CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE)

Studies **88**

NIKOLAOS RODOUSAKIS
THEODORE TSEKERIS

SECTORAL AND REGIONAL MULTIPLIER VALUES OF THE GREEK ECONOMY

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CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE)

The Centre was initially established as a research unit, under the title "Centre of Economic Research", in 1959. Its primary aims were the scientific study of the problems of the Greek economy, the encouragement of economic research and cooperation with other scientific institutions.

In 1964, the Centre acquired its present name and organizational structure, with the following additional objectives: first, the preparation of short, medium and long-term development plans, including plans for local and regional development as well as public investment plans, in accordance with guidelines laid down by the Government; second, the analysis of current developments in the Greek economy along with appropriate short and medium-term forecasts, the formulation of proposals for stabilization and development policies; and, third, the additional education of young economists, particularly in the fields of planning and economic development.

Today, KEPE is the largest economics research institute in Greece, focuses on applied research projects concerning the Greek economy and provides technical advice to the Greek government and the country's regional authorities on economic and social policy issues.

In the context of these activities, KEPE has issued more than 700 publications since its inception, and currently produces several series of publications, notably the Studies, *which are research monographs;* Reports *on applied economic issues concerning sectoral and regional problems;* Discussion Papers *that relate to ongoing research projects.* KEPE also publishes a tri-annual *review entitled* Greek Economic Outlook, *which focuses on issues of current economic interest for Greece.*

PREFACE

This study applies a consistent methodological framework for the estimation of multiplier effects in the Greek economy and across all thirteen NUTS 2 regions. These multipliers incorporate the distributive variables – profits and wages – into the analysis of intersectoral relationships. Unlike the traditional approach, which focuses solely on technical input-output coefficients, this framework captures both technological and distributive conditions, thereby offering a more comprehensive representation of the circular flow between production, income distribution, and final demand.

The originality of this study lies in the theoretical consistency and methodological robustness of the framework used to regionalise the national input-output table of the Greek economy and estimate the corresponding regional multipliers. This approach provides deeper insights into the structural interdependencies that govern regional economic performance and the mechanisms through which demand shocks propagate within and across regions.

Spatial disparities are interpreted through the lens of Greece's long-standing core-periphery structure, especially the divide between the metropolitan region of Attiki and the remaining regions. Recognising such heterogeneity is essential for identifying key sectors with the highest multiplier effects on output, employment, and trade and for supporting evidence-based regional development strategies.

The empirical analysis reveals significant regional variation in multiplier magnitudes, classifying the Greek regions into four clusters. A notable finding is the inverse relationship between the reliance on Primary and Industrial sectors and the magnitude of output multipliers.

Importantly, the study distinguishes between productivity and multiplier effects. High productivity does not necessarily coincide with strong multiplier capacity, indicating that policies based solely on productivity enhancement may produce uneven or transient results. Sustained and inclusive regional growth requires strategies that combine productivity im-

provements with measures aimed at strengthening local supply chains, deepening interregional linkages, and reducing import leakage.

From a policy perspective, the findings highlight the need for regionally differentiated development strategies. Regions with low multipliers should focus on building endogenous productive capacities, promoting innovation and skills upgrading, and encouraging import substitution where feasible. Regions with high multipliers, by contrast, should pursue diversification and technological upgrading to avoid over-specialisation. These policy directions should be embedded within a broader national framework that integrates multiplier analysis with indicators of productivity, competitiveness, and sustainability.

The study concludes that understanding regional multiplier structures offers a powerful diagnostic and planning tool for Greece's economic policy. By combining demand-side and supply-side measures, reinforcing domestic production linkages, and fostering interregional cooperation, policymakers can design strategies that promote balanced, resilient, and inclusive development. As Greece faces the twin transitions of digitalisation and the green transformation, the adoption of multiplier analysis provides a coherent framework for aligning industrial, regional, and fiscal policies, enabling the transition from cyclical recovery to sustained and equitable growth across all regions of the country.

PANAGIOTIS G. LIARGOVAS
Chairman of the Board
and Scientific Director

CENTRE OF PLANNING AND
ECONOMIC RESEARCH
October 2025

This study investigates the significance of regionalising input-output (IO) analysis to address persistent economic disparities across the Greek regions. Greece, like several other countries in the European Union, exhibits pronounced core-periphery divisions in terms of productivity, income, and employment. These spatial inequalities undermine efforts to achieve territorial cohesion and balanced national growth. By employing a regionally adapted framework to calculate output multipliers across sectors and geographic areas, this research provides new insights into how different regions contribute to – and benefit from – national economic activity.

The core idea behind the analysis is that multiplier effects can be used to evaluate the performance of economic sectors and regions. A multiplier effect refers to the ability of an increase in demand in one sector to generate additional output, income, and employment both within that sector and across the broader economy. In this sense, regions that generate larger multiplier effects are better positioned to drive national growth. However, when multiplier effects vary significantly across regions, these differences can exacerbate spatial inequalities, leaving some areas behind.

This study constructs region-specific multipliers by adapting the national input-output table to reflect the economic characteristics of Greece's thirteen administrative regions. Through this regionalisation process, important variations in economic structure, import dependence, and sectoral composition are revealed. The analysis segments Greece into four groups of regions based on the magnitude of their output multipliers. The first group includes island regions such as the North Aegean, South Aegean, and Ionian Islands, which show elevated output multiplier effects. These areas, despite their geographical remoteness, demonstrate strong economic connectivity and internal demand linkages. The second group, including Western Greece, Attica, the Peloponnese, and Crete, shows moderate multiplier effects, indicating a balanced, although not optimal, capacity to amplify economic activity. The third and fourth groups, made *up of regions such as Eastern Macedonia and Thrace, Central Macedonia, Western Macedonia, Epirus, Thessaly, and Central Greece, exhibit relatively weaker multiplier effects, reflecting structural challenges and limited internal economic linkages.*

One of the most important findings is the inverse relationship between the dominance of primary and industrial sectors in a region and its output multipliers. Regions with economies heavily reliant on agriculture or traditional manufacturing tend to exhibit lower output multipliers. This is partly due to their high dependence on imports, which reduces the retention of economic benefits within the region. In contrast, regions that rely more on sectors with stronger local linkages – such as services or tourism – tend to exhibit stronger multipliers. This insight has crucial policy implications. Enhancing a region's capacity to generate high multiplier effects is not simply about boosting productivity; it is also about strengthening the local economic web, reducing leakages, and improving sectoral diversity.

Import multipliers emerge as a critical factor in the analysis. Regions with low output multipliers often exhibit high import multipliers, suggesting that a large portion of their demand is met by goods and services produced elsewhere, both domestically and internationally. This dependence weakens the potential for internal economic stimulus and highlights the need for more localised production strategies. Policies aimed at reducing import reliance could therefore have a substantial positive impact on these regions' economic self-sufficiency and multiplier effects.

Another key conclusion from the study challenges the assumption that high productivity automatically correlates with high multiplier effects. Some highly productive regions do not necessarily generate strong ripple effects in the wider economy. This distinction implies that productivity-focused policies must be carefully calibrated to ensure that they also contribute to broader economic inclusion and cohesion. Otherwise, such strategies risk intensifying regional imbalances by favoring already advanced areas at the expense of lagging ones.

The regional multiplier analysis presented here offers a valuable lens through which to design targeted development strategies. It supports the identification of key sectors within each region that can drive the largest economic benefits. These sectors can become focal points for investment, training, innovation, and infrastructure development. Moreover, rec-

ognising the unique geographical and economic attributes of each region allows for a more customised approach to policy-making. For example, island regions with logistical challenges may benefit from enhanced connectivity and green energy solutions, while mainland peripheral industrial areas may require support in modernising their production systems or shifting towards more knowledge-intensive industries.

From a national planning perspective, the study emphasises that regional multipliers should play a central role in crafting long-term development strategies. Rather than implementing uniform policies, governments should use these multipliers to assess where investments will have the greatest systemic impact. This can help to prioritise projects that not only offer short-term economic gains, but also build the foundations for resilient, self-reinforcing growth in underperforming areas.

The results further underscore the importance of integrating regional analysis into demand management strategies. Focusing solely on regions with high multipliers might yield quick wins, but risks creating imbalances, overheating in certain areas, and underutilisation of potential in others. A balanced strategy would combine support for high-multiplier regions with structural reforms in lagging regions to boost their future capacity.

As Greece continues to navigate complex economic challenges—including post-crisis recovery, demographic shifts, and global economic transitions—understanding the spatial dimension of economic activity becomes ever more crucial. Regional multiplier effects offer a tool not only for diagnosing current disparities but also for anticipating the consequences of policy decisions. They enable a shift from reactive to proactive regional development planning.

To ensure long-term success, policy-makers must adopt a holistic view. Output multipliers should be used in conjunction with other metrics such as productivity, employment elasticity, trade balances, and innovation capacity. This integrated approach ensures that policies are not only efficient in economic terms but also equitable and sustainable.

Finally, this research offers a methodological pathway for other countries grappling with similar regional disparities. By adapting national data to reflect local realities, decision-makers can gain a much clearer picture of where to direct resources, how to balance growth, and how to build inclusive economies from the ground up. For Greece, this approach could *be a cornerstone of a renewed growth model – one that respects regional diversity and competitive advantages, strengthens local economies, and enhances national resilience in a rapidly changing world.*

We acknowledge three anonymous referees for their constructive comments that helped us to substantially improve our study, George Soklis, Ass. Professor at Panteion University for his contribution in earlier versions of the study, Helen Soultanakis for her valuable editorial help and the Editorial Office and Library staff of KEPE for their kind assistance in producing this study.

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THEODORE TSEKERIS

October, 2025

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ΣΥΝΟΨΗ

Η παρούσα εργασία παρέχει μια συστηματική και θεωρητικά τεκμηριωμένη ανάλυση των περιφερειακών πολλαπλασιαστών εισροών-εκροών (input-output multipliers) για την ελληνική οικονομία, με στόχο να συμβάλει στον σχεδιασμό στοχευμένων και αποτελεσματικών αναπτυξιακών πολιτικών σε εθνικό και περιφερειακό επίπεδο. Η ανάλυση βασίζεται στη μεθοδολογία των πινάκων εισροών-εκροών, η οποία αναγνωρίζεται διεθνώς ως το πλέον κατάλληλο εργαλείο για την αποτύπωση των τεχνικών σχέσεων μεταξύ των παραγωγικών κλάδων και για την εκτίμηση των πολλαπλασιαστικών επιδράσεων λόγω μεταβολών στη ζήτηση.

Το υπόδειγμα εισροών-εκροών έχει ως πλεονέκτημα τη σταθερότητα και τη συστηματική καταγραφή της διάρθρωσης της οικονομίας, αποφεύγοντας προβλήματα που χαρακτηρίζουν τις οικονομετρικές προσεγγίσεις, όπως η ευαισθησία σε διαρθρωτικές μεταβολές και η αναξιοπιστία των πρόσφατων δεδομένων. Μέσω της κατασκευής πινάκων εισροών-εκροών, επιτυγχάνεται η απεικόνιση των ενδιάμεσων και τελικών συναλλαγών, η κατανομή των πληρωμών στους συντελεστές παραγωγής και η καταγραφή εισαγωγών, με τρόπο που επιτρέπει την εκτίμηση του ΑΕΠ ανά κλάδο και την κατανόηση της δομής της παραγωγής και της ζήτησης.

Η εργασία αναδεικνύει τη σημασία της περιφερειοποίησης της ανάλυσης εισροών-εκροών, δεδομένων των έντονων και διαρκών περιφερειακών ανισοτήτων που παρατηρούνται στην Ελλάδα, σε όρους παραγωγικότητας, απασχόλησης και εισοδήματος. Οι περιφερειακοί πολλαπλασιαστές επιτρέπουν την εκτίμηση της ικανότητας κάθε περιφέρειας να ανταποκρίνεται σε αυξήσεις της τελικής ζήτησης, ενισχύοντας το ΑΕΠ, την απασχόληση και την παραγωγικότητα. Η γνώση αυτή είναι κρίσιμη για την προτεραιοποίηση επενδύσεων και τον σχεδιασμό πολιτικών περιφερειακής σύγκλισης και συνοχής.

Η μέχρι σήμερα βιβλιογραφία για την περιφερειακή ανάλυση εισροών-εκροών στην Ελλάδα είναι περιορισμένη και επικεντρωμένη κυ-

ρίως σε αξιολογήσεις επενδυτικών σχεδίων και αγροτικών πολιτικών σε επιλεγμένες περιφέρειες. Οι περισσότερες μελέτες χρησιμοποιούν απλές τεχνικές περιφερειοποίησης βάσει απλών διανεμητικών πηλίκων (location quotients) και στηρίζονται στην παραδοσιακή προσέγγιση του αντίστροφου πίνακα Leontief. Αντίθετα, η παρούσα εργασία υιοθετεί μια προηγμένη μεθοδολογική προσέγγιση περιφερειοποίησης, βασισμένη στο εμπλουτισμένο διανεμητικό πηλίκο διακλαδικών σχέσεων του Flegg (FLQ), που λαμβάνει υπόψη το μέγεθος της αγοράς και την παραγωγική εξειδίκευση.

Η ανάλυση βασίζεται στον εθνικό πίνακα εισροών-εκροών του 2015 και εισάγει την έννοια της ανοικτής οικονομίας, επιτρέποντας την εκτίμηση των πολλαπλασιαστών παραγωγής, απασχόλησης και παραγωγικότητας για το σύνολο των περιφερειών της χώρας. Οι εκτιμήσεις είναι συνεπείς θεωρητικά και επιτρέπουν τη σύγκριση μεταξύ περιφερειών και μεταξύ κλάδων, αποτυπώνοντας με ακρίβεια τη διάρθρωση της παραγωγικής βάσης.

Η εργασία διατυπώνει και εξετάζει ερευνητικές υποθέσεις σχετικά με την ύπαρξη σημαντικής χωρικής και κλαδικής ετερογένειας στους πολλαπλασιαστές, καθώς και την επίδραση των εισαγωγών στην παραγωγική δυνατότητα των περιφερειών. Τα αποτελέσματα επιβεβαιώνουν ότι η ελληνική οικονομία χαρακτηρίζεται από έντονες ανισομετρίες, οι οποίες συσχετίζονται με τις διαφοροποιήσεις στη δομή της παραγωγής, την εξάρτηση από τις εισαγωγές, και στη θέση των περιφερειών στον εθνικό παραγωγικό ιστό.

Με βάση τις εκτιμήσεις των πολλαπλασιαστών, οι περιφέρειες κατατάσσονται σε τέσσερις βασικές ομάδες. Η πρώτη ομάδα περιλαμβάνει τις νησιωτικές περιφέρειες του Νοτίου Αιγαίου, του Βορείου Αιγαίου και των Ιονίων Νήσων, οι οποίες εμφανίζουν τους υψηλότερους πολλαπλασιαστές παραγωγής, γεγονός που τις καθιστά ξεχωριστές οικονομικές ενότητες. Η δεύτερη ομάδα περιλαμβάνει τη Δυτική Ελλάδα, την Αττική, την Πελοπόννησο και την Κρήτη, με σχετικά υψηλούς πολλαπλασιαστές. Στην τρίτη και τέταρτη ομάδα εντάσσονται οι περιφέρειες της Ανατολικής Μακεδονίας και Θράκης, της Κεντρικής και Δυτικής Μακεδονίας, της Ηπείρου, της Θεσσαλίας και της Στερεάς Ελλάδας, οι οποίες παρουσιάζουν χαμηλότερους πολλαπλασιαστές.

Μία από τις βασικές επισημάνσεις της μελέτης αφορά τον ρόλο των εισαγωγών. Η σύγκριση των πολλαπλασιαστών με και χωρίς την ενσωμάτωση των εισαγωγών δείχνει ότι η αυτοτελής λειτουργία των περιφερειακών οικονομιών θα ενίσχυε περαιτέρω τις χωρικές ανισότητες, ευνοώντας κυρίως την Αττική. Αυτό καθιστά αναγκαία την υιοθέτηση πολιτικών υποκατάστασης εισαγωγών που να έχουν σαφές κλαδικό και περιφερειακό περιεχόμενο.

Επιπλέον, καταγράφεται αρνητική συσχέτιση μεταξύ της κυριαρχίας του πρωτογενούς και δευτερογενούς τομέα στην παραγωγική βάση μιας περιφέρειας και του μεγέθους των πολλαπλασιαστών της. Περιφέρειες με έντονη εξειδίκευση σε κλάδους πρώτων υλών ή ενέργειας παρουσιάζουν χαμηλότερους πολλαπλασιαστές, λόγω περιορισμένων διακλαδικών διασυνδέσεων. Παράλληλα, διαπιστώνεται ότι υψηλή παραγωγικότητα δεν συνεπάγεται απαραίτητα υψηλό πολλαπλασιαστή, γεγονός που υποδεικνύει ότι μία ολοκληρωμένη περιφερειακή πολιτική πρέπει να λαμβάνει υπόψη πολλαπλά κριτήρια.

Ειδικότερα, η συνδυαστική αξιολόγηση των ευρημάτων υποστηρίζει την ανάγκη για μια πολυδιάστατη αναπτυξιακή στρατηγική, που να ενσωματώνει την ενίσχυση τόσο των πολλαπλασιαστικών επιδράσεων όσο και της παραγωγικότητας και της διαφοροποίησης της παραγωγής. Η μονομερής στόχευση στις περιφέρειες με υψηλούς πολλαπλασιαστές ενδέχεται να οδηγήσει σε βραχυχρόνιες μόνο επιδράσεις, χωρίς να επιτυγχάνεται βιώσιμη περιφερειακή σύγκλιση. Αντίθετα, η ισόρροπη ενίσχυση των ασθενέστερων περιφερειών μπορεί να εξασφαλίσει σταθερότερες και διαρκέστερες επιδόσεις.

Η μελέτη καταλήγει προτείνοντας την ανάπτυξη ενός γενικευμένου υποδείγματος διαπεριφερειακών εισροών-εκροών, όπου οι πίνακες κάθε περιφέρειας θα ενσωματώνονται σε μία πολυπεριφερειακή μήτρα. Ένα τέτοιο υπόδειγμα θα επιτρέψει την εκτίμηση των άμεσων και έμμεσων επιδράσεων έργων διαπεριφερειακής υποδομής και πολιτικών μείωσης του κόστους μεταφοράς και ενίσχυσης της διασυνδεσιμότητας.

EXECUTIVE SUMMARY

This study aims to provide original analytical estimates of sectoral and regional multiplier values for the Greek economy, offering a systematic and theoretically consistent framework that captures the structure and spatial heterogeneity of production, demand, and employment in the country. It relies on the input-output (IO) methodology, which represents a reliable and effective approach to quantifying the economic interdependencies between industries and regions.

The input-output analysis, as embedded in the national accounting systems, captures the technical interrelations between the sectors of the economy, the goods and services they produce, and the flow of inputs required across production chains. A key advantage of this approach is its relative stability over time, as structural changes in economies tend to be gradual. Therefore, the use of the most recent available IO tables – despite their publication lag – remains analytically robust. Derived multipliers summarise these complex relations into clear, synthetic indicators that reflect the capacity of a sector or a region to generate output, employment, or income in response to a unit change in final demand. In this regard, the IO framework offers a general equilibrium perspective suitable for understanding and planning structural policies.

By contrast, econometric models often exhibit limitations, including an inability to fully capture intersectoral linkages, high sensitivity to structural breaks, reliance on contemporaneous data quality, and the requirement to distinguish between normal and crisis periods. These constraints render IO analysis more appropriate for the scope of this study, which is to provide an integrated understanding of multiplier effects across all sectors and regions of Greece.

The analysis further highlights the importance of regional IO frameworks. Spatial inequalities, both across and within European countries such as Greece, are persistent and marked by long-term productivity and income disparities between core and peripheral regions. In this context, multiplier effects serve as important indicators of the capacity of regions to respond to increases in demand and generate broader macroeconomic benefits. Regional analysis of multiplier values allows for the identification of best-performing and underperforming regions, in line with key policy objectives related to output, employment, and productivity growth.

Most existing studies in Greece focus on specific regions and apply location quotient (LQ)-based techniques to regionalise the national IO table. These have included assessments of regional investment programmes and agricultural reforms, particularly in areas such as Peloponnisos, Western Greece, Crete, and Macedonia. While informative, these studies are constrained by their localised scope, the simplistic assumptions of traditional Leontief inverse multipliers, and their limited capacity to capture import trade dependencies.

This study distinguishes itself by employing an advanced regionalisation of the 2015 Greek national IO table, based on an augmented Flegg's Location Quotient (FLQ) methodology that accounts for market size and productive specialisation. In this way, it provides estimates of output, employment, and productivity multipliers that are not only internally consistent but also comparable across all Greek regions and sectors.

The main objective of the study is to identify and quantify intersectoral and regional multiplier effects, allowing for a nuanced understanding of structural asymmetries across the Greek economy. Several hypotheses are tested to evaluate the spatial and sectoral heterogeneity of multipliers, and to assess the impact of imports on the output capabilities of different regions. The results reveal considerable variation in multiplier effects, which reflect the distinct productive structures and trade dependencies of each region.

Based on the estimated multipliers, the study classifies the Greek regions into four main groups. The first group includes the island regions of Notio Aigaio, Voreio Aigaio, and Ionia Nisia, which exhibit high output multipliers, forming a distinct economic cluster. The second group comprises regions such as Western Greece, Attiki, Peloponnisos, and Crete, which demonstrate moderately high multiplier values. The third and fourth groups, encompassing Eastern Macedonia and Thrace, Central and Western Macedonia, Epirus, Thessaly, and Central Greece, exhibit lower multiplier values, indicating more limited capacity for economic propagation.

A key insight from the analysis is that regions with a high degree of dependency on imported goods tend to exhibit lower output multipliers. This suggests that policies promoting import substitution and enhancing local production capacity must be pursued with both sectoral and regional targeting, so as to increase domestic linkages and foster a more balanced pattern of regional development. Excluding imports from the analysis would disproportionately benefit Attiki and further widen existing disparities.

The study also highlights a negative correlation between the dominance of the primary and industrial sectors in a region's economic structure and its average output multipliers. This finding reflects the limited internal linkages typically associated with such sectors. Additionally, it challenges the assumption that high productivity automatically translates into strong multiplier effects. In fact, regions with high output multipliers do not always align with those that display high productivity. This divergence underscores the need for a more comprehensive development strategy that considers multiplier values, productivity, import dependencies, and other structural characteristics in tandem.

In this context, the policy relevance of the study is manifold. The findings support the formulation of integrated regional development strategies, the targeting of sectoral investments, and the implementation of reforms designed to enhance both the depth and breadth of regional production systems. The evidence indicates that demand management strategies focused solely on regions with high output multipliers may result in short-term gains without addressing long-term structural weaknesses. Conversely, a more balanced approach can stimulate convergence, resilience, and sustainable growth.

Finally, the study offers a perspective for future research and policy development. It proposes that the methodology employed here could form the core of a broader interregional or multiregional input-output framework. Such a framework would enable the estimation of the interregional economic effects of infrastructure investments, through improved accessibility and more integrated regional value chains. In the context of evolving global economic challenges – digitalisation, decarbonisation, and demographic change – the need for such an advanced modelling approach becomes even more pressing.

CHAPTER 1

INTRODUCTION

1.1. The concept of input-output analysis

A fundamental query for any economic system pertains to the prioritisation of sectors that warrant heightened expenditure in the context of a recovery and resilience plan following an adverse economic shock. This question is met with a multitude of heterogeneous and oftentimes equivocal responses, wherein the determining factors largely rest upon the respective spending multipliers. Predominantly, these methodologies pivot on econometric strategies, though a subset employs input-output (IO) methodologies (Miller and Blair, 2009).

The IO analysis is embedded within the National Account Systems, effectively capturing the symbiotic relationship between distinct sectors, the commodities they generate, and the sectors reliant on these commodities (Leontief, 1986). An additional advantage of IO analysis is its immunity against data structural breaks, given that the structural evolution of an economy is a protracted process. Consequently, the research can be predicated on the most recent IO data available. In this vein, multipliers derived on the basis of the structural framework of IO systems confer the benefit of encapsulating the technological landscape across all sectors of the production system and the technical interconnections established amongst them, effectively summarising this intricate web of technical relations into solitary indicators (Timmer et al., 2015). Hence, the IO approach is esteemed as a more appropriate foundation for a resilient recovery plan.

In contrast with IO analysis, some principal limitations inherent to econometric strategies are distinguished by (i) the inability to accommodate the interconnections spanning different sectors, (ii) the acute sensitivity towards structural dislocations, (iii) the dependability and quality of the most contemporaneous data, (iv) the necessity to juxtapose "normal" economic periods with those characterised by adverse conditions, and (v) the challenge in providing robust valuations within an industry-specific or sectoral context.

Therefore, the cornerstone of our investigation is input-output analysis, which is known to provide a concise and effective means of representing the interdependence between output, final demand, and value added in an economy. In particular, given the range of inputs used by different sectors and the sale of outputs from one sector to another, input-output analysis provides a general equilibrium framework that is useful for investigating all transactions within the economy. Input-output tables play an essential role in national accounts by recording intermediate goods and services exchanged between sectors, as well as non-sectoral inputs, such as payments for labour, indirect business taxes and dividends, interest and rents, depreciation, and other income such as profits and imports. Gross domestic product by industry and final demand are also calculated using input-output tables.

However, the data requirements for such an analysis are considerable, and the quality of the data varies across countries. The compilation of the input-output tables requires specialised work and extensive computer processing, resulting in a publication time of 5-7 years. Nevertheless, this time lag is not a major issue as the input-output tables serve as a record of the structural composition of an economy, which changes gradually over time. It is worth mentioning that a notable structural change in the economy usually takes 10 to 20 years to occur (see, e.g., Pierros et al., 2024).

1.2. The importance of IO regionalisation

Increased regional inequalities are evident both across the European Union as well as within specific countries, such as Greece, which face long and persistent core-periphery disparities in wealth and productivity measures (Papaioannou et al., 2017; Tsekeris and Papaioannou, 2021). For this purpose, territorial cohesion and regional development and convergence have constituted principal objectives of the European Union and national policies over the last decades. In this context, multiplier effects can be regarded as a crucial measure of the performance of a region, in terms of generating output, income, and employment in a sector, given a unit value increase in the demand for the same or other sectors (Rasmussen, 1957; Hirschman, 1958; Jones, 1976). Hence, best-performing regions can be defined, among others, as those experiencing the largest gains in macroeconomic measures, such as output, employment, and productivity, according to given policy objectives. In the same vein, regional inequalities may arise and become intensified due to substantial differences between (best-performing and worst-performing) regions in generating positive multiplying effects on their local economies.

Therefore, the regional analysis of multiplier values should be considered as an integral part of a national growth plan, to address the particular needs and harness the comparative advantages of each region. For instance, such an analysis can promote the return of investment in specific sectors of a region and can help to diminish spatial disparities in income and growth, beyond the limited scope of the project selection and evaluation processes for monitoring purposes. The benefits of utilising regional multipliers have long been acknowledged in the existing literature for a range of applications. Such applications may involve the planning and prioritisation of investment projects, the regional specification of industrial location decisions, fiscal stimuli to enhance regional development and cohesion (Archibald, 1967; Steele, 1969; Lever, 1974; Jensen et al., 1988; Domański and Gwosdz, 2010; Morrissey, 2016; Römisch, 2020), and even the impact assessment of macroeconomic shocks, such as those induced by Brexit (Chen et al., 2018; McCombie and Spreafico, 2018).

1.3. Regional IO analyses in Greece

Scholarly literature on the use of regional input-output analysis and multiplier values in the Greek economy and its regions is scarce. Nonetheless, the regional IO analyses can link public policies with the character and structure of the productive system of a region. This is important to improve the network of interdependencies of critical sectors and ensure the conditions for the transformation of the productive system of developmental "monocultures" (Tourism - Agriculture) with the development of synergies and complementarity across several production sectors and with the international market (Belegri-Roboli et al., 2010). Existing studies focused on the regional analysis of IO tables in Greece have mostly been used to evaluate region-wide investment programmes or plans for specific regions and sectors of economic activity.

More specifically, Panagou et al. (2006) discussed the national accounts and the input-output tables in Greece and applied the location quotient (LQ)-based methodology for the regionalisation of the national tables for the years 1995, 1998, and 2000 for Peloponnisos, Dytiki Ellada, Ionia Nisia, and Ipeiros.[1] Similarly, Skountzos et al. (2007) employed the LQ-based methodology to regionalise the 2005 national IO table and calculated output, employment, and income (labour compensation) intersectoral linkages and multipliers for five Greek macro-regions: Kentriki-Dytiki-Anatoliki Makedonia and Thraki, Thessalia-Ipeiros and Sterea Ellada, Dytiki Ellada-Peloponnisos and Ionia Nisia, Voreio-Notio Aigaio and Kriti, and Attiki.

Mattas et al. (2006) used the regionalised IO tables to estimate the sectoral output, employment, and income generation effects of implementing three development programmes financed by EU structural funds and the Greek authorities: the Regional Development Programme, the Agricultural Development Programme, and the Operational Programme for the Restructuring of Rural Areas. These three programmes were found to have significant knock-on effects on the regional economy, affecting all sectors, despite the fact that the programmes target agricultural and rural activities.

Polyzos and Sofios (2008) provided traditional (Leontief-inverse-based) multipliers for the Greek regions and analysed their relationship with the

[1] The names of Greek regions follow the second-level classification of the Nomenclature of Territorial Units for Statistics (NUTS-2) for the sub-national division of EU regions and are translated to English as follows: Attica (Attiki), Central Greece (Sterea Ellada), Central Macedonia (Kentriki Makedonia), Crete (Kriti), Eastern Macedonia and Thrace (Anatoliki Makedonia-Thraki), Epirus (Ipeiros), Ionian Islands (Ionia Nisia), the North Aegean (Voreio Aigaio), the Peloponnese (Peloponnisos), the South Aegean (Notio Aigaio), Thessaly (Thessalia), Western Greece (Dytiki Ellada), Western Macedonia (Dytiki Makedonia) (Accessed online at: https://publications.europa.eu/code/en/en-5001000.htm) (see also Table A.1 of the Appendix).

distribution of the public and private investment targeted at achieving the economic convergence. By adopting the same approach, Pnevmatikos et al. (2019) estimated regional multipliers to detect structural changes in Greece during the period prior to the economic crisis (2000–2010) and found that the most significant changes took place in the tertiary sector. Additionally, Giannakis and Bruggeman (2017) estimated and used Leontief-inverse-based regional multipliers as an effective tool for the impact analysis of the economic crisis across the Greek regions.

Furthermore, regional input-output analysis using Leontief-inverse-based multipliers has been employed to investigate the potential impacts of (hypothetical) structural changes on the economy of less developed areas of the country, e.g., Evros (Hewings and Romanos, 1981) and Anatoliki Makedonia and Thraki (Ciobanu et al., 2004), and the implementation of specific (common agricultural policy-CAP) reforms in specific prefectures, such as those of Heraklion (Psaltopoulos et al., 2006) and Trikala (Giannakis and Efstratoglou, 2011), and regions, such as Kentriki Makedonia (Lampiris et al., 2018), Anatoliki Makedonia and Thraki (Loizou et al., 2019), and Voreio Aigaio and Notio Aigaio (Karelakis et al., 2020). Recently, Vachanelidou et al. (2024) also used a regional IO table to estimate the significance of the agri-food-related sectors in Anatoliki Makedonia and Thraki, through the development of strong interconnections with the rest of the local economy and the induced economy-wide impacts.

In most of the studies mentioned above, the regionalisation of the national IO table took place based on a location quotient-based approach and, to a lesser extent, incorporating the effect of market size and/or productive/employment specialisation, based on the so-called Flegg's Location Quotient (FLQ) (see Section 3). In comparison with the previous studies in the relevant scholarly literature, the present one estimates the output, employment, and productivity multipliers, accounting for an open economy (see Section 2), for all regions of the country, through an advanced (augmented FLQ) regionalisation of the national IO table. In turn, the present findings allow us to evaluate the characteristics of the production base and the comparative production advantages and weaknesses of each region and, thus, draw conclusions regarding the impact of national and regional policies on interregional inequalities and the core-periphery disparities in the country.

1.4. Scope and objectives of the study

A consistent methodological framework for the estimation of multipliers (Mariolis and Soklis, 2018) is employed in this study to provide original analytical estimates of the (inter)sectoral multiplier values in the Greek economy and across all the Greek regions. Among others, the originality of this study lies in the theoretically sound and comprehensive methodological framework employed to (i) regionalise the existing national input-output table of the Greek economy and (ii) estimate the regional multipliers, compared to the traditional analysis that relies on the inverse Leontief matrix.

Several hypotheses are made here in order to test the relationship and the existence of significant variations between the regional multipliers at the national and sectoral levels, as well as among the region-industry multipliers. These statistical tests principally aim to examine the spatial heterogeneity of multipliers and the impact of imports on the output possibilities of regions and sectors of the Greek economy. Among others, the spatial heterogeneity may be associated with the existence of interregional differences which follow the pattern of core-periphery disparities in the Gross Domestic Product (GDP) and productivity (between the capital region of Attiki and the remaining regions of the country).

Moreover, the sectoral heterogeneity may be linked with the productive specialisation of the Greek regions. For instance, this specialisation may refer to the raw material and/or energy resource intensity pertaining to the regions of Dytiki Makedonia and – to a lesser extent – Peloponnisos, which is also highly specialised in the primary sector, and peculiar geographical characteristics, such as the remoteness and island (or insular) character of the regions of Voreio Aigaio, Notio Aigaio, Kriti, and Ionia Nisia.

The recognition of this heterogeneity is critical for identifying key sectors in a region, namely, those sectors which bear the largest multiplier effects on key macroeconomic measures (output, employment, productivity, imports, and exports). In turn, this approach allows us to support the formulation and assessment of a comprehensive growth plan at the subnational level, which involves both sectoral and regional dimensions. Among others, such a plan can support policy decisions about the proper mixture of investment and the deployment of appropriate structural reforms to broaden the economic base and export capacity of a region.

As far as the organisation of the study is concerned, Section 2 describes the methods used in the scholarly literature to estimate multiplier values, giving emphasis to the Greek economy, and it provides historical explanations about the concept of multiplier(s). Section 3 portrays the approaches used here to regionalise national input-output tables, including an adjusted location quotient (LQ)-based method and an adjusted cross-hauling approach for the commodity balancing of imports and exports at the regional level. Section 4 presents the main aggregate regional variables used to regionalise the (latest available) Greek national input-output table of 2015 and depicts the basic outcomes of the regionalisation process. Section 5 presents the results of the multiplier values for the whole economy of Greece and of its regions, providing specific explanations about the role of imports. Section 6 shows and analyses the results of the regional multipliers across the industries (sectors) of the Greek economy. Section 7 concludes and offers valuable insights into how the current findings can be used to formulate targeted economic development plans; strengthen regional trade, education, skills, and Research and Development (R&D) strategies; promote infrastructure development; enhance the green economy of regions and usage of financial instruments; and revise import policies and foster interregional collaborations and effective policy implementation.

CHAPTER 2

METHODS FOR ESTIMATING MULTIPLIER VALUES

2.1. Literature review for input-output multipliers of the Greek economy

2.1.1. The traditional input-output approach

In exploring the input-output multipliers of the Greek economy, it is essential to begin with a foundational understanding of the traditional input-output approach. This approach, originating from the work of the Nobel Laureate Wassily Leontief in the 1930s (Leontief, 1936, 1937), provides a systematic framework to examine the interrelationships between various sectors within an economy. Specifically, it quantifies the effects of changes in one industry's output on the entire economic system. In the context of the Greek economy, understanding this traditional methodology is critical, as it lays the groundwork for a more nuanced analysis of its multi-sectoral linkages and the resulting multiplier effects.[2]

We focus on two studies published during the last decade. First, Athanassiou et al. (2014) carried out an IO analysis of the Greek economy, using the 2010 IO tables, focused on output and employment multipliers to analyse how changes in demand for a given sector's output influence not just production but also employment within the sector. Interestingly, the study found that sectors with significant multiplier effects on both output and employment often had limited involvement in the production of goods and services traded internationally. This implies that the sectors driving growth and employment within Greece were not necessarily the same as those contributing to Greece's trade balance. The study also emphasised the role of certain sectors that, despite having a significant influence only on production or consumption, were vital in promoting interdependencies and synergies within the Greek econ-

[2] For an overview of recent developments in IO analysis, see Miller and Blair (2022).

omy. This finding underscores the importance of looking beyond simple output or employment multipliers when assessing a sector's role in the economy.

More recently, Backinezos et al. (2020) utilised the 2015 IO tables, compiled according to the European System of Accounts (ESA) 2010, to evaluate the sectoral output, gross value added, and employment multipliers for the Greek economy. The study employed the Leontief model in its open and closed variations with respect to household consumption. This enabled an assessment of the direct and indirect production effects as well as the induced consumption effects resulting from exogenous changes in the final demand of each sector. In other words, this study evaluated how changes in the demand for a given sector's output would ripple through the Greek economy, influencing not only the sector in question but also other sectors that supply inputs to it (direct and indirect production effects) and sectors that benefit from changes in household consumption as a result of changes in production (induced consumption effects). The study also offered a systematic ranking of sectors, highlighting those with the greatest potential for economic impact based on their technological features and intersectoral linkages. This outcome provides a perspective on which sectors are likely to contribute most to the Greek economy's growth and how they are interconnected with each other.

To sum up, while both studies use input-output analysis and focus on multiplier values in the Greek economy, they differ in their specific methodologies, the range of effects they examine, and the aspects of the Greek economy they highlight. They offer complementary insights: the former sheds light on the relationship between domestic and international economic activity and the importance of intersectoral synergies, while the latter provides a systematic ranking of sectors and the role of induced consumption effects.

2.1.2. Alternative approaches

While the traditional input-output approach has long been the cornerstone for analysing the intersectoral relationships within an economy, it is by no means the only methodology available. Over the years, as the intricacies of economies evolved and the need for more comprehensive tools emerged, various alternative approaches have been developed. These alternatives often seek to address the limitations of the conventional method or offer new perspectives on the intricate web of economic interactions. In this section, we will delve into some of these alternative methodologies, highlighting their unique contributions and relevance to the study of the Greek economy's input-output multipliers during the last decade.

Ntemiroglou (2016) focused on specifying the 'key-commodities' for the Greek economy, estimating multipliers for the years 2000, 2005, and 2010. This study found a positive trend in the output multiplier over time, indicating that an increase in demand has a progressively larger impact on total output. This outcome could be due to improved efficiencies, technological advancements, or the strengthening intersectoral relations. However, the employment multipliers declined over the same period, suggesting that while output increased, the same level of growth was not reflected in employment. This might be a result of increased automation or other changes that have made production processes less labour intensive. The research further suggested that short-term effective demand management, i.e., policies that have significant positive effects on growth and employment, should target the primary and service sectors. This would likely have the most immediate impact on boosting the Greek economy due to the existing structure and linkages of these sectors. The effective demand management outcome suggests that stimulating demand in the specific sectors would have significant positive effects on the Greek economy as a whole, mostly in terms of growth and employment. However, in the long run, structural changes, reinforcement of intersectoral relations, and diversification are required to promote a more robust industrial sector and sustained long-term growth.

Mariolis and Soklis (2018) estimated the multipliers for the Greek economy using data from the Supply and Use Table for 2010, based on the economic theories of Piero Sraffa (1960), an Italian economist known for his work on production and prices. The results revealed two key findings: First, an effective demand management policy could be primarily focused on the service sector. This outcome suggests that stimulating demand in the service sector could have significant positive effects on the Greek economy as a whole, due to the specific interconnections between sectors in this economy. Second, the entire economic system, and especially its industrial sector, is heavily dependent on imports. This high level of import dependency suggests vulnerability to external shocks, and it could be a contributing factor to the deep recession experienced by the Greek economy. The study's findings suggested that the intersectoral structure of the Greek economy needs to structurally change, pointing towards the implementation of longer-term economic strategies to drive growth and stability through reducing import dependency, diversifying the economy, and stimulating domestic production in various sectors.

Next, Mariolis et al. (2021a) used a multisectoral model, along with data from the Supply and Use Tables, to estimate the COVID-19 multiplier effects of tourism on the Greek GDP, total employment, and the trade balance. The implications of their findings highlighted the vital role of tourism in the Greek economy. As the COVID-19 pandemic drastically reduced international travel, the Greek economy faced substantial challenges, including significant contractions in GDP and employment and an exacerbation of the trade deficit. The tourism sector-specific analysis demonstrated the value of this level of granularity in economic impact evaluation, especially in the broader understanding of the impact of the COVID-19 pandemic, and the importance of targeted interventions to support sectors heavily influenced by global events such as the pandemic.

In the more recent study of Mariolis et al. (2022), a multi-sector model was employed with joint products and heterogeneous labour, using data from the Supply and Use Tables, to analyse the intersectoral structure of the Greek economy and estimate the COVID-19 multiplier effects on the economy. The authors discovered that the Greek economy is heavily reliant on imports of industrial commodities and that the significant multiplier values are mainly concentrated in services and, to a lesser extent, in primary production. Using these estimates and available data, they investigated the impact of COVID-19 on autonomous demand elements in 2020. Based on their findings, they suggested two courses of action: (i) a short-term demand management recovery plan, primarily implemented through the public sector and, secondarily, through the tourism sector and (ii) a long-term growth-oriented policy directed towards industrial production and implementing policies of import substitution. The first approach would aim to quickly stimulate demand and help the economy recover from the immediate impact of the pandemic. The latter policy recommendation is more strategic and forward-looking. It acknowledges the Greek economy's heavy reliance on imported industrial commodities and suggests a shift towards domestic production, which would help to insulate the economy from global shocks and promote a sustainable long-term growth.

2.2. The concept of a multiplier in the history of economic thought: From "the" multiplier to multipliers

Until this pont, our discussion has primarily centred around a comprehensive literature review regarding the input-output multipliers relevant to the Greek economy. Yet, it remains pivotal to articulate the temporal and logical progression from a single-sector analytical framework to a multisectoral one. This essentially denotes the evolution from "the" multiplier concept to "multipliers". Subsequent sections will also elucidate the rationale underpinning our shift from the traditional input-output multipliers towards a more contemporaneous analytical framework of multipliers.

