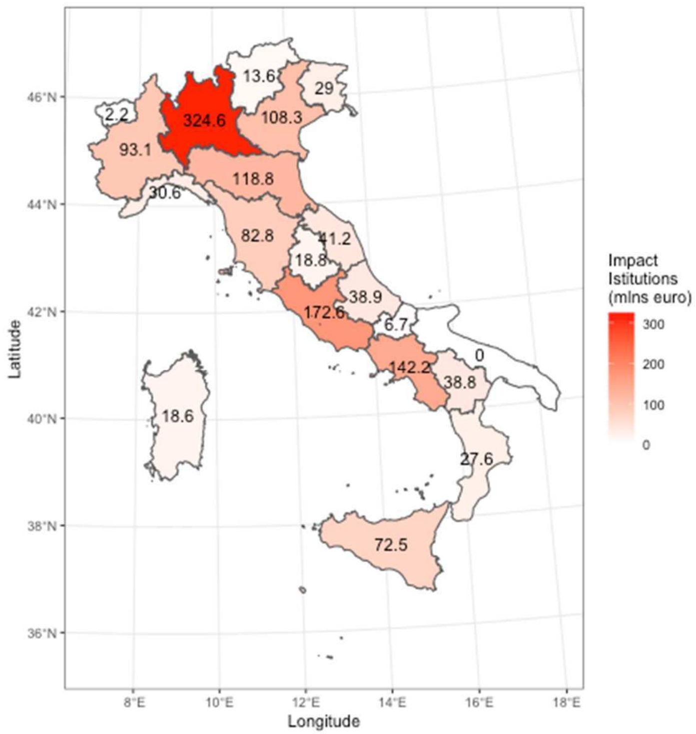
Note: Italy's northern regions include Piemont, Aosta Valley, Liguria, Lombardy Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia and Emilia-Romagna. The Centre regions include Tuscany, Umbria, Marche and Lazio. The southern regions include Abruzzo, Molise, Campania, Basilicata Calabria, Sicily and Sardinia.

Figure 5. Interregional effects: total impact and induced effects on institutional consumption

Total impact on other regions



Induced impact on institutional consumption



Note: Figure 5, shows the interregional total impact of the recovery investments made in the Apulia region on other Italian 19 regions and the induced effects on institutional consumption. Here the Apulia intra-regional impact is set to zero to better reflect the distributional aspect of the analysis

3.2.3 National impact of the CIS local-NGEU investment in Italy

Lastly, the spillover effect that is produced at the national level was estimated, which corresponds to the sum of the intraregional and interregional effects, as shown in **Table 7**. The national impact of recovery investments estimated with the MRIO model is worth € 5851.92M. The impact on intermediate input consumption of € 3976.42M is equal to 67.95% of the total impact. The impact on national added value is equal to € 1875.50M, 32.05% of the total national impact.

Table 7. National impact of CIS (in millions of Euros)

Sectors	Impact (€ Mln)	Impact/Total (%)
Interm. Consumption	**3976.42**	**67.95**
Direct effects	*1608.51*	*27.49*
Indirect effects	*2367.90*	*40.46*
Value-added (VA)	**1875.50**	**32.05**
Income (Low)	*305.87*	*5.23*
Income (Mid)	*330.29*	*5.64*
Income (High)	*131.54*	*2.25*
Capital Income	*872.56*	*14.91*
Indirect Taxes	*235.24*	*4.02*
Impact on institutions	**3368.08**	**100%**
Households	*1626.43*	*48.29*
Government	*1115.79*	*33.13*
Enterprises	*625.87*	*18.58*
Total impact (TI)	**5851.92**	**100%**

Note: Total impact (TI) is the sum total of Intermediate consumption and Value-added.

The impact on national value-added to of € 1875.50M within the Italian economy divided by the total investment costs of (€ 876.35M) in **Table *4*** produces a value-added benefit/cost ratio of 2.14 after accounting for the interregional and inter-sectoral supply chain linkages and spillover effects through trade at the national level.

4 Concluding remarks and their policy implications across Italy and Europe

The purpose of this paper was to estimates the socio-economic impact of CIS local-NGEU recovery investments and resilience plan for the Apulia region on different categories of households, labor markets (skilled and unskilled), and private enterprises across Italy implementing a MRIO model with inter-regional trade. The intraregional effects are almost two times of the interregional effects. Almost 51% of the inter-regional impact on value-added accrues to northern regions, 22% at the centre, while about 27% is captured by the regions in southern Italy. This empirical evidence clearly shows a good degree of connection between the Apulia local economy with the macro region of northern Italy, while it is quite weak relative to the macro southern Italy. However, Apulia is particularly connected to the regions of Lombardy, Lazio, and Campania. The impact on intraregional value-added within the

Apulia region divided by the total investment costs produces a value-added benefit/cost ratio of 1.27 that increases to 2.14 after accounting for the interregional and inter-sectoral supply chain linkages and spillover effects through trade at the national level.

From a policy perspective these empirical results show how an ex-ante impact evaluation of investments provides useful indications for orienting the recovery investments themselves so that they can be as advantageous as possible for local economic development and to redress regional disparities in Italy. In this regard, the considerable share of inter-regional spillover effects in terms of value-added, which is transferred outside the southern macro-region, over 73% reflects the persisting regional disparities in Italy, where the productive northern-regions mostly benefit from the national development policies made in the most marginal areas in southern Italy, as widely discussed in the case of EU Cohesion policy. However, in order to trigger a catching-up process structural reforms are necessary in terms of institutional capacity in the southern regions for the efficient implementation of national development policies associated with the recovery investments.

The application of a static MRIO analysis has some limitations, including the assumptions of constant returns to scale in production technology and no substitution among inputs. This implies that relative prices play no role in the allocation of resources between activities. In addition, the constant trade coefficients assumption implies that regions continue to demand and supply a given fraction of the consumption of another regions. A further concern is the lack of supply-side constraints assumption in the model implies that supply is not able to respond perfectly elastically to changes in demand also because supply capacity is limited by the existing labor, capital, and other productive inputs. Further research is needed to measure spatial multi-regional relationships of the dynamic general equilibrium model for the national economy.

References

Batten, D. (1983). Spatial Analysis of Interacting Economies: The Role of Entropy and Information Theory in Spatial Input-Output Modeling. Springer Netherlands, 1-305.

Bentivogli, C., Ferraresi, T., Monti, P., Paniccià, R., & Rosignoli, S. (2018). Italian regions in the global value chains: an input-output approach. The Bank of Italy and the Eurosystem (Occational papers) (462), 1-35. [Crossref]

Bon, R. (1975). Some Conditions of Macroeconomic Stability in Multiregional models (PhD Thesis). Massachusetts Institute of Technology. Dept of Urban Studies and Planning, 1-52. [Crossref]

Bon., R. (1984). Comparative Stability Analysis of Multiregional Input-Output Models: Column, Row, and Leontief-strout Gravity Models. The Quarterly Journal of Economics, 99(4), 791-815. [Crossref]

Burfisher, M. E. (2011). Introduction to Computable General Equilibrium Models. Cambridge University Press, 1-346.

Civardi, M., & Lenti, R. (2006). Multiplier decomposition, inequality, and poverty in a SAM framework. La Società Italiana di Economia Pubblica (SIEP), 1-26. [Crossref]

Defourny, J., & Thorbecke, E. (1984). Structural Path Analysis and Multiplier Decomposition within a Social Accounting Matrix Framework. The Economic Journal, 94(373), 111-136. [Crossref]

Dennet, A. (2012). Estimating flows between geographical locations: 'get me started in' spatial interaction modelling. *UCL, London.*, Paper 181.

Eurostat. (2008). Eurostat Manuel of Supply, Use and Input–Output Tables (Manual No. KS-RA-07–013-EN-N). Eurostat, 5-581. [Crossref]

Fabbris, T., & Michielin, F. (2010). The economy of the Italian regions: recent developments and responses to the economic crisis. European Union Regional Policy, 1-15. [Crossref]

Fotheringham, A. (1983b). Some theoretical aspects of destination choice and their relevance to production-constrained gravity models. *Environment and Planning A, 15*(8), 1121-1132.

Fotheringham. (1983a). A new set of spatial-interaction models: the theory of competing destinations. *Environment and Planning A, 15*(1), 15-36.

Fujimoto, T. (2019). Appropriate assumption on cross-hauling national input-output table regionalization. *Spatial Economic Analysis, 14*(128), 106-128. [Crossref]

Golan, A., Judge, G., & Robinson, S. (1994). Recovering information from incomplete or partial multicultural economic data. Review of Economics and Statistics, 76(3), 541-549. [Crossref]

Governo Italiano. (2021). Italia domani. Piano Nazionale di Ripresa e Resilienza. *Governo Italiano | Presidenza del Consiglio dei Ministri*, 1-247. [Crossref]

Hosoe, N., Gasawa, K., & Hashimoto, H. (2010). Textbook of Computable General Equilibrium Modelling: Programming and Simulations. Palgrave Macmillan, 1-134.