The concept of the multiplier in economics is most famously associated with John Maynard Keynes in his seminal work (Keynes, 1936). The multiplier concept is integral to Keynesian economics, explaining how a change in spending can lead to a proportionally larger change in aggregate income or output. While Keynes is credited with popularising the multiplier theory and integrating it into a comprehensive macroeconomic framework, Richard Kahn, a student and close associate of Keynes, introduced the idea of the multiplier in a more rudimentary form (Kahn, 1931).

Both played crucial roles in the development and understanding of the multiplier in economic thought. This section aims to provide a comprehensive understanding of economic multipliers from the theoretical perspectives of renowned economists. The exploration encompasses their individual contributions to the multiplier concept, as well as their overlapping views and contrasts. By bridging the commonalities and distinctions in their works, we highlight the relevance of their theories in contemporary macroeconomic policymaking and development.

2.2.1. Before Keynes, there was Kahn

In his groundbreaking paper, Kahn (1931) introduced the concept of the 'employment multiplier', which came to be a cornerstone of Keynesian economics. Kahn's employment multiplier was based on a simple yet compelling premise: a unit increase in investment in one sector would lead not only to a direct increase in employment but also to an indirect (more than proportionate) one due to induced spending. The indirect effect emerges as the newly employed workers, thanks to the original investment, spend their incomes, thereby spurring additional employment and income. This secondary effect, in turn, leads to tertiary effects and so forth, in decreasing proportions but adding up to a total effect that is a multiple of the initial direct effect, hence the term 'multiplier'.

The concept of the multiplier value came to revolutionise our understanding of macroeconomic policy implications, highlighting the powerful ripple effects that an initial change in demand can have throughout the economy. Kahn's analysis, however, went beyond merely introducing the multiplier concept. He provided crucial insights into the factors that determine the size of the multiplier, with the marginal propensity to consume (MPC) being of central importance. In Kahn's formulation, the MPC reflects the fraction of additional income that a household decides to spend on consumption, as opposed to saving it. The higher the MPC, the larger the subsequent rounds of consumption generated by an initial increase in investment and employment, and, thus, the larger the overall multiplier value. This focus on the MPC was not only insightful but also gave the multiplier concept its policy relevance. By influencing the MPC through various policy measures, governments could, in principle, control the size of the multiplier and, thus the overall impact of their spending decisions on the economy. For instance, if the MPC is high, meaning households tend to spend a large proportion of their additional income, an increase in government investment could have a substantial positive effect on employment and income. In contrast, if the MPC is low, the same increase in government investment may not yield significant results.

In a nutshell, Kahn (1931) presented a profound shift in the understanding of macroeconomic dynamics and fiscal policy effectiveness. His employment multiplier concept, built around the crucial role of the MPC, shaped the development of macroeconomic theory in subsequent decades, contributing to the emergence of Keynesian economics and inspiring a rich body of subsequent research on multiplier values in various economic contexts. The policy implications of Kahn's work, based on the understanding of the multiplier process, continue to guide economic policy decisions to this day.

2.2.2. The Keynesian multiplier

Keynes (1936) emphasised the MPC and the marginal propensity to save (MPS), which he defined as the increase in consumption or savings, respectively, due to an incremental increase in income. He suggested that these concepts are crucial in determining the size and effectiveness of the multiplier. These ideas revolutionised economic thought and policy, fundamentally shaping our understanding of macroeconomic stability and growth. Keynes posited that total income was not merely consumed or saved in fixed proportions but depended on the level of income itself. In Keynes' view, the MPC and MPS were critical determinants of the multiplier. An economy with a higher MPC would have a higher multiplier value because a larger portion of the income increase would be spent, triggering further rounds of consumption and income creation. In contrast, if the MPS was high, less of the additional income would be spent, resulting in a smaller multiplier value.

The concept of the multiplier emerged as a key component of Keynes' revolutionary theory of effective demand, i.e., the idea that economic activity was driven primarily by aggregate demand. According to Keynes, changes in autonomous expenditures, such as government spending or private investment, would result in more than proportionate changes in national income, thereby leading to a 'multiplication' effect. This relationship underpinned Keynes' argument for active government intervention in managing aggregate demand to ensure economic stability and growth. Keynes' multiplier theory emphasised the potent role fiscal policy could play in economic stabilisation and growth. His analysis suggested that fiscal policy – through changes in government spending and taxation – could influence the level of aggregate demand and, consequently, the level of economic activity, employment, and income in the economy.

In an economic downturn, Keynes argued, an increase in government spending or a decrease in taxes could stimulate aggregate demand, triggering a multiplied increase in national income and helping to lift the economy out of recession. These ideas transformed macroeconomic policy and shaped the economic landscape of the post-war period. Keynes' multiplier theory underpinned the adoption of countercyclical fiscal policies aimed at smoothing out economic cycles and maintaining high levels of employment and economic activity. It gave policymakers a powerful tool to manage the economy and a new framework for understanding the relationships between consumption, savings, investment, and income.

However, Keynes' multiplier theory was not without its critics. Many economists, particularly those of the Neoclassical school, argued that the multiplier value was much smaller in practice than Keynes had suggested. They pointed out that increased government spending could crowd out private investment or lead to higher interest rates, thereby offsetting the positive multiplier value. Additionally, some economists argued that changes in government spending or taxation could also influence people's expectations about future taxes, which could also affect their spending and saving behaviour and, consequently, the size of the multiplier. Despite these criticisms, Keynes' work on the multiplier theory, embedded in his *General Theory,* played a transformative role in macroeconomic thought and policy. It provided a powerful tool for understanding and managing economic cycles and a useful framework for analysing the impacts of fiscal policy on economic activity to this day.

2.2.3. A Keynesian parallel

Michał Kalecki, a Polish economist, is recognised for his extensive contributions to macroeconomic theory, particularly for his elucidation of the concept of the 'investment multiplier'. His work (Kalecki, 1954) predates and indeed parallels Keynes' *General Theory,* though he receives less recognition in the English-speaking world because his works were primarily published in Polish. Kalecki's investment multiplier is founded on the principle of the 'profit equation', a seminal idea in which he proposed that the total profits of the capitalist class equal their total expenditures.

This idea encapsulates the notion that capitalists ‘get what they spend’, with their expenditures translating directly into their earned profits.

According to Kalecki’s theory, an initial increase in investment by capitalists increases not just their profits but also the total income in the economy. These higher profits, in turn, enable further investments, thereby creating a self-perpetuating cycle of investment, profit generation, and income growth. This cycle is what Kalecki referred to as the ‘investment multiplier’. Here, the multiplier value is not just the process of income transmission, as Kahn described, but also a process of capital accumulation. Increased investment leads to a multiplied increase in income and output, which then flows back as increased profits for the investing capitalists, who can then reinvest these profits. This investment-profit relationship results in a spiral of growth, where each round of investment and profit stimulates further investment and production in successive rounds.

The multiplier value in Kalecki’s theory is largely determined by the proportion of profits reinvested in the economy. A higher proportion of reinvested profits implies a larger multiplier value, leading to more substantial economic growth. Conversely, a lower proportion of reinvested profits results in a smaller multiplier value, leading to slower economic growth. From the above, we can understand that Kalecki’s work expanded the understanding of the multiplier value in macroeconomics, focusing on the investment-profit relationship. His insights continue to inform modern economic policymaking, particularly in managing the dynamics of investment-led growth.

2.2.4. Cumulative causation and the concept of a multiplier

Nicholas Kaldor, a notable figure in the Cambridge School of Economics, made significant contributions to the development of growth theory, particularly through his model of ‘cumulative causation’ (Kaldor, 1972). In Kaldor’s theory, the interaction between different economic factors and variables leads to self-reinforcing cycles of growth or decline. The principle of cumulative causation postulates that economic change is a dynamic process driven by a host of interrelated factors that mutually reinforce each other over time. The circular aspect of this theory refers to the fact that these reinforcing cycles of growth or decline do not happen in a linear fashion but instead influence and feedback into each other in a continuous loop.

The theory of cumulative causation is thus inherently dynamic and non-linear, emphasising the complexity and interdependence of economic systems. This contrasts with more traditional, neoclassical economic models, which assume equilibrium and independence between economic variables. Kaldor's theory of cumulative causation fits perfectly with the multiplier theory, as the latter essentially describes a similar process of reinforcing cycles of growth or decline. In the context of the multiplier theory, an initial increase in autonomous spending leads to a multiplied increase in income and output, which then leads to further increases in spending, and so on. This process can thus be seen as a particular instance of cumulative causation, where an initial change in one economic variable (autonomous spending) sets off a self-reinforcing cycle of growth (or decline) in the overall economy.

In this sense, the multiplier theory can be seen as a mechanism through which cumulative causation operates in an economy. Moreover, Kaldor's cumulative causation theory provides a useful framework for understanding the long-term implications of the multiplier value. While the multiplier value tends to be discussed mainly in terms of short-run fluctuations in income and output, Kaldor's cumulative causation theory underscores the potential long-run impact of these fluctuations on the overall economic growth trajectory. Hence, Kaldor's work on cumulative causation provides a rich and dynamic framework for understanding the complexities of economic growth and the role played by multiplier processes within this context.

2.2.5. Additional nuances to understanding the multiplier value

Franco Modigliani, a Nobel laureate, is best known for his Life-Cycle Hypothesis (LCH). This theory, co-developed with Richard Brumberg, posits that individuals plan their consumption and savings behaviour over their lifetime (Modigliani and Brumberg, 1954). They aim to maintain a stable level of consumption by saving during their working years and spending their savings during retirement. The LCH challenged the traditional Keynesian view that consumption depends primarily on current income and introduced wealth as a crucial determinant of consumption. In terms of the multiplier value, the LCH implies a lower MPC out of current income than the traditional Keynesian model. Because individuals save more to smooth consumption over their life cycle, an increase in income may lead to a smaller increase in consumption than Keynesian theory would predict. Consequently, the multiplier value may be smaller than suggested by Keynesian theory. However, the LCH also implies that changes in wealth can significantly impact consumption and, therefore, the size of the multiplier value. For instance, an increase in wealth, such as rising house prices or stock market values, can boost consumption and magnify the multiplier value.

Hyman Minsky, on the other hand, is famous for his Financial Instability Hypothesis (FIH). Minsky's FIH posits that financial stability encourages risk-taking, which leads to financial instability and eventually a crisis. According to Minsky (1986), during stable times, firms and households increase their debt levels, creating financial fragility. When an adverse shock occurs, this fragility can lead to a financial crisis, with severe impacts on investment, consumption, and overall economic activity. Minsky's FIH has several implications for the multiplier value. In stable times, high levels of investment financed by debt can lead to a larger multiplier value, as investment stimulates income and consumption. However, when a crisis occurs, the collapse in investment and consumption can trigger a negative multiplier value, leading to a severe contraction in economic activity. Thus, Minsky's FIH underscores the importance of financial factors in determining the size and direction of the multiplier value. Both Modigliani's Life-Cycle Hypothesis and Minsky's Financial Instability Hypothesis add significant nuances to the understanding of the multiplier value and its role in macroeconomic dynamics.

2.2.6. The multiplier is a matrix

Richard M. Goodwin was an American economist known for his work on business cycles, growth theory, and income distribution. His seminal paper (Goodwin, 1949) is an important contribution to the understanding of the multiplier value. Goodwin's approach extended the conventional Keynesian multiplier analysis by considering the economy's structure, specifically the interdependence among different sectors. He argued that the simple Keynesian multiplier, which considered the economy as a single unit, was insufficient for understanding the full effects of income propagation.

Goodwin proposed a matrix approach, where the economy is broken down into multiple sectors. Each sector has its specific consumption and production characteristics, implying different MPC, MPS, and marginal propensity to invest. The interactions between these sectors create a "multiplier matrix", which determines the overall effect of an autonomous change in expenditure. This matrix approach allows for a more nuanced understanding of the multiplier value. It accounts for the fact that different sectors can have different multipliers due to variations in their marginal propensities to consume and invest. Additionally, it acknowledges that spending in one sector can lead to increased income and further spending in other sectors, adding another layer to the multiplier process. Goodwin's work, therefore, adds considerable depth to the understanding of the multiplier value. It emphasises that the economy's structure and intersectoral linkages can significantly influence the size and direction of the multiplier value, a critical consideration for economic policymaking.

John S. Chipman, on the other hand, focused on the open-economy aspects of the multiplier concept. In his article (Chipman, 1965), he proposed that, in an open economy, the multiplier value was affected not just by domestic marginal propensities to consume, save, and invest, but also by the marginal propensity to import. Thus, international trade could influence the magnitude and operation of the multiplier. Chipman's contribution is essential because it recognises that the impact of fiscal policy on income and employment is not confined to the domestic economy but can be influenced significantly by international trade. As such, his work is particularly relevant for small, open economies where trade constitutes a substantial portion of GDP. Both works of Goodwin and Chipman are crucial for understanding the size and direction of the multiplier effect and have significant implications for economic policymaking.

2.2.7. The Miyazawa multiplier

Kenichi Miyazawa was a Japanese economist who made significant contributions to input-output analysis and the concept of the multiplier value. In the seminal article (Miyazawa and Masegi, 1963), the concept of the “interindustry multiplier” or the “Miyazawa multiplier” is introduced, which poses a significant advancement in the field. Miyazawa’s multiplier extends the Keynesian and Goodwin multipliers by incorporating the interindustry relations within an economy (Miyazawa, 1966). His work is a part of the broader field of input-output analysis, initiated by Leontief, which studies how different sectors of an economy interact with each other. The “Miyazawa multiplier” measures the impact of a shock in one industry on all other industries, considering both direct and indirect effects. It gives an overview of the interdependencies between different sectors of the economy and how a change in one sector affects others. Miyazawa’s work facilitated the understanding of how economic fluctuations can propagate through an interconnected economy, helping in policy planning and economic forecasting. His model has been used widely in regional economics and is a fundamental tool for understanding complex economic systems.

2.2.8. An invigorated framework rectifying earlier gaps

Keynes posited in *The General Theory* that it was the income level, not the interest rate, that assured a balance between saving and investment (Keynes, 1937, p. 250). He expanded on this perspective in Chapter 10 using multiplier analysis. Yet, even as Keynes accentuated the significance of a two-sector approach for a holistic understanding of the implications of investment on employment and income, his primary discussions predominantly revolved around a single-commodity framework. This methodology, embraced extensively by macroeconomists, tends to bypass intricate intersectoral production relationships.

The simplicity of the single-commodity model has been its primary defence, but a discerning approach is essential. Historical studies intimate that findings from this model may not easily transpose to multi-commodity scenarios, with research by Goodwin, Chipman, and Morishima underscoring this point. Morishima (1976, Chapter 9) identified two scenarios where a singular industry perspective might suffice: when the consumption propensities of workers and capitalists converge and when there is a uniform wage-profit ratio across consumption sectors. Given the implausibility of these preconditions, there is a compelling case to revisit the multiplier principle within a multi-sectoral ambit.

Kurz (1985) introduced a "classical" perspective to the theory of value and distribution, which operates on the premise of fixed profit rates and static technical production conditions, setting the stage for predetermined wage rates and relative prices. Such an assumption hinges on the absence of barriers in the multiplier process, zeroing in exclusively on "unemployment equilibria". Kurz then navigated the multiplier principle within a multi-sectoral linear model, casting homogeneous labour as the sole primary input. Some foundational elements of this approach, like the ubiquity of joint production or labour's inherent heterogeneity, might be subjects of debate. Still, for the sake of coherency, Kurz retains these premises. He centres his discourse on a closed economy, free from governmental interventions, establishing constant consumption patterns and saving propensities linked to primary income categories: wages and profits.

Mirroring Keynes' methodology in *The General Theory,* Kurz regards investment demand value as inherently autonomous. Nevertheless, he underscores that his core arguments are adaptable to other self-reliant demand components, such as public expenditure or foreign demand. The invigorated framework developed by Kurz (1985) for understanding multipliers, addressing and rectifying earlier pinpointed gaps, has been advanced by the works of Metcalfe and Steedman (1981) and Mariolis (2008), who provided further generalisations in an open economy and joint production framework.

2.3. Our methodological approach

2.3.1. The model proposed by Kurz

The concept of the multiplier that we use in this study was theoretically and analytically constructed in the works of Metcalfe and Steedman (1981), Kurz (1985), and Mariolis (2008). It includes as special cases the Keynesian multiplier(s) of standard macroeconomic theory and the multipliers of traditional (Leontief inverse matrix) input-output analysis (see, e.g., Miller and Blair, 2009, Ch. 4). This multiplier is not a stepwise quantity, but a quadratic matrix of the sectors of the economy, the components of which depend on the technical conditions of production, the distribution of income (commodity prices), the flows to savings by form of income, and the compositions of consumption by form of income. For an overview of multiplier measures through IO analysis for the Greek economy, see Backinezos et al. (2020) and Ntemiroglou (2022). Our analytical framework is detailed in Mariolis et al. (2021b, Ch. 8).

Following Kurz (1985), we consider a closed economy involving only single products while (a) all capital is circulating; (b) the input-output coefficients are fixed; (c) there are non-competitive imports; (d) the net product is distributed to profits and wages that are paid at the end of the common production period; (e) the price of a commodity obtained as an output at the end of the production period is the same as the price of that commodity used as an input at the beginning of that period ("stationary prices"); and (f) labour is homogeneous within each industry but heterogeneous across industries.[3] Based on these assumptions, on the one hand, the price side of the system is described as[4]

$$\mathbf{p} = \mathbf{pA}[\mathbf{I} + \langle\mathbf{r}\rangle] + \mathbf{w}\langle\mathbf{l}\rangle, \tag{2.1}$$

where $\mathbf{p}\{p_j > 0\}$ is the $1 \times n$ vector of prices of each commodity j, $\mathbf{A}$ is the $n \times n$ matrix of total input-output coefficients, $\mathbf{I}$ is the $n \times n$ identity matrix, $\langle\mathbf{r}\rangle\{r_j > 0\}$ is $n \times n$ the diagonal matrix of the sectoral profit rates, $\mathbf{w}\{w_j > 0\}$ is the $1 \times n$ vector of money wage rates, and $\langle\mathbf{l}\rangle\{l_j > 0\}$ is the $n \times n$ diagonal matrix of direct labour coefficients. On the other hand, the quantity side of the system is described as

$$\mathbf{x}^{\mathrm{T}} = \mathbf{Ax}^{\mathrm{T}} + \mathbf{y}^{\mathrm{T}} \tag{2.2}$$

or

$$\mathbf{y}^{\mathrm{T}} = \mathbf{c}_w^{\mathrm{T}} + \mathbf{c}_p^{\mathrm{T}} + \mathbf{d}^{\mathrm{T}}, \tag{2.3}$$

[3] Goodwin (1949) first shows that it is appropriate to reformulate the principle of the multiplier in a multisectoral framework.

[4] Matrices (and vectors) are delineated in boldface letters. The transpose of a $1 \times n$ vector $\mathbf{x} \equiv [x_j]$ is denoted by $\mathbf{x}^{\mathrm{T}}$, and the diagonal matrix formed from the elements of x is denoted by $\langle\mathbf{x}\rangle$. Finally, $\mathbf{e}$ denotes the summation vector and $\mathbf{e}_j$ the j-th unit vector.

where $\mathbf{x}^{\mathrm{T}}$ denotes the gross output vector, $\mathbf{y}^{\mathrm{T}}$ is the vector of net output, $\mathbf{c}_w^{\mathrm{T}}$ and $\mathbf{c}_p^{\mathrm{T}}$ are the vectors of consumption demand out of wages and profits, respectively, and $\mathbf{d}^{\mathrm{T}}$ is the vector of autonomous demand (government consumption, investments).[5] By considering the above equations, we derive:

$$\mathbf{y}^{\mathrm{T}} = \mathbf{\Pi d}^{\mathrm{T}}, \tag{2.4}$$

where $\mathbf{\Pi} \equiv [\mathbf{I} - \mathbf{C}]^{-1}$ denotes the $n \times n$ matrix of multipliers linking autonomous demand to net output. Furthermore, $\mathbf{C} \equiv [\mathbf{p} - (s_w \mathbf{w\Lambda} + s_p \mathbf{pH})](\mathbf{pc}^{\mathrm{T}})^{-1}\mathbf{c}^{\mathrm{T}}$ denotes the $n \times n$ matrix of total consumption demand, $\mathbf{c}^{\mathrm{T}}$ is the uniform consumption pattern (associated with the two types of income), s_w and s_p are the saving ratios out of wages and profits, respectively, $\mathbf{\Lambda} \equiv <\mathbf{l}>[\mathbf{I} - \mathbf{A}]^{-1}$ is the $n \times n$ matrix of "vertically integrated labour coefficients", and $\mathbf{H} \equiv \mathbf{A}<\mathbf{r}>[\mathbf{I} - \mathbf{A}]^{-1}$ is the $n \times n$ **r**-vertically integrated technical coefficients matrix.

From equations (2.2) and (2.3), and given that $\mathbf{L}^{\mathrm{T}} \equiv <\mathbf{l}>\mathbf{x}^{\mathrm{T}}$ denotes the vector of sectoral employment, we derive that

$$\mathbf{L}^{\mathrm{T}} = \mathbf{\Lambda \Pi d}^{\mathrm{T}}, \tag{2.5}$$

where $\mathbf{\Lambda\Pi}$ denotes the $n \times n$ matrix of employment multipliers linking autonomous investments to total employment.[6]

Thus, the effects of an increase in autonomous demand for a specific commodity are analysed through two key multipliers: the output multiplier and the employment multiplier. These metrics represent the changes in the economy's net output and employment, respectively, in response to a unit increase in demand for the commodity in question. The output multiplier measures the change in the monetary value of net output. This multiplier captures the overall production effects induced by the demand

[5] According to Kurz (1985), the consumption demands out of wages and out of profits, in physical terms, amount to $\mathbf{c}_w^{\mathrm{T}} = [(1 - s_w)(\mathbf{pc}^{\mathrm{T}})^{-1}\mathbf{c}^{\mathrm{T}}]\mathbf{w\Lambda y}^{\mathrm{T}}$ and $\mathbf{c}_p^{\mathrm{T}} = [(1 - s_p)(\mathbf{pc}^{\mathrm{T}})^{-1}\mathbf{c}^{\mathrm{T}}]\mathbf{pHy}^{\mathrm{T}}$, respectively. Furthermore, we have deviated from Kurz's original framework by including in autonomous demand not only investments but also government consumption.

[6] Kurz (1985) also shows that this framework includes as special cases the Keynes and Kaldor multipliers and the multipliers of the traditional input-output analysis (see, e.g., Miller and Blair, 2009, Chap. 6).

shock. The employment multiplier measures the change in total employment due to the demand shock. This multiplier quantifies the impact on the labour market.

2.3.2. An open economy model

In order to increase the reliability of our results, we extend the analysis to include open economy conditions, based on Metcalfe and Steedman (1981) and Mariolis (2008). Hence, the equation (2.3) becomes

$$\mathbf{y}^{\mathrm{T}} = \mathbf{c}_w^{\mathrm{T}} + \mathbf{c}_p^{\mathrm{T}} - \mathbf{im}^{\mathrm{T}} + \mathbf{d}^{\mathrm{T}}, \qquad (2.6)$$

where $\mathbf{im} = <\mathbf{m}>\mathbf{x}^{\mathrm{T}}$ denotes the import demand vector, $<\mathbf{m}>$ the $n \times n$ diagonal matrix of imports per unit of gross output of each commodity, while the vector of autonomous demand now includes (except from the government consumption and the investments) also the exports. Therefore, the matrix of multipliers enlarges to $\mathbf{\Pi}_m \equiv [\mathbf{I} - \mathbf{C} + \mathbf{M}]^{-1}$, and equations (2.4) and (2.5) become

$$\mathbf{y}^{\mathrm{T}} = \mathbf{\Pi}_m \mathbf{d}^{\mathrm{T}}, \qquad (2.7)$$

$$\mathbf{L}^{\mathrm{T}} = \mathbf{\Lambda}\mathbf{\Pi}_m \mathbf{d}^{\mathrm{T}}, \qquad (2.8)$$

where $\mathbf{M} \equiv <\mathbf{m}>[\mathbf{I} - \mathbf{A}]^{-1}$ denotes the $n \times n$ matrix of total import demand. Finally, we can derive the matrix multiplier linking autonomous demand to imports as

$$\mathbf{im}^{\mathrm{T}} = <\mathbf{m}>[\mathbf{I} - \mathbf{A}]^{-1}\,\mathbf{\Pi}_m \mathbf{d}^{\mathrm{T}}. \qquad (2.9)$$

In similar way with the output and employment multipliers, the import multiplier reflects the change in the monetary value of imports as a result of the demand shock.

2.3.3. A regional model

By taking into account both the price and quantity sides of all the regions of Greece, we derive the following equation:

$$\mathbf{y}_r^{\mathrm{T}} = \mathbf{\Pi}_r^m \mathbf{d}_r^{\mathrm{T}}, \qquad (2.10)$$

where $r = 1,2,3 \ldots 13$ denotes the NUTS-2 regions, $\mathbf{\Pi}_r^m \equiv [\mathbf{I} - \mathbf{C}_r + \mathbf{M}_r]^{-1}$ denotes the regional matrix of multipliers linking the vector of regional autonomous demand, $\mathbf{d}_r^{\mathrm{T}}$, to the vector of regional final demand, $\mathbf{y}_r^{\mathrm{T}}$. Furthermore, $\mathbf{C}_r$ is the $n \times n$ matrix of regional total consumption demand, and $\mathbf{M}_r$ is the matrix of regional import demand. We derive the regional matrix multiplier linking autonomous demand to the levels of regional total employment as follows:

$$\mathbf{L}_r^{\mathrm{T}} = \mathbf{\Lambda}_r \mathbf{\Pi}_r^m \mathbf{d}_r^{\mathrm{T}}, \tag{2.11}$$

where $\mathbf{\Lambda}_r \mathbf{\Pi}_r^m$ denotes the matrix of regional employment multipliers linking regional autonomous demand to the regional vector of employment, $\mathbf{L}_r^{\mathrm{T}}$; and $\mathbf{\Lambda}_m$ is the matrix of direct and regional indirect labour requirements per unit of net output. Finally, we derive the matrix regional multiplier linking autonomous demand to imports, as follows:

$$\mathbf{Im}_r^{\mathrm{T}} = \mathbf{M}_r \mathbf{\Pi}_r^m \mathbf{d}_r^{\mathrm{T}}, \tag{2.12}$$

where $\mathbf{M}_r \mathbf{\Pi}_r^m$ denotes the matrix of regional import multipliers linking regional autonomous demand to the regional vector of imports, $\mathbf{Im}_r^{\mathrm{T}}$.

2.4. Extraction of model variables

The application of the above methodological framework requires, first of all, the empirical assessment of the current technical conditions of production, i.e., $\{\mathbf{A}, \mathbf{l}\}$. For this purpose, we use data from the input-output table of the Greek economy for 2015 and follow the usual methodology in the relevant literature.

2.4.1. Extraction of the technical coefficients matrix

If we denote by $\mathbf{Z} \equiv [z_{ij}]$ the intermediate consumption matrix of $n \times n$, which is directly available from the input-output table, then we can set $z_{ij} = p_i a_{ij} x_j$, where p_i is the price of the commodity i, and x_j is the gross output of sector j.[7] Also directly available from the input-output table is the value of the total gross output of each sector, $p_j x_j$.

If now we set as a physical unit of measurement of each commodity the quantity of each commodity that costs 1 monetary unit,[8] i.e., we set $p_1 = p_2 = \ldots = p_n = 1$, then we can construct the $1 \times n$ vector of the gross output of the economy, $\mathbf{x} \equiv [x_j]$, and, therefore, now for each element of the intermediate consumption matrix, it holds that $z_{ij} = a_{ij} x_j$. Finally, we estimate the technical coefficients matrix of the Greek economy as $\mathbf{A} = \mathbf{Z}<\mathbf{x}>^{-1}$, where $\hat{x}$ is the diagonal matrix formed by the elements of vector $\mathbf{x}$.

2.4.2. Extraction of the vector of direct homogeneous labour

The sectoral employment levels correspond to the total number of employed persons in each sector of the economy. Since the application of our methodological framework assumes that labour is homogeneous, while in the real world labour is heterogeneous, it follows that we must apply a process of homogenisation of labour.[9] If we denote by W_j the "compensation of employees" of sector j, which are directly available from the input-output table, then we can set $W_j = w_j L_j = w_j a_j^h x_j$, where w_j is the nominal wage rate in sector j; L_j is the total employment in sector j; and a_j^h is the direct amount of heterogeneous labour required to produce a single unit of commodity j.

2.4.3. Extraction of the nominal wage rate and profit rate

From the above, we can estimate the nominal wage rate of sector j as $w_j = W_j L_j^{-1}$. Finally, we denote by w_m the minimum of the estimated w_j and, accordingly, we estimate $l_j = w_j w_m^{-1} a_j^h$, where l_j is the amount of direct homogeneous labour required to produce one unit of the commodity j as gross output. Therefore, we have constructed the vector of direct homogeneous labour. As it is understood, the described homogenisation pro-

[7] For details, see, e.g., Miller and Blair (2009, Ch. 2).

[8] In our case, the monetary unit is set to 1 million euro.

[9] We follow the procedure used, e.g., by Ochoa (1989, p. 428). See also Sraffa (1960, §10) and Kurz and Salvadori (1995, pp. 322-325).

cess is based on the current nominal wage rates; in particular, the heterogeneous labour of each sector has been reduced, through the ratio $w_j w_m^{-1}$, to the labour corresponding to the lowest nominal wage rate. Finally, taking into account that we have set the market prices of all goods equal to one, we get $\mathbf{e}^{\mathrm{T}}[\mathbf{I} + <\mathbf{r}>] = [\mathbf{e}^{\mathrm{T}} - \mathbf{w}<\mathbf{l}>]\mathbf{A}^{-1}$, and therefore, we can estimate the profit rate, r_j.

2.4.4. Extraction of regional variables

By utilising an analogous methodological approach that has been employed for the analysis of the Greek economy at the national level, we will extrapolate these strategic processes to the regional economies comprising the thirteen distinct regions of the country. The next chapter analytically describes the methodological approach employed to regionalise the IO table of the Greek economy.

CHAPTER 3

THE REGIONALISATION OF INPUT-OUTPUT TABLES

3.1. Types of input-output regionalisation methods

The construction of regional input-output tables can be distinguished into three main approaches: survey, non-survey, and hybrid methods. Survey-based approaches are considered as capable of representing input-output linkages at the regional level most accurately. However, in practice, no readily available data exist to construct these tables, or existing data are incomplete and outdated. Additionally, the collection of new data or surveys necessary to supplement the lacking data is quite expensive and time-consuming. Furthermore, the application of hybrid (survey and non-survey) or partial survey (such as the RAS) techniques can practically yield reliable estimates only in the case of correct margins (row and column sums), which essentially requires the availability of a survey.

For these reasons, in order to overcome the disadvantages of the two previously mentioned approaches, researchers have turned to non-survey methods, which typically necessitate the availability of national supply-use tables or national input-output tables. The most common non-survey-based approaches include adjustment methods on the basis of simple location quotient (LQ) measures (for relevant reviews, see Sawyer and Miller, 1983; Richardson, 1985; Lahr, 1993; Oosterhaven, 2019; Hewings, 2020). Earlier (or so-called first generation) non-survey methods relied or started on the assumption that the unknown regional technical coefficients equal the corresponding national coefficients. Additionally, most of these non-survey methods tend to diminish cross-hauling, that is, the simultaneous import and export of comparable products, which leads to a systematic overestimation (upward bias) of intra-regional transactions and, hence, of all regional multipliers. The cross-industry quotient (CILQ), the semi-logarithmic quotient, the supply-demand pool, and the commodity trade balance methods all belong to these first-generation models, which share the asymmetric nature of the LQ method (Miller and Blair, 2009; Oosterhaven, 2019).

The second-generation non-survey methods principally originated from the work of Flegg et al. (1995), which properly adds interregional cross-hauling and adapts the CILQ according to the size of each region (see Section 2.2). Specifically, the Flegg's adjusted method can be implemented to provide more reliable input coefficients and sectoral output and employment multipliers by region than the earlier methods. When the focus of the study is put on the overall supply of goods, Kronenberg's (2009) Cross-Hauling Adjusted Regionalisation Method (CHARM) can be employed to estimate supply (import) multipliers and for purposes of environmental analysis. This is because CHARM explicitly takes into account and allocates (international) cross-hauling at the regional level, assuming that (cross-hauling) increases with the heterogeneity of the products traded (see Section 2.3). It is, however, noted that Flegg et al. (2015) implemented CHARM and reported problems of reliability in the estimation of sectoral exports, imports, and volume of trade for a relatively small region (Province of Hubei) of a very large country (China) where there is a large divergence between regional and national technology and the pattern of final demand.

Thus, both of these second-generation non-survey methods are described below and employed in this study to produce more accurate output and employment multiplier values, and import multiplier values, respectively, than the first-generation methods. In Section 2.2, the adjusted Flegg method is applied to the Greek national input-output table that excludes imports from abroad, whereas such imports are included when Kronenberg's CHARM method is used for the regionalisation of the national input-output table.

3.2. Flegg's Location Quotient approach

The first step in the application of LQ-based approaches refers to transforming the national input-output transaction matrix into a matrix of national technical (input) coefficients a_{ij}, which measure the amount of national input (commodity) i required to produce one unit of national gross output (commodity) *j*. Specifically, input coefficients a_{ij} are obtained from dividing X_{ij}, which represents the input of industry (sector) *j* from industry (sector) *i,* by $X_j = \sum_i X_{ij}$, which represents the domestic production of industry *j*, namely,

$$a_{ij} = \frac{X_{ij}}{X_j}. \tag{3.1}$$

The sum of input coefficients including the gross value-added portion in each sector is defined as $\sum_i a_{ij} = 1$. The input coefficient table is also referred to as the basic production unit table, as its entries a_{ij} reflect production technologies adopted in a certain year. However, changes in production technologies are generally not supposed to occur in short timeframes. The national input coefficient matrix is then regionalised through the formula

$$r_{ij} = \beta_{ij} \times a_{ij}, \tag{3.2}$$

where r_{ij} is the regional input coefficient and β_{ij} is an adjustment coefficient. In equation (3.2), r_{ij} measures the amount of regional input *i* required to produce one unit of regional gross output *j*; thus, it excludes any supplies of *i* obtained (imported) from other regions or from abroad, as a_{ij} also excludes any foreign inputs. Hence, β_{ij} takes account of a region's purchases of input *i* from other regions in the country. This adjustment suggests that regional industries are less able to produce intermediate inputs for their own region than are the corresponding national industries.

As mentioned before, in earlier models, when β_{ij} is replaced in equation (3.2) with a simple location quotient (SLQ), estimates of r_{ij} can be obtained. The SLQ, also known as the Hoover-Balassa index (Hoover, 1936), is given as follows:

$$SLQ_i \equiv \frac{E_i^r / \sum_i E_i^r}{E_i^n / \sum_i E_i^n} \equiv \frac{E_i^r}{E_i^n} \times \frac{\sum_i E_i^n}{\sum_i E_i^r}, \tag{3.3}$$

where E_i^r is the regional employment in sector *i,* and E_i^n is the corresponding national figure; $\sum_i E_i^r$ and $\sum_i E_i^n$ are the respective regional and national totals. It is noted here that sectoral data on employment instead of output is used to estimate LQs, as the former data are typically available at the regional level from Labour Force Surveys or Business Registries. Likewise, the cross-industry location quotient (CILQ) can be defined as

$$CILQ_{ij} \equiv \frac{SLQ_i}{SLQ_j} \equiv \frac{E_i^r / E_i^n}{E_j^r / E_j^n}, \tag{3.4}$$

where the subscripts i and j refer to the supplying and purchasing sectors, respectively. It is noted that no adjustment is made to the national input coefficient a_{ij} in the cases where $CILQ_{ij} \geq 1$, similar to the case where $SLQ_i \geq 1$.

Compared to the SLQ method, which is a uniform adjustment taking into consideration only the supply (row) side, i.e., the size of the selling industry, the CILQ considers both the relative size of the supplying and purchasing sectors. However, several studies in the existing scholarly literature have empirically proved that the conventional LQ-based methods tend to overestimate regional multipliers, because they underestimate imports from other regions (Bonfiglio and Chelli, 2008; Flegg and Tohmo, 2013; Morrissey, 2016). This shortcoming of conventional LQ-based methods can be attributed to the underestimation of interregional trade, either because they preclude or fail to take sufficiently into consideration the phenomenon of cross-hauling.

The introduction of Flegg's location quotient (FLQ) formula was an initial attempt to treat the underestimation of interregional trade with the use of CILQ (Flegg et al., 1995). In its refined form (Flegg and Webber, 1997), the FLQ formula is given as

$$r_{ij} = \begin{Bmatrix} a_{ij} & \text{if } FLQ_{ij} \geq 1 \\ FLQ_{ij} \times a_{ij} & \text{if } FLQ_{ij} < 1 \end{Bmatrix}, \tag{3.5}$$

where

$$FLQ_{ij} = CILQ_{ij} \times \lambda^* \qquad \text{for } i \neq j, \tag{3.6}$$

$$FLQ_{ij} = SLQ_i \times \lambda^* \qquad \text{for } i = j. \tag{3.7}$$

The FLQ formula inherits the asymmetric nature of the LQ-based method; namely, it tends to yield larger imports as FLQ declines below unity, but it does not result in smaller imports as FLQ increases above unity. The parameter λ is given as

$$\lambda^{*} = \left[\log_2\left(1+\sum_i E_i^r / \sum_i E_i^n\right)\right]^{\delta}, \tag{3.8}$$

where $0 \leq \delta < 1$; as the value of parameter δ increases, the allowance for interregional imports of commodities of sector *i* to region *r* from all the other regions also increases. In the special (no-import) case where $\lambda = 0$, it is implied that $FLQ_{ij} = CILQ_{ij}$, for $i \neq j$, and $FLQ_{ij} = SLQ_i$, for $i = j$. Similar to the previous LQ-based methods, the FLQ_{ij} is constrained to unity. The FLQ approach allows us to take into consideration the relative size of the regional purchasing and supplying sectors as well as the relative size of the region.

The FLQ formula adds cross-hauling in cases where sectors are regionally poorly represented, whereas it only partially adds cross-hauling for sectors that are regionally strongly represented. More specifically, larger values of δ would reduce the value of λ in equation (3.8) and, consequently, the amount of intraregional intermediate transaction estimates would become smaller, based on equations (3.5)-(3.7). Additionally, δ determines the total amount of interregional intermediate transactions, as they are given by the national input-output table. Therefore, δ values affect the estimated amount of interregional cross-hauling, since the amounts of sectoral exports to other regions and of sectoral imports from other regions is roughly proportional to the total amount of interregional intermediate transactions and to the value of δ.

In order to address the potential impact of the regional specialisation on the rise of the magnitude of regional input coefficients, possibly above the corresponding national input coefficients (McCann and Dewhurst, 1998), a variant of the FLQ formula, referred to as the augmented FLQ (AFLQ) formula, was suggested by Flegg and Webber (2000). According to the AFLQ, a specialisation term is added to the FLQ formula, as follows:

$$AFLQ_{ij} = \left\{ \begin{array}{ll} FLQ_{ij} \times [\log_2(1+SLQ_{ij})] & \text{for } SLQ_j > 1 \\ FLQ_{ij} & \text{for } SLQ_j \leq 1 \end{array} \right\}. \tag{3.9}$$

Equation (3.9) suggests that the correction with the specialisation term $\log_2(1 + SLQ_{ij})$ only applies when $SLQ_j > 1$. In other words, other things being equal, increased sectoral specialisation should raise the value of SLQ_j and, consequently, the value of $AFLQ_{ij}$, thus lowering the allowance for imports from other regions. This situation typically reflects the existence of a strong regional purchasing sector, which attracts suppliers to locate close to the source of demand and yields larger intraregional sourcing of inputs.

It is stressed that several empirical applications have demonstrated the superior performance of the AFLQ method in terms of providing slightly more accurate results, particularly when dealing with relatively small- or modest-sized economies, compared with those of large countries, in comparison to other variant LQ-based approaches, especially in the cases where δ ranges between 0.1 and 0.2 (Lamonica and Chelli, 2018) (this is the case of the current application, as shown in Section 3). Furthermore, the AFLQ formula can be regarded as preferable, in relation to other LQ-based methods, since it takes into consideration aspects of the economic geography of the region, such as the regional specialisation, and can encompass situations where regional input coefficients are larger than the corresponding national coefficients; namely, it may allow for cases where $r_{ij} > a_{ij}$ in equation 3.2. Similar to the FLQ_{ij}, the $AFLQ_{ij}$ is also constrained to unity.

The previous discussion signifies that the use of an appropriate value for δ is crucial to the successful application of the AFLQ formula. The selection of such a value is based here on the novel solution proposed by Lehtonen and Tykkyläinen (2014), using as a starting point the original version of the FLQ formula (Flegg et al., 1995) and making use of earlier empirical work for this problem (Tohmo, 2004). Specifically, the following formula can be used for the value of δ:

$$\delta = \frac{\log\left[\left(\sum_i E_i^r / \sum_i E_i^n\right) \Big/ \left\{\log_2\left(1+\sum_i E_i^r / \sum_i E_i^n\right)\right\}\right]}{\log\left[\log_2\left(1+\sum_i E_i^r / \sum_i E_i^n\right)\right]}. \tag{3.10}$$

Relationship (3.10) can be considered plausible because it inherently associates the δ value with the ability of regions to be self-sufficient on intermediate inputs. Namely, larger δ values suggest that this ability is smaller, and hence, a larger share of intermediate transactions is made with other regions, implying that the intraregional component of the multiplier would be smaller. Although this is an empirical relationship, it has generally been found to yield sensible results, as its formulation ensures that the value of δ will rise with regional size $\left(\sum_i E_i^r / \sum_i E_i^n\right)$, which, in turn, suggests that greater adjustments of regional imports need to be made. In cases of regions which are relatively self-sufficient, for instance, due to a high degree of specialisation or remoteness from large markets, such as the case of insular peripheral or island regions, then a relatively low value of δ may be obtained, compared to the larger regions, which is associated with higher multipliers (Flegg and Tohmo, 2016).

It is further noted that several scholars have developed alternative functional forms to determine δ, using additional industry-level explanatory variables or attributes for specific regions and countries, such as Finland (Flegg and Tohmo, 2016), Germany (Jahn, 2017), and South Korea (Jahn et al., 2020). However, these statistical (regression) models may well be biased, since it is difficult to select appropriate variables, collect suitable data for them (e.g., for the propensity of a region to import from other regions), and validate their parameters, which typically necessitate the use of survey-based estimates for each region.