Huang, S., & Koutroumpis, P. (2023). European multi regional input output data for 2008-2018. *10*(218), 1-9. [Crossref]

Hyland, M., Jennings, A., & Tol, R. S. (2012). Trade, Energy, and Carbon Dioxide: An Analysis for the Two Economies of Ireland. Journal of the Statistical and Social Inquiry Society of Ireland, 42, 153-172. [Crossref]

Isard, W. (1951). Interregional and Regional Input-Output Analysis: A Model of a Space-Economy. The Review of Economics and Statistics, 33(4), 318-328. [Crossref]

Istat (2019). Le Differenze Territoriali di Benessere: una lettura a livello provinciale. Roma: Territori, Lettura di Statistiche, 5-175. [Crossref]

Kemal, D., Jaime, D., & Sherman, R. (1982). General Equilibrium Models for Development Policy. A World Bank Research Publication, 1-503. [Crossref]

Keuning, S. J., & de Ruuter, W. A. (1988). Guidelines of the construction of a social accounting matrix. Review of income and wealth, 34(1), 71-100. [Crossref]

Kronenberg., T. (2009). Construction of regional input-output tables using nonsurvey methods: the role of cross-hauling. International Regional Science Review, 32(1), 40–64. [Crossref]

Lemelin, A., Fofana, I., & Cockburn, J. (2013). Balancing a Social Accounting Matrix: Theory and application (revised edition. SSRN, 1-24. [Crossref]

Leontief, W. (1986). Input-Output Economics -second edition. New York: Oxford University Press, USA, 1-436.

Leontief., W., & Strout, A. (1963). Multiregional Input-Output Analysis. In: Barna T. (eds) Structural Interdependence and Economic Development. Palgrave Macmillan, London, 119-150. [Crossref]

Mainar-Causapé, A., Ferrari, E., & McDonald, S. (2018). Social Accounting Matrices: basic aspects and main steps for estimation. Joint Research Centre (JRC) Technical Reports, European Commission, 1-35. [Crossref]

Menon, M., Perali, F., Ray, R., & Tommasi, N. (2021). The Tale of the Two Italies: Regional Price Parities Accounting for Differences in the Quality of Services. Centre for Household, Income, Labour and Demographic Economics (CHILD)-CCA, (No. 89), 1-50. [Crossref]

Miller, R., & Blair, P. (2009). Input-Output Analysis: Foundations and Extensions (second edition). New York: Cambridge University Press, 1-733.

Moses, L. N. (1955). The Stability of Interregional Trading Patterns and Input-Output Analysis. The America Economic Review, 45(5), 803-826. [Crossref]

OECD. (2021). The Inequality-Environment Nexus: Towards a people-centred green transition. OECD Green Growth Papers, 2021-01, OECD Publishing, Paris, 3-55. [Crossref]

Pasquini, A., & Rosati, F. (2020). A Human Capital Index for the Italian Provinces. IZA – Institute of Labor Economics - Discussion Paper Series (13301), 1-32. [Crossref]

Polenske. (1969). Empirical implementation of a multiregional input-output gravity model. In: Carter AP, Brody A (eds) Contributions to input-output analysis. *North-Holland, Amsterdam*, 143–163.

Polenske. (1970). An Empirical Test of Interregional Input-Output Models: Estimation of 1963 Japanese Production. The American Economic Review, 60(2), 76-82. [Crossref]

Polenske., K., & Hewings, G. (2004). Trade and spatial economic interdependence. Papers in Regional Science, 83, 269-289. [Crossref]

Robinson, D., & Liu, Z. (2006). The effects of interregional trade flow estimating procedures on multiregional social accounting matrix multipliers. Journal of Regional Analysis and Policy, 36(1), 94-114. [Crossref]

Robinson, S., Cattaneo, A., & El-Said, M. (2001). Updating and Estimating a Social Accounting Matrix using Cross Entropy Methods. Economic System Research, 13(1), 47-64. [Crossref]

Round, J. (2003b). Constructing SAMs for Development Policy Analysis: Lessons Learned and Challenges Ahead. Economic Systems Research, 15(2), 161-183. [Crossref]

Round., J. (2003a). Social accounting matrices and SAM-based multipliers. The impact of economic policies on poverty and income distribution: Evaluation techniques and tools, 14, 261-276. [Crossref]

Scandizzo, P., & Ferrarese, C. (2015). Social accounting matrix: A new estimation methodology. Journal of Policy Modelling, 37, 14-34. [Crossref]

Sraffa, P. (1960) Production of Commodities by Means of Commodities: Prelude to a Critique of Economic Theory. London: Cambridge University Press, 3-117. [Crossref]

Svimez. (2020). L'italia diseguale di fronte all'emergenza pandemica: il contributo del Sud alla ricostruzione. Associazione per lo sviluppo dell'industria del Mezzogiorno (SVIMEZ), Roma, 1-66. [Crossref]

Szabó, N. (2015). Methods for regionalizing input-output tables. Regional Statistics, 5(1), 44–65. [Crossref]

Többen, J., & Kronenberg, T. H. (2015). CONSTRUCTION OF MULTI-REGIONAL INPUT–OUTPUT TABLES USING THE CHARM METHOD. Economic System Research, 27(4), 487-507. [Crossref]

Toyomane, N. (1988). Multiregional Input-Output Models in Long-Run Simulation. Springer Netherlands, 1-229.

Ungsoo, K. (1974). Evaluation of Interregional Input-Output Models for Potential use in MacClellan_Kerr Arkansas River Multiple Purpose Project Impact Study. The Catholic University of America Washington DC Institute of Social and Behavioral Research, 1-96. [Crossref]

Wilson, A. (1971). A family of spatial interaction models, and associated developments. *Environment and Planning A*(3), 1-32.

Appendix A

Table A1: Apulia Regional SAM sectoral classification

#	SECTORS	#	SECTORS
1	Agriculture	43	Activities auxiliary to financial services and insurance activities
2	Fisheries	44	Real estate activities
3	Forestry	45	Legal and accounting activities; activities of head offices; management consulting
4	Mining and quarrying	46	Architectural and engineering activities
5	Food, drink and tobacco industries	47	Scientific research and development
6	Textile industry, manufacture of wearing apparel and leather goods.	48	Advertising and market research
7	Manufacture of wood and of products of wood and cork, except furniture	49	Other professional, scientific and technical activities; veterinary services
8	Manufacture of paper and paper products	50	Rental and leasing activities
9	Printing and reproduction of recorded media	51	Personnel recruitment, selection and supply activities
10	Manufacture of coke and refined petroleum products	52	Travel agency service activities
11	Manufacture of chemicals and chemical products	53	Investigation and security services
12	Manufacture of pharmaceutical products	54	Public administration and defence; compulsory social security
13	Manufacture of rubber and plastic products	55	Education
14	Manufacture of other non-metallic mineral products	56	Human health activities
15	Manufacture of basic metals	57	Social work activities
16	Manufacture of fabricated metal products, except machinery and equipment	58	Creative, arts and entertainment activities
17	Manufacture of computer, electronic and optical products	59	Sporting, entertainment and recreational activities
18	Manufacture of electrical equipment	60	Activities of membership organisations
19	Manufacture of machinery and equipment n.e.c.	61	Repair of computers and goods for personal and home use
20	Manufacture of motor vehicles, trailers and semi-trailers	62	Other personal service activities
21	Manufacture of other means of transport	63	Activities of households as employers of domestic staff
22	Manufacture of furniture; other manufacturing	64	Income from employee work (low)
23	Repair and installation of machinery and equipment	65	Income from employee work (mid)
24	Electricity, gas, steam and air conditioning supply	66	Income from employee work (high)
25	Water collection, treatment and supply	67	Capital
26	Management of sewer networks; waste collection, treatment and disposal	68	Indirect taxes
27	Construction	69	Households_1st_decil
28	Wholesale and retail trade and repair of motor vehicles and motorbikes	70	Household_2nd_decil
29	Wholesale trade, except of motor vehicles and motorbikes	71	Household_3rd_decil
30	Retail trade, except of motor vehicles and motorbikes	72	Household_4th_decil
31	Land transport and transport via pipelines	73	Household_5th_decil
32	Sea and water transport	74	Household_6th_decil
33	Airplane transport	75	Households_7th_decil
34	Warehousing and support activities for transportation	76	Households_8th_decil
35	Postal and courier activities	77	Household_9th_decil
36	Accommodation; food service activities	78	Households_10th_decil
37	Publishing activities	79	PA
38	Motion picture, video and television programme production, sound recording and music publishing activities	80	Direct taxes
39	Telecommunications	81	Enterprises
40	Computer programming, consultancy and related activities; information service activities	82	Capital formation
41	Financial service activities (except insurance and pension funding)	83	Imports Interr.
42	Insurance, reinsurance and pension funding, except compulsory social security	84	Imports rest of the world