Finally, it is stressed that the AFLQ method can be implemented in the context of the regional ‘type B’ tables, where imported intermediate inputs appear as a row on the input side and which depict the intermediate and final demand for regional products from domestic production, allowing the estimation of the corresponding output and employment multiplier values. In the context of considering the total intermediate and final demand from both the domestic production and imports, CHARM has been explicitly designed for this purpose and is analytically presented in the following section.

3.3. Cross-Hauling Adjusted Regionalisation Method

The Cross-Hauling Adjusted Regionalisation Method (CHARM) is another type of non-survey method, which is particularly useful when a limited amount of regional data (such as for sectoral employment) is used to regionalise the national input-output table that incorporates imports. Before proceeding to the description of CHARM, it is useful to first explain some key concepts underlying the classical Cross-Balancing (CB) method for regional commodity flows, which was introduced several decades ago to construct regional input-output tables (Isard, 1953). Let us consider the following equation to estimate the demand for each regional sector:

$$y_i^r = \sum_j a_{ij} x_j^r + f_i^r, \tag{3.11}$$

where y_i^r is total regional demand for commodity i in region r; a_{ij} is the national technical coefficient; x_j^r is the output of regional industry j; $\sum_j a_{ij} x_j^r = z_i^r$ is the total intermediate demand of regional industry j; and f_i^r is the final demand (excluding exports) of industry j in region r. A key underlying assumption of this methodology is that the region and the country share the same technology. This assumption is justified by the fact that data on regional technology are rarely available.

In turn, the following cases can be detected: If $y_i^r \leq x_i^r$, the entire surplus is assumed to be exported; conversely, if $y_i^r > x_i^r$, it is presumed that sufficient imports will be available to cover the shortfall in regional output. According to the classical CB approach, cross-hauling is excluded and the principle of maximum local trade holds; namely, if commodity i is available from a local source in region r, it will be purchased from that source. However, this assumption neglects the fact that any commodity in practice will be an aggregation of a number of several distinct commodities, which makes the phenomenon of cross-hauling almost certain to occur. Cross-hauling can be regarded as ubiquitous in small regions, but it also very often takes place in larger regions. In order to address this problem, Kronenberg (2009) pointed to the heterogeneity of industry commodities as the main cause of cross-hauling and proposed CHARM as a novel way of dealing with it, through explicitly expressing cross-hauling, in terms of the volume of trade.

Both the CB method and CHARM aim to capture the underlying technology of production, and therefore, they employ the concept of commodity balance. For commodity i, this balance, b_i, is defined as

$$b_i = e_i - m_i, \tag{3.12}$$

where e_i and m_i denote exports and imports, respectively, and b_i represents net exports. The value of b_i can be computed as the estimated output of commodity i minus the estimated sum of intermediate and domestic final use (Kronenberg, 2009). Although the CB and CHARM yield identical values for b_i, they generally yield different values for the volume of trade, $v_i = e_i + m_i$. This is because CHARM takes explicitly into account cross-hauling, q_i, through the following equation:

$$q_i = v_i - |\, b_i \,| = (e_i + m_i) - |\, (e_i - m_i) \,|. \tag{3.13}$$

Based on equation (3.13), cross-hauling q_i becomes greater when the volume of trade increases and the absolute trade balance decreases. In the CB method, $q_i = 0$, since it presumes that the volume of trade is equal to the absolute trade balance, whereas in CHARM, $q_i > 0$ is possible, and it does happen in most cases in reality. As a first step for the regionalisation of trade transactions, CHARM represents the cross-hauling q_i^r for each commodity i in each region r on the basis of equation (3.13), as follows:

$$q_i^r = v_i^r - |\, b_i^r \,| = (e_i^r + m_i^r) - |(e_i^r - m_i^r)|, \tag{3.14}$$

where v_i^r is the volume of regional trade, calculated as the sum of regional exports e_i^r and regional imports m_i^r, and b_i^r is the regional commodity balance or the net regional exports.

In order to quantify the volume of regional trade, Kronenberg (2009) suggested the following formula to estimate the commodity balance (or net exports) b_i^r for each commodity i in each region r:

$$b_i^r = x_i^r - (z_i^r + f_i^r), \tag{3.15}$$

where x_i^r is the regional output of this commodity in region r. The regionalised variables of the right-hand side of equation (3.15) are obtained through the following relationships:

$$x_i^r = \frac{E_i^r}{E_i^n} x_i, \tag{3.16}$$

$$z_i^r = a_{ij} x_i^r, \tag{3.17}$$

$$f_i^r = \frac{E_i^r}{E_i^n} f_i, \tag{3.18}$$

where x_i is the national output of commodity, i, and f_i is the domestic final use (excluding exports) of this commodity. This proportional scaling of output and final use is a very common approach, which is dictated by the absence of more refined data at the regional level.

The heterogeneity h_i of products is different among industries, with $0 \leq h_i < \infty$. In line with Kronenberg (2009), cross-hauling q_i is proportional to the sum of domestic production, x_i; total intermediate use, z_i; and domestic final use, f_i. In turn, product heterogeneity can be calculated on the basis of national data, as follows:

$$q_i = h_i(x_i + z_i + f_i) \Rightarrow h_i = \frac{q_i}{(x_i + z_i + f_i)}. \tag{3.19}$$

Based on equations (3.13) and (3.19), there is no product heterogeneity ($h_i = 0$) if cross-hauling $q_i = 0$, and vice versa, which will occur if $e_i = 0$ with $m_i > 0$, or $m_i = 0$ with $e_i > 0$, or if $e_i = m_i = 0$. According to CHARM, each commodity i presents the same degree of product heterogeneity at the national and regional levels; namely, heterogeneity is invariant across regions and depends solely on the characteristics of products, i.e., $h_i^r = h_i$. Therefore, regional cross-hauling can be given as

$$q_i^r = h_i^r(x_i^r + z_i^r + f_i^r). \tag{3.20}$$

Combining equations (3.14), (3.15) and (3.20), the volume of trade for each commodity i in each region r will be

$$v_i^r = q_i^r + |\, b_i^r \,| = h_i^r(x_i^r + z_i^r + f_i^r) + |\, b_i^r \,|. \tag{3.21}$$

Following the calculation of the volume of regional trade v_i^r and of net regional exports b_i^r, the exports and imports of each commodity i in each region r can be calculated through the following system of equations:

$$e_i^r = ½\,(v_i^r + b_i^r). \tag{3.22}$$

$$m_i^r = ½\,(v_i^r - b_i^r). \tag{3.23}$$

Theoretical investigation (Kronenberg, 2012) and empirical analyses (Flegg and Tohmo, 2013; Többen and Kronenberg, 2015) have shown the importance of using FLQ methods for the regionalisation of 'type B' tables and CHARM, where we consider imported intermediate inputs together with the inter-industry transactions. As mentioned before, depending on the research question and the study area, the analysis may focus on either the estimation of regional multipliers for output and employment or the estimation of import multiplier values and/or the assessment of environmental impacts. The following section describes the main input data used and the set of estimated variables and parameters needed to implement the AFLQ formula and CHARM for the regionalisation of the national input-output table and the derivation of various (output, employment, and import) multiplier values for the Greek regions.

CHAPTER 4

DESCRIPTION OF REGIONAL ECONOMIC VARIABLES

The availability and use of input data on sectoral employment at the regional (NUTS-2) level is crucial for this study, as it allows us to calculate the simple location quotient (SLQ) and the cross-industry location quotient (CILQ) and, hence, the measures of FLQ and AFLQ, as well as the specialisation term and the values of λ and δ parameters (see Section 2.2). These data originate from the Labour Force Surveys of ELSTAT for 2015, that is, the year for which the most recent national input-output table is available, according to the Greek National Accounts of ELSTAT. Moreover, the estimation of such regional variables as those of sectoral output and final use in CHARM (see Section 2.3) relies on the employment-size proportional downscaling of the corresponding national aggregate output and final demand, assuming that each region and the country share the same technology.

Before proceeding to the description of the data used in the present analysis, it should be noted that the spatial disaggregation of the national input-output table concerns the 13 NUTS-2 regions of Greece, whose coding and description are included in Table A1 of the Appendix, while the sectoral analysis is extended to 20 sectors of economic activity (see Table A2 of the Appendix), for which (employment) data for the production of regional input-output tables were available.

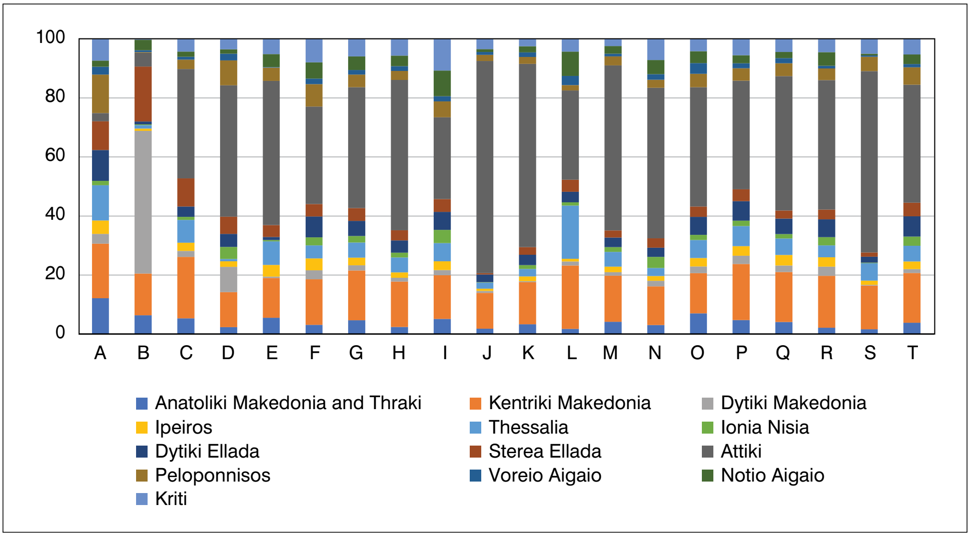
The selection of this level of detail for the regional and sectoral analysis of the input-output tables is due to the unavailability of reliable, representative data at a spatial level lower than NUTS-2 based on the employment (Labour Force Surveys) or gross value-added statistics of ELSTAT. At the same time, the highest possible disaggregation of economic activities into 20 sectors at the regional level allows for the assessment of a wide range of policies with a sectoral dimension. It is also stressed that this assessment at the NUTS-2 level is policy relevant and meaningful, since this is the administrative unit of analysis at which the resources originating from the European (and national) structural and investment funds are typically allocated. It is also recognised that the one-digit classification limits the possibilities of the regional IO analysis, particularly with regard to the manufacturing industry, as the country's regions are specialised at different degrees in various two-digit manufacturing sectors.

As it is clearly shown in Figures 4.1(a) and 4.1(b), employment size is quite diverse among the economic sectors and regions, respectively. This increased heterogeneity, which also reflects the *SLQ* values of the Greek regions (Table 4.1), suggests the particular geographical and economic characteristics of the country. More specifically, there are significant core-periphery disparities, as the region of Attiki, where the capital city of Athens is located, includes the largest number of persons employed in all sectors of economic activity, except for the primary sector (A), where the most persons employed are located in the region of Kentriki Makedonia (where the second largest city of the country, Thessaloniki, is located), and the Mining and quarrying sector (B), where the most persons employed are located in the region of Dytiki Makedonia. The latter region is also the most specialised one (with the highest value of SLQ) in the sectors of Mining and quarrying (B), and Electricity, gas, steam, and air conditioning supply (D), mainly due to the operation of electric power generation units in the constituent prefectures of Kozani and Florina.

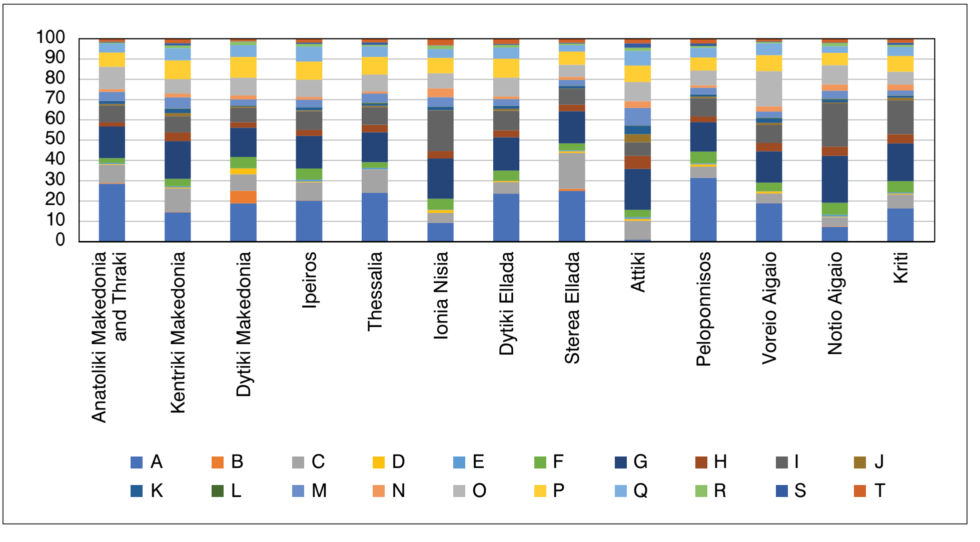
The most urbanised and densely populated regions, i.e., those of Attiki and Kentriki Makedonia, also present the most diverse specialisation patterns. Specifically, the region of Attiki has the highest SLQ values in six economic sectors (all of which refer to services) and a total of 14 economic sectors with SLQ>1 (Table 4.1). The region of Kentriki Makedonia has a total of 8 economic sectors with SLQ>1. Similarly, the island region of Notio Aigaio has a total of 8 economic sectors with SLQ>1 and the highest SLQ values in three sectors: Construction; Wholesale and retail trade; and Accommodation and food service activities. These specialisation patterns can be largely attributed to the intense tourist activity of the given region. Additionally, the region of Peloponnisos is the most specialised (has the highest SLQ value) in Agriculture, forestry, and fishing, while the region of Sterea Ellada is the most specialised in Manufacturing, particularly due to the intense activity in the industrial area of the prefecture of Viotia, located north of the region of Attiki (Tsekeris and Vogiatzoglou, 2014).

FIGURE 4.1
Employment (persons employed) as (a) regional shares by sector, and (b) sectoral shares by region

(a)



(b)



Source: Authors' own calculations.

TABLE 4.1
Single Location Quotients (SLQ) of the Greek regions

Sector	Anatoliki Makedonia and Thraki	Kentriki Makedonia	Dytiki Makedonia	Ipeiros	Thessalia	Ionia Nisia	Dytiki Ellada	Sterea Ellada	Attiki	Peloponnisos	Voreio Aigaio	Notio Aigaio	Kriti
A	**2.21**	**1.11**	**1.46**	**1.57**	**1.88**	0.71	**1.84**	**1.94**	0.08	**2.44**	**1.47**	0.57	**1.27**
B	**1.16**	0.85	**21.46**	0.28	0.18	0.13	0.17	**3.72**	0.12	0.05	0.36	0.96	0.05
C	0.98	**1.25**	0.88	0.97	**1.21**	0.53	0.61	**1.90**	**1.00**	0.60	0.51	0.48	0.74
D	0.42	0.72	**3.80**	0.63	0.13	**2.00**	0.77	**1.16**	**1.20**	**1.57**	**1.26**	0.42	0.60
E	**1.01**	0.81	0.21	**1.35**	**1.26**	0.20	0.19	0.80	**1.32**	0.83	0.13	**1.19**	0.89
F	0.57	0.93	**1.38**	**1.37**	0.70	**1.34**	**1.24**	0.84	0.89	**1.42**	**1.06**	**1.49**	**1.37**
G	0.85	**1.01**	0.79	0.88	0.80	**1.09**	0.90	0.87	**1.11**	0.80	0.85	**1.27**	**1.02**
H	0.44	0.93	0.56	0.62	0.80	0.80	0.73	0.67	**1.38**	0.57	0.87	0.97	0.98
I	0.94	0.89	0.79	**1.03**	0.96	**2.23**	**1.07**	0.86	0.75	**1.01**	0.98	**2.36**	**1.86**
J	0.33	0.73	0.32	0.25	0.33	0.08	0.45	0.08	**1.94**	0.39	0.55	0.26	0.60
K	0.60	0.86	0.14	0.57	0.40	0.63	0.61	0.52	**1.68**	0.43	0.87	0.56	0.43
L	0.32	**1.29**	0.59	0.31	**2.84**	0.54	0.62	0.82	0.82	0.34	**1.72**	**2.24**	0.74
M	0.76	0.94	0.53	0.65	0.78	0.80	0.56	0.49	**1.51**	0.56	0.53	0.69	0.42
N	0.56	0.79	0.82	0.56	0.43	**1.84**	0.54	0.64	**1.38**	0.50	**1.06**	**1.32**	**1.23**
O	**1.28**	0.82	**1.02**	0.98	0.96	0.86	**1.07**	0.69	**1.09**	0.84	**2.01**	**1.09**	0.72
P	0.87	**1.14**	**1.26**	**1.10**	**1.07**	0.92	**1.16**	0.80	0.99	0.79	0.96	0.74	0.95
Q	0.74	**1.02**	0.98	**1.24**	0.88	0.73	0.92	0.54	**1.23**	0.81	0.99	0.57	0.76
R	0.39	**1.06**	**1.38**	**1.09**	0.63	**1.38**	**1.06**	0.66	**1.19**	0.74	0.52	**1.24**	0.78
S	0.30	0.89	0.11	0.50	0.92	0.12	0.35	0.28	**1.66**	0.92	0.24	0.17	0.86
T	0.70	**1.01**	0.59	0.89	0.84	**1.53**	**1.20**	0.92	**1.08**	**1.11**	0.62	0.88	0.91

Source: Authors' own calculations.

Note: Figures in bold indicate LQ>1.

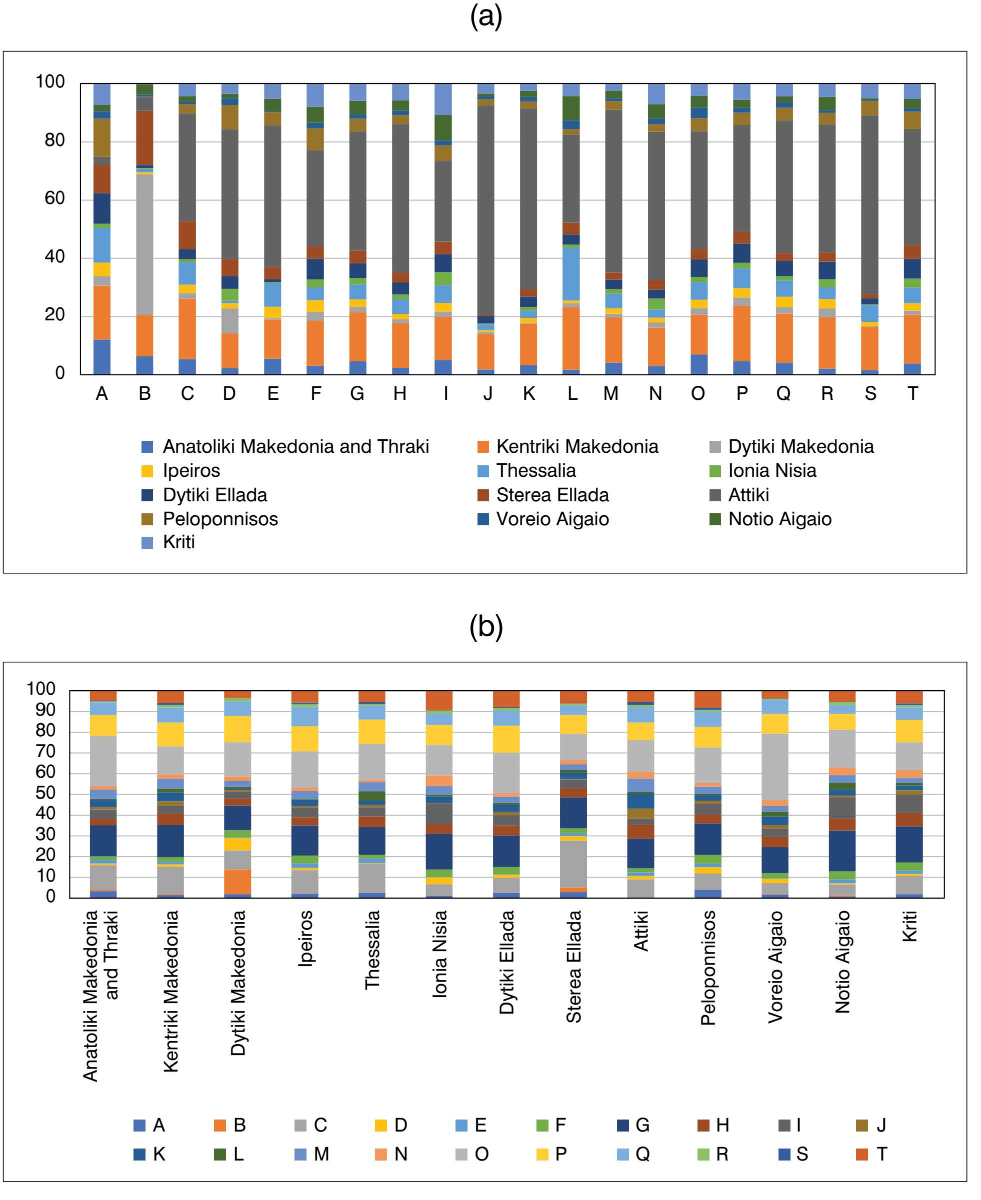
Similar to the regional output and final use (see Section 2.3), the regional wages are obtained from the national input-output table, where sectoral wages appear as a row on the input side, through the proportional scaling of national wages, as follows:

$$w_i^r = \frac{E_i^r}{E_i^n} w_i , \qquad (4.1)$$

where w_i^r and w_i are the regional and national wage compensation (wages and salaries), respectively, corresponding to commodity *i*. Figures 4.2(a) and 4.2(b) illustrate the resulting wage shares by sector and region of the country. By and large, these shares corroborate the findings of the corresponding employment shares (Figure 4.1) and SLQ (Table 4.1), regarding (a) the increased sectoral shares of specific peripheral regions, such as in Agriculture, forestry, and fishing in Peloponnisos; Mining and quarrying, and Electricity, gas, steam, and air conditioning supply in Dytiki Makedonia; Manufacturing in Sterea Ellada and Wholesale and retail trade, and Accommodation and food service activities in Notio Aigaio and (b) the dominance of the region of Attiki in all sectors of economic activity, except for Agriculture, forestry, and fishing, and Mining and quarrying, as well as its diverse specialisation, especially in sectors of services.

These sectoral and regional patterns of economic activity across the country also become obvious when we illustrate the total intermediate demand shares, as they are obtained from the use of the AFLQ method and CHARM and shown in Figures 4.3 and 4.4, respectively. It should be stressed here that, although the increased shares of demand in specific sectors in the island regions (Ionia Nisia, Voreio Aigaio, Notio Aigaio, Kriti), the latter regions, together with those of Attiki, Peloponnisos, and Dytiki Ellada, generally exhibit higher sectoral diversity, compared to the other regions of mainland Greece, i.e., Anatoliki Makedonia and Thraki, Kentriki Makedonia, Dytiki Makedonia, Ipeiros, Thessalia, and Sterea Ellada (Figure 4.3(b) and Figure 4.4(b)).

FIGURE 4.2
Wage shares (a) by sector and (b) by region



Source: Authors' own calculations.

In order to determine the degree of sectoral diversity, or, inversely, the degree of sectoral concentration in regional intermediate demand, we calculate the Herfindahl-Hirschman index (HHI), which provides us with a measure of sectoral concentration in each region (Hirschman, 1945; Herfindahl, 1950), as follows:

$$HHI_z^r = \sum_i \left(\frac{z_i^r}{\sum_i z_i^r} \right)^2 . \tag{4.2}$$

Equation (4.2) defines the measure of sectoral concentration as the weighted arithmetic mean of the sectoral shares z_i^r of the intermediate demand in region r, with the sectoral shares themselves being used as the weights. Correspondingly, the degree of sectoral concentration in regional gross output is calculated as

$$HHI_x^r = \sum_i \left(\frac{x_i^r}{\sum_i x_i^r} \right)^2 . \tag{4.3}$$

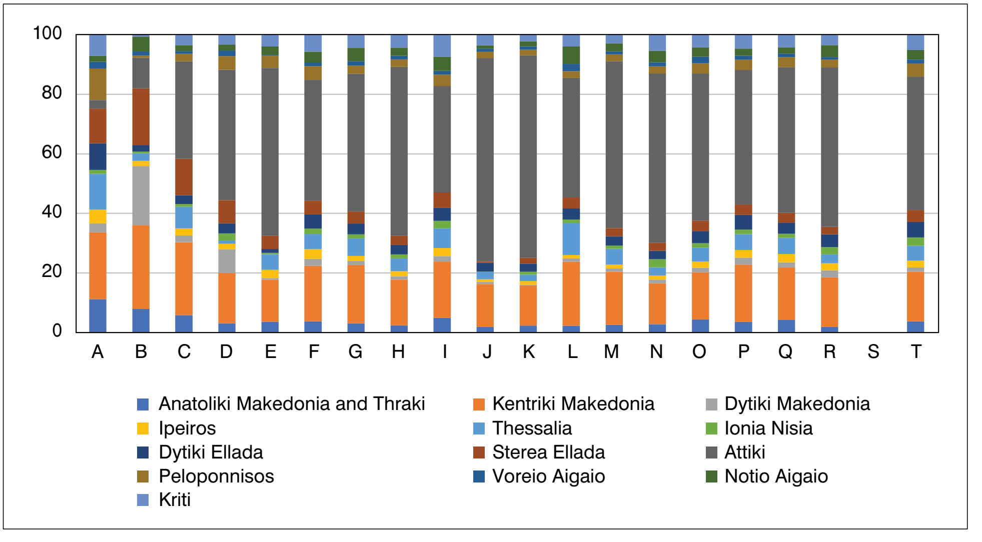
Finally, the degree of sectoral concentration in regional final household consumption (i.e., the portion of regional final demand assigned to household consumption c_i^r of commodity i in region r) is given as

$$HHI_c^r = \sum_i \left(\frac{c_i^r}{\sum_i c_i^r} \right)^2 . \tag{4.4}$$

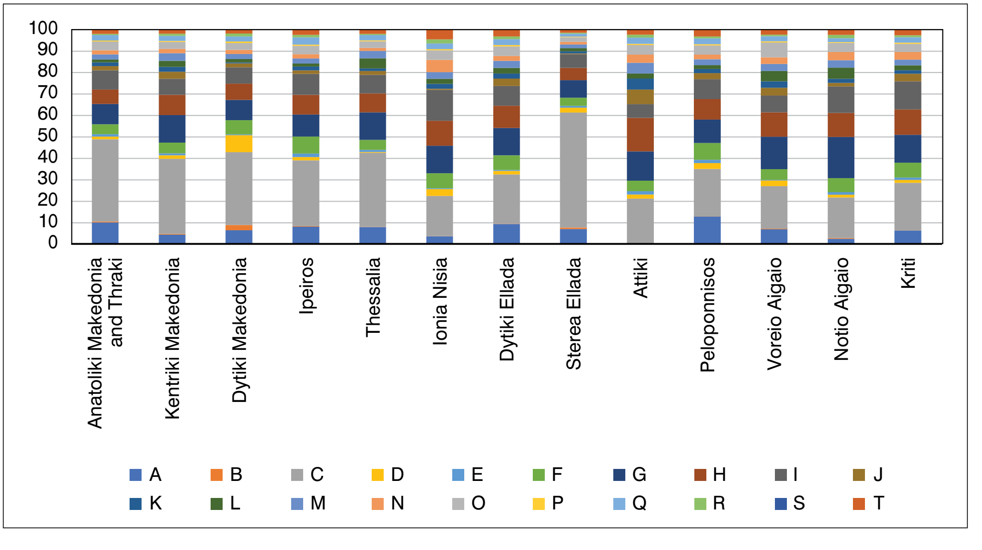
In all the above cases, the larger the value of HHI^r, the higher (lower) the degree of sectoral concentration (diversity) in region r. By definition, $1/N \leq HHI^r \leq 1$, namely, $HHI = 1$ if the regional variable under investigation is completely concentrated (in some industry i), and $HHI = 1/N$ (here, $1/20 = 0.05$ or 5%) if all $N = 20$ industries incur exactly equal shares.

FIGURE 4.3
Total intermediate demand shares (a) by sector and (b) by region, according to the AFLQ method

(a)



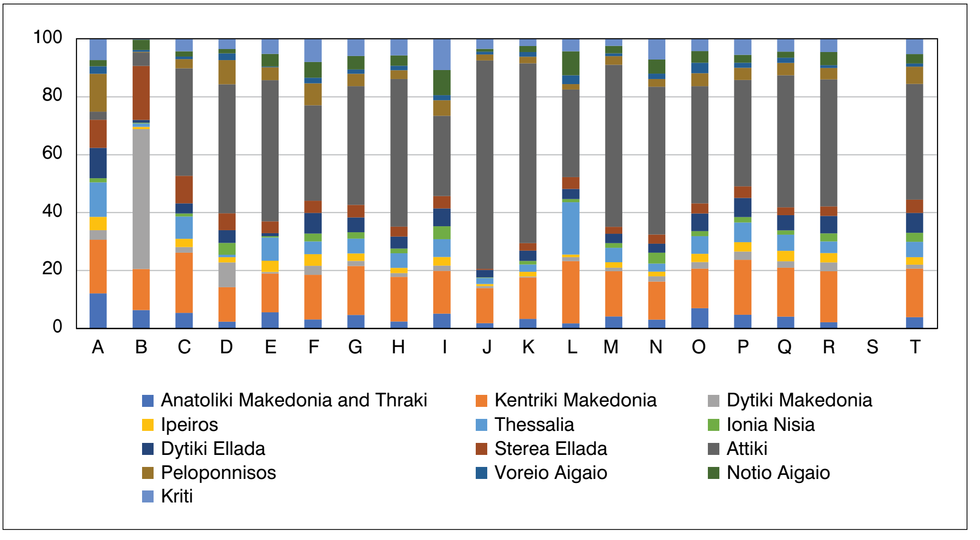
(b)



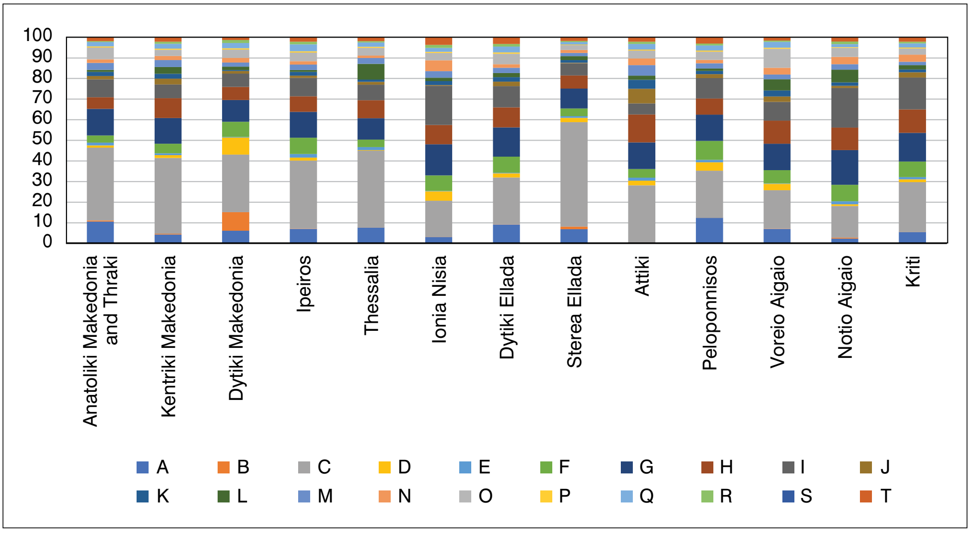
Source: Authors' own calculations.

FIGURE 4.4
Total intermediate demand shares (a) by sector and (b) by region, according to CHARM

(a)



(b)



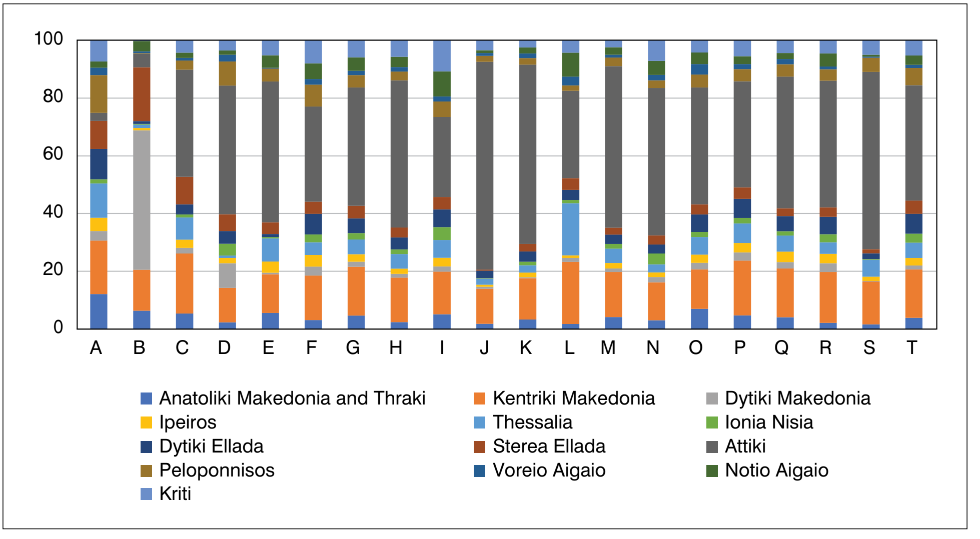
Source: Authors' own calculations.

The relatively high sectoral concentration or the limited sectoral diversity in intermediate demand of these six regions of mainland Greece can be primarily attributed to the increased participation of manufacturing in the total intermediate demand of these regions. These findings are also largely verified by the sectoral patterns of gross output shares across the Greek regions (Figure 4.5(b)). Nevertheless, in the latter case, it is noted that the region of Notio Aigaio presents an increased degree of sectoral concentration, following the regions of Sterea Ellada and Thessalia, which are the most sectorally concentrated (or the least sectorally diversified) in gross output. Furthermore, the analysis of the sectoral patterns of regional final private (household) consumption, as obtained from the use of the AFLQ method and CHARM and illustrated in Figures 4.6(b) and 4.7(b), respectively, denotes that Notio Aigaio and Voreio Aigaio are the second and third most sectorally concentrated regions of the country, following the region of Thessalia. Figure 4.8 provides a graphical comparison of the degree of sectoral concentration (*HHI*) of the Greek regions in terms of the intermediate demand, gross output, and household consumption demand.

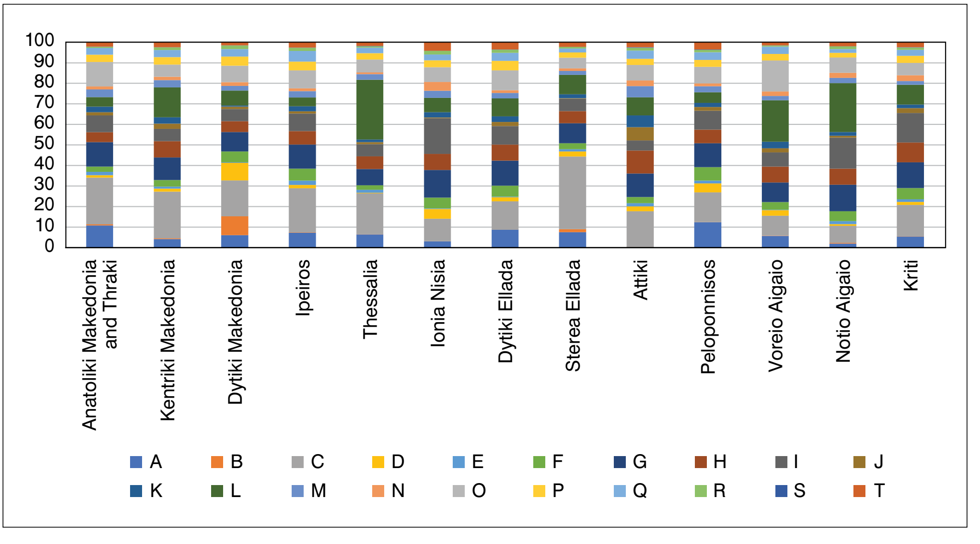
Regarding the estimation of the parameters used in the AFLQ method, Figure 4.9 presents the estimated values of λ and δ. As expected, both of these values tend to vary across the Greek regions, being higher for the most highly and densely populated regions of Attiki ($\delta=0.26$) and, to a lesser extent, Kentriki Makedonia ($\delta=0.19$), while they receive lower values as the magnitude of output and employment declines, reaching their lowest values (around $\delta=0.1$) for the region of Dytiki Makedonia and the island regions of Voreio Aigaio and Ionia Nisia. These results as a whole can be regarded as plausible according to the relevant scholarly literature, where typical values for the δ parameter range between 0.1 and 0.2 (or slightly higher) for the AFLQ (Flegg et al., 2016) and do not significantly depart from those of other similar applications (see, e.g., Lampiris et al., 2020).

FIGURE 4.5
Gross output shares (a) by sector and (b) by region

(a)



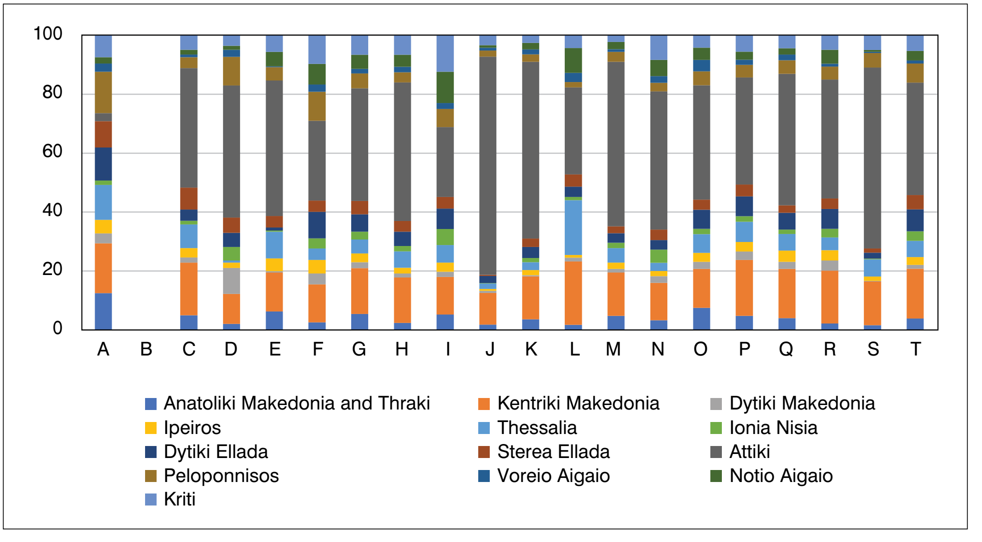
(b)



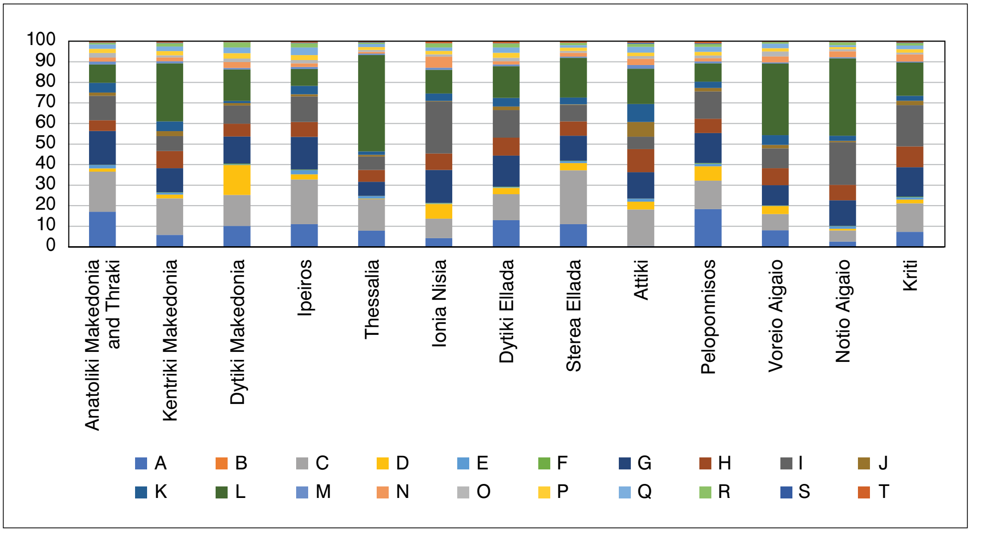
Source: Authors' own calculations.

FIGURE 4.6
Final household consumption expenditure shares (a) by sector and (b) by region, according to the AFLQ method

(a)



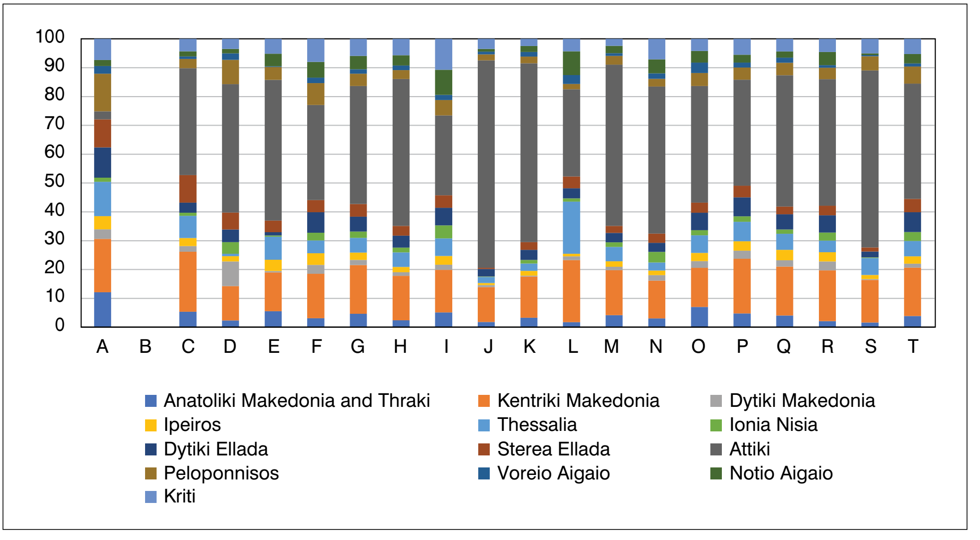
(b)



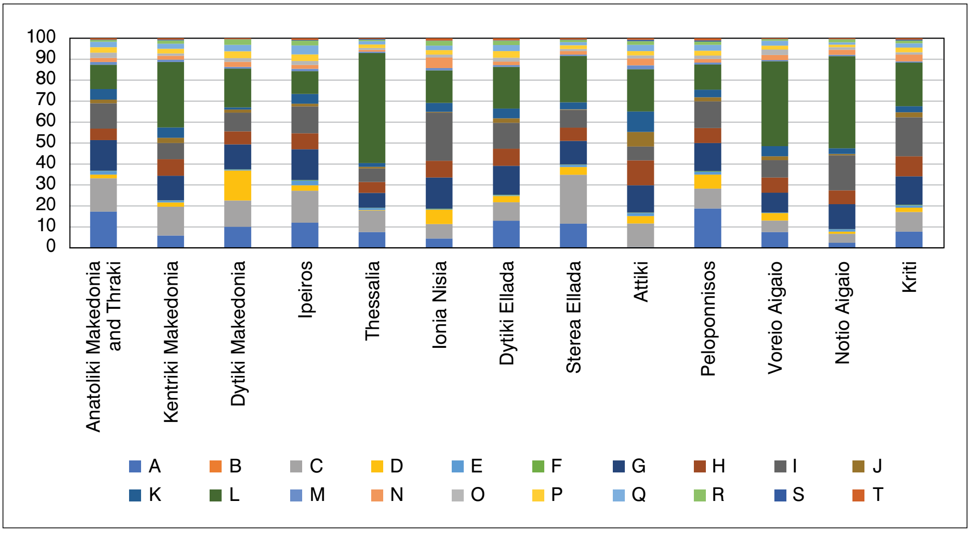
Source: Authors' own calculations.

FIGURE 4.7
Final household consumption expenditure shares (a) by sector and (b) by region, according to CHARM

(a)

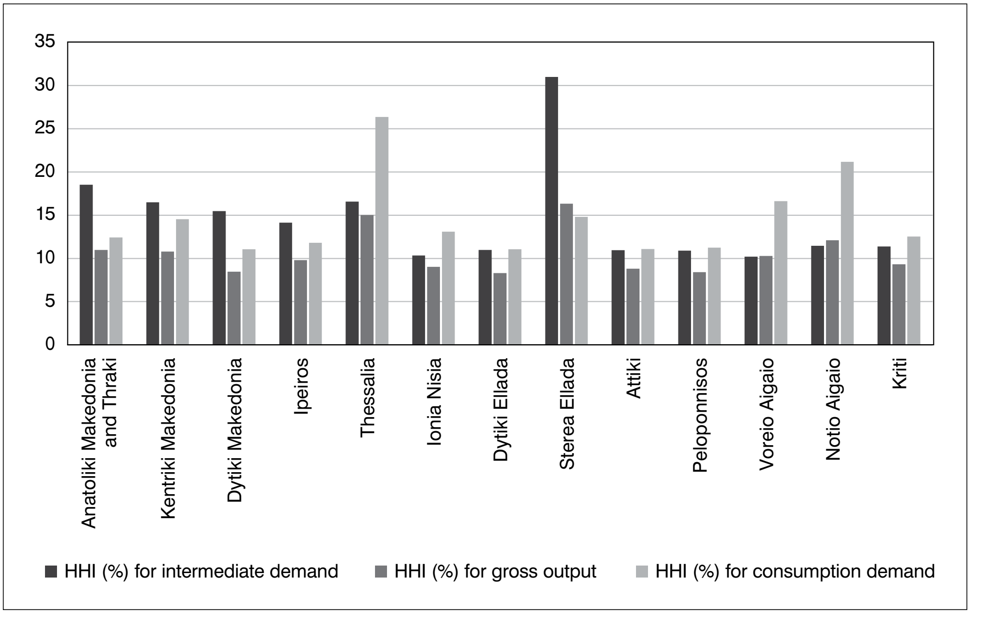


(b)



Source: Authors' own calculations.

FIGURE 4.8
Sectoral concentration index (HHI) across the Greek regions for the intermediate demand, gross output, and household consumption demand

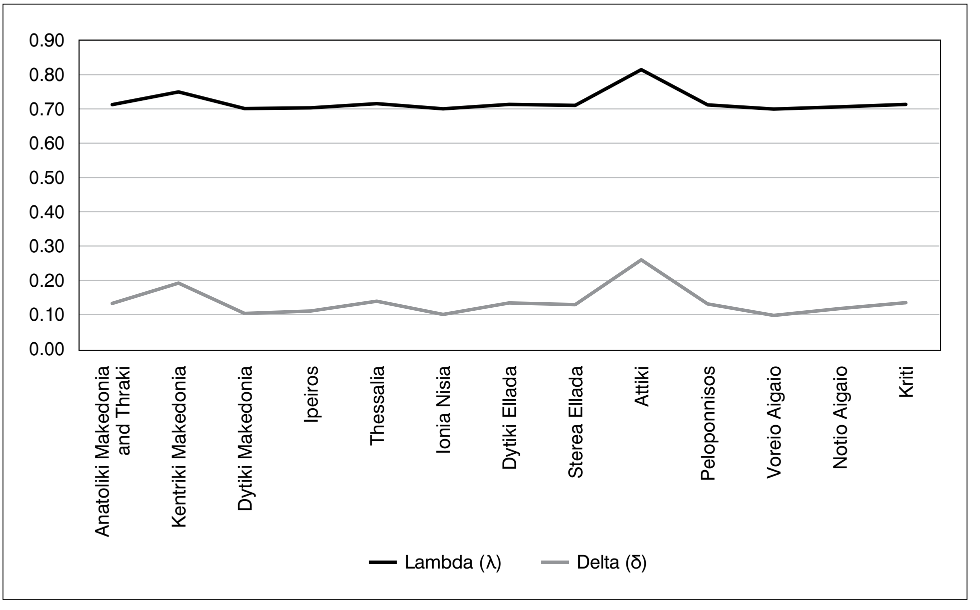


Source: Authors' own calculations.

Note: The estimation of the regional intermediate demand and regional household consumption demand are based on the AFLQ method.

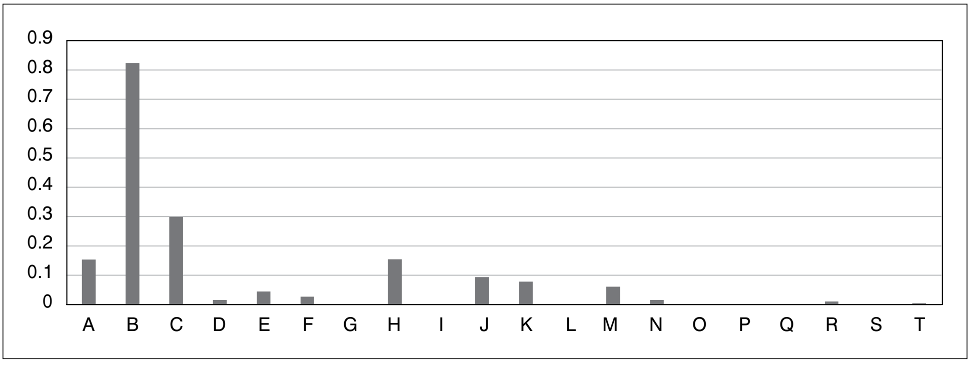
As far as the estimation of the parameters used in CHARM is concerned, Figure 4.10 presents the estimated values of product heterogeneity *h* by sector, while Figure 4.11 shows the estimated values of cross-hauling *q* by region and by sector of the Greek economy. The *h* values verify the considerable heterogeneity underlying the various industries, ranging from the very highly heterogeneous commodities of Mining and quarrying ($h = 0.82$) and the highly heterogeneous commodities of Manufacturing ($h = 0.30$) to the medium heterogeneity of Agriculture, forestry, and fishing, and Transportation and storage (both with $h = 0.15$) and the very low heterogeneity of several sectors mostly belonging to services (Figure 4.10).

FIGURE 4.9
Estimated values of (a) the lambda (λ) parameter and (b) the delta (δ) parameter for the AFLQ model



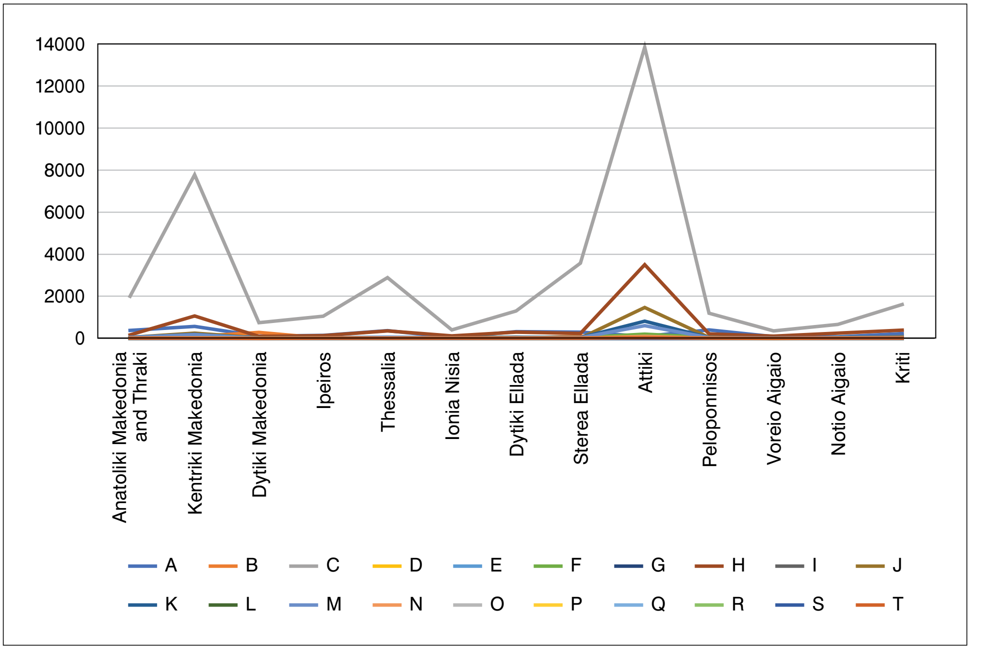
Source: Authors' own calculations.

FIGURE 4.10
Product heterogeneity by sector



Source: Authors' own calculations.

FIGURE 4.11
Cross-hauling by region and sector



Source: Authors' own calculations.

The degree of product heterogeneity affects the magnitude of cross-hauling, in combination with the sectoral composition and the size of each region (see equation (3.20)). More specifically, as expected, the largest and most urbanised region, Attiki, involves the greatest magnitude of cross-hauling in the sector of Manufacturing, with the second largest region, Kentriki Makedonia, following in order in the same sector. All other regions (particularly, Sterea Ellada, Thessalia, Anatoliki Makedonia and Thraki, Kriti, Dytiki Ellada, Peloponnisos, Ipeiros) also exhibit increased cross-hauling in the sector of Manufacturing. In addition, the regions of Attiki and, to a lesser extent, Kentriki Makedonia demonstrate increased cross-hauling in the sector of Transportation and storage. Furthermore, the region of Attiki shows increased cross-hauling in some services sectors, such as Information and communication and Financial and insurance activities, while the region of Kentriki Makedonia shows increased cross-hauling in the sector of Agriculture, forestry, and fishing.

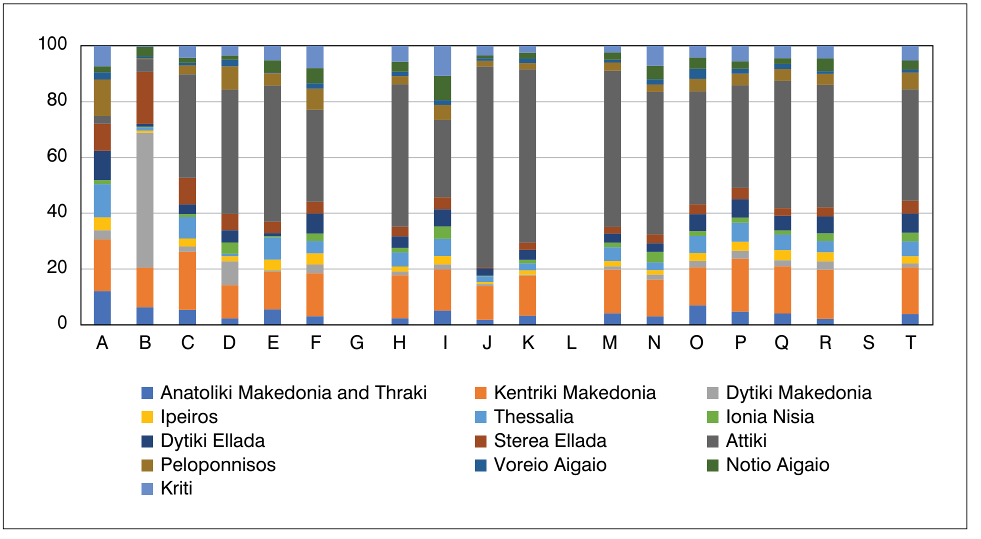
Figures 4.12 and 4.13 illustrate the distribution of the estimated regional imports and exports by sector and by region, respectively. Both imports and exports are found to present quite diverse sectoral and regional patterns. More specifically, the Manufacturing sector concentrates the largest volume of imports, with the regions of Sterea Ellada, Thessalia, and Kentriki Makedonia being the most reliant on import activity. Accommodation and food service activities is the second most import-intensive sector, with the island regions of Notio Aigaio, Ionia Nisia, and Kriti being the most dependent on imports. Public administration and defence and Construction are found to be the third and fourth most import-intensive sectors of the Greek economy.

Manufacturing is also the most export-intensive sector, with Sterea Ellada having the largest volume of exports. Real estate activities is found to be the second most export-intensive sector, with the island region of Notio Aigaio having the most exports of these services. Transportation and storage is found to be the third most export-intensive sector, with the region of Kriti producing the most exports of these services. There is also a considerable amount of export activity in the sector of Agriculture, forestry, and fishing, with the region of Peloponnisos exporting most of these commodities.

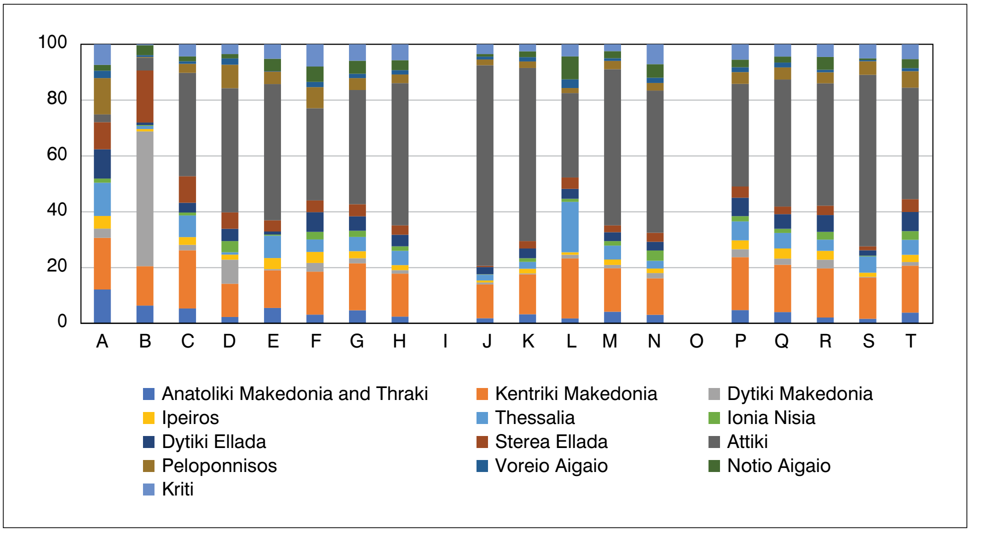
Finally, Figures 4.14 and 4.15 illustrate the estimated volume of trade and the next exports (exports-imports) by sector and by region, respectively. At the sectoral level, Manufacturing carries the largest volume of trade, with the sectors of Transportation and storage, Real estate activities, and Accommodation and food service activities following in order. However, Manufacturing and Accommodation and food service activities are the sectors with the most negative net exports. Conversely, Real estate activities and Transportation and storage are the sectors with the largest (most positive) net exports (Figure 4.14).

FIGURE 4.12
Distribution of (a) regional imports and (b) regional exports by sector

(a)



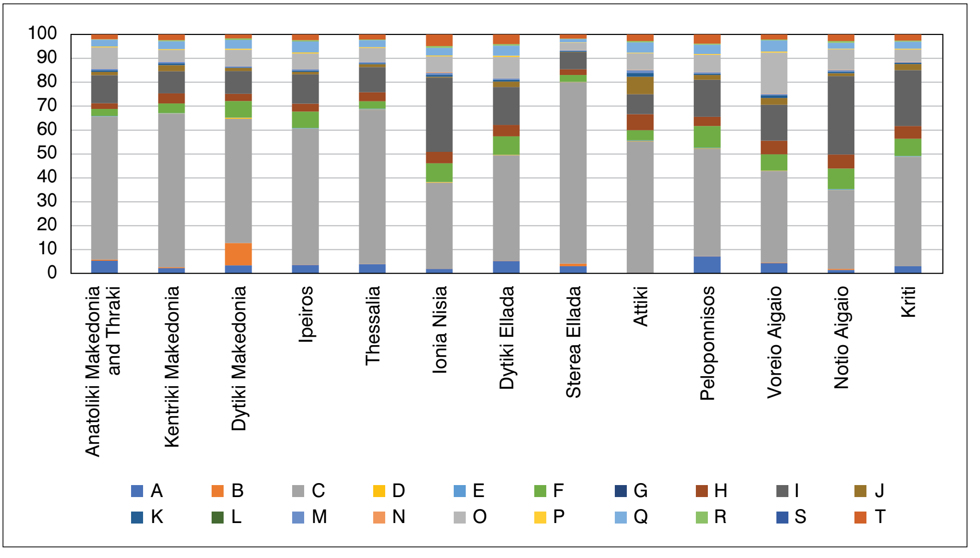
(b)



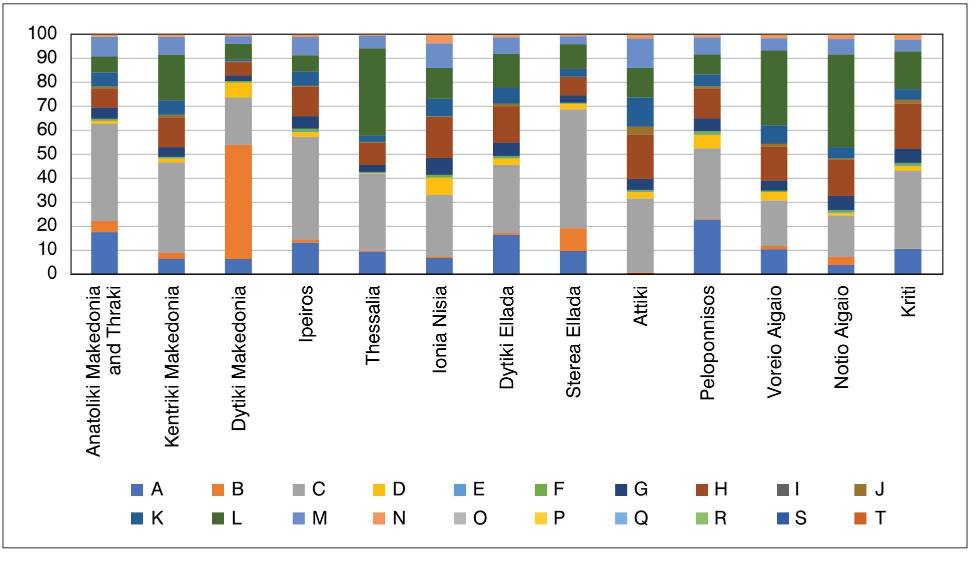
Source: Authors' own calculations.

FIGURE 4.13
Distribution of (a) sectoral imports and (b) sectoral exports by region

(a)

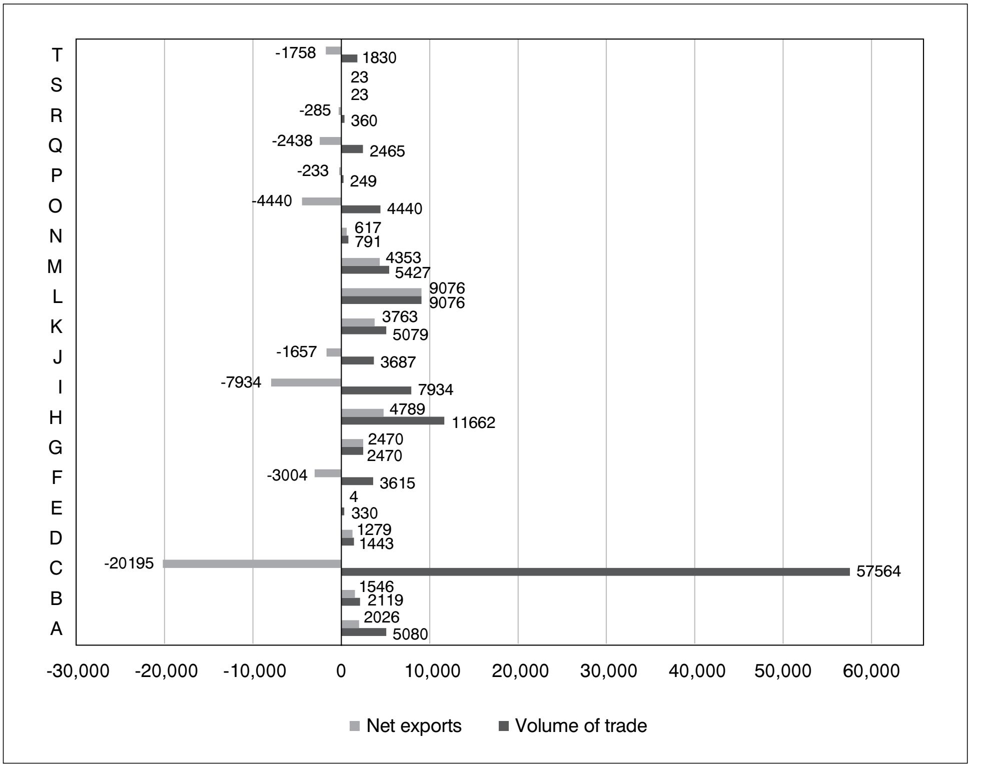


(b)



Source: Authors' own calculations.

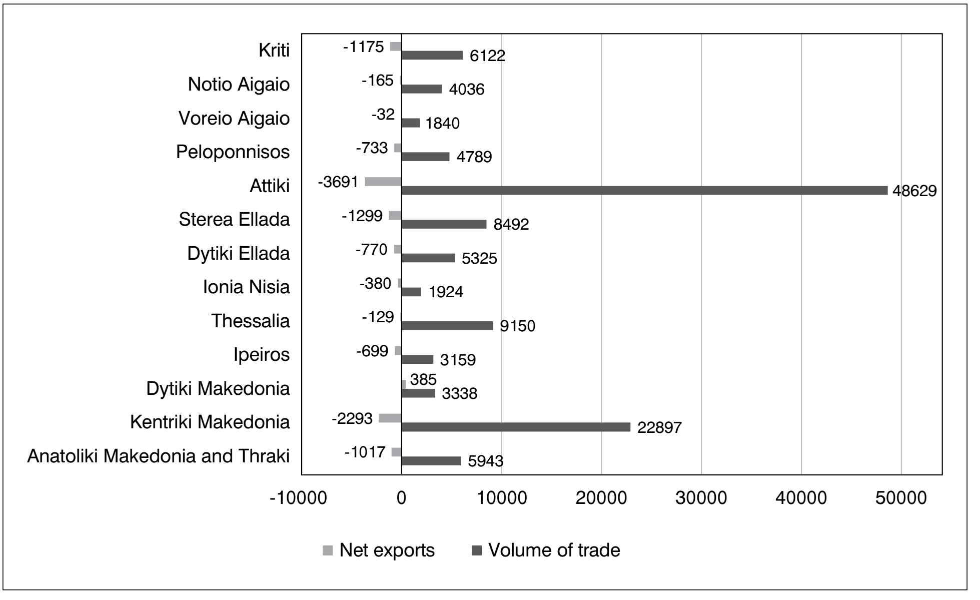
FIGURE 4.14
Volume of trade and net exports by sector



Source: Authors' own calculations.

At the regional level, the distribution of the volume of trade largely follows the distribution of the size of regions. Moreover, Attiki and Kentriki Makedonia are the regions with the most negative net exports. Dytiki Makedonia is the only Greek region with positive net exports. It is also noted that the island regions of Voreio Aigaio, Notio Aigaio, and Ionia Nisia, as well as the region of Thessalia, have larger (less negative) net exports compared to Kriti and the rest of the mainland regions (Figure 4.15).

FIGURE 4.15
Volume of trade and net exports by region



Source: Authors' own calculations.

CHAPTER 5

MULTIPLIERS FOR THE WHOLE ECONOMY AND REGIONS OF GREECE

5.1. Multiplier values of the Greek economy

In this section, we examine the multiplier values of the whole economy of the country, considering the cases where imports are either not included or are explicitly taken into account. In the former case, we refer to multipliers without imports, as if we were to consider the current production structure of the economy while overlooking the fact that part of it is imported. Essentially, we are examining how the economy produces using all the available technical coefficients, but ignoring the parts that it gets from other countries. This method of analysis helps us better understand a crucial fact: when we start considering the commodities we do import, i.e., in terms of multipliers with imports, we can determine how much each sector of the Greek economy relies on imports, as well as how much each region and region-sector depends on these imports. This step-by-step method gives us a clear picture of how our economy is connected with and dependent upon the rest of the world.

5.1.1. Multipliers without imports

The application of the IO analysis of the Greek economy for the year 2015 yields the net output, employment, and imports, which are summarised in Table 5.1.1. The first row of Table 5.1.1 shows that an increase (decrease) of one monetary unit in the autonomous demand for "Agriculture, forestry, and fishing" (A) induces an increase (decrease) of 1.2 monetary units in net output and an increase (decrease) of 61 units in employment. Thus, it follows that an increase (decrease) of €1 million in the autonomous demand induces, on average, an increase (decrease) of €1.2 million in net output and of 61 persons in employment. The remaining rows of this table are read in the same way.

For a more detailed analysis, Figure 5.1.1 offers a visual representation of the multiplier values of output and employment to enhance understanding through a more nuanced perspective. Specifically, Figure 5.1.1 (similar to the subsequent ones in this section) comprises a ‘heat map’: a graphical representation of data where the individual values contained in the matrix are represented as colours. This illustration dissects the values on individual sectors rather than providing a total view of the entire economy as encapsulated in Table 5.1.1. In particular, within the matrix plot of Figure 5.1.1, the numerical representation is replaced by a spectrum of orange hues. Each cell’s luminosity correlates with its value: the brighter the cell, the higher the value it represents. Conversely, a cell that approaches the purity of white indicates a value nearing zero. This representation not only captures the magnitude of each element, but it also offers a visual guide to the distribution and intensity of values within the matrix. As it can be clearly observed in these heat maps, the brighter orange values refer to the diagonal cells of the matrices, which correspond to the intrasectoral multipliers of the national economy as well as of the economy of each region (Section 5.3).

To further enhance the clarity and utility of the diagrams, it is essential to provide a detailed walkthrough of how to interpret the visual elements, to ensure readability for a broader audience. For example, the heat maps in Figure 5.1.1 are organised such that each axis represents a specific sector, with the rows indicating the sector experiencing a change in autonomous demand and the columns reflecting the sectors impacted by that change. The diagonal cells, with their brighter orange hues, signify the intrasectoral multipliers, where changes in demand within a sector predominantly affect its own output or employment. In contrast, off-diagonal cells highlight intersectoral linkages, showcasing the broader economic ripple effects of demand changes across different sectors. This configuration allows readers to visually discern patterns of economic interdependence and identify sectors that serve as key drivers of economic activity.

Moreover, the heat maps are particularly valuable in revealing the relative intensity of sectoral responses. By substituting numerical values with a gradient of orange hues, the diagrams provide an intuitive understanding of the magnitude of each multiplier. For instance, in the Agriculture, forestry, and fishing sector, the brighter diagonal one cell, underscores its strong intrasectoral impact, while lighter off-diagonal cells illustrate its more limited influence on other sectors. This dual perspective, combining quantitative precision from Table 5.1.1 with the qualitative insights of the heat maps, not only aids in identifying high-leverage sectors for targeted policy interventions but also fosters a deeper understanding of the structural complexity underlying the Greek economy in 2015. These visual tools thus serve as a bridge between complex numerical analysis and actionable insights, making them indispensable for both researchers and policymakers.[10]

Next, we can detect which of these industries are characterised by output multipliers that are above the corresponding average of the whole economy. These industries are Mining and quarrying, and Administrative and support service activities; Public administration and defence; compulsory social security; Education; Human health and social work activities; Arts, entertainment, and recreation; Activities of households as employers, and Other service activities. The employment multipliers that are above the corresponding average of the whole economy are: Agriculture, forestry, and fishing; Construction; Wholesale and retail trade; repair of motor vehicles and motorcycles; Education; Human health and social work activities; Activities of households as employers.

Hence, we can easily identify the industries where both output multipliers and employment multipliers are above the average multipliers of the whole economy. These industries can be regarded as key commodities for the deployment of an effective demand management policy. Such a policy constitutes a strategic approach used by economic policymakers to stimulate a country's short-term goals that correspond to economic growth and employment levels. By increasing investments, exports, and government expenditures, policymakers can leverage the multiplier value to amplify the impact on the country's GDP. This multiplier value refers to the phenomenon where an initial increase in spending leads to an increase in national income and jobs.

[10] Note that all heat maps in this study follow the same interpretive framework.

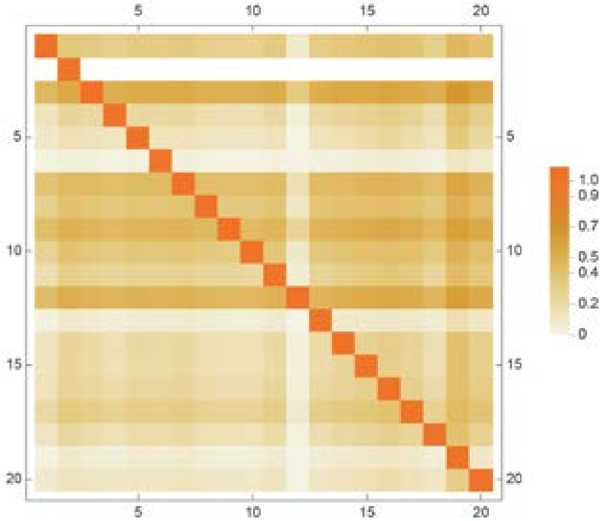
TABLE 5.1.1
Output and employment multipliers (without imports) by industry for the Greek economy

No.	Industries	Output multipliers (without imports)	Employment multipliers (without imports)
1	A	1.200240	61.091400
2	B	1.434840	28.037400
3	C	1.350440	31.260500
4	D	1.285550	17.812500
5	E	1.360260	20.424300
6	F	1.348370	36.171900
7	G	1.386190	36.069200
8	H	1.303770	23.984100
9	I	1.277660	34.261500
10	J	1.276720	19.073200
11	K	1.368520	21.749100
12	L	1.055340	3.060550
13	M	1.342770	30.988600
14	N	1.433610	34.605700
15	O	1.516630	30.572300
16	P	1.640290	47.098800
17	Q	1.505280	39.297000
18	R	1.305460	26.715500
19	S	2.300850	117.514000
20	T	1.607180	32.370200
	Economy's Average	**1.415000**	**34.607880**

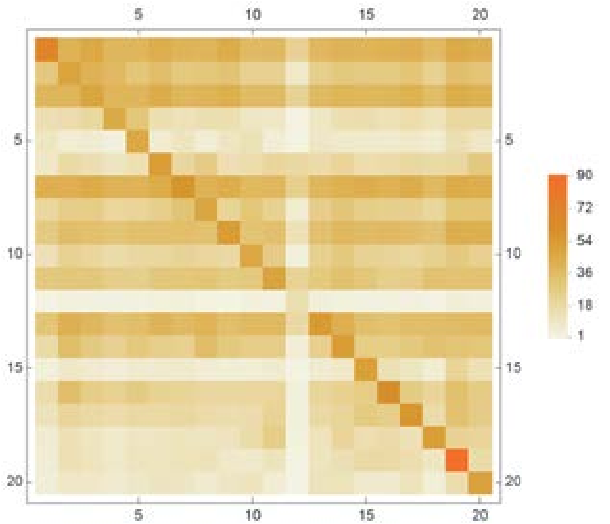
Source: Authors' own calculations.

FIGURE 5.1.1
The matrices of (a) output and (b) employment multipliers (without imports) for the 20 sectors of the Greek economy

(a)



(b)



Source: Authors' own calculations.

All of these industries belong to services and are Education; Human health and social work activities; and Activities of households as employers. This is confirmed by Table 5.1.2, which shows the multipliers for the primary products, industry, and services of the Greek economy. However, none of the key industries are characterised by an incremental output-employment ratio, i.e., an output multiplier relative to an employment multiplier, that is above the economy's average.

As shown in Table 5.1.3, the industries that are characterised by an incremental output-employment ratio above average are: Mining and quarrying; Manufacturing; Electricity, gas, steam, and air conditioning supply; Water supply; sewerage, waste management, and remediation activities; Transportation and storage; Information and communication; Financial and insurance activities; Real estate activities; Public administration and defence; compulsory social security; Arts, entertainment, and recreation; and Other service activities. Since the above analysis represents the Greek economy in the case where it operates as a self-sufficient economy without the need for imports, we will next move on to the realistic case of an open economy.

TABLE 5.1.2
Output and employment multipliers (without imports) by broad sector for the Greek economy

Sectors	Output multipliers (without imports)	Employment multipliers (without imports)
Primary	1.31754	44.5644
Industry	1.336155	26.4173
Services	1.451448	35.525696

Source: Authors' own calculations.

TABLE 5.1.3
Ratio of output-employment multipliers (without imports) by industry for the Greek economy

No.	Industries	Output-employment multipliers (without imports) ratio
1	A	0.01964663
2	B	0.05117593
3	C	0.04319956
4	D	0.07217123
5	E	0.06660008
6	F	0.03727673
7	G	0.0384314
8	H	0.05435976
9	I	0.03729142
10	J	0.0669379
11	K	0.06292306
12	L	0.34482038
13	M	0.0433311
14	N	0.04142699
15	O	0.04960798
16	P	0.03482658
17	Q	0.03830521
18	R	0.04886527
19	S	0.01957937
20	T	0.04964999
	Economy's Average	**0.04088664**

Source: Authors' own calculations.

5.1.2. Multipliers with imports

Table 5.1.4 presents the results of the application of the IO analysis of the Greek economy regarding the net output (with imports), import, and employment (with imports) multipliers. In the first row of the table, the import multiplier shows that an increase (decrease) of one monetary unit in the autonomous demand for "Agriculture, forestry, and fishing" induces an increase (decrease) of 0.28 monetary units or of €0.28 million of imports. For a more detailed analyses, Figure 5.1.2 provides a visual representation of the output, import, and employment, when we consider imports.

Hence, we can detect which of these industries are characterised by an output multiplier value that is above the average multiplier of the economy. These industries are: Wholesale and retail trade; repair of motor vehicles and motorcycles; Financial and insurance activities; Professional, scientific, and technical activities; Administrative and support service activities; Public administration and defence; compulsory social security; Education; Human health and social work activities; Arts, entertainment, and recreation; Activities of households as employers; and Other service activities.

Correspondingly, the industries that are characterised by an employment multiplier value above the national average are: Wholesale and retail trade; repair of motor vehicles and motorcycles; Administrative and support service activities; Education; Human health and social work activities; and Activities of households as employers; and Other service activities. Furthermore, the industries that are characterised by an import multiplier value above the national average are the same with one exception: Activities of households as employers. Finally, the industries that have both output and employment multipliers above the national average (when we consider imports) all belong to the Services sector.

Table 5.1.5 shows the output, import, and employment multipliers when we consider imports for the three broad sectors of the economy. Among other things, this table shows the high dependence of the Primary products sector and the Industry sector on imports. Furthermore, given that the incremental output-employment ratios can be conceived as labour productivity indices, it can be argued that industries characterised by a relatively high (above average) labour productivity index are different from those key industries suitable for effective demand management policy. This is because, when there is a target for more spending on infrastructure, the former industries will experience not only direct employment growth but also an increase in demand, leading to further job creation and economic activity.

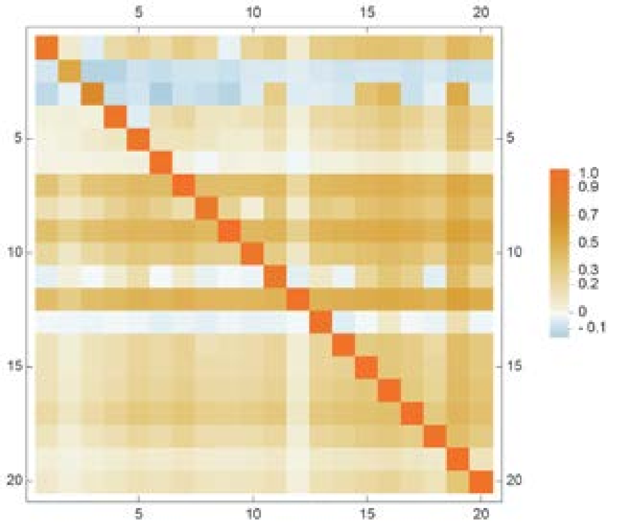
TABLE 5.1.4
Output and employment multipliers (with imports) by industry for the Greek economy

No.	Industries	Output multipliers (imports)	Import multipliers	Employment multipliers (imports)
1	A	0.839229	0.281657	48.290500
2	B	0.141035	0.902877	2.674090
3	C	0.481946	0.637301	11.539000
4	D	0.883528	0.294506	9.990170
5	E	1.031970	0.241447	14.034200
6	F	0.908244	0.323382	26.097600
7	G	1.144180	0.178573	30.711000
8	H	0.908883	0.296038	15.877900
9	I	0.970392	0.226458	27.181800
10	J	1.000590	0.209587	13.916900
11	K	1.052880	0.231825	15.860300
12	L	1.011320	0.032389	2.112310
13	M	1.114820	0.168690	25.901300
14	N	1.158460	0.202220	28.505500
15	O	1.305430	0.155805	25.877000
16	P	1.428400	0.156164	42.308900
17	Q	1.227160	0.204583	33.028300
18	R	1.129330	0.130468	22.908000
19	S	1.906840	0.290758	108.585000
20	T	1.305870	0.221289	25.671100
	Economy's Average	**1.047530**	**0.269301**	**26.553600**

Source: Authors' own calculations.

FIGURE 5.1.2
The matrices of (a) output, (b) imports, and (c) employment multipliers (with imports) for the 20 sectors of the Greek economy

(a)



(b)

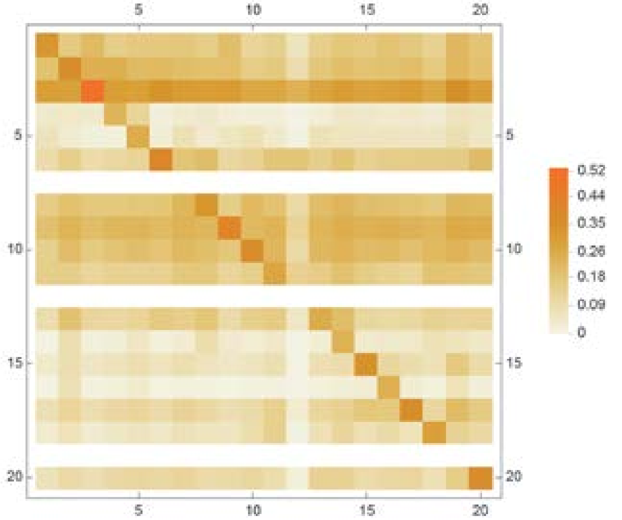
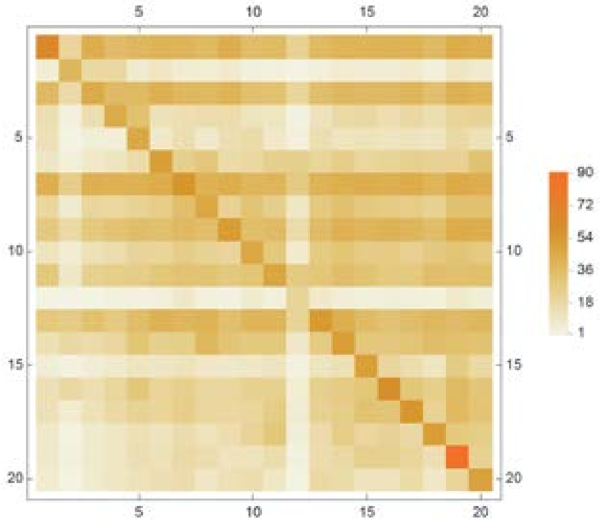


FIGURE 5.1.2 (continued)

(c)



Source: Authors' own calculations.

TABLE 5.1.5
Output, import, and employment multipliers (with imports), and output-employment multiplier ratios by broad sector for the Greek economy

Sectors	Output multipliers (with imports)	Import multipliers	Employment multipliers (with imports)	Output-employment multipliers (with imports) ratio
Primary	0.490132	0.592267	25.482295	0.01923422
Industry	0.826422	0.374159	15.415243	0.0536107
Services	1.190325	0.193203	29.888951	0.03982492

Source: Authors' own calculations.

Specifically, the Primary sector shows a moderate output multiplier of 0.49, suggesting that each unit of output in this sector generates less than half a unit in the wider economy. However, it has a relatively high import multiplier of 0.59, indicating a significant reliance on imports. Employment in this sector is substantial, yet its productivity index is the lowest, suggesting lower efficiency or value added per worker.

In contrast, the Industry sector demonstrates a stronger output multiplier of 0.826, meaning each unit of output significantly influences the overall economy. Its import multiplier is lower, at 0.374, indicating less dependence on imported goods or services. Furthermore, its productivity index is considerably high, at 0.054, reflecting greater efficiency compared to the Primary sector.