Table A1.1. Apulia: Total interregional trade with the rest of Italy

Regions of Italy	Interr_exports	Share (%)	Interr_imports	Share (%)	Trade balance
Piedmont	1286.40	5.47	1578.65	5.61	-292.24
Aosta Valley	28.08	0.12	24.81	0.09	3.27
Liguria	337.22	1.43	396.14	1.41	-58.93
Lombardy	4236.25	18.03	6206.73	22.04	-1970.48
Trentino-Alto Adige	261.33	1.11	306.10	1.09	-44.78
Veneto	1524.65	6.49	2089.78	7.42	-565.13
Friuli-Venezia Giulia	366.17	1.56	474.29	1.68	-108.13
Emilia-Romagna	1521.11	6.47	2013.89	7.15	-492.77
Tuscany	1239.80	5.28	1647.75	5.85	-407.95
Umbria	269.50	1.15	320.20	1.14	-50.71
Marche	615.99	2.62	895.42	3.18	-279.44
Lazio	2937.01	12.50	3204.57	11.38	-267.56
Abruzzo	656.45	2.79	800.95	2.84	-144.50
Molise	139.05	0.59	146.46	0.52	-7.41
Campania	3894.80	16.57	3959.30	14.06	-64.50
Apulia	0.00	0.00	0.00	0.00	0.00
Basilicata	1071.10	4.56	1303.87	4.63	-232.77
Calabria	857.37	3.65	657.65	2.34	199.72
Sicily	1859.89	7.91	1775.57	6.31	84.32
Sardinia	398.49	1.70	354.28	1.26	44.21
Total	**23500.66**	**100**	**28156.43**	**100**	**-4655.77**

Note: the Apulia intraregional exports and imports is set to zero by construction.

Table A1.2. Implementation status CIS Taranto

STATUS OF IMPLEMENTATION BY SECTOR OF INTERVENTION OF THE CIS OF TARANTO					
SECTOR	AMOUNT FINANCED AT 30.06.2018 (mlns €)	SECTOR IMPACT ON THE TOTAL CIS (%)	EXPENDITURE MADE AT 30.06.2018 (mlns €)	IMPACT OF SECTOR EXPENDITURE ON THE TOTAL CIS FUNDED (%)	IMPACT OF SECTOR EXPENDITURE ON THE FUNDED SECTOR (%)
Reclamation and environmental dev't	161.00	15.99	16.23	1.61	10
Port infrastructure and transport	416.64	41.37	252.74	25.09	61
Health	277.50	27.55	4.30	0.43	2
Urban regeneration	91.84	9.12	1.51	0.15	2
Redevelopment and adaptation of school buildings	8.28	0.82	7.01	0.70	85
Infrastructural recovery and tourist enhancement Arsenale Militare	42.89	4.26	1.16	0.11	3
Cultural assets and activities for tourism promotion	7.02	0.70	6.76	0.67	96
System actions to support the acceleration of interventions	2.00	0.20	0.00*	0.00*	0*
Total CIS	**€ 1007.18**	**100**	**€ 289.71**	**28.76**	**--**

Table A1.2. Economic- Financial Framework

Economic - Financial Framework (Costs for works and Infrastructure for the Mediterranean Games – Taranto 2025)				
Financing costs and funds / *Amount in millions of euros*	*Public with State contribution*	*Region, Municipality, and other Local Authorities*	*Private*	***TOTAL***
WORKS AND INFRASTRUCTURE	***100***	***130***	***20***	***250***
Restructuring, adjustment				*75%*
Construction of new sports facilities				*15%*
Athletes' villages and media centre				*2%*
Competition set-up and equipment				*3%*

Economic - Financial Framework (Costs for organizing the Mediterranean Games - Taranto 2025)				
financial costs and funds / ***Amount in millions of euros***	*Public with State contribution*	*Region, Municipality, and other Local Authorities*	*Private*	***TOTAL***
ORGANIZATION	*20*	*12*	*8*	*40*
SPORTS, GAMES SERVICES AND OPERATIONS				*30%*
Hotel accommodation services, Food and Beverage, Medical Services (incl. Anti-Doping), Logistics Costs, Safety Costs, Sports Competition Costs, Transportation Costs, Spectator Services, Venue Operation Management, Test Events, etc.				
TECHNOLOGIES				*20%*
IT & Telecommunications				
COST OF LABOR				*20%*
Staff, volunteers, law enforcement, security				
CEREMONIES AND CULTURAL PROGRAMS				*10%*
Opening and closing ceremony, cultural and educational programs				
COMMUNICATION, PROMOTION AND MARKETING				*5%*
ADMINISTRATION AND LEGACY				*10%*
OTHER COSTS (RIGHRS, Trademarks, etc.)				*5%*

Source: http://asset.regione.Puglia.it/?Ambiente-dossier