Finally, the Services sector has the highest output multiplier, at 1.19, indicating a strong ripple effect on the economy for each unit of output. It has the lowest import multiplier, at 0.193, suggesting a high degree of self-sufficiency. Employment is the highest among the sectors, and the productivity index stands at almost 0.04, which is higher than the Primary sector but lower than the Industry sector. These data collectively provide insights into how each broad sector of the country contributes to the overall economic landscape in terms of output, imports, employment, and productivity.

From Table 5.1.6, we can identify the industries that are characterised by a relatively high (above average) labour productivity index. These high-productivity industries are: Mining and quarrying; Manufacturing; Electricity, gas, steam, and air conditioning supply; Water supply; sewerage, waste management, and remediation activities; Transportation and storage; Information and communication; Financial and insurance activities; Real estate activities; Professional, scientific, and technical activities; Administrative and support service activities; Public administration and defence; compulsory social security; Arts, entertainment, and recreation; and Other service activities.

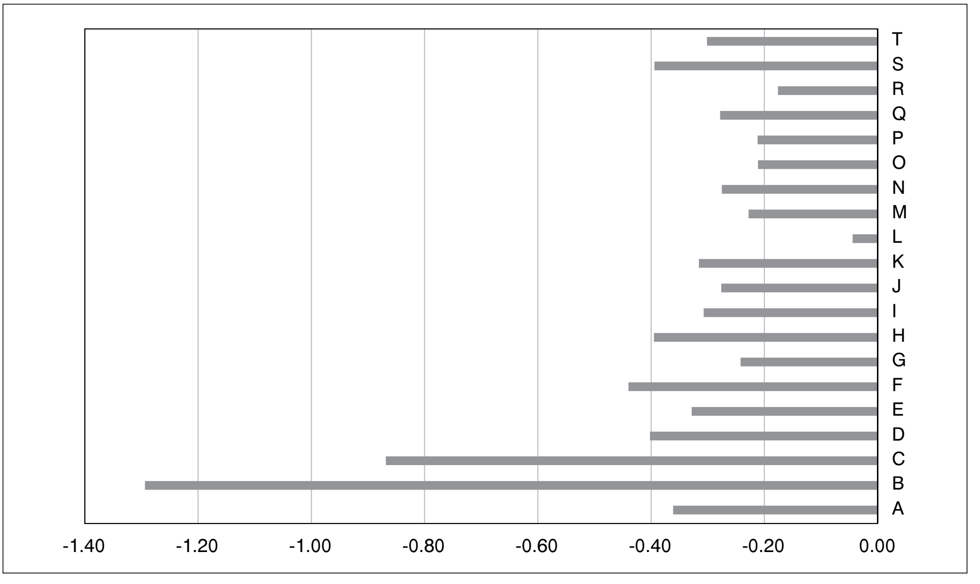
These findings imply that a long-term policy should be directed towards those industries that are characterised by high labour productivity indices. However, we should note that all the industries of the Primary and Secondary sectors are characterised by high import dependency (i.e., a low output multiplier relative to the import multiplier), while all the industries of Services – except for Transportation and storage activities – are characterised by low import dependency. Figure 5.1.3 illustrates the

TABLE 5.1.6
Output-employment (with imports) and output (with imports)-import multipliers by sector of the Greek economy

No.	Industries	Output-employment multipliers (with imports) ratio	Output (with imports) -import multipliers ratio
1	A	0.01737876	2.9796135
2	B	0.05274131	0.15620622
3	C	0.0417667	0.75622979
4	D	0.08843974	3.00003396
5	E	0.07353251	4.2741057
6	F	0.03480182	2.80857933
7	G	0.03725636	6.40735162
8	H	0.05724202	3.07015653
9	I	0.03570006	4.28508598
10	J	0.07189748	4.77410336
11	K	0.06638462	4.54170171
12	L	0.47877442	31.2246631
13	M	0.04304108	6.6086905
14	N	0.04063988	5.7287113
15	O	0.0504475	8.37861429
16	P	0.03376122	9.1467944
17	Q	0.0371548	5.99834786
18	R	0.0492985	8.65599227
19	S	0.0175608	6.55816865
20	T	0.05086927	5.90119708
	Economy's Average	**0.03944964**	**3.88981103**

Source: Authors' own calculations.

FIGURE 5.1.3
Difference between output multipliers with and without imports by sector of the Greek economy



Source: Authors' own calculations.

difference between output multipliers with and without imports by industry for the Greek economy.

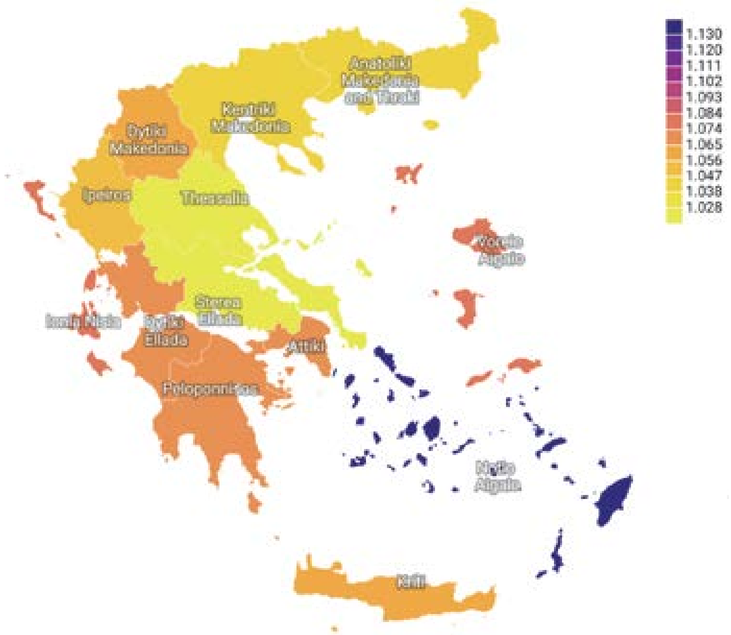
From the above results, it is clear that – more or less – all industries are dependent on imports, with the most remarkable dependency observed in Mining and quarrying activities. Finally, focusing on the comparison of productivity, we conclude that, in the case of the open economy, there are more industries whose productivity index exceeds the average productivity of the national economy, compared to the case of the closed economy (without imports).

5.2. Regional multipliers for the Greek economy

In this section, we present the results of the various multipliers for the whole economy of each region of the country. Map 5.2.1 visualises the arithmetic mean of the output multipliers (with imports) for all the NUTS-2 regions of Greece. According to our estimates, we can distinguish four groups of regions that are characterised by similar output multipliers, in terms of order of magnitude, as follows:

- The first group consists of the regions of Notio Aigaio, Voreio Aigaio, and Ionia Nisia, with output multipliers in the range of 1.077 to 1.139.
- The second group consists of the regions of Dytiki Ellada, Attiki, Peloponnisos, and Kriti, with output multipliers in the range of 1.060 to 1.070.
- The third group consists of the regions of Anatoliki Makedonia and Thraki, Kentriki Makedonia, Dytiki Makedonia, and Ipeiros, with output multipliers in the range of 1.045 to 1.056.

MAP 5.2.1
Output multipliers of the Greek regions

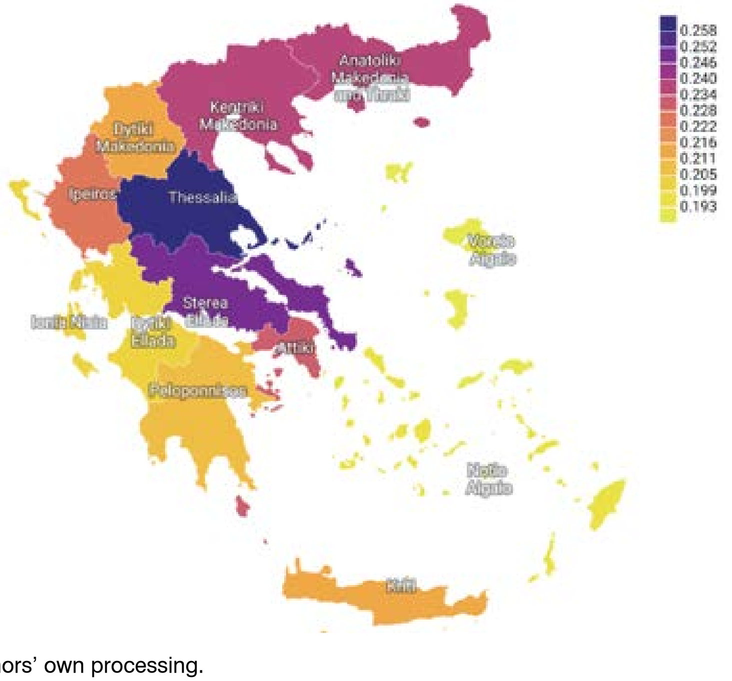


Source: Authors' own processing.

- The last group consists of the regions of Thessalia and Sterea Ellada, with output multipliers in the range of 1.019 to 1.024.

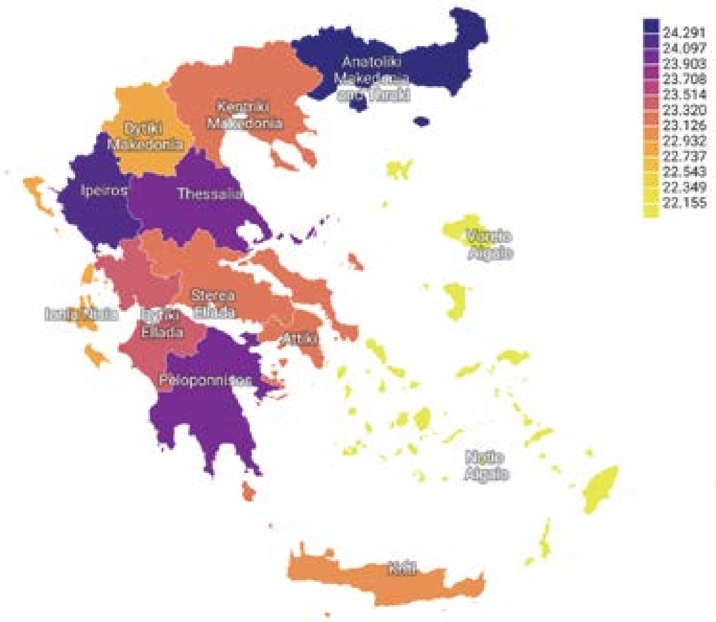
Thus, we observe that the regions with the highest output multipliers are the island complexes of the Notio Aigaio and Voreio Aigaio as well as the Ionia Nisia, i.e., those regions with relatively low participation of the Primary and Industrial sectors in their total economy. On the contrary, the areas with the lowest output multipliers are Thessalia and Sterea Ellada, i.e., regions with relatively high participation of the Primary and Industrial sectors in their total economy. These sectors, as we have shown before, are characterised by a high dependence on imports. This feature becomes even clearer if we estimate the average import multipliers. Map 5.2.2 reports the arithmetic mean of import multipliers for all the regions of the country.

MAP 5.2.2
Import multipliers of the Greek regions



Source: Authors' own processing.

MAP 5.2.3
Employment multipliers of the Greek regions

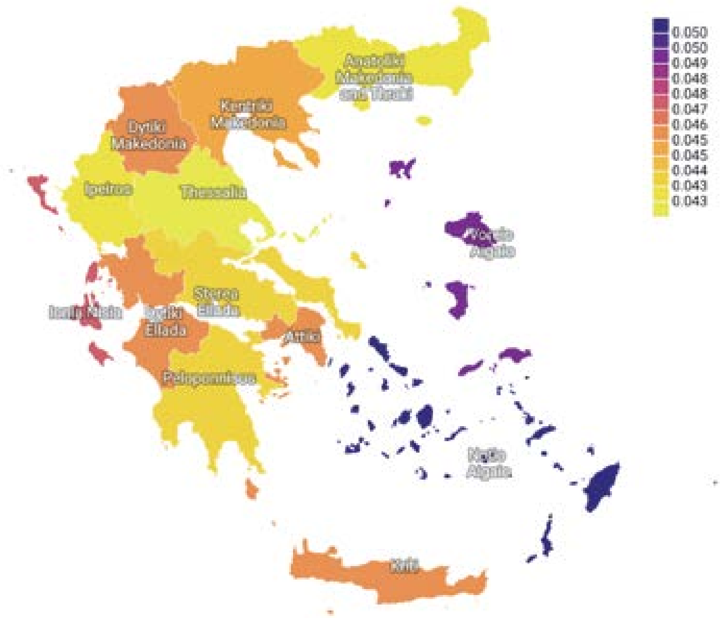


Source: Authors' own processing.

Therefore, it becomes evident that the regions with high output multipliers are those with low import multipliers, and vice versa. However, there are some slight differences in the classification of regions according to these two types of multipliers. This fact also holds in the case where we classify the regions in terms of employment multipliers. Map 5.2.3 reports the arithmetic mean of employment multipliers for all the regions of the Greek economy. Given the employment multipliers, we can then focus on the labour productivity indices of the different regions of the country (see Map 5.2.4). A long-term structural policy to enhance the overall productivity of the Greek economy should be directed towards the regions (and the sectors) that are characterised by high productivity indices.

From the comparison between the Maps 5.2.1 and 5.2.4, we observe that the classification of the regions according to productivity indices differs from their classification on the basis of output multiplier values. This

MAP 5.2.4
Productivity indices of the Greek regions



Source: Authors' own processing.

outcome suggests that an effective demand management policy relying on the regions with the highest output multipliers can only have a temporary (short-term) positive impact on the growth potential of the economy.

5.3. Output, employment, and import multipliers for the Greek regions

5.3.1. Multipliers for Anatoliki Makedonia and Thraki

To begin with, we present the multiplier values of a change in autonomous demand for the different industries of the region of Anatoliki Makedonia and Thraki on its output, imports, and employment. Table 5.3.1 reports the output multipliers with and without imports, import multipliers, and employment multipliers for the 20 industries of Anatoliki Makedonia and Thraki.

TABLE 5.3.1
Multipliers for the region of Anatoliki Makedonia and Thraki by industry

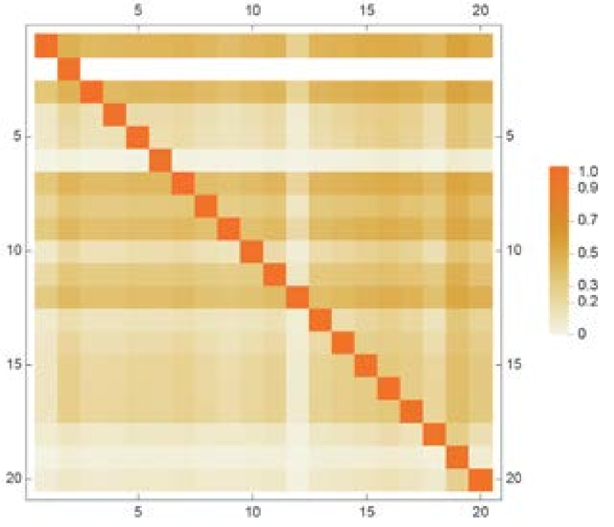
	Sectors	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.882591	1.114220	0.201185	45.543700
2	B	0.150200	1.328870	0.890730	14.756800
3	C	0.580749	1.227810	0.525805	10.398200
4	D	1.046170	1.231750	0.148573	11.529000
5	E	1.108690	1.272800	0.131435	12.507800
6	F	0.733249	1.265050	0.424499	18.791800
7	G	1.166460	1.305950	0.112859	28.615800
8	H	0.928251	1.230010	0.244580	14.035200
9	I	0.725917	1.187450	0.385245	17.386800
10	J	0.880063	1.233210	0.285853	11.588100
11	K	1.120000	1.300040	0.142252	15.193500
12	L	1.013240	1.046520	0.026732	1.998870
13	M	1.119780	1.281940	0.129234	24.459700
14	N	1.151730	1.341690	0.152504	25.350400
15	O	1.084160	1.444500	0.261859	20.119500
16	P	1.402020	1.592540	0.146773	41.958100
17	Q	0.999368	1.438960	0.322945	25.907300
18	R	1.038660	1.246360	0.167030	19.157500
19	S	1.927570	2.227720	0.242983	111.515000
20	T	1.031910	1.524190	0.350033	18.891900

Source: Authors' own calculations.

In order to get a more complete picture of the composition of these multipliers, Figure 5.3.1 gives a visual representation of the matrix of output, import, and employment multipliers for each industry.

FIGURE 5.3.1
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Anatoliki Makedonia and Thraki

(a)



(b)

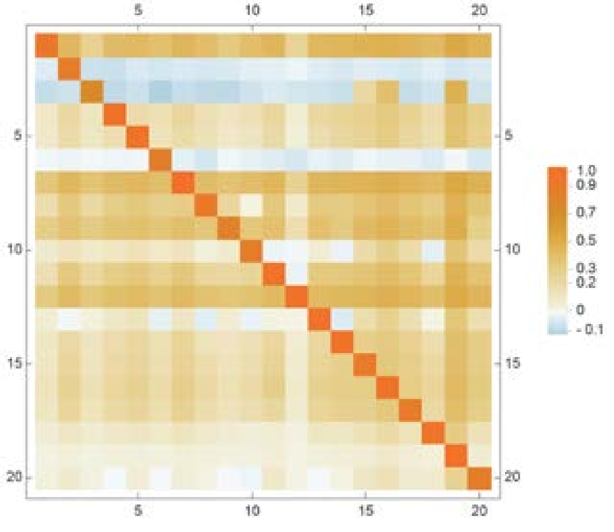
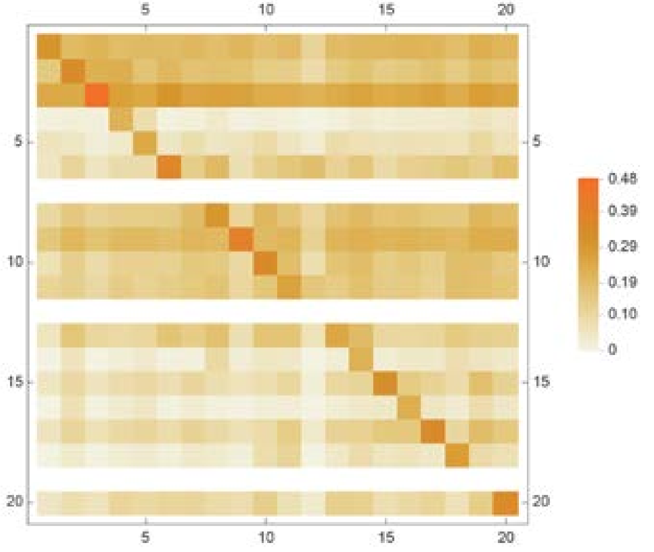
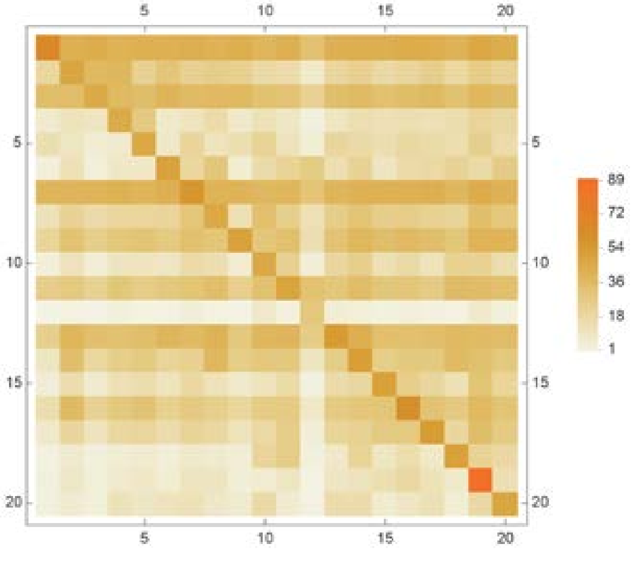


FIGURE 5.3.1 (continued)

(c)



(d)



Source: Authors' own calculations.

For output multipliers with imports, the average value (mean) for this category is approximately 1.005, suggesting that, on average, a unit increase in economic activity results in a 1.005-fold increase when considering imports. The middle value (median), 1.035, indicates that half of the data points lie above this value and half below, providing a balanced perspective on the data distribution. The standard deviation value of approximately 0.340 reveals a moderate spread around the mean. This suggests that most of the multipliers are within this range from the average. The range of this category spans from 0.150 (minimum) to 1.928 (maximum), highlighting the variability in how different sectors or industries might respond to economic stimuli when imports are considered.

Regarding the output multipliers without imports, the mean value in the region of Anatoliki Makedonia and Thraki is 1.342, indicating the average multiplier value when imports are excluded. The standard deviation is about 0.245, and the values range between 1.047 and 2.228. For the import multipliers, the average value is approximately 0.265 with a median of 0.222. The data variability is indicated by a standard deviation of about 0.191, and the values span from 0.027 to 0.891. On the employment front, the average multiplier value is around 24.485, suggesting significant potential employment increases from economic activity. The median value stands at 18.842. The diverse nature of employment values across sectors is highlighted by a standard deviation of roughly 22.914, ranging between 1.999 and a substantial 111.515. The descriptive statistics for the output (with and without imports), import, and employment multipliers corresponding to all the Greek regions are included in Table A3 of the Appendix.

These statistical measures provide a comprehensive understanding of the inherent variability and central tendencies across the four categories. The data suggests that different sectors or industries might have varying responses to economic stimuli, especially when considering factors like imports and their subsequent impact on employment. Table 5.3.2 reports the arithmetic mean of GDP, import, and employment multipliers for the broad (Primary, Industrial, and Service) sectors of the Greek economy, as well as the region's average.

TABLE 5.3.2
Multipliers for the region of Anatoliki Makedonia and Thraki
by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.516396	1.221545	0.554243	30.150250
Industrial products	0.723812	1.265256	0.427522	13.596720
Services	1.113509	1.385791	0.212206	26.869834
Region's average	1.044540	1.342079	0.234655	24.485300

Source: Authors' own calculations.

For the metric of output multipliers with imports, the Services sector exhibits a pronounced value of 1.114, which is significantly above the economy's mean of 1.045. This outcome suggests a superior efficacy of the Services sector in leveraging imports for output. Conversely, the Primary products sector manifests the minimum value in this category at 0.516, indicating a constrained output efficiency with respect to imports.

In the dimension of output multipliers without imports, the Services sector continues to predominate with a multiplier of 1.386, surpassing the region's average of 1.342. This outcome denotes the inherent strength of the Services sector in generating output, independent of import considerations. The Industrial products sector, with a value of 1.265, demonstrates a commendable performance, albeit trailing the Services sector. The Primary products sector, with a value of 1.222, delineates a slightly subdued output efficiency in this context.

Analysing the Import multipliers, the Primary products sector delineates a pronounced value of 0.554, signifying a heightened dependency on imports. This is juxtaposed with the Services sector, which manifests a more conservative import multiplier of 0.212, marginally below the region's mean of 0.234655. In the domain of Employment multipliers, the Services sector emerges preeminent with a multiplier of 26.870, underscoring its pivotal role in employment generation within the economic framework. The Primary products sector, with a multiplier of 30.150, accentuates its significance in the labour market. In contrast, the Industrial products sector, with a value of 13.597, is indicative of a more restrained employment potential, residing below the region's mean of 24.485.

5.3.2. Multipliers for Kentriki Makedonia

Table 5.3.3 shows the output multipliers with and without imports, import multipliers, and employment multipliers for the 20 industries of the region of Kentriki Makedonia. In order to get a more complete picture of the composition of these multipliers, Figure 5.3.2 also provides a visual representation of the matrix of output, import, and employment multipliers for each industry in Kentriki Makedonia.

Based on the results shown in Table 5.3.3 and Figure 5.3.2, the mean value for the output multipliers (with imports) stands at approximately 1.006, with the data ranging from a minimum of 0.154 to a maximum of 1.952. The median value is 1.042, and the standard deviation is approximately 0.347. Regarding the output multipliers (without imports), the average is approximately 1.351. The values span from 1.039 to 2.211. The median for this category is 1.296, and the standard deviation is approximately 0.239.

For the import multipliers, the mean is approximately 0.267. The values in this category range from a low of 0.020 to a high of 0.909. The median stands at 0.219, and the standard deviation is approximately 0.197, indicating a moderate spread around the mean. Lastly, the employment multipliers have an average of 23.231. The values in this category range between a minimum of 1.357 and a maximum of 104.276. The median employment multiplier is 17.709, and the standard deviation is approximately 21.576, highlighting the diverse nature of employment multipliers in the dataset. Table 5.3.4 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the corresponding average values for the economy of the region of Kentriki Makedonia.

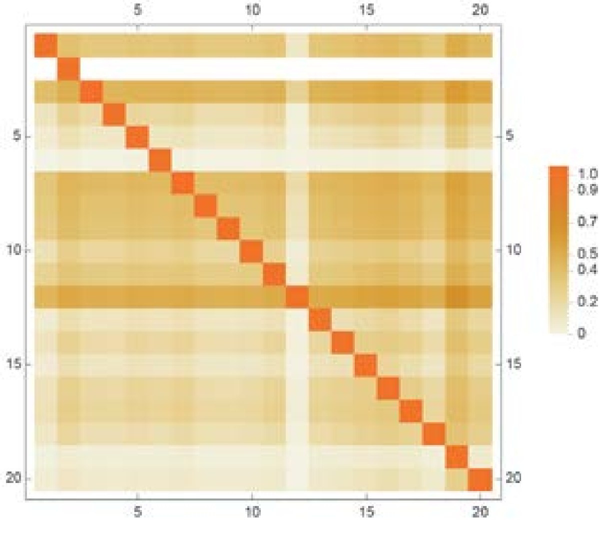
TABLE 5.3.3
Multipliers for the region of Kentriki Makedonia by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.86382	1.14334	0.23506	45.85140
2	B	0.15436	1.36617	0.90910	15.31160
3	C	0.56706	1.24336	0.54233	9.81665
4	D	1.04907	1.23556	0.14675	10.55740
5	E	1.10697	1.29901	0.15074	12.48340
6	F	0.72502	1.26731	0.42982	17.67540
7	G	1.16597	1.32098	0.12296	27.74560
8	H	0.92165	1.22630	0.24550	12.58570
9	I	0.70916	1.21819	0.41449	17.74240
10	J	0.88084	1.23443	0.28467	10.63040
11	K	1.12648	1.31030	0.14286	14.18460
12	L	1.01394	1.03930	0.02008	1.35687
13	M	1.12381	1.29231	0.13202	23.54490
14	N	1.15771	1.35454	0.15503	24.26080
15	O	1.09176	1.46359	0.26594	19.26340
16	P	1.41392	1.58861	0.13075	38.81080
17	Q	1.00343	1.43730	0.31594	23.96450
18	R	1.04042	1.24428	0.16265	18.10350
19	S	1.95197	2.21053	0.20262	104.27600
20	T	1.04288	1.52118	0.33593	16.44850

Source: Authors' own calculations.

FIGURE 5.3.2
The matrix of (a) output with imports, (b) output without imports,
(c) import and (d) employment multipliers for the 20 economic sectors
of the region of Kentriki Makedonia

(a)



(b)

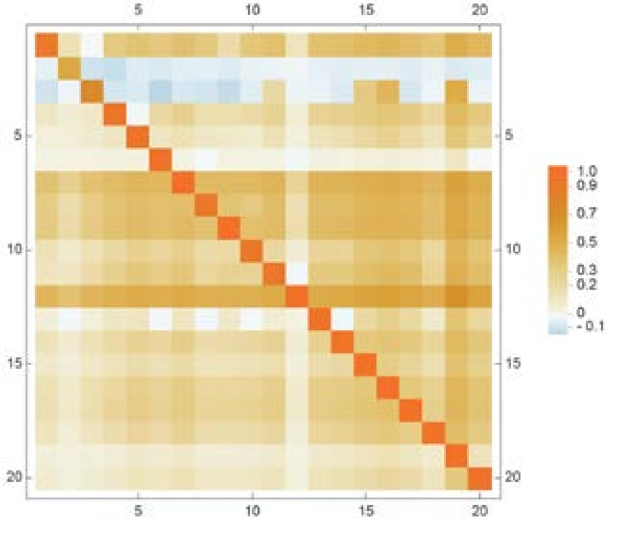
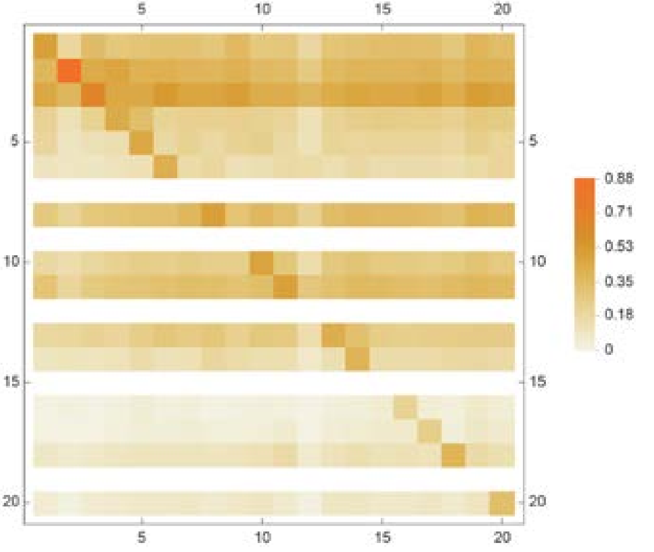
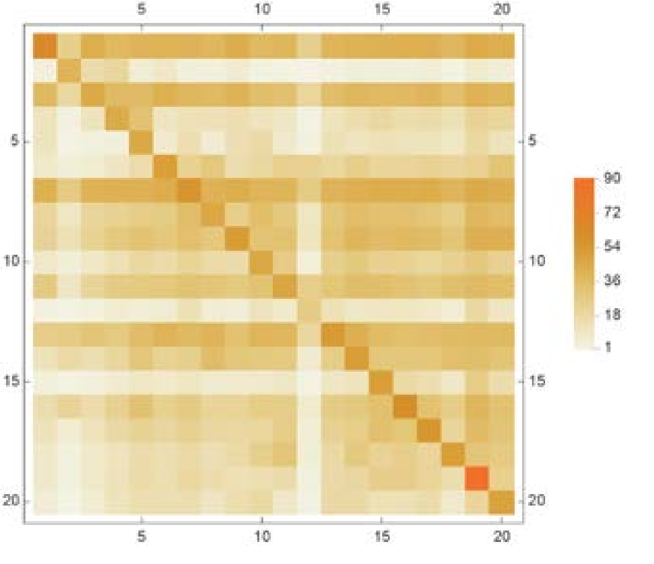


FIGURE 5.3.2 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.4
Multipliers for the region of Kentriki Makedonia by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.509087	1.254755	0.572078	30.581500
Industrial products	0.720495	1.282282	0.435747	13.168890
Services	1.117425	1.390131	0.209389	25.208426
Region's average	1.04551	1.35083	0.23726	23.23070

Source: Authors' own calculations.

The Services sector consistently demonstrates superior performance in the output multipliers, both with and without imports. With values of 1.117 and 1.390, respectively, Services outpace the region's average of 1.0456 with imports and 1.351 without imports. The Primary products sector, while presenting a modest output multiplier with imports at 0.509087, exhibits a commendable performance in output without imports, registering a value of 1.254755.

In the realm of import multipliers, the Primary products sector stands out with a significant value of 0.572, indicating a pronounced dependency on imports. This contrasts with the Services sector, which, despite its dominant output, maintains a relatively low import multiplier of 0.209389. However, it is worth noting that this is slightly below the region's average import multiplier of 0.237.

When it comes to employment potential, the Primary products sector shines with a robust multiplier of 30.582, emphasising its vital role in the job market. The Services sector follows closely with a value of 25.208, further underscoring its significance in the economy. The Industrial products sector, while showcasing a consistent output, records an employment multiplier of 13.169, which is below the region's average of 23.231.

5.3.3. Multipliers for Dytiki Makedonia

Table 5.3.5 reports the output multipliers with and without imports, import multipliers, and employment multipliers for the 20 industries of the region of Dytiki Makedonia. Figure 5.3.3 offers a visual representation of the matrix of output, import, and employment multipliers for each industry to obtain a more complete picture of the composition of these multipliers in Dytiki Makedonia.

The output multipliers (with imports) for Dytiki Makedonia have an average value of 1.016, ranging from 0.162 to 1.965 with a median of 1.043. The output multipliers (without imports) have a mean of 1.327, spanning from 1.035 to 2.209, with a median of 1.280. The Import multipliers have an average value of 0.245, ranging between 0.020 and 0.850, and a median of 0.197. Lastly, the employment multipliers present an average of 22.859, ranging from 1.316 to 106.643, with a median of 17.299. Table 5.3.6 reports the arithmetic means of GDP, import, and employment multipliers for the primary, industrial, and service sectors, as well as the average of the economy of Dytiki Makedonia.

The Services sector consistently exhibits a higher output multiplier, both with and without imports, with values of 1.123 and 1.374, respectively. These figures surpass the region's average of 1.056 with imports and 1.327 without imports. The Primary products sector, while having the lowest output multiplier with imports at 0.522989, is closely aligned with the Industrial products in output without imports, although it slightly lags behind. Interestingly, the Primary products sector has the highest import multiplier, at 0.574, indicating a significant dependency on imports. This is in contrast to the Services sector, which has the lowest reliance on imports, with a multiplier of 0.195, even though it is slightly below the region's average of 0.215. In terms of employment potential, the Services sector leads with a multiplier of 25.223, emphasising its crucial role in job creation within the economy. The Industrial products sector, however, registers the lowest employment multiplier, at 11.770, falling well below the region's average of 22.859.

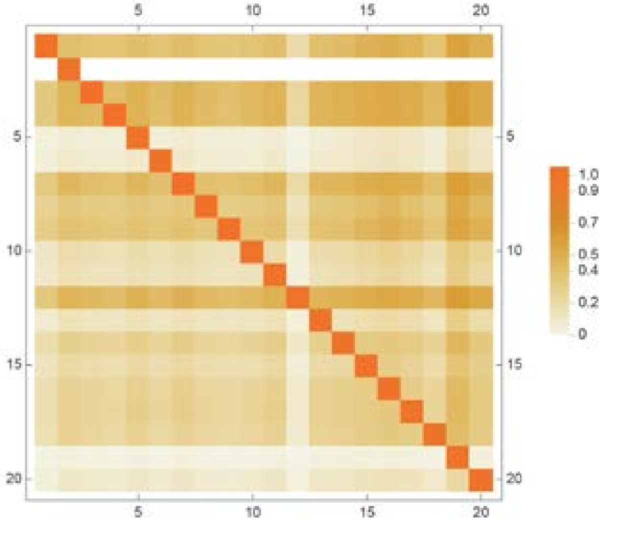
TABLE 5.3.5
Multipliers for the region of Dytiki Makedonia by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.88415	1.11216	0.19868	45.20730
2	B	0.16183	1.28036	0.84999	11.31880
3	C	0.58879	1.22216	0.51737	9.82344
4	D	1.08130	1.19695	0.09314	8.86979
5	E	1.11578	1.29640	0.14389	13.03530
6	F	0.76739	1.20685	0.36219	15.80080
7	G	1.17348	1.29734	0.10028	27.22290
8	H	0.92902	1.21188	0.23174	12.53910
9	I	0.72789	1.18753	0.38401	17.09660
10	J	0.88267	1.22193	0.27670	10.60440
11	K	1.12258	1.29688	0.13779	14.33620
12	L	1.01120	1.03532	0.01963	1.31554
13	M	1.12466	1.28003	0.12372	23.52020
14	N	1.16429	1.30876	0.11613	22.28460
15	O	1.09506	1.43741	0.24787	18.66820
16	P	1.42184	1.58525	0.12419	39.80710
17	Q	1.01997	1.41616	0.29125	23.77420
18	R	1.04420	1.22635	0.14798	17.80390
19	S	1.96508	2.20915	0.19578	106.64300
20	T	1.04154	1.51873	0.33869	17.50080

Source: Authors' own calculations.

FIGURE 5.3.3
The matrix of (a) output with imports, (b) output without imports,
(c) import and (d) employment multipliers for the 20 economic sectors
of the region of Dytiki Makedonia

(a)



(b)

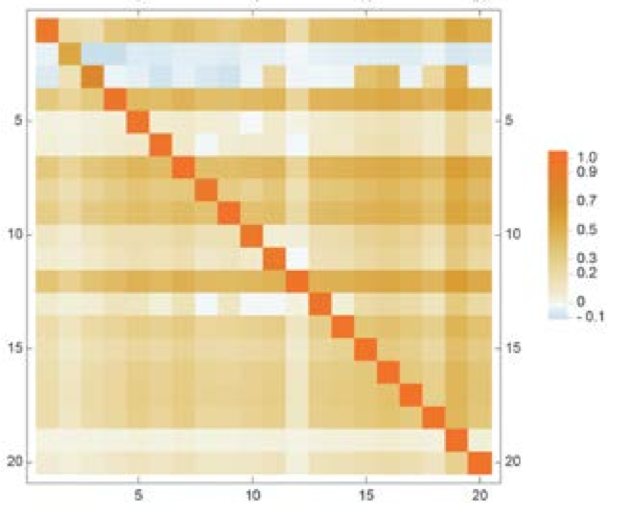
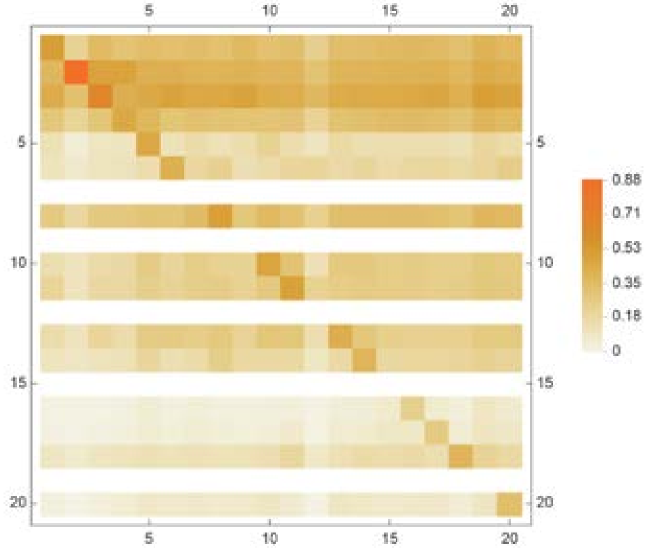
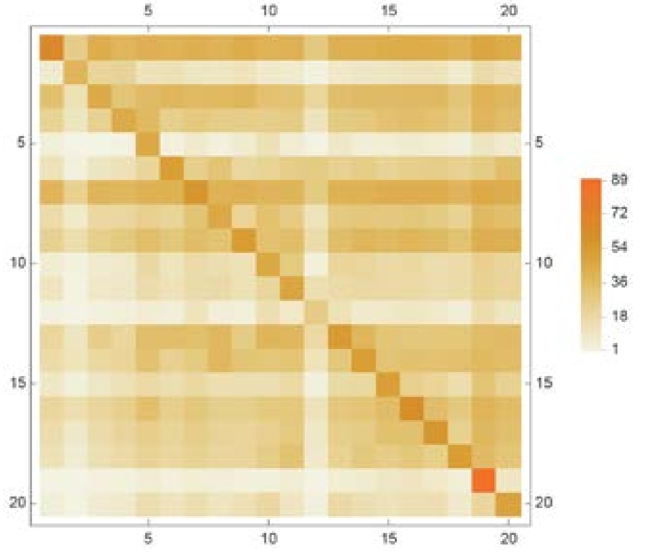


FIGURE 5.3.3 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.6
Multipliers for the region of Dytiki Makedonia by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.522989	1.196260	0.574332	28.263050
Industrial products	0.743017	1.240544	0.413313	11.769626
Services	1.123106	1.373766	0.195412	25.222624
Region’s average	1.05614	1.32738	0.21505	22.85860

Source: Authors’ own calculations.

5.3.4. Multipliers for Ipeiros

Table 5.3.7 shows the output multipliers with and without imports, import multipliers, and employment multipliers for the 20 industries of the region of Ipeiros. In order to get a more complete picture of the composition of these multipliers, Figure 5.3.4 gives a visual representation of the matrix of output, import, and employment multipliers for each industry in Ipeiros.

The output multipliers (with imports) are characterised by a mean of approximately 1.010. The distribution of this data set, as indicated by a standard deviation of 0.340, reveals a moderate variability around this mean. The data range from a minimum of 0.158 to a maximum of 1.940, while the median is 1.039. The output multipliers (without imports) exhibit a mean of 1.333, ranging from 1.045 to 2.225. The median for this category is 1.278, and its standard deviation is 0.248, suggesting a consistent spread of values around the mean. This consistency is indicative of a relatively stable dataset, with fewer outliers affecting the overall distribution. The import multipliers present a mean of 0.258, with values ranging from a minimal 0.025 to a peak of 0.916. The median value is 0.222, and the standard deviation is 0.193, highlighting the variability inherent in this category. Lastly, the employment multipliers are characterised by an average of 24.197. The values in this category span from a low of 1.958 to a significant 110.241. The median employment multiplier is 18.682, and the standard deviation is 22.680, underscoring the diverse nature of employment

TABLE 5.3.7
Multipliers for the region of Ipeiros by industry

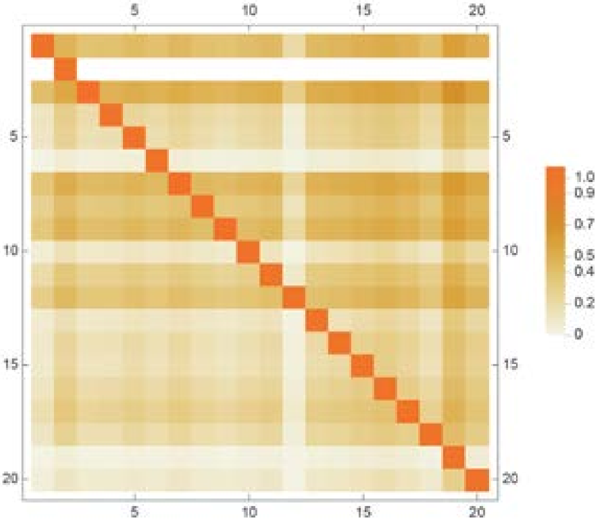
	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.88128	1.11580	0.20556	45.41750
2	B	0.15828	1.37290	0.91585	14.67630
3	C	0.58617	1.18608	0.50513	10.24920
4	D	1.05195	1.20078	0.12350	11.24490
5	E	1.11557	1.27298	0.12864	12.33010
6	F	0.75996	1.20870	0.37270	18.90700
7	G	1.16975	1.30165	0.11009	28.30460
8	H	0.92423	1.21058	0.23772	13.69430
9	I	0.73178	1.17607	0.37672	17.32840
10	J	0.88229	1.23136	0.28493	11.41150
11	K	1.12192	1.29904	0.14225	14.88220
12	L	1.01410	1.04478	0.02540	1.95778
13	M	1.12093	1.28342	0.13190	24.16610
14	N	1.15264	1.33501	0.15018	24.95830
15	O	1.08799	1.44716	0.26313	19.74810
16	P	1.40870	1.59176	0.14445	41.37420
17	Q	1.01239	1.41919	0.30276	25.68270
18	R	1.03918	1.22867	0.15556	18.84180
19	S	1.93970	2.22484	0.23830	110.24100
20	T	1.03963	1.51352	0.34049	18.52220

Source: Authors’ own calculations.

multipliers in the dataset. Table 5.3.8 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region’s average.

FIGURE 5.3.4
The matrix of (a) output with imports, (b) output without imports, (c) import and (d) employment multipliers for the 20 economic sectors of the region of Ipeiros

(a)



(b)

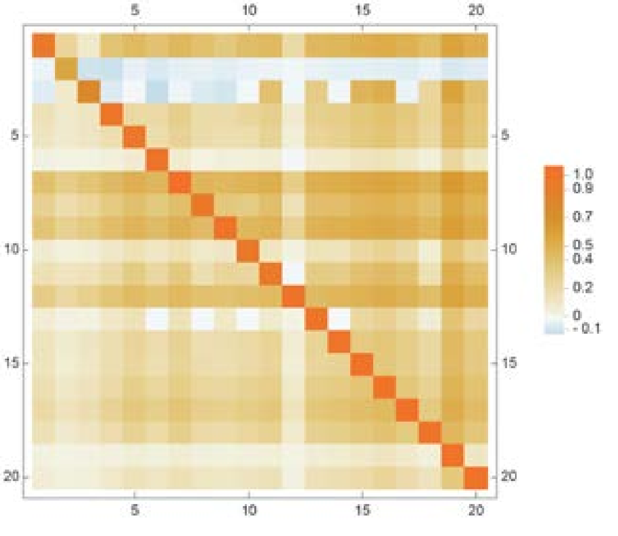
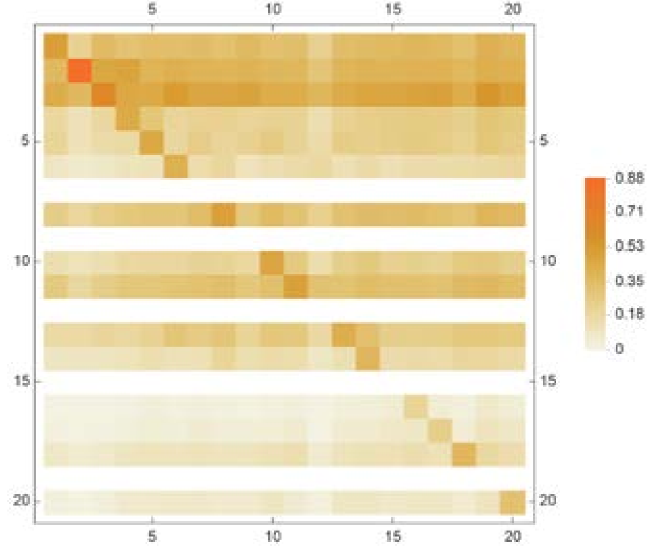
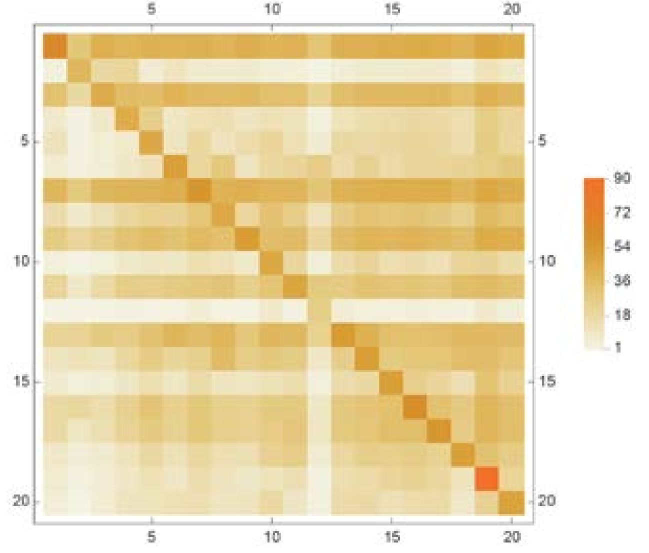


FIGURE 5.3.4 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.8
Multipliers for the region of Ipeiros by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.519778	1.244350	0.560704	30.046900
Industrial products	0.734385	1.248288	0.409162	13.481500
Services	1.117516	1.379075	0.207420	26.508084
Region's average	1.04992	1.33321	0.22776	24.19690

Source: Authors' own calculations.

Based on the data analysis, it is evident that the Services sector consistently outperforms in output multipliers, both with and without imports, registering values of 1.118 and 1.379, respectively. These figures surpass the region's average of 1.050 with imports and 1.333 without imports. The Primary products sector, while having a slightly lower output multiplier with imports at 0.520, is closely aligned with the Industrial products in output without imports. Notably, the Primary products sector exhibits a high import multiplier of 0.561, indicating a significant dependency on imports. In the realm of employment, the Services sector leads with a multiplier of 26.508, underscoring its pivotal role in job creation. Industrial products fall below the region's average employment multiplier of 24.197, with a value of 13.482. In summary, in the region of Ipeiros, the Services sector remains dominant in both output and employment; the Primary products sector is heavily reliant on imports; and the Industrial products sector offers a balanced performance, albeit with slightly lower employment potential.

5.3.5. Multipliers for Thessalia

Table 5.3.9 presents the output multipliers with and without imports, import multipliers and employment multipliers for the 20 industries of Thessalia. In order to obtain a more complete picture of the composition of these four multipliers, Figure 5.3.5 illustrates the matrices of output, import, and employment multipliers for each industry in Thessalia.

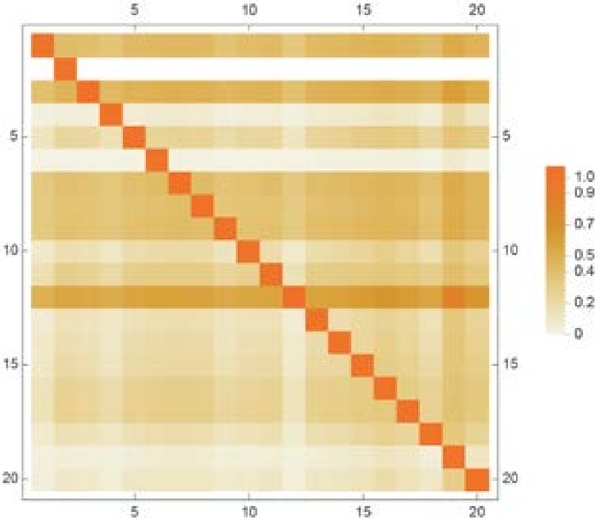
TABLE 5.3.9
Multipliers for the region of Thessalia by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.86427	1.12309	0.22070	45.46230
2	B	0.15215	1.28092	0.85675	11.13260
3	C	0.52988	1.24825	0.57566	11.56120
4	D	1.07137	1.17114	0.07964	7.61437
5	E	1.08764	1.29217	0.16063	12.31200
6	F	0.66185	1.32713	0.51529	20.68290
7	G	1.13197	1.34430	0.16736	29.28020
8	H	0.84099	1.32637	0.37788	18.02220
9	I	0.68880	1.21720	0.43012	18.17640
10	J	0.86146	1.26728	0.31954	12.27020
11	K	1.11103	1.29330	0.14182	13.54910
12	L	0.96497	1.11951	0.12188	6.04171
13	M	1.09910	1.31309	0.16652	24.80220
14	N	1.13455	1.34412	0.16412	23.85000
15	O	1.07600	1.43962	0.26225	18.15290
16	P	1.39612	1.58770	0.14334	38.98680
17	Q	0.96935	1.45619	0.35460	25.06530
18	R	1.02060	1.28524	0.20711	20.54390
19	S	1.91787	2.20313	0.22222	104.28400
20	T	1.00306	1.54584	0.38232	18.01410

Source: Authors' own calculations.

FIGURE 5.3.5
The matrix of (a) output with imports, (b) output without imports, (c) import and (d) employment multipliers for the 20 economic sectors of the region of Thessalia

(a)



(b)

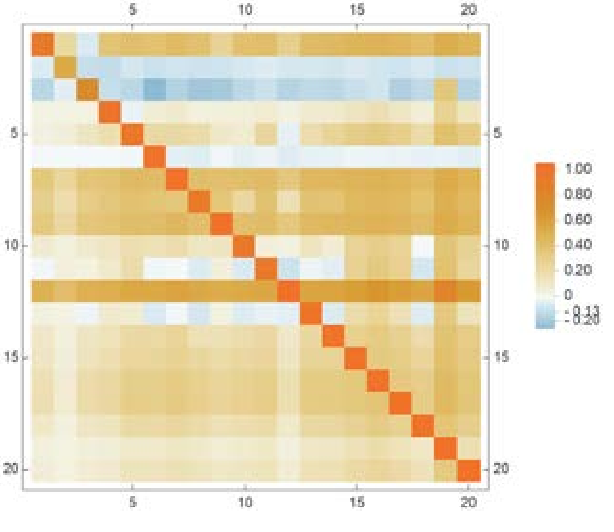
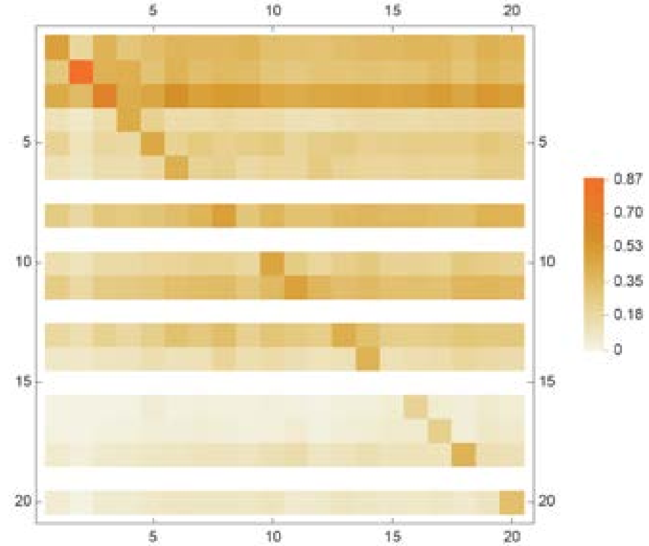
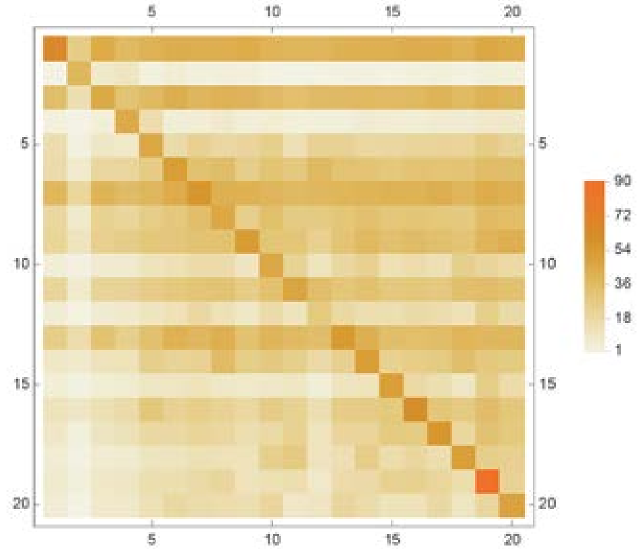


FIGURE 5.3.5 (continued)

(c)



(d)



Source: Authors' own calculations.

For the output multipliers (with imports), the average value is approximately 0.979, with values ranging from 0.152 to 1.918. The median stands at 1.012, and the standard deviation of 0.347 indicates a moderate spread around the mean. For the output multipliers (without imports), the average value is 1.359, with a range from 1.120 to 2.203. The median is 1.303, and the standard deviation of 0.233 suggests a consistent variability in the data. The import multipliers have an average value of 0.293, spanning from 0.080 to 0.857, with a median of 0.221 and a standard deviation of 0.191.

Lastly, the employment multipliers present an average of 23.990. The values in this category range between 6.042 and 104.284, with a median of 18.165. The high standard deviation of 21.297 highlights the diverse nature of employment multipliers for the region of Thessalia. Table 5.3.10 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region's average.

From the statistical analysis, we observe that the Services sector consistently demonstrates a higher output multiplier, both with and without imports, with values of 1.087 and 1.410, respectively. This is notably above the region's average of 1.019 with imports and 1.359 without imports. The Primary products, while having the lowest output multiplier with imports at 0.508, show a closer alignment to the Industrial products in output without imports. Interestingly, despite its lower output, the Primary products sector has a high import multiplier of 0.538729, only slightly be-

TABLE 5.3.10
Multipliers for the region of Thessalia by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.508207	1.202005	0.538729	28.297450
Industrial products	0.700578	1.263922	0.437593	12.660614
Services	1.086847	1.410206	0.247221	26.502786
Region's average	1.01915	1.35928	0.26349	23.99020

Source: Authors' own calculations.

low the region's average of 0.26349. This outcome suggests a significant dependency on imports for Primary products in Thessalia. In terms of employment potential, Services lead with a multiplier of 26.503, indicating its substantial role in job creation in Thessalia, while Industrial products lag slightly behind the region's average (23.990) with a value of 12.661. This finding underscores the dominance of the Services sector in both output and employment, the reliance of Primary products on imports, and the balanced performance of Industrial products in the region of Thessalia.

5.3.6. Multipliers for Ionia Nisia

Table 5.3.11 reports the output with and without imports, import, and employment multipliers for the 20 industries of the region of Ionia Nisia. In order to get a more complete picture of the composition of these multipliers, Figure 5.3.6 gives a visual representation of the matrices of output, import, and employment multipliers for each industry in the region.

The output multipliers (with imports) have an average value of approximately 1.037. This category's values span between a minimum of 0.175 and a peak of 1.984. The median value stands at 1.062, and the standard deviation is approximately 0.343, which suggests a moderate spread of values around the mean. The output multipliers (without imports) have a slightly elevated average at 1.326. The values in this set range from a low of 1.041 to a high of 2.206. The median for this category is 1.282, and the standard deviation is 0.246, indicating a consistent spread of values around the mean.

Regarding the import multipliers, they present an average of 0.229. The range of values in this category is quite broad, spanning from a minimal 0.019 to a substantial 0.896. The median value is 0.184, and the standard deviation is 0.194. Lastly, the employment multipliers are characterised by an average of 22.834. The values in this category range widely from 1.599 to 106.030. The median employment multiplier is 16.402, and the standard deviation is 21.952, which underscores the diverse nature of employment multipliers in the region of Ionia Nisia according to the specific industry. Table 5.3.12 reports the arithmetic means of GDP, import, and employment multipliers for the primary, industrial, and service sectors, as well as the region's average.

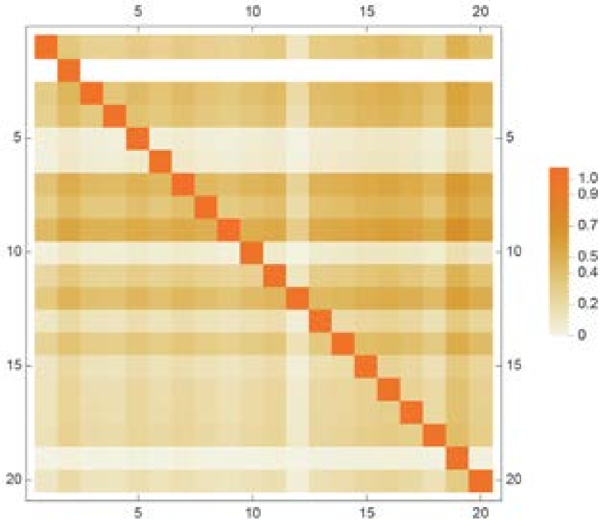
TABLE 5.3.11
Multipliers for the region of Ionia Nisia by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.90672	1.11745	0.18462	43.47080
2	B	0.17511	1.36399	0.89564	16.16130
3	C	0.61653	1.18879	0.48072	9.34609
4	D	1.09646	1.17025	0.06148	7.99221
5	E	1.12653	1.28926	0.13221	12.77330
6	F	0.80082	1.19458	0.32926	15.71920
7	G	1.20151	1.29042	0.07369	26.94840
8	H	0.96356	1.20069	0.19728	12.21740
9	I	0.76952	1.15457	0.33177	15.29160
10	J	0.89367	1.22634	0.27200	10.77770
11	K	1.14025	1.29446	0.12309	14.12990
12	L	1.01788	1.04054	0.01873	1.59901
13	M	1.14292	1.27383	0.10558	23.27740
14	N	1.19361	1.31519	0.09961	22.92500
15	O	1.10986	1.44535	0.24323	19.14970
16	P	1.43157	1.58224	0.11697	39.47520
17	Q	1.03999	1.42262	0.28154	24.37550
18	R	1.05875	1.23592	0.14435	18.37730
19	S	1.98443	2.20559	0.18349	106.03000
20	T	1.06567	1.50201	0.31107	16.64200

Source: Authors' own calculations.

FIGURE 5.3.6
The matrix of (a) output with imports, (b) output without imports, (c) import and (d) employment multipliers for the 20 economic sectors of the region of Ionia Nisia

(a)



(b)

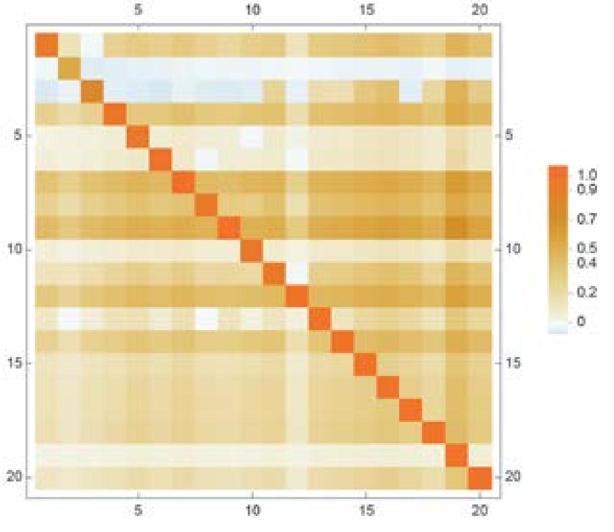
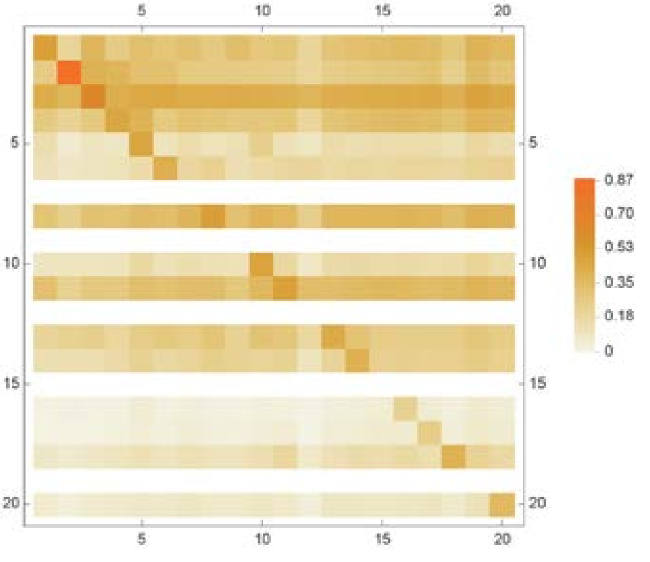
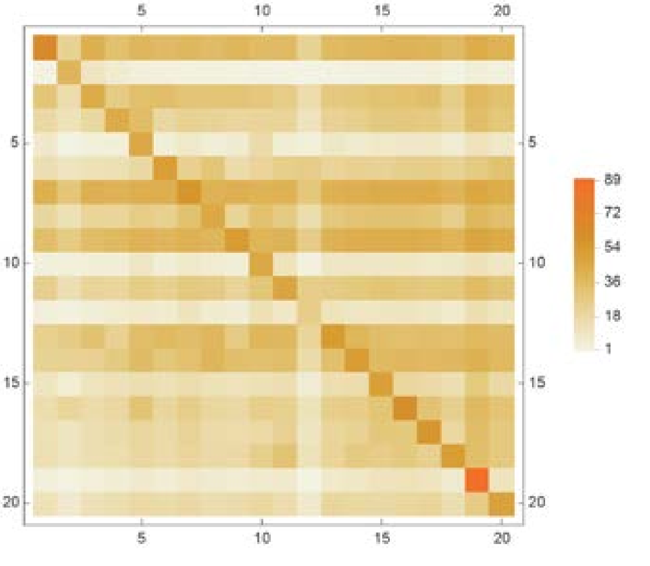


FIGURE 5.3.6 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.12
Multipliers for the region of Ionia Nisia by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.540915	1.240720	0.540126	29.816050
Industrial products	0.763091	1.241374	0.379862	12.398420
Services	1.143799	1.370698	0.178742	25.086865
Region's average	1.07677	1.32570	0.19932	22.83400

Source: Authors' own calculations.

The output multipliers with imports have a reginal average value of 1.077. Services exhibit a maximum value of 1.144, suggesting a robust output when imports are factored in, while Primary products record their minimum value at 0.541. When examining the output multipliers without imports, the regional average value is 1.326. Services again lead with a maximum value of 1.370698, indicating their heightened output when imports are excluded. Industrial products and Primary products have closely matched values, with 1.241 and 1.241, respectively, showcasing their similar output levels without considering imports.

For the import multipliers, the regional average value is 0.199. Primary products have their maximum value at 0.540, highlighting their significant dependency on imports. In contrast, Services record their minimum value at 0.179, indicating their reduced reliance on imports compared to the other sectors in the region of Ionia Nisia. Finally, the employment multipliers have a regional average of 22.834. Primary products lead with a maximum value of 29.816, suggesting that they offer the most substantial employment opportunities. In contrast, Industrial products have a minimum value of 12.398, indicating the lowest employment potential among the three sectors in this region.

5.3.7. Multipliers for Dytiki Ellada

Table 5.3.13 reports the output with and without imports, import, and employment multipliers for the 20 industries of Dytiki Ellada. Figure 5.3.7 offers a visual representation of the matrices of output, import, and employment multipliers in each industry to get a comprehensive picture of their composition in the region of Dytiki Ellada.

The output multipliers (with imports) have an average value of approximately 1.028. This category's values range between a minimum of 0.170 and a maximum of 1.978, with the median value of 1.056 and a standard deviation at approximately 0.343. The output multipliers (without imports) have a slightly higher average value, at 1.323, with values ranging from 1.039 to 2.198. The corresponding median is 1.285, and the standard deviation stands at 0.245. The import multipliers have an average value of 0.234, spanning from a low of 0.019 to a high of 0.900, with a median of 0.181 and a standard deviation of 0.193. Lastly, the employment multipliers are characterised by an average value of 23.438 and varies considerably, ranging from 1.585 to 108.491. The median value is 16.951, and the standard deviation is 22.484.

Table 5.3.14 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region's average. In the output multipliers with imports, the regional average stands at 1.068. The Services sector takes the lead with a value of 1.135, signifying the highest output multiplier when imports are incorporated. In contrast, Primary products register the lowest value in this category at 0.535. When examining the output multipliers without imports, the regional average increases to 1.323. Services continue to dominate with a multiplier equal to 1.367, indicating a robust output even when imports are excluded. Industrial products closely follow with a value of 1.243, while Primary products record a value of 1.234.

In the realm of import multipliers, the regional average is pinpointed at 0.204. Primary products show the highest dependency on imports, with a multiplier of 0.541. Conversely, Services demonstrate the least reliance on imports, with a value of 0.183. Finally, the Employment multipliers have a

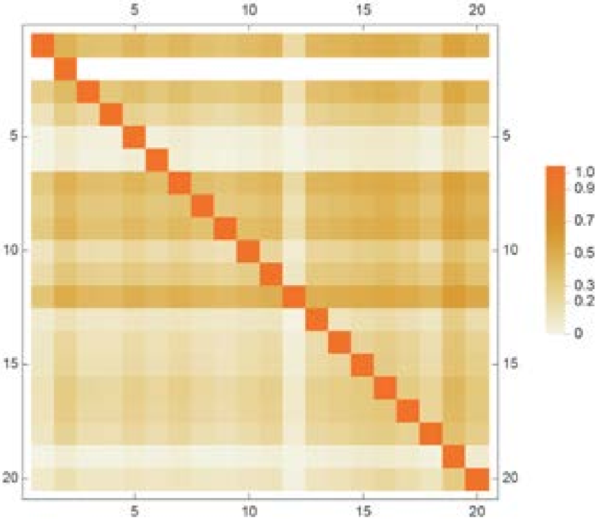
TABLE 5.3.13
Multipliers for the region of Dytiki Ellada by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.89972	1.10325	0.18081	45.14140
2	B	0.17008	1.36516	0.90039	16.86480
3	C	0.60978	1.18791	0.48600	9.68706
4	D	1.08170	1.17941	0.08103	8.94462
5	E	1.12132	1.29038	0.13725	13.47810
6	F	0.78957	1.19242	0.33739	15.82140
7	G	1.19180	1.29057	0.08182	27.58380
8	H	0.94811	1.19117	0.20328	11.89190
9	I	0.75498	1.16024	0.34753	16.43060
10	J	0.88831	1.22085	0.27283	10.89840
11	K	1.13257	1.29236	0.12766	14.50670
12	L	1.01626	1.03887	0.01871	1.58459
13	M	1.13411	1.28010	0.11774	24.09570
14	N	1.16979	1.32734	0.12915	24.23070
15	O	1.10260	1.43435	0.24149	19.32620
16	P	1.42818	1.57866	0.11645	40.60860
17	Q	1.03283	1.40879	0.27807	24.29780
18	R	1.04869	1.22163	0.14194	17.83800
19	S	1.97762	2.19827	0.18216	108.49100
20	T	1.06258	1.49308	0.30727	17.03810

Source: Authors' own calculations.

FIGURE 5.3.7
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Dytiki Ellada

(a)



(b)

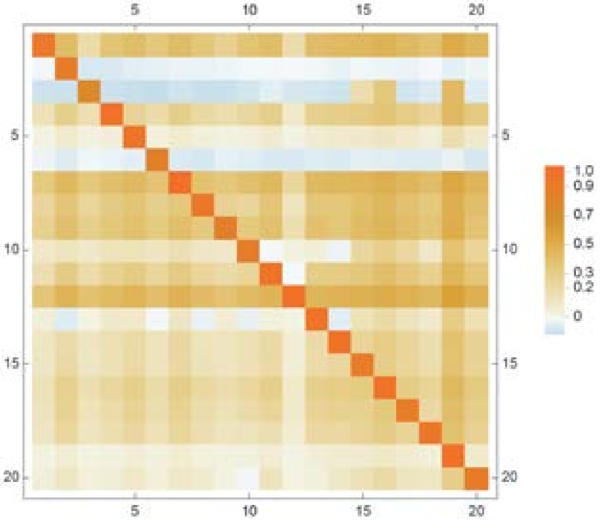
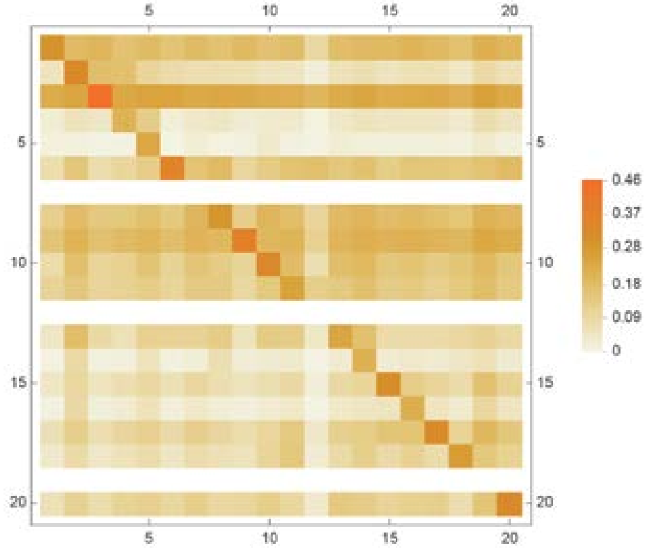
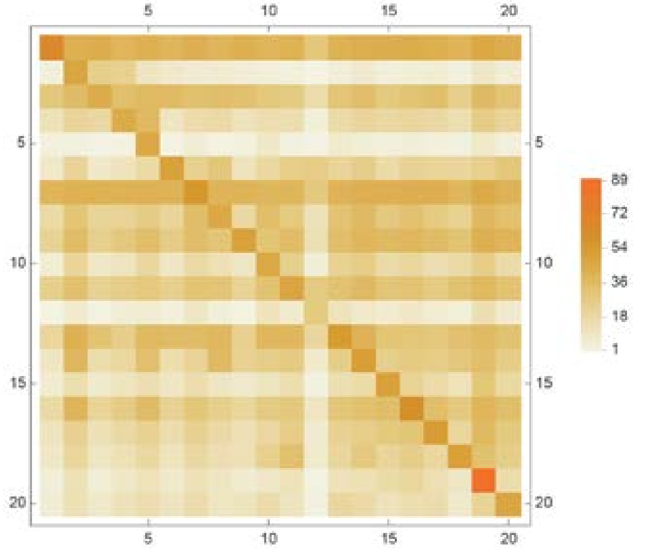


FIGURE 5.3.7 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.14
Multipliers for the region of Dytiki Ellada by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.534900	1.234205	0.540599	31.003100
Industrial products	0.754490	1.243056	0.388412	12.959196
Services	1.134888	1.366877	0.183292	25.630149
Region's average	1.06803	1.32274	0.20445	23.43800

Source: Authors' own calculations.

regional average of 23.438. The Primary products sector has a significant multiplier of 31.003, indicating that it offers the most substantial employment opportunities in the region of Dytiki Ellada. Services follow with a value of 25.630, while Industrial products lag behind with a multiplier of 12.959.

5.3.8. Multipliers for Sterea Ellada

Table 5.3.15 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of the region of Sterea Ellada. In order to get a more complete picture of the composition of these multipliers, Figure 5.3.8 gives a visual representation of the matrices of output, import, and employment multipliers for each industry in the region.

The output multipliers (with imports) have an average value of approximately 0.984. The standard deviation is 0.338, and the multiplier values range from a low of 0.128 to a high of 1.881. For the output multipliers (without imports), the average value rises to 1.343, with values spanning between 1.038 and 2.215, and a standard deviation of 0.241. The import multipliers have an average value of 0.279 and a standard deviation of 0.193, with values ranging between a minimum of 0.022 and a peak of 0.896. Lastly, the employment multipliers stand out with an average value of 23.222 and a standard deviation of 22.094, with a broad range from 1.356 to 106.348.

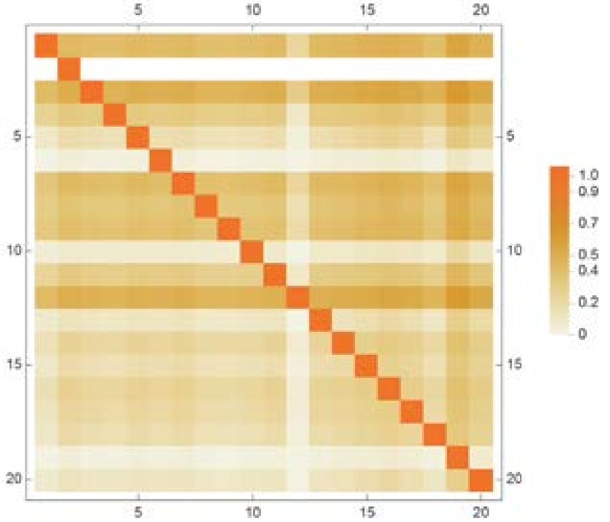
TABLE 5.3.15
Multipliers for the region of Sterea Ellada by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.84435	1.13908	0.24751	46.06100
2	B	0.12795	1.31273	0.89641	12.69500
3	C	0.55100	1.25111	0.55862	10.25470
4	D	1.03100	1.22866	0.15622	10.21880
5	E	1.08860	1.30020	0.16615	12.71010
6	F	0.71138	1.25653	0.43374	17.23830
7	G	1.14285	1.31185	0.13395	27.61010
8	H	0.90984	1.21633	0.24770	12.27110
9	I	0.69735	1.21129	0.41960	17.60260
10	J	0.87227	1.23293	0.29049	10.85100
11	K	1.10741	1.29572	0.14726	13.92020
12	L	1.00989	1.03812	0.02238	1.35615
13	M	1.10741	1.29085	0.14387	23.78000
14	N	1.13229	1.33003	0.15611	23.14800
15	O	1.06822	1.45642	0.28005	19.43880
16	P	1.37840	1.58744	0.15820	39.57870
17	Q	0.98172	1.44897	0.34046	25.08050
18	R	1.02596	1.23178	0.16510	17.59720
19	S	1.88095	2.21450	0.26247	106.34800
20	T	1.01694	1.51400	0.35218	16.67760

Source: Authors' own calculations.

FIGURE 5.3.8
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Sterea Ellada

(a)



(b)

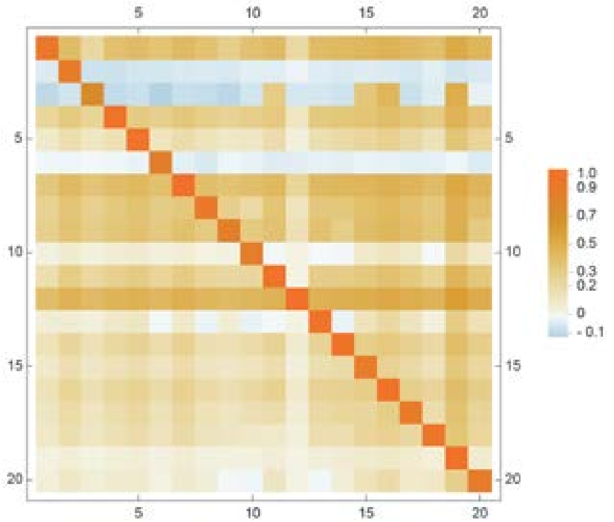
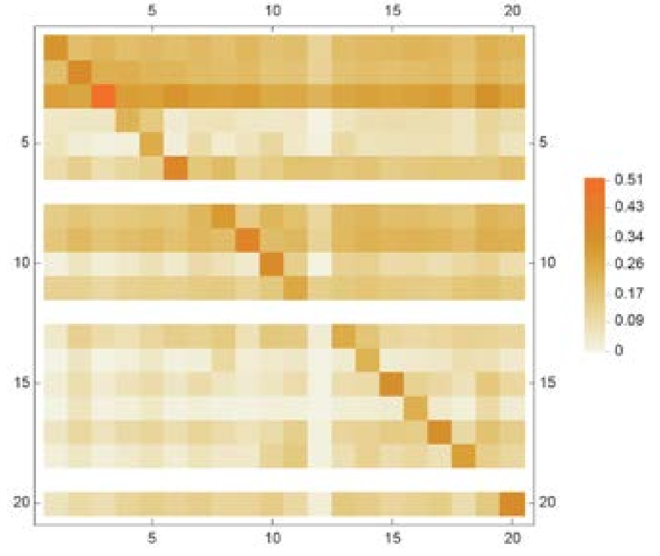
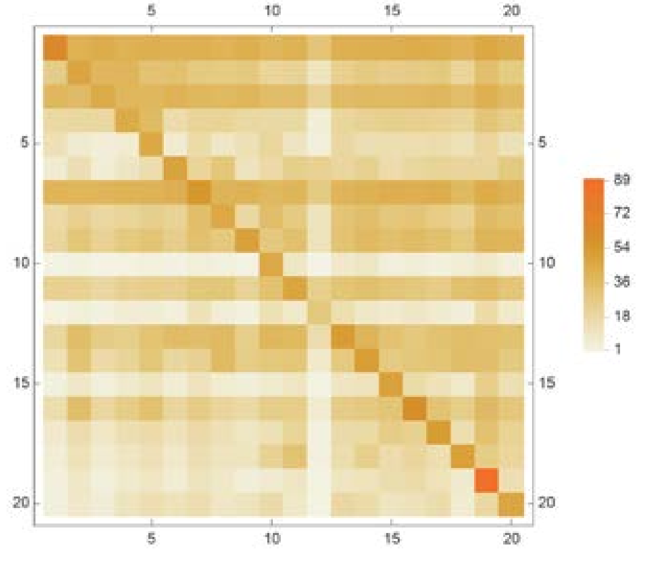


FIGURE 5.3.8 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.16
Multipliers for the region of Sterea Ellada by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.486149	1.225905	0.621958	29.378000
Industrial products	0.701985	1.269846	0.462228	12.623380
Services	1.095107	1.384302	0.222845	25.375711
Region's average	1.02429	1.34343	0.24892	23.22190

Source: Authors' own calculations.

Table 5.3.16 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region's average. Regarding the output multipliers with imports, the region's average is 1.024. The Services sector leads with a value of 1.095, the highest value when imports are considered. On the contrary, the Primary sector registers the lowest output multiplier value at 0.486. When we shift our focus to output multipliers without imports, the regional average rises to 1.343. Services again dominate with a multiplier of 1.384, showcasing their strong output when imports are excluded. Industrial products follow closely with 1.270, while Primary products record a value of 1.226.

Regarding the import multipliers, their regional average amounts to 0.249. Primary products exhibit the highest dependency on imports, with a significant multiplier of 0.622. In stark contrast, Services demonstrate the least reliance on imports, recording a value of 0.223. Lastly, when observing the employment multipliers, the overarching average for the region of Sterea Ellada is 23.222. The Primary products sector emerges as a significant employment generator for this region, with a multiplier of 29.378, dwarfing the other sectors. Services follow suit with a value of 25.376, while Industrial products present the lowest employment potential in the region, with a value of 12.623.

5.3.9. Multipliers for Attiki

Table 5.3.17 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of the region of Attiki. Figure 5.3.9 offers a visual representation of the matrices of output, import, and employment multipliers for each industry in the region.

The output multipliers (with imports) have an average value of 1.030, with a standard deviation of 0.351, indicating a moderate spread around the mean. The values in this category range between 0.175 and 1.999. In the output multipliers (without imports), the mean is slightly higher at 1.366, with a spread represented by a standard deviation of 0.249, and the values range widely from 1.048 to 2.255. The import multipliers present an average value of 0.261, with a standard deviation of 0.195, and a range spanning from 0.025 to 0.911. Lastly, the employment multipliers have an average value of 23.272. This category displays a significant range from 1.750 to 104.609, with a standard deviation of 21.498, highlighting the strong sectoral variability of employment multipliers in the region of Attiki.

Table 5.3.18 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region's average. In the output multipliers with imports category, the average value for the region of Attiki is 1.070. The Services sector leads with a multiplier of 1.141, showing that it has the highest output when imports are considered. Conversely, Primary products have the lowest multiplier in this category, with a value of 0.530. When examining the output multipliers without imports, the region's average rises to 1.366. In the region of Attiki, Services again take the forefront with a multiplier of 1.413, indicating a strong output even when imports are excluded. Industrial products closely follow with a value of 1.278, while Primary products register an average value of 1.268.

Turning to the import multipliers, the regional average is 0.231. Primary products display the highest dependency on imports, with a multiplier of 0.565. In contrast, Services have a relatively lower reliance on imports, with a multiplier of 0.209. Lastly, in the employment multipliers, the average employment potential for Attiki is 23.272. The Primary products

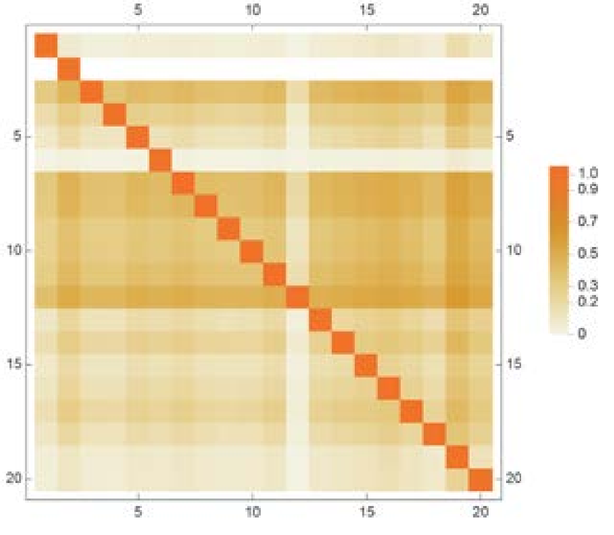
TABLE 5.3.17
Multipliers for the region of Attiki by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.88585	1.14431	0.21907	41.99150
2	B	0.17511	1.39145	0.91056	16.08010
3	C	0.59500	1.21074	0.50726	7.77906
4	D	1.07617	1.20299	0.10302	8.88996
5	E	1.13565	1.31299	0.14047	12.61690
6	F	0.75150	1.27147	0.41463	17.80530
7	G	1.19044	1.34322	0.12307	28.48000
8	H	0.95286	1.25164	0.23977	13.69610
9	I	0.72629	1.22464	0.40684	16.91610
10	J	0.89351	1.23934	0.27845	10.56010
11	K	1.14847	1.34096	0.14913	15.17660
12	L	1.01713	1.04847	0.02507	1.75027
13	M	1.14292	1.31013	0.13154	24.12390
14	N	1.19564	1.38534	0.15041	25.46030
15	O	1.11179	1.48414	0.26502	19.50900
16	P	1.43739	1.61255	0.13278	39.10020
17	Q	1.02992	1.45382	0.30748	24.22800
18	R	1.06068	1.28063	0.17355	19.64540
19	S	1.99946	2.25502	0.20449	104.60900
20	T	1.06850	1.55240	0.33685	17.02690

Source: Authors' own calculations.

FIGURE 5.3.9
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Attiki

(a)



(b)

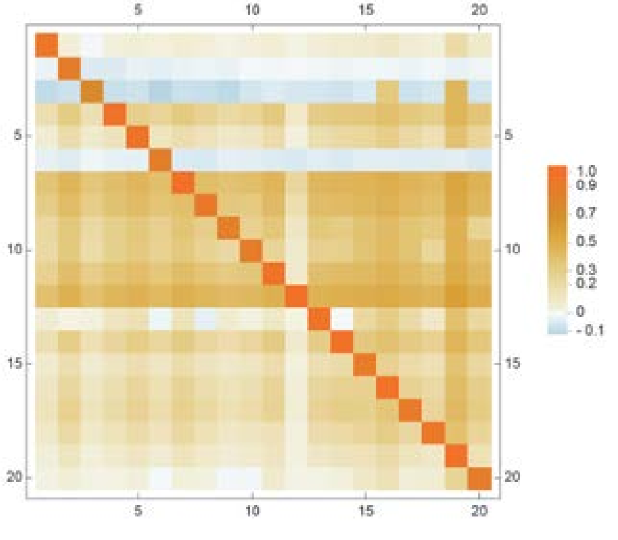
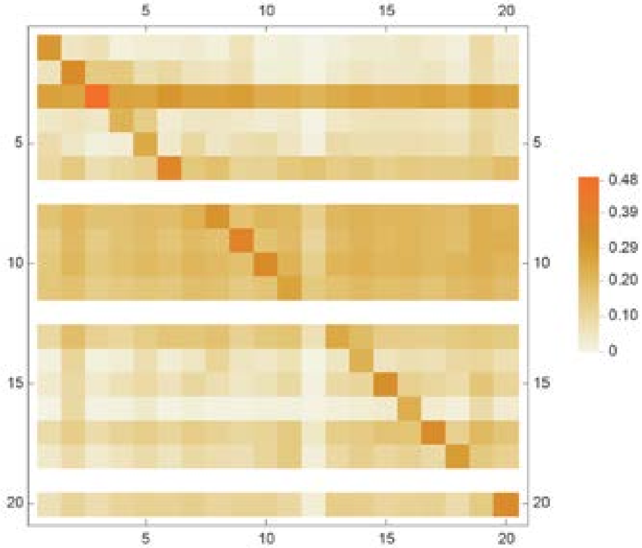
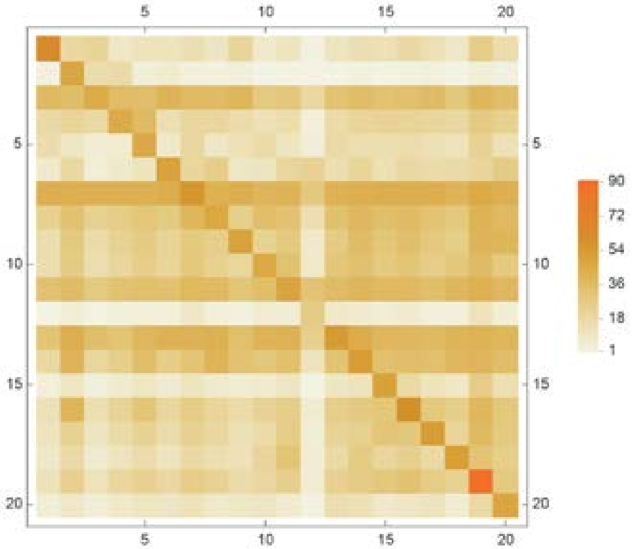


FIGURE 5.3.9 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.18
Multipliers for the region of Attiki by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.530479	1.267880	0.564818	29.035800
Industrial products	0.746684	1.277928	0.415186	12.634264
Services	1.141072	1.413021	0.208890	25.734419
Region's average	1.06971	1.36581	0.23097	23.27220

Source: Authors' own calculations.

sector stands out with a significant multiplier of 29.036, indicating that it offers the most substantial employment opportunities in the region. Services follow with a value of 25.734, while Industrial products lag behind with a multiplier of 12.634.

5.3.10. Multipliers for Peloponnisos

Table 5.3.19 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of the region of Peloponnisos. Additionally, Figure 5.3.10 offers a visual representation of the matrices of output, import, and employment multipliers for each industry in the region.

The output multipliers (with imports) have an average value of approximately 1.026, with a relatively moderate spread, as indicated by the standard deviation of 0.342. The values in this category range from a minimum of 0.168 to a maximum of 1.969. When considering the output multipliers (without imports), the mean is slightly higher at 1.416, with an almost similar standard deviation at 0.248. The values broadly span from 1.055 to 2.304. The import multipliers have an average value of 0.235, but what is particularly interesting is their wide variability in this region, as shown by the standard deviation of 0.193 and the range from 0.023 to 0.902. Lastly, the employment multipliers present the highest variability in the region of Peloponnisos, with an average value of 24.000, a standard deviation of 23.057, and a range from 1.885 to 111.453.

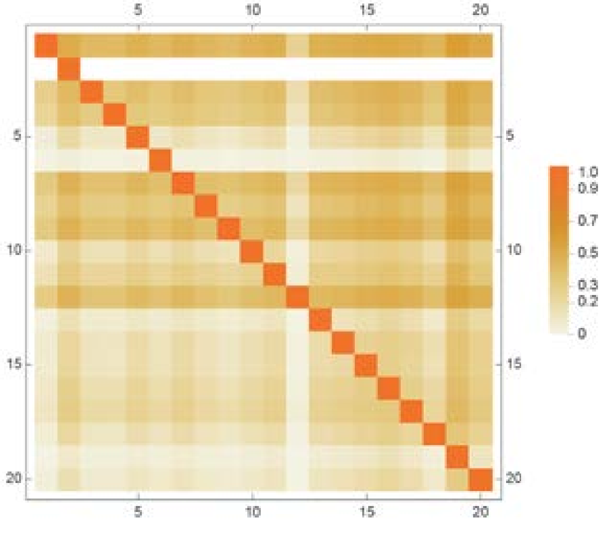
TABLE 5.3.19
Multipliers for the region of Peloponnisos by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.90068	1.20068	0.17738	45.04680
2	B	0.16793	1.43580	0.90213	17.47810
3	C	0.60944	1.35121	0.48113	9.53504
4	D	1.08865	1.28618	0.06556	8.51888
5	E	1.13312	1.36105	0.11523	12.96800
6	F	0.78974	1.34914	0.33393	15.82190
7	G	1.18782	1.38704	0.08619	28.26030
8	H	0.94386	1.30444	0.21185	12.69540
9	I	0.75410	1.27827	0.34788	16.58220
10	J	0.88703	1.27733	0.27533	11.42190
11	K	1.12832	1.36933	0.13414	15.43530
12	L	1.01553	1.05546	0.02251	1.88492
13	M	1.13215	1.34352	0.11772	24.56790
14	N	1.16572	1.43456	0.13085	24.82800
15	O	1.10028	1.51777	0.24703	20.38980
16	P	1.42204	1.64169	0.12311	41.92030
17	Q	1.02864	1.50639	0.28425	25.17240
18	R	1.04560	1.30613	0.14402	18.12460
19	S	1.96855	2.30370	0.19460	111.45300
20	T	1.05970	1.60851	0.31032	17.89940

Source: Authors' own calculations.

FIGURE 5.3.10
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Peloponnisos

(a)



(b)

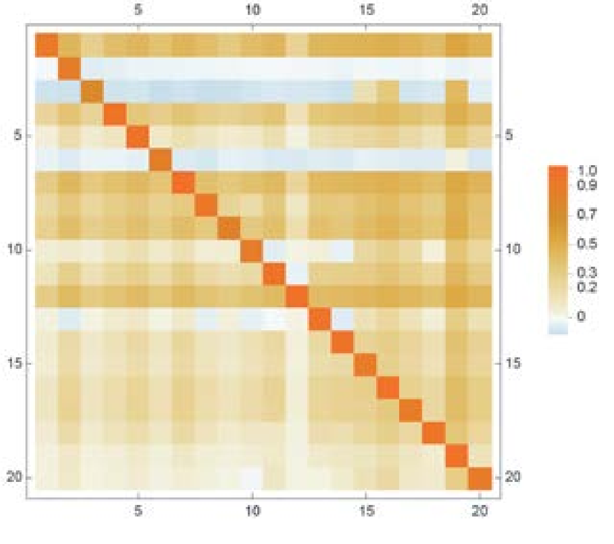
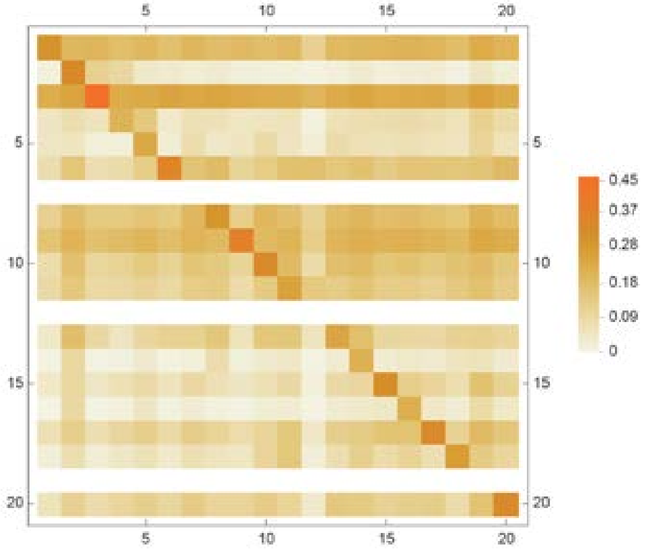
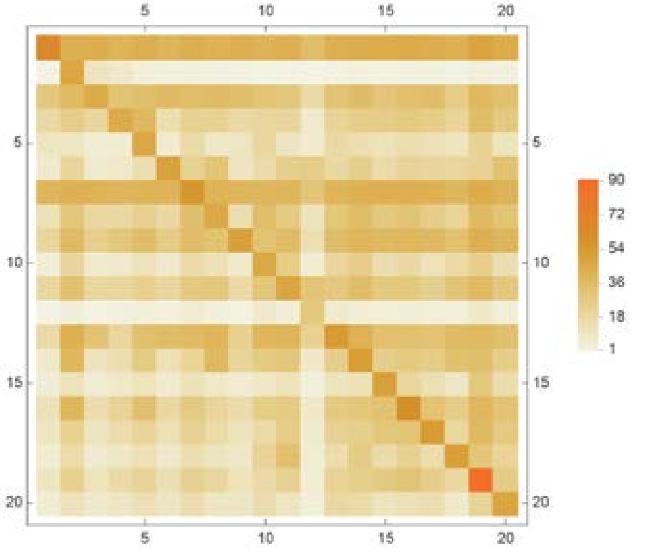


FIGURE 5.3.10 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.20
Multipliers for the region of Peloponnisos by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.534307	1.318240	0.539753	31.262450
Industrial products	0.757777	1.356676	0.379596	12.864384
Services	1.131381	1.452439	0.187842	26.473959
Region's average	1.06645	1.41591	0.20526	24.00020

Source: Authors' own calculations.

Table 5.3.20 indicates the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the region's average. The output multipliers with imports have an average of 1.066 for the region of Peloponnisos. Services lead with a value of 1.131, indicating the highest output multiplier when imports are considered, while Primary products register the lowest value at 0.534. For the output multipliers without imports, the regional average increases to 1.416. Services again dominate with a multiplier of 1.452, showcasing their robust output when imports are excluded in the region. Industrial products follow closely with 1.357, and Primary products trail slightly behind at 1.318. In the import multipliers, the average stands at 0.205 for the region of Peloponnisos. Primary products exhibit the most significant dependency on imports, with a multiplier of 0.540. In contrast, Services demonstrate the least reliance on imports among the broad sectors of this region, with an average value of 0.188.

Lastly, when observing the employment multipliers in the region of Peloponnisos, the average employment potential is 24.000. Primary products stand out with a high multiplier of 31.262, suggesting that they offer the most substantial employment opportunities in the region. Services follow with a value of 26.474, while Industrial products have a multiplier of 12.864, indicating the lowest employment potential among the three broad sectors in this region. In summary, Primary products, despite their high dependency on imports, provide the most significant employment opportunities in the region of Peloponnisos. Services consistently outperform in output multipliers, both with and without imports. Industrial products, while closely aligned with Services in output without imports, lag in employment potential.

5.3.11. Multipliers for Voreio Aigaio

Table 5.3.21 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of Voreio Aigaio. Moreover, Figure 5.3.11 gives a visual representation of the matrices of output, import, and employment multipliers for each industry in the region.

The output multipliers that incorporate imports have an average value of approximately 1.039 in the region of Voreio Aigaio, with a median close to 1.063, a standard deviation of 0.346, and a range of values between 0.178 and 2.004. When imports are excluded from the output multipliers in the region, the mean value increases to 1.314, with a median of 1.277 and a range between 1.032 and 2.161. The import multipliers present a regional average of 0.217 and a median of 0.157, with values ranging between 0.011 and 0.886. Lastly, the employment multipliers showcase an average value of 21.961 in the region, with a median of 16.122, a large standard deviation of 21.399, and a wide range of values between 1.050 and 102.382.

Table 5.3.22 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors, as well as the average values for the region of Voreio Aigaio. The output multipliers with imports have a mean value of 1.079 in the region. Services lead this metric with a value of 1.147, signifying the highest output multiplier when imports are factored into the region of Voreio Aigaio. In contrast, Primary products have the lowest value (0.542) in this category. When we shift our focus to output multipliers without imports, the regional average rises to 1.314. Here, the multipliers for Industrial products and Primary products are closely matched, with values of 1.239 and 1.229, respectively. However, Services again take the lead with a value of 1.356. In the realm of import multipliers, the average for the region of Voreio Aigaio is 0.187.

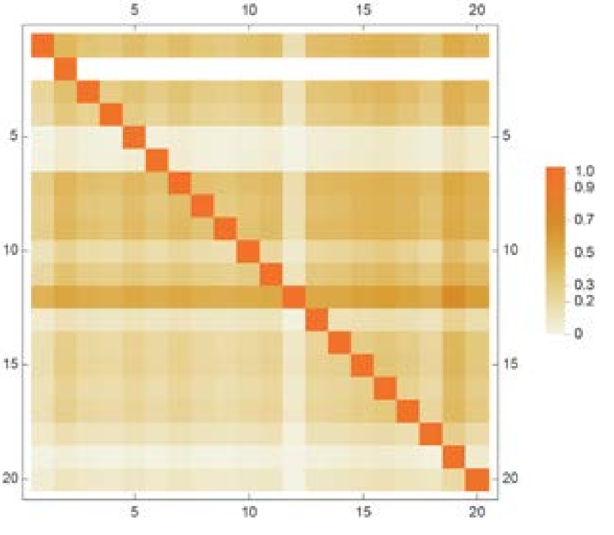
TABLE 5.3.21
Multipliers for the region of Voreio Aigaio by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.90550	1.10300	0.17508	44.80500
2	B	0.17824	1.35560	0.88553	15.44000
3	C	0.61672	1.20217	0.48541	9.66143
4	D	1.09701	1.17336	0.06201	7.85350
5	E	1.12943	1.28206	0.12210	12.07690
6	F	0.80136	1.18420	0.32129	14.93280
7	G	1.20333	1.28645	0.06727	26.30460
8	H	0.96345	1.18568	0.18547	11.01990
9	I	0.76347	1.15715	0.33773	15.93250
10	J	0.89595	1.20812	0.25730	9.70590
11	K	1.14311	1.28052	0.10840	12.76910
12	L	1.01931	1.03231	0.01058	1.04952
13	M	1.14339	1.27378	0.10368	22.83570
14	N	1.19346	1.29898	0.08474	21.39520
15	O	1.11115	1.41705	0.22085	17.22890
16	P	1.44058	1.55999	0.08836	37.68920
17	Q	1.04476	1.39286	0.25583	22.45440
18	R	1.05771	1.22885	0.13873	17.36220
19	S	2.00446	2.16065	0.12291	102.38200
20	T	1.06858	1.50106	0.30583	16.31230

Source: Authors' own calculations.

FIGURE 5.3.11
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Voreio Aigaio

(a)



(b)

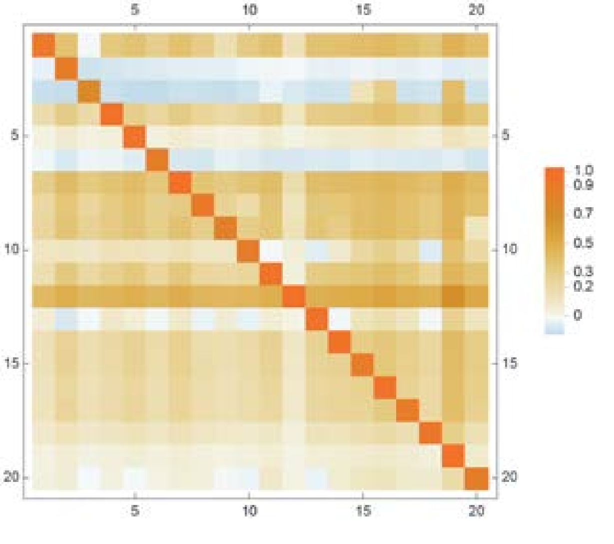
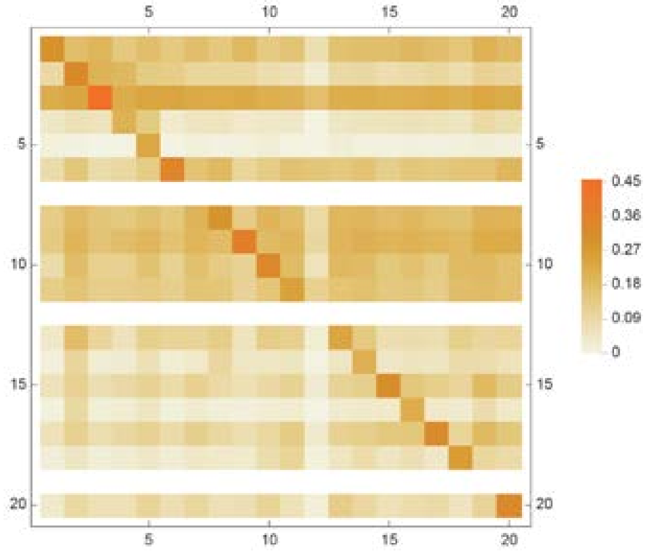
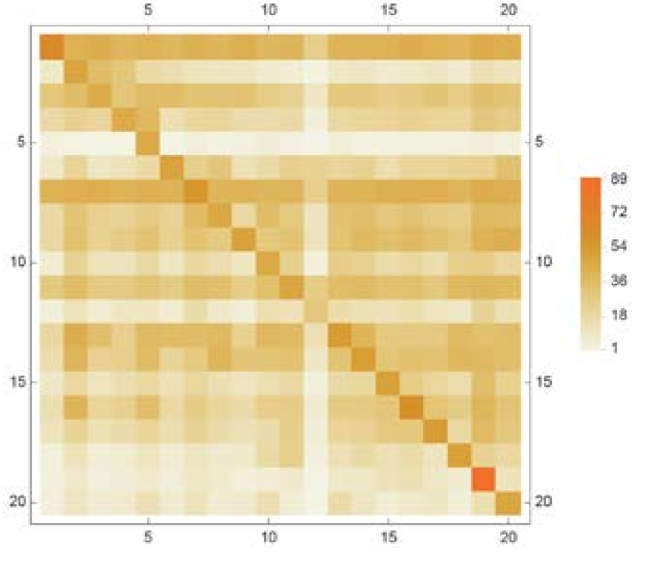


FIGURE 5.3.11 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.22
Multipliers for the region of Voreio Aigaio by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.541869	1.229300	0.530302	30.122500
Industrial products	0.764551	1.239478	0.375266	11.992926
Services	1.146623	1.355961	0.163405	23.888673
Region's average	1.07905	1.31419	0.18695	21.96060

Source: Authors' own calculations.

Primary products exhibit the highest dependency on imports, with a multiplier of 0.530, while Services demonstrate the least reliance on imports in this region, recording a value of 0.163.

Lastly, the employment multipliers have an average of 21.961 for the region of Voreio Aigaio. Primary products emerge as a significant employment generator in the region with a multiplier of 30.123, dwarfing the other sectors. On the other end of the spectrum, Industrial products present the lowest employment potential in the region, with a value of 11.993. In a nutshell, the Primary products sector, while being heavily reliant on imports, offers the most substantial employment opportunities for the region of Voreio Aigaio. Services consistently exhibit higher output multipliers, both with and without the inclusion of imports. Industrial products, although closely aligned with Primary products in output without imports, lag behind in terms of employment potential.

5.3.12. Multipliers for Notio Aigaio

Table 5.3.23 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of the region of Notio Aigaio. In order to get a more complete picture of the composition of these multipliers, Figure 5.3.12 provides us with a visual representation of the matrices of output, import, and employment multipliers for each industry in the region of Notio Aigaio.

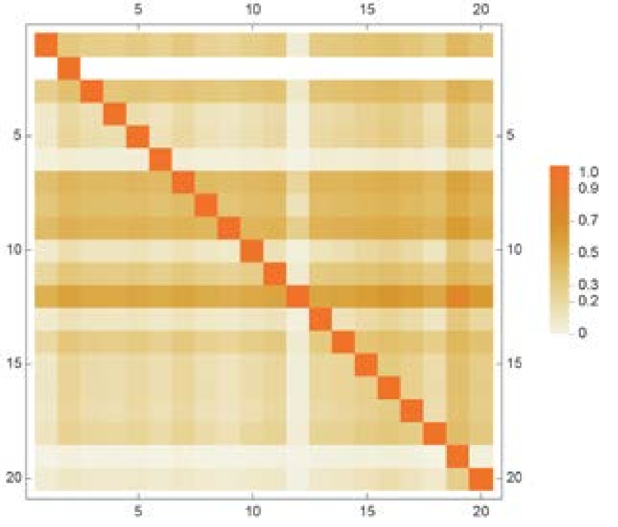
TABLE 5.3.23
Multipliers for the region of Notio Aigaio by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.93971	1.15195	0.17984	42.89820
2	B	0.20173	1.39609	0.88982	13.02990
3	C	0.65432	1.28438	0.49072	10.04130
4	D	1.17640	1.26959	0.07294	10.91230
5	E	1.15713	1.32086	0.12687	10.24900
6	F	0.83230	1.23845	0.32584	15.41530
7	G	1.26024	1.35616	0.07587	26.37120
8	H	0.99848	1.23633	0.19067	11.45440
9	I	0.77881	1.18685	0.34018	14.60790
10	J	0.93869	1.27427	0.26352	10.50040
11	K	1.20192	1.35562	0.11715	13.59540
12	L	1.02479	1.03926	0.01142	1.04993
13	M	1.19308	1.33750	0.11125	22.78530
14	N	1.26371	1.38527	0.09508	22.57690
15	O	1.18994	1.53022	0.23255	18.10820
16	P	1.55555	1.69922	0.10564	38.15200
17	Q	1.12735	1.51622	0.26786	24.05620
18	R	1.09753	1.28253	0.14478	17.74890
19	S	2.24745	2.44666	0.15950	103.16000
20	T	1.13907	1.61016	0.31667	15.87220

Source: Authors' own calculations.

FIGURE 5.3.12
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Notio Aigaio

(a)



(b)

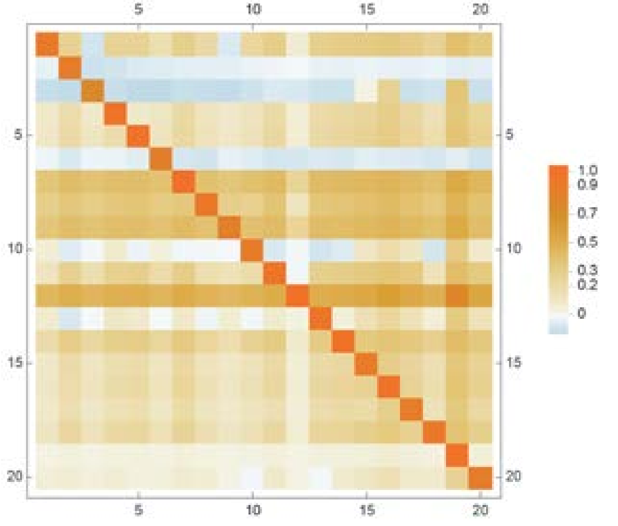
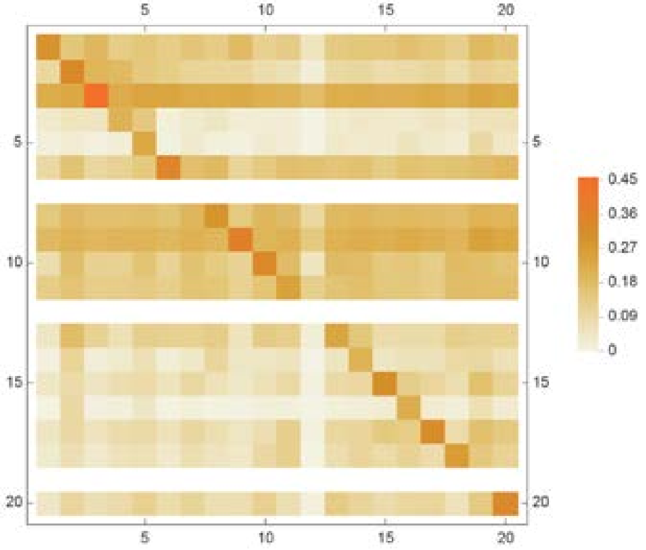
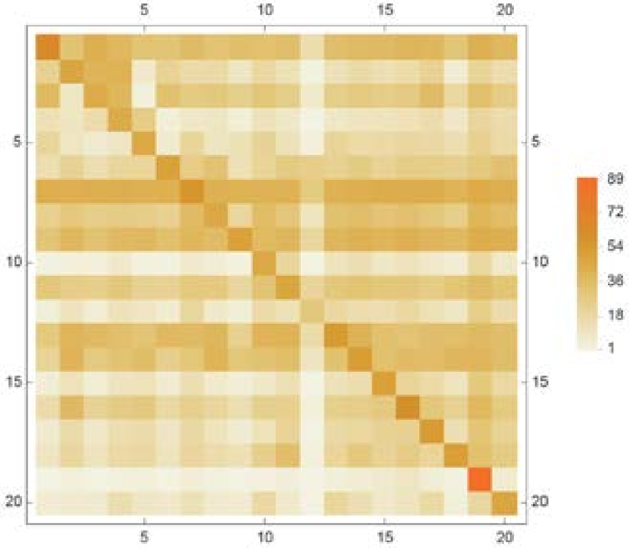


FIGURE 5.3.12 (continued)

(c)



(d)



Source: Authors' own calculations.

The output multipliers that include imports have an average value of 1.099 in the region of Notio Aigaio, with a median of 1.133, a standard deviation of 0.388, and a range of values between 0.202 and 2.247. When we exclude imports from the output multipliers, the mean rises to 1.396 and the median to 1.329, with values ranging from 1.039 to 2.447. The import multipliers have a regional average of 0.226 and a median of 0.170, exhibiting a spread from 0.011 to 0.890. Lastly, the employment multipliers in the region of Notio Aigaio present an average of 22.129, a median of 15.644, a high standard deviation of 21.417, and a wide range of values from 1.050 to 103.160.

Table 5.3.24 reports the arithmetic means of GDP, import, and employment multipliers for the primary, industrial, and service sectors, as well as the corresponding average values for the region of Notio Aigaio. For the output multipliers with imports, the average value for the region of Notio Aigaio is 1.139. Services lead this category with a multiplier of 1.215, indicating a robust output with imports in the region, while Primary products trail with the lowest multiplier of 0.570. When considering the output multipliers without imports, the average value for the region rises to 1.396. Services again dominate with a multiplier of 1.447, exhibiting their heightened output when imports are excluded in the region. Primary products register the lowest value of 1.274. Turning our attention to import multipliers, their average value is 0.196 for the region of Notio Aigaio. Primary products demonstrate a pronounced dependency on imports with a mul-

TABLE 5.3.24
Multipliers for the region of Notio Aigaio by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.569942	1.274020	0.534833	27.964050
Industrial products	0.804066	1.301874	0.381238	11.929560
Services	1.215472	1.446876	0.173724	24.288495
Region’s average	1.13891	1.39588	0.19591	22.12920

Source: Authors’ own calculations.

tiplier of 0.535, which is significantly higher than the other sectors in the region of Notio Aigaio. In contrast, Services exhibit the least reliance on imports, with a multiplier of 0.174.

Finally, the average value of employment multipliers is 22.129 for the region of Notio Aigaio. Primary products stand out with a high multiplier of 27.964, suggesting that this sector offers the most substantial employment opportunities in the region. Conversely, Industrial products have the lowest employment potential in the region, with a multiplier of 11.930. Overall, while Primary products are heavily import-dependent and offer significant employment, Services consistently demonstrate superior output multipliers, both with and without imports. Industrial products, meanwhile, lag in employment potential for the region of Notio Aigaio.

5.3.13. Multipliers for Kriti

Table 5.3.25 reports the output multipliers with and without imports as well as the import and employment multipliers for the 20 industries of the region of Kriti. Figure 5.3.13 illustrates the matrices of output, import, and employment multipliers for each industry, in order to obtain a more complete picture of their composition in the region.

The output multipliers with imports have an average value of 1.039 for the region of Kriti, with a median of 1.063, a standard deviation of 0.346 and a range of values from 0.164 to 1.956. When considering output multipliers without imports, the mean rises to 1.314 and the median to 1.277, while the dispersion is slightly less, with a standard deviation of 0.237 and a range of values between 1.032 and 2.192. When focusing on import multipliers, the average stands at 0.217 for the region of Kriti, with a median of 0.157, a standard deviation of 0.196, and a range of values between 0.011 and 0.904. Lastly, for employment multipliers, the mean is 21.961 for the region of Kriti, with a median of 16.122, a high standard deviation of 21.399, and a range of values between 1.050 and 106.447.

Table 5.3.26 reports the arithmetic means of GDP, import, and employment multipliers for the Primary, Industrial, and Service sectors in Kriti, as well as the region's average. For the output multipliers with imports, the mean value for the region is 1.060. The minimum value in this category is for Primary products, at 0.528, while Services have the maximum value of 1.127.

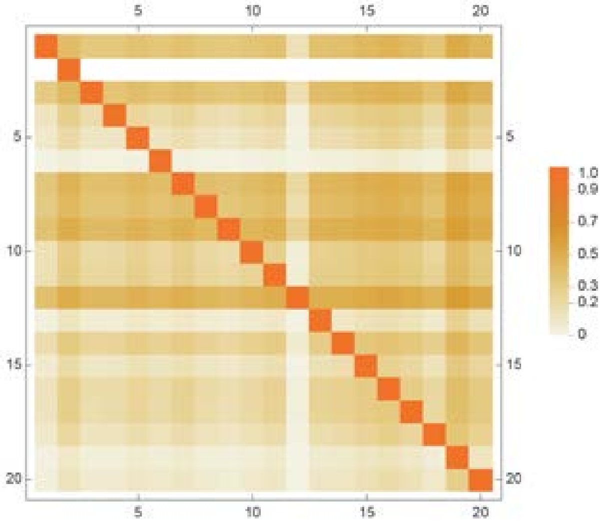
TABLE 5.3.25
Multipliers for the region of Kriti by industry

	Sector	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
1	A	0.89122	1.11111	0.19420	45.51680
2	B	0.16401	1.36150	0.90402	16.33510
3	C	0.60101	1.17608	0.48871	9.21135
4	D	1.06367	1.18268	0.10010	9.00972
5	E	1.12225	1.26732	0.11885	11.80790
6	F	0.77834	1.19319	0.34826	15.70020
7	G	1.18340	1.28971	0.08908	27.15120
8	H	0.94514	1.18855	0.20465	11.56530
9	I	0.75276	1.15768	0.34842	15.92250
10	J	0.88273	1.21240	0.27253	10.18610
11	K	1.12240	1.29414	0.13822	14.25520
12	L	1.01403	1.03599	0.01836	1.38723
13	M	1.12446	1.28499	0.13045	23.91620
14	N	1.17291	1.31237	0.11533	22.96480
15	O	1.09669	1.44551	0.25486	19.57180
16	P	1.41626	1.57564	0.12501	39.65460
17	Q	1.02067	1.41925	0.29630	24.50620
18	R	1.04370	1.22527	0.14941	17.73550
19	S	1.95552	2.19170	0.19725	106.44700
20	T	1.04641	1.49988	0.32651	17.02180

Source: Authors' own calculations.

FIGURE 5.3.13
The matrix of (a) output with imports, (b) output without imports, (c) import, and (d) employment multipliers for the 20 economic sectors of the region of Kriti

(a)



(b)

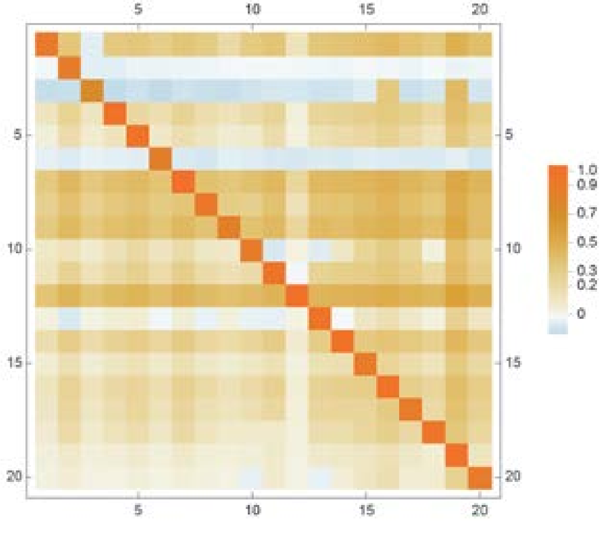
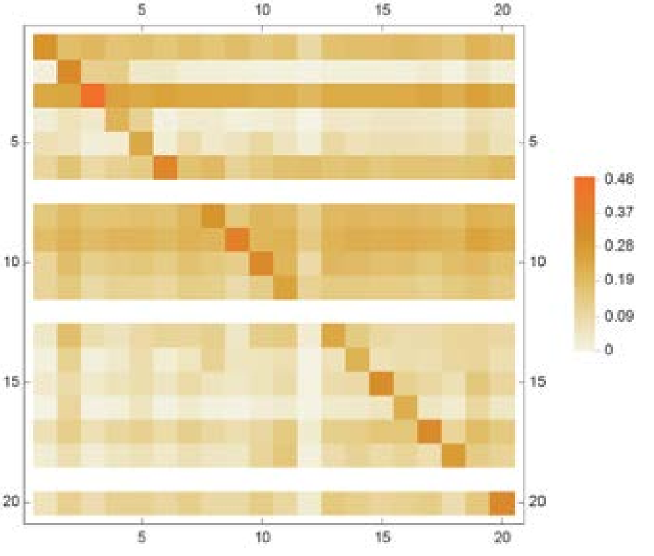
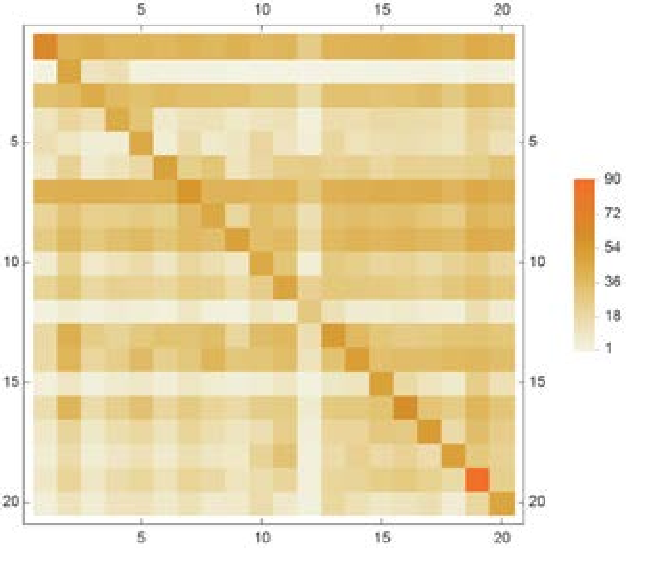


FIGURE 5.3.13 (continued)

(c)



(d)



Source: Authors' own calculations.

TABLE 5.3.26
Multipliers for the region of Kriti by broad sector of its economy

	Output multipliers (with imports)	Output multipliers (without imports)	Import multipliers	Employment multipliers
Primary products	0.527619	1.236305	0.549108	30.925950
Industrial products	0.745856	1.236154	0.391988	12.412854
Services	1.126934	1.366649	0.190455	25.163245
Region's average	1.05988	1.32125	0.21103	22.99330

Source: Authors' own calculations.

This outcome suggests that, on average, Services have a higher output multiplier with imports in the region of Kriti, compared to Primary products. In the output multipliers without imports category, the regional average is 1.321. Primary products and Industrial products have values close to this mean, as they are both equal to 1.236. Services exceed the region's average with a value of 1.367, indicating that the output for Services is relatively higher when imports are excluded in the region.

For import multipliers, the average stands at 0.211 for the region of Kriti. Primary products have the highest value (0.549), indicating a significant dependency on imports. In contrast, Services have the lowest import multiplier (0.190), demonstrating a lower reliance on imports. Lastly, on the basis of employment multipliers, the regional average employment potential is 22.993. Primary products lead in this category with a high value of 30.926, indicating that this sector has the highest potential for employment in the region of Kriti. Conversely, Industrial products have the lowest employment multiplier, which amounts to 12.413.

5.4. Statistical analysis of regional multipliers

In order to comprehensively examine the role of imports on the regional multipliers of the Greek economy, in this section, we perform a series of statistical comparisons of the resulting multipliers across industries and across region-sectors. We also test a series of hypotheses and discuss the relevant results. The comparison of multipliers is carried out with the use of nonparametric statistics, which test for the null hypothesis of the equality of matched pairs of multipliers of the same category (namely, that both distributions are the same) at the national, regional, and region-industry levels, by employing the Wilcoxon matched-pairs signed-ranks test (Wilcoxon 1945; Mann and Whitney, 1947). In comparison with the assumptions required for using parametric test statistics, this nonparametric test can yield efficient estimates for sample sizes larger than 16 observations (Snedecor, 1956).

Table 5.4.1 demonstrates the results, in terms of the z-values and significance levels, of the Wilcoxon signed-rank test of the differences among the output multipliers with and without import, at the regional, region-industry, and national levels. This comparison clearly shows that the output multipliers with imports are significantly (at the 99% level of confidence) lower – as reflects negative signs – than the output multipliers without imports, at all levels of statistical analysis. The latter outcome signifies the considerable impact of imports on the output and growth possibilities of the regional economies at the total and industry levels as well as the whole country, underlying the limited competitiveness of its production base.

Furthermore, we present the results of the comparison of the sectoral output multipliers with imports (Table 5.4.2), the sectoral output multipliers without imports (Table 5.4.3), the import multipliers (Table 5.4.4), and the employment multipliers with imports (Table 5.4.5), among the 13 regions of the country, using the Wilcoxon signed-rank test statistics. By and large, the statistical comparisons among the output multipliers (with imports) across sectors at the regional level (Table 5.4.2) verify the classification of the Greek regions into distinct groups, according to the magnitude of output multipliers (see Section 5.2). Nevertheless, a few significant differences are found between the output (with imports) multipliers of regions classified into the same group.

More specifically, Notio Aigaio is found to be the frontier region in the first group, as its output multipliers are significantly higher than those of the other regions in the group, i.e., Voreio Aigaio and Ionia Nisia. The output multipliers of the latter regions are not found to be significantly differ-

TABLE 5.4.1
Comparison between the output multipliers with and without imports across industries at the regional, region-industry, and national levels, using the Wilcoxon signed-rank test statistics

	Region	Region-Industry	Country
An. Makedonia-Thraki	**-3.920 (0.000)**		
Kentriki Makedonia	**-3.920 (0.000)**		
Dytiki Makedonia	**-3.920 (0.000)**		
Ipeiros	**-3.920 (0.000)**		
Thessalia	**-3.920 (0.000)**		
Ionia Nisia	**-3.920 (0.000)**		
Dytiki Ellada	**-3.920 (0.000)**		
Sterea Ellada	**-3.920 (0.000)**		
Attiki	**-3.920 (0.000)**		
Peloponnisos	**-3.920 (0.000)**		
Voreio Aigaio	**-3.920 (0.000)**		
Notio Aigaio	**-3.920 (0.000)**		
Kriti	**-3.920 (0.000)**		
		-13.978 (0.000)	
			-3.920 (0.000)

Source: Authors' own calculations.

Notes: Figures show *z*-values and significance levels (in the parenthesis). Bold figures indicate statistically significant differences at the 99% level of confidence. The same holds for the next tables of this section.

ent than those of Attiki, which is the frontier region in the second group. Kriti can be regarded as the laggard region in the second group, since its output multipliers are not found to be significantly different than those of Dytiki Makedonia, which can be considered as the frontier region in the third group, outperforming the regions of Anatoliki Makedonia and Thraki, Kentriki Makedonia, and Ipeiros (Table 5.4.2).

The ranking of regions, in terms of their sectoral output multipliers, presents some significant differences when we do not include imports (Table 5.4.3). In this case, the two regions of the fourth group, i.e., Thessalia and Sterea Ellada, are found to have output multipliers which are either non-significantly different or higher than those of the other regions, except for Peloponnisos, whose output multipliers with imports are significantly higher than those of Thessalia and Sterea Ellada.

Regarding the remaining regions, on the one side, about half of these regions are found to be more competitive since their output multipliers without imports are significantly higher than those of the other regions, except for Peloponnisos, Thessalia, and Sterea Ellada. These regions refer to the most populated ones, i.e., Attiki and Kentriki Makedonia, as well as those of Notio Aigaio, Anatoliki Makedonia and Thraki, and Ipeiros. These regions can be regarded as more robust or resilient to an exogenous trade (import) shock, compared to the remaining ones (except for Peloponnisos, Thessalia, and Sterea Ellada).

On the other side, the remaining regions, i.e., those of Voreio Aigaio, Dytiki Makedonia, Dytiki Ellada, Kriti, and Ionia Nisia, are found to be less competitive since most of their sectoral output multipliers without imports are significantly lower than those of the other regions. In turn, these regions can be considered as more vulnerable (or less resilient) to a negative shock in import trade.

Moreover, the regions with the lowest output (with imports) multipliers, i.e., Thessalia and Sterea Ellada, are found to have the highest import multipliers compared to the other regions (Table 5.4.4). Many of the regions that were found to be more robust in output multipliers when omitting imports, such as Anatoliki Makedonia and Thraki, Ipeiros, Attiki, and Kentriki Makedonia, have relatively high import multipliers. This outcome signifies the fact that, despite these regions being reliant on import trade, they can better respond to reduced imports and maintain their competitive positions, compared to the other regions.

Regarding the sectoral employment multipliers, they are not found to differ significantly among regions, compared to the differences observed in output and import multipliers. Regions with relatively high employment multipliers belong to various groups – based on their output multipliers –

and include those of Anatoliki Makedonia and Thraki, Ipeiros, Peloponnisos, and Thessalia (Table 5.4.5).

In Figures 5.4.1-5.4.3, we graphically illustrate through scatter plots the relationships between the output (with imports) multipliers, the import multipliers, and the employment multipliers at the sectoral and region-industry levels in order to further explain statistical correlation patterns between them. In line with previous findings, we observe an inverse linear association – as indicated by the downward trend (best-fit line) and the negative slope value – and a moderate coefficient of determination (approximately $R^2=0.5$) between the output (with import) multipliers and the import multipliers, at both the sectoral and region-industry levels (Figure 5.4.1). This outcome implies that, on average, as values in output (with imports) multipliers increase, values in import multipliers tend to decrease, and vice versa; hence, it confirms the negative impact that imports have on the total output possibilities of the Greek economy.

On the contrary, Figure 5.4.2 illustrates that, on average, there is no systematic relationship nor a considerable R^2 value between the employment (with imports) multipliers and the import multipliers at both the sectoral and region-industry levels. This outcome suggests that imports do not have an overall significant impact on the employment potential of the country. Finally, we identify a positive linear association – as reflected in the upward trend (best-fit line) and the positive slope value – and a moderate coefficient of determination between the output (with imports) multipliers and the employment multipliers at both the sectoral and region-industry levels (Figure 5.4.3). This trend suggests that, on average, as values in output (with imports) multipliers increase, values in employment multipliers also tend to increase, and vice versa. Thus, higher output multipliers keep pace with an increased employment potential in Greece.

TABLE 5.4.2
Comparison of the sectoral output multipliers (with imports) among regions using the Wilcoxon signed-rank test statistics

	Anatoliki Makedonia-Thraki	Kentriki Makedonia	Dytiki Makedonia	Ipeiros	Thessalia	Ionia Nisia	Dytiki Ellada	Sterea Ellada	Attiki	Peloponnisos	Voreio Aigaio	Notio Aigaio
Anatoliki Makedonia-Thraki												
Kentriki Makedonia	0.747 (0.455)											
Dytiki Makedonia	**3.771 (0.000)**	**3.435 (0.001)**										
Ipeiros	**3.360 (0.001)**	1.120 (0.263)	**-3.248 (0.001)**									
Thessalia	**-3.435 (0.001)**	**-3.509 (0.000)**	**-3.920 (0.000)**	**-3.622 (0.000)**								
Ionia Nisia	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**							
Dytiki Ellada	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**-3.920 (0.000)**						

Sterea Ellada	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.920 (0.000)**	0.821 (0.412)	**-3.920 (0.000)**	**-3.920 (0.000)**					
Attiki	**3.920 (0.000)**	**3.920 (0.000)**	**3.397 (0.001)**	**3.659 (0.000)**	**3.920 (0.000)**	-1.214 (0.225)	0.971 (0.332)	**3.920 (0.000)**				
Peloponnisos	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.0001)**	**-3.771 (0.000)**	-2.277 (0.023)	**3.920 (0.000)**	-1.195 (0.232)			
Voreio Aigaio	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.0001)**	2.576 (0.010)	**3.920 (0.000)**	**3.920 (0.000)**	2.520 (0.012)	**3.883 (0.000)**		
Notio Aigaio	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.0001)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	
Kriti	**3.920 (0.000)**	**3.621 (0.000)**	1.979 (0.048)	**3.883 (0.000)**	**3.883 (0.000)**	**-3.920 (0.000)**	**-3.696 (0.000)**	**3.920 (0.000)**	-2.352 (0.019)	**-3.472 (0.000)**	**3.920 (0.000)**	**-3.920 (0.000)**

Source: Authors' own calculations.

TABLE 5.4.3
Comparison of the sectoral output multipliers (without imports) among regions using the Wilcoxon signed-rank test statistics

	Anatoliki Makedonia-Thraki	Kentriki Makedonia	Dytiki Makedonia	Ipeiros	Thessalia	Ionia Nisia	Dytiki Ellada	Sterea Ellada	Attiki	Peloponnisos	Voreio Aigaio	Notio Aigaio
Anatoliki Makedonia-Thraki												
Kentriki Makedonia	2.128 (0.033)											
Dytiki Makedonia	**-3.285 (0.001)**	**-3.920 (0.000)**										
Ipeiros	-2.539 (0.011)	**-3.285 (0.001)**	1.605 (0.108)									
Thessalia	1.979 (0.048)	0.859 (0.391)	**3.061 (0.002)**	2.427 (0.015)								
Ionia Nisia	**-2.763 (0.006)**	**-3.883 (0.000)**	-1.045 (0.296)	**-2.725 (0.006)**	**-2.800 (0.005)**							

Dytiki Ellada	**-2.949 (0.003)**	**-3.920 (0.000)**	-2.427 (0.015)	**-3.285 (0.001)**	**-3.061 (0.002)**	-1.680 (0.093)						
Sterea Ellada	0.112 (0.911)	-2.539 (0.011)	**3.659 (0.000)**	1.904 (0.057)	-1.456 (0.145)	**3.136 (0.002)**	**3.211 (0.001)**					
Attiki	**3.323 (0.001)**	**2.613 (0.009)**	**3.845 (0.000)**	**3.920 (0.000)**	0.709 (0.478)	**3.920 (0.000)**	**3.920 (0.000)**	**2.987 (0.003)**				
Peloponnisos	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.397 (0.001)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**	**3.920 (0.000)**			
Voreio Aigaio	**-3.435 (0.001)**	**-3.920 (0.000)**	**-3.136 (0.002)**	**-3.509 (0.000)**	**-3.248 (0.001)**	**-3.248 (0.001)**	**-2.725 (0.006)**	**-3.397 (0.001)**	**-3.920 (0.000)**	**-3.920 (0.000)**		
Notio Aigaio	**3.621 (0.000)**	**3.397 (0.001)**	**3.883 (0.000)**	**3.883 (0.000)**	2.053 (0.040)	**3.883 (0.000)**	**3.920 (0.000)**	**3.584 (0.000)**	2.427 (0.015)	-2.240 (0.025)	**3.920 (0.000)**	
Kriti	**-3.248 (0.001)**	**-3.920 (0.000)**	-2.128 (0.033)	**-3.808 (0.000)**	**-3.024 (0.003)**	-2.464 (0.014)	**-0.485 (0.627)**	**-3.285 (0.001)**	**-3.920 (0.000)**	**-3.920 (0.000)**	2.464 (0.014)	**-3.920 (0.000)**

Source: Authors' own calculations.

TABLE 5.4.4
Comparison of the sectoral import multipliers among regions using the Wilcoxon signed-rank test statistics

	Anatoliki Makedonia-Thraki	Kentriki Makedonia	Dytiki Makedonia	Ipeiros	Thessalia	Ionia Nisia	Dytiki Ellada	Sterea Ellada	Attiki	Peloponnisos	Voreio Aigaio	Notio Aigaio
Anatoliki Makedonia-Thraki												
Kentriki Makedonia	0.821 (0.412)											
Dytiki Makedonia	**-3.584 (0.000)**	**-3.845 (0.000)**										
Ipeiros	-2.464 (0.014)	-1.979 (0.048)	**2.688 (0.007)**									
Thessalia	2.464 (0.013)	2.352 (0.019)	**3.808 (0.000)**	2.464 (0.014)								
Ionia Nisia	**-3.808 (0.000)**	**-3.920 (0.000)**	**-3.211 (0.001)**	**-3.883 (0.000)**	**-3.621 (0.000)**							

Dytiki Ellada	**-3.771 (0.000)**	**-3.920 (0.000)**	**-2.800 (0.005)**	**-3.845 (0.000)**	**-3.547 (0.000)**	2.352 (0.019)						
Sterea Ellada	**3.696 (0.000)**	**3.435 (0.001)**	**3.920 (0.000)**	**3.472 (0.000)**	-1.195 (0.232)	**3.920 (0.000)**	**3.845 (0.000)**					
Attiki	-0.560 (0.576)	-1.699 (0.089)	**3.360 (0.000)**	0.971 (0.332)	**-2.800 (0.005)**	**3.920 (0.000)**	**3.920 (0.000)**	**-3.248 (0.001)**				
Peloponnisos	**-3.771 (0.000)**	**-3.883 (0.000)**	-2.576 (0.010)	**-3.920 (0.000)**	**-3.584 (0.000)**	**2.613 (0.009)**	1.344 (0.179)	**-3.808 (0.000)**	**-3.920 (0.000)**			
Voreio Aigaio	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.360 (0.001)**	**-3.920 (0.000)**	**-3.845 (0.000)**	**-3.547 (0.000)**	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.584 (0.000)**		
Notio Aigaio	**-3.920 (0.000)**	**-3.920 (0.000)**	**-3.248 (0.001)**	**-3.920 (0.000)**	**-3.771 (0.000)**	-1.531 (0.126)	**-3.323 (0.001)**	**-3.920 (0.000)**	**-3.920 (0.000)**	**-2.800 (0.005)**	**3.920 (0.000)**	
Kriti	**-3.621 (0.000)**	**-3.920 (0.000)**	-1.045 (0.296)	**-3.920 (0.000)**	**-3.397 (0.000)**	**3.509 (0.000)**	-2.576 (0.010)	**-3.845 (0.000)**	**-3.920 (0.000)**	2.352 (0.019)	**3.883 (0.000)**	**3.733 (0.000)**

Source: Authors' own calculations.

TABLE 5.4.5
Comparison of the sectoral employment multipliers (with imports) among regions using the Wilcoxon signed-rank test statistics

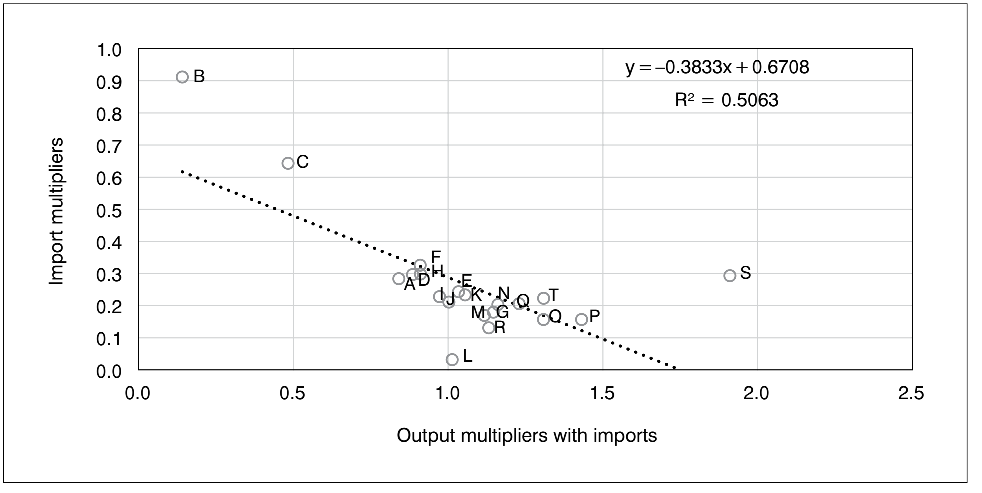
	Anatoliki Makedonia-Thraki	Kentriki Makedonia	Dytiki Makedonia	Ipeiros	Thessalia	Ionia Nisia	Dytiki Ellada	Sterea Ellada	Attiki	Peloponnisos	Voreio Aigaio	Notio Aigaio
Anatoliki Makedonia-Thraki												
Kentriki Makedonia	**-3.584 (0.000)**											
Dytiki Makedonia	**-3.808 (0.000)**	-1.493 (0.135)										
Ipeiros	**-3.771 (0.000)**	**3.323 (0.000)**	**3.659 (0.000)**									
Thessalia	-0.672 (0.502)	1.643 (0.101)	2.128 (0.033)	-0.112 (0.911)								
Ionia Nisia	**-3.547 (0.000)**	-0.971 (0.332)	-0.933 (0.351)	**-3.397 (0.001)**	-2.165 (0.030)							

Dytiki Ellada	**-2.987** **(0.003)**	0.560 (0.576)	2.091 (0.037)	**-2.763** **(0.006)**	-1.045 (0.296)	**3.211** **(0.001)**						
Sterea Ellada	**-3.584** **(0.000)**	0.037 (0.970)	2.053 (0.040)	**-3.323** **(0.001)**	-1.307 (0.191)	2.016 (0.044)	-0.299 (0.765)					
Attiki	**-2.912** **(0.004)**	1.269 (0.204)	1.045 (0.296)	-2.091 (0.037)	-1.232 (0.218)	1.531 (0.126)	-0.037 (0.970)	0.299 (0.765)				
Peloponnisos	-2.315 (0.021)	1.792 (0.073)	**2.912** **(0.004)**	-0.821 (0.412)	-0.224 (0.823)	**3.771** **(0.000)**	**3.099** **(0.000)**	1.605 (0.108)	1.493 (0.135)			
Voreio Aigaio	**-3.845** **(0.000)**	**-3.883** **(0.000)**	**-3.211** **(0.001)**	**-3.771** **(0.000)**	**-3.211** **(0.001)**	**-3.099** **(0.002)**	**-3.920** **(0.000)**	**-3.211** **(0.001)**	**-2.837** **(0.005)**	**-3.883** **(0.000)**		
Notio Aigaio	**-3.920** **(0.000)**	**-3.547** **(0.000)**	-2.240 (0.025)	**-3.920** **(0.000)**	**-2.912** **(0.004)**	**-2.763** **(0.006)**	**-3.248** **(0.001)**	**-3.397** **(0.001)**	**-2.763** **(0.006)**	**-3.211** **(0.001)**	1.008 (0.314)	
Kriti	**-3.435** **(0.000)**	-1.045 (0.296)	-0.485 (0.627)	**-3.360** **(0.001)**	-1.643 (0.101)	0.971 (0.332)	**-2.875** **(0.004)**	-1.755 (0.079)	-1.157 (0.247)	**-3.584** **(0.000)**	**3.621** **(0.000)**	**2.725** **(0.006)**

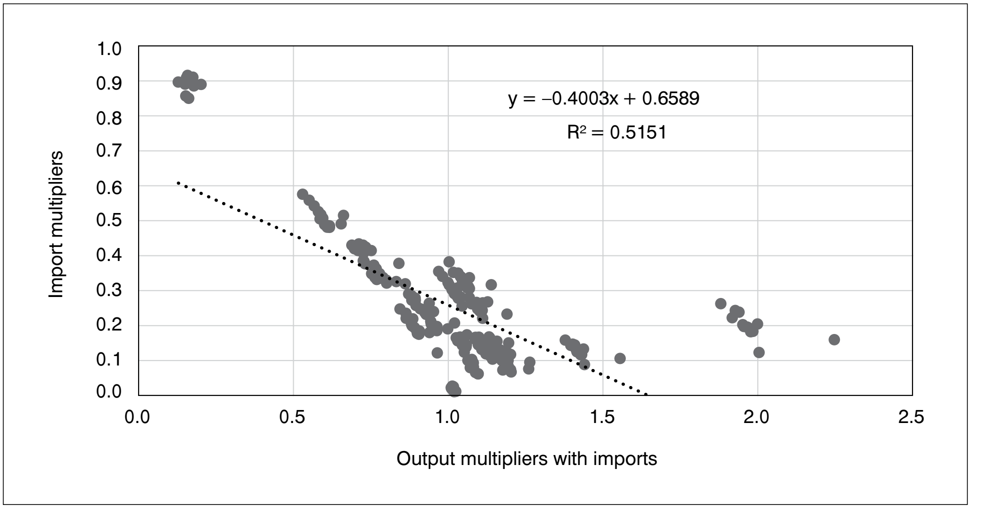
Source: Authors' own calculations.

FIGURE 5.4.1
Scatter plot between the output (with imports) multipliers and the import multipliers at (a) the sectoral level and (b) the region-industry level

(a)



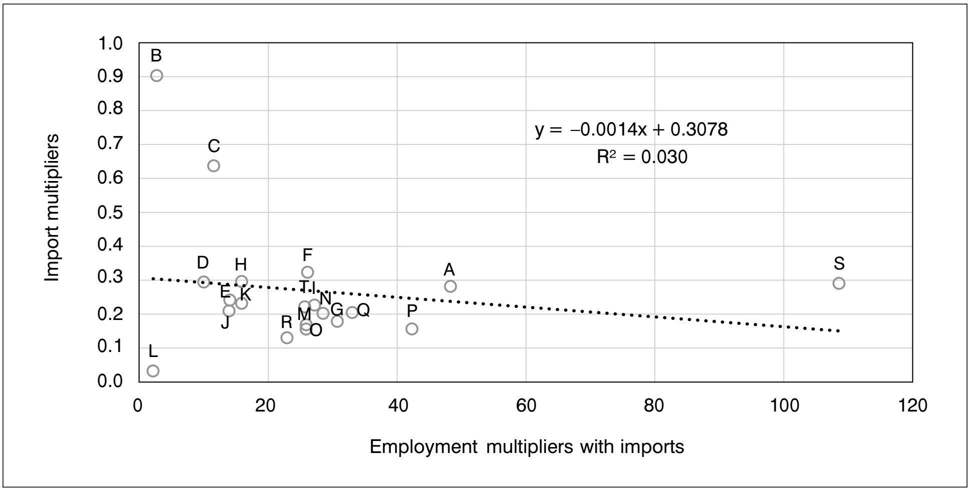
(b)



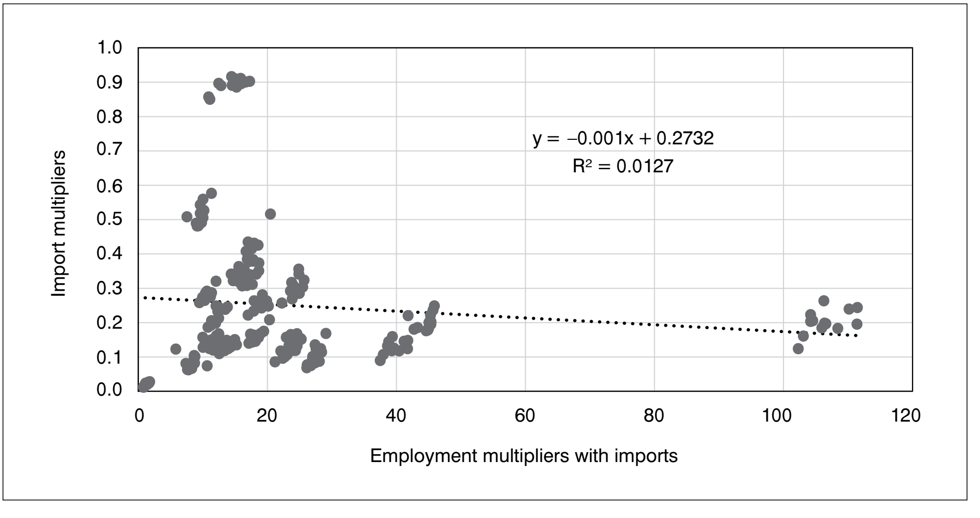
Source: Authors' own calculations.

FIGURE 5.4.2
Scatter plot between the employment multipliers and the import multipliers at (a) the sectoral level and (b) the region-industry level

(a)



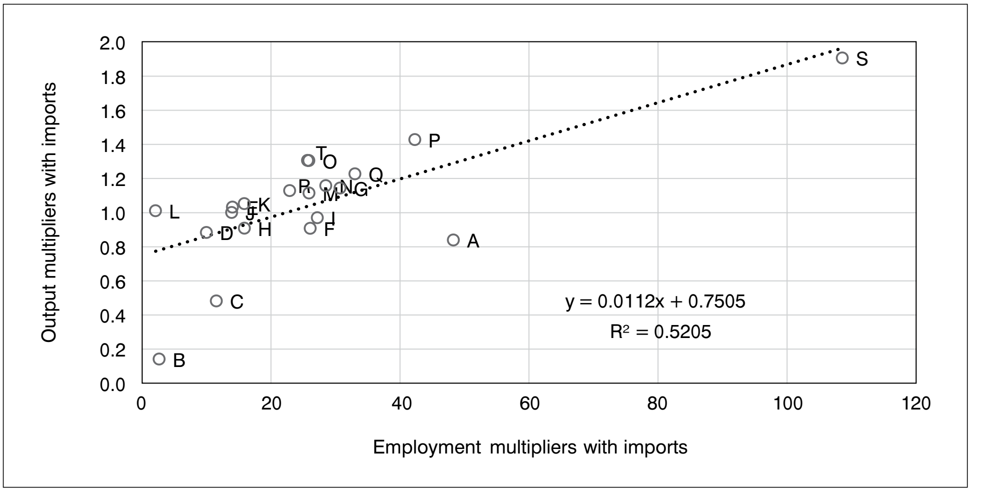
(b)



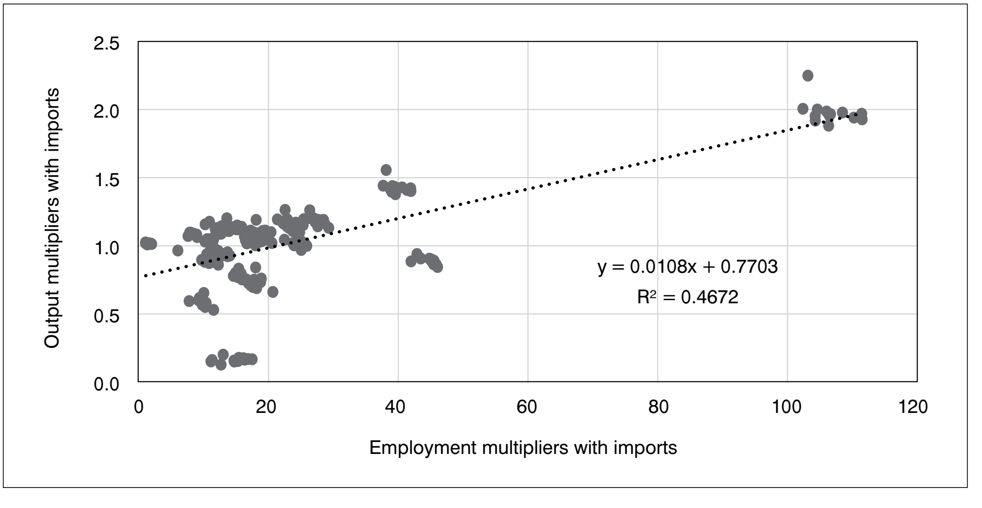
Source: Authors' own calculations.

FIGURE 5.4.3
Scatter plot between the output (with imports) multipliers and the employment multipliers at (a) the sectoral level and (b) the region-industry level

(a)



(b)



Source: Authors' own calculations.

CHAPTER 6

REGIONAL MULTIPLIERS ACROSS INDUSTRIES IN GREECE

As we have already made clear, the output and employment multipliers offer profound insights into regional economic health and potential. A strategic approach, considering these multipliers across industries, can aid in framing policies that harness the strengths of each region while addressing its needs and challenges. Hence, in what follows, we focus on the regional output and employment multipliers (including imports) for each of the 20 industries of the Greek economy.

6.1. Agriculture, forestry, and fishing

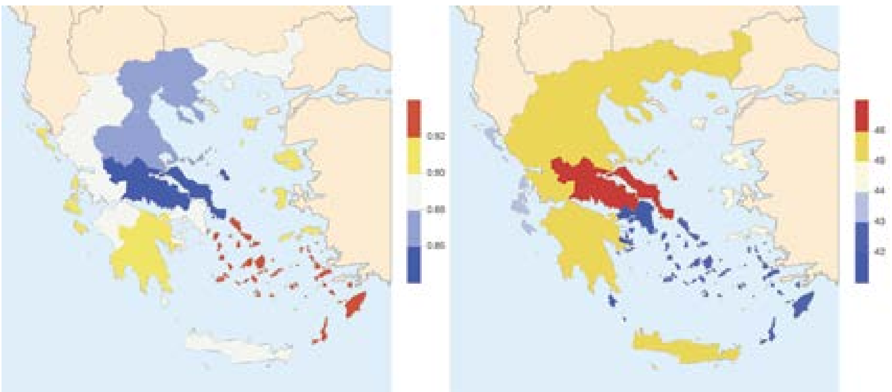
From Map 6.1, we observe that the regions with the highest output multipliers in Agriculture, forestry, and fishing are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Peloponnisos. On the contrary, the regions with the lowest output multipliers are Sterea Ellada, Anatoliki Makedonia and Thraki, Thessalia, and Ipeiros. Furthermore, the regions with the highest employment multipliers in Agriculture, forestry, and fishing are Sterea Ellada, Kentriki Makedonia, Thessalia, and Kriti, while the regions with the lowest employment multipliers are Attiki, Ionia Nisia, Voreio Aigaio, and Notio Aigaio.

6.2. Mining and quarrying

Map 6.2 illustrates that the regions with the highest output multipliers in Mining and quarrying are Notio Aigaio, Voreio Aigaio, Ionia Nisia, and Attiki, while the regions with the lowest output multipliers are Sterea Ellada, Anatoliki Makedonia and Thraki, Thessalia, and Kentriki Makedonia. Additionally, the regions with the highest employment multipliers in Min-

MAP 6.1
Regional multipliers for (a) output and (b) employment in Agriculture, forestry, and fishing

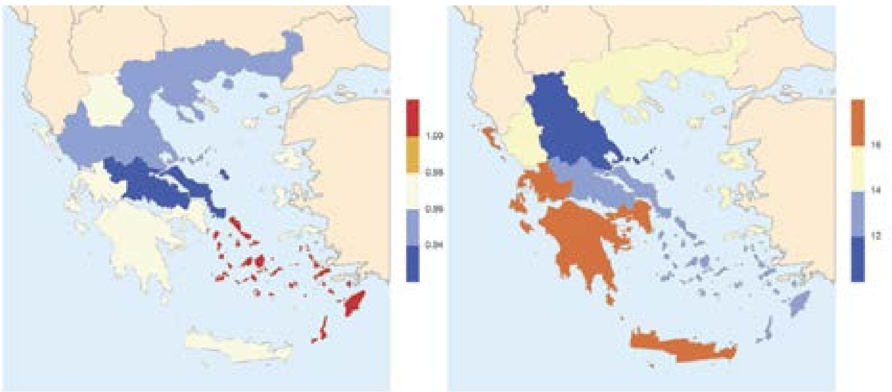
(a) (b)



Source: Authors' own processing.

MAP 6.2
Regional multipliers for (a) output and (b) employment in Mining and quarrying

(a) (b)



Source: Authors' own processing.

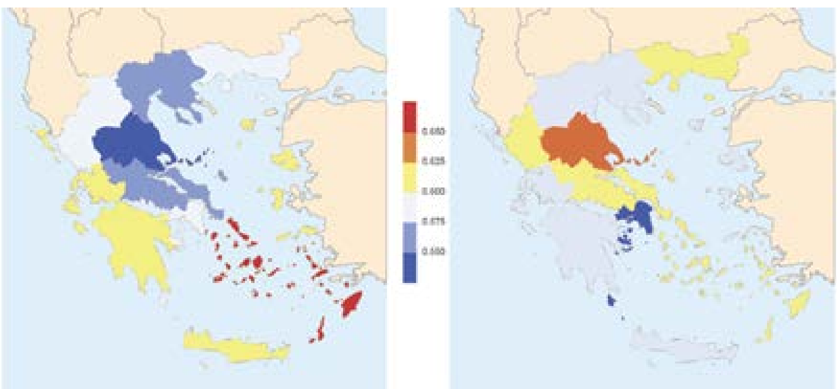
ing and quarrying are Dytiki Ellada, Peloponnisos, Ionia Nisia, and Kentriki Makedonia, while the regions with the lowest employment multipliers are Dytiki Makedonia, Thessalia, Notio Aigaio, and Ipeiros.

6.3. Manufacturing

Map 6.3 illustrates that the regions with the highest output multipliers in Manufacturing are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Kentriki Makedonia, and Anatoliki Makedonia and Thraki. Additionally, the regions with the highest employment multipliers in Manufacturing are Thessalia, Anatoliki Makedonia and Thraki, Kentriki Makedonia, and Sterea Ellada, while the regions with the lowest employment multipliers are Attiki, Kriti, Ionia Nisia, and Dytiki Makedonia.

MAP 6.3
Regional multipliers for (a) output and (b) employment
in Manufacturing

(a) (b)



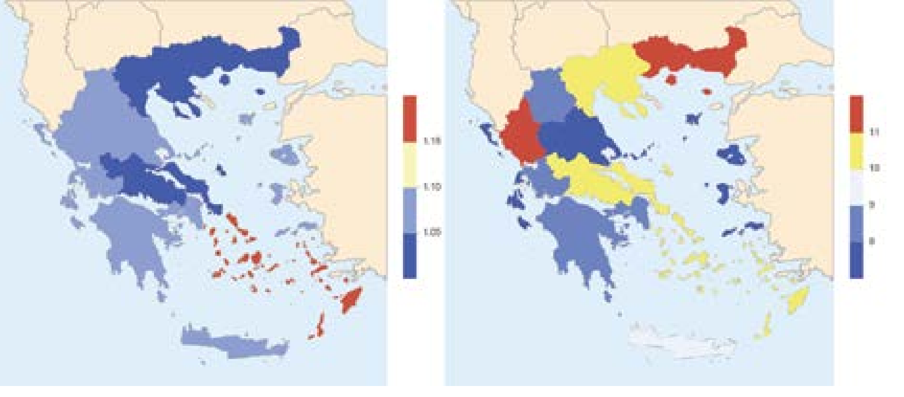
Source: Authors' own processing.

6.4. Electricity, gas, steam, and air conditioning supply

Map 6.4 shows that the regions with the highest output multipliers in Electricity, gas, steam, and air conditioning supply are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Dytiki Makedonia, while the regions with the lowest output multipliers are Sterea Ellada, Anatoliki Makedonia and Thraki, Ipeiros, and Kentriki Makedonia. The regions with the highest employment multipliers in Electricity, gas, steam, and air conditioning supply are Anatoliki Makedonia and Thraki, Ipeiros, Sterea Ellada, and Notio Aigaio, while the regions with the lowest employment multipliers are Ionia Nisia, Voreio Aigaio, Kriti, and Dytiki Makedonia.

MAP 6.4
Regional multipliers for (a) output and (b) employment in Electricity, gas, steam, and air conditioning supply

(a) (b)



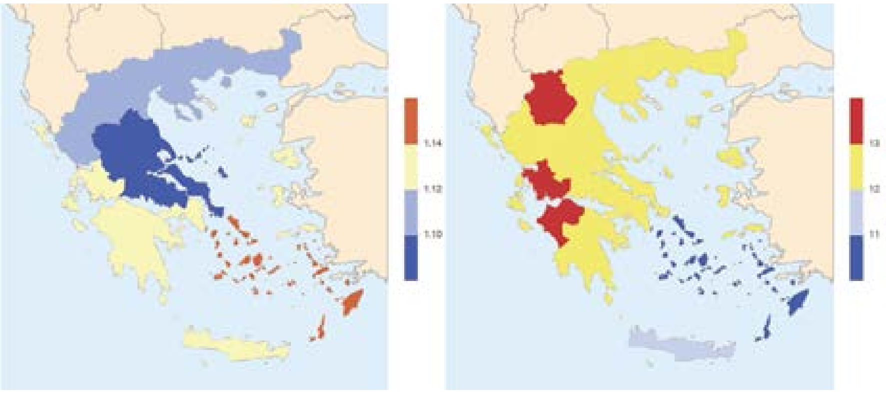
Source: Authors' own processing.

6.5. Water supply; sewerage, waste management, and remediation activities

Map 6.5 illustrates that the regions with the highest output multipliers in Water supply; sewerage, waste management, and remediation activities are Notio Aigaio, Attiki, Ionia Nisia, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Water supply; sewerage, waste management; and remediation activities are Dytiki Ellada, Sterea Ellada, Dytiki Makedonia, and Peloponnisos, while the regions with the lowest employment multipliers are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Kriti.

MAP 6.5
Regional multipliers for (a) output and (b) employment in Water supply; sewerage, waste management, and remediation activities

(a) (b)



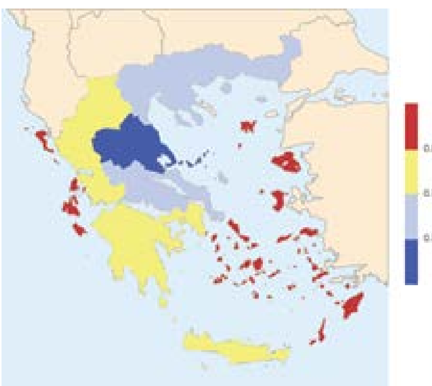
Source: Authors' own processing.

6.6. Construction

From Map 6.6, we observe that the regions with the highest output multipliers in Construction are Notio Aigaio, Attiki, Ionia Nisia, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Construction are Thessalia, Ipeiros, Anatoliki Makedonia and Thraki, and Sterea Ellada, while the regions with the lowest employment multipliers are Ionia Nisia, Dytiki Makedonia, Voreio Aigaio, and Dytiki Ellada.

MAP 6.6
Regional multipliers for (a) output and (b) employment in Construction

(a)



(b)

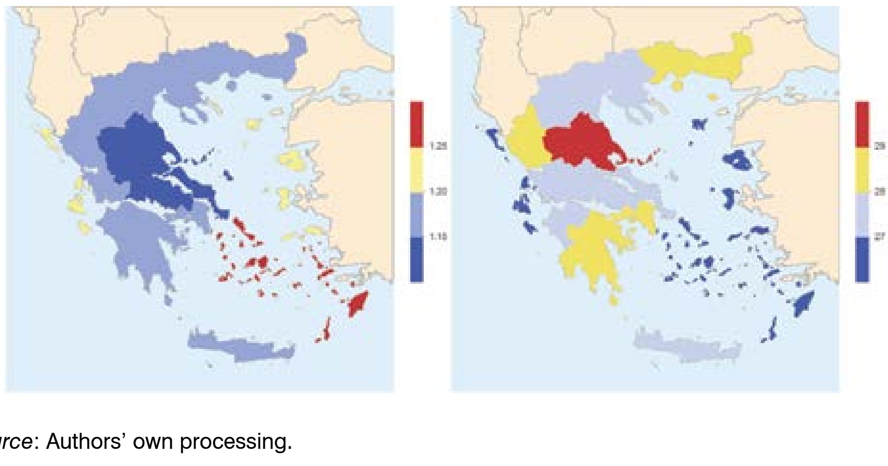
Source: Authors' own processing.

6.7. Wholesale and retail trade; repair of motor vehicles and motorcycles

Map 6.7 shows that the regions with the highest output multipliers in Wholesale and retail trade; repair of motor vehicles and motorcycles are Ionia Nisia, Voreio Aigaio, Dytiki Ellada, and Peloponnisos, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Kentriki Makedonia, and Anatoliki Makedonia and Thraki. The regions with the highest employment multipliers in Wholesale and retail trade; repair of motor vehicles and motorcycles are Thessalia, Anatoliki Makedonia and Thraki, Ipeiros, and Attiki, while the regions with the lowest employment multipliers are Voreio Aigaio, Ionia Nisia, Notio Aigaio, and Dytiki Makedonia.

MAP 6.7
Regional multipliers for (a) output and (b) employment in Wholesale and retail trade; repair of motor vehicles and motorcycles

(a) (b)



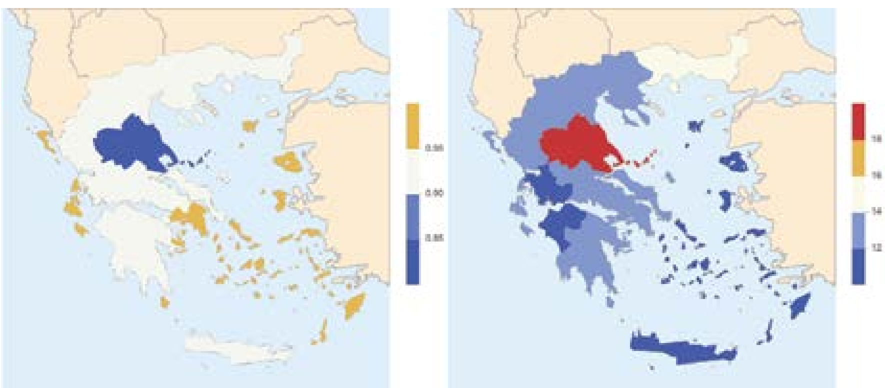
Source: Authors' own processing.

6.8. Transportation and storage

From Map 6.8, we observe that the regions with the highest output multipliers in Transportation and storage are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Attiki; the regions with the lowest output multipliers are Thessalia, Anatoliki Makedonia and Thraki, Sterea Ellada, and Ipeiros. Regarding the regions with the highest employment multipliers in Transportation and storage, these are Thessalia, Anatoliki Makedonia and Thraki, Attiki, and Ipeiros, while the regions with the lowest employment multipliers are Voreio Aigaio, Ionia Nisia, Dytiki Makedonia, and Dytiki Ellada.

MAP 6.8
Regional multipliers for (a) output and (b) employment in Transportation and storage

(a) (b)



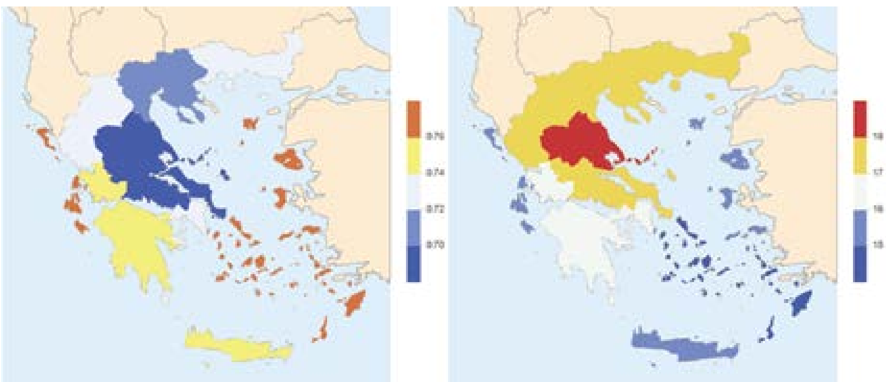
Source: Authors' own processing.

6.9. Accommodation and food service activities

Map 6.9 illustrates that the regions with the highest output multipliers in Accommodation and food service activities are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Accommodation and food service activities are Thessalia, Kentriki Makedonia, Sterea Ellada, and Anatoliki Makedonia and Thraki, while the regions with the lowest employment multipliers are Notio Aigaio, Ionia Nisia, Attiki, and Voreio Aigaio.

MAP 6.9
Regional multipliers for (a) output and (b) employment in Accommodation and food service activities

(a) (b)



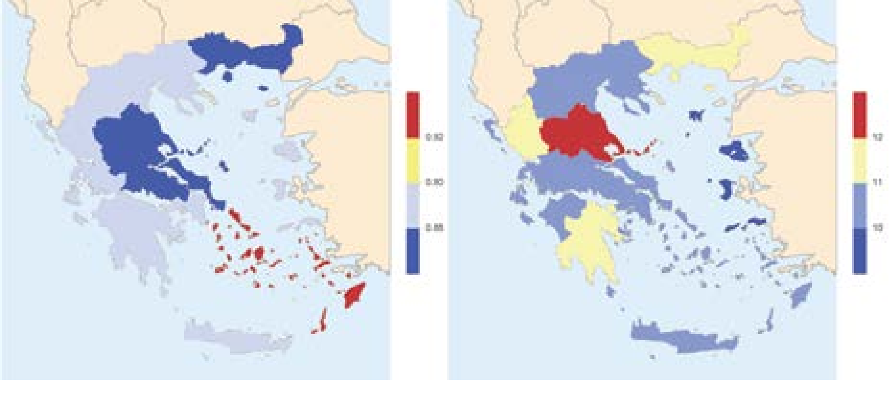
Source: Authors' own processing.

6.10. Information and communication

From Map 6.10, we observe that the regions with the highest output multipliers in Information and communication are Notio Aigaio, Ionia Nisia, Attiki, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Information and communication are Thessalia, Anatoliki Makedonia and Thraki, Sterea Ellada, and Peloponnisos, while the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Attiki, and Kentriki Makedonia.

MAP 6.10
Regional multipliers for (a) output and (b) employment in Information and communication

(a) (b)



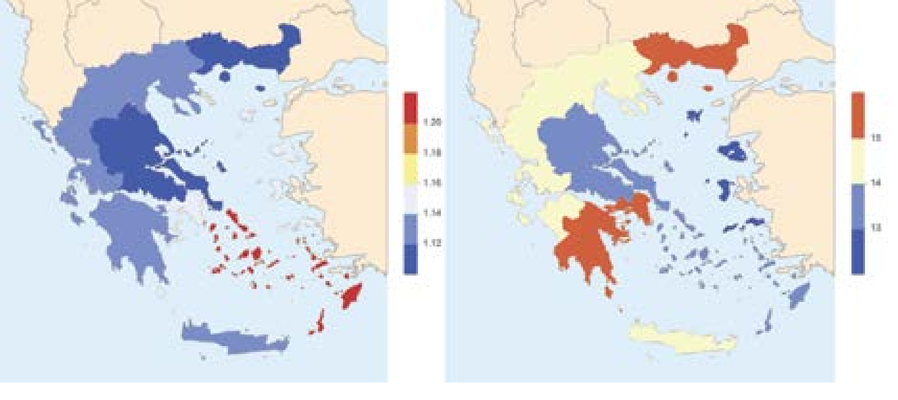
Source: Authors' own processing.

6.11. Financial and insurance activities

From Map 6.11, we observe that the regions with the highest output multipliers in Financial and insurance activities are Notio Aigaio, Ionia Nisia, Attiki, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Financial and insurance activities are Attiki, Peloponnisos, Ipeiros, and Anatoliki Makedonia and Thraki, while the regions with the lowest employment multipliers are Notio Aigaio, Thessalia, Kentriki Makedonia, and Sterea Ellada.

MAP 6.11
Regional multipliers for (a) output and (b) employment in Financial and insurance activities

(a) (b)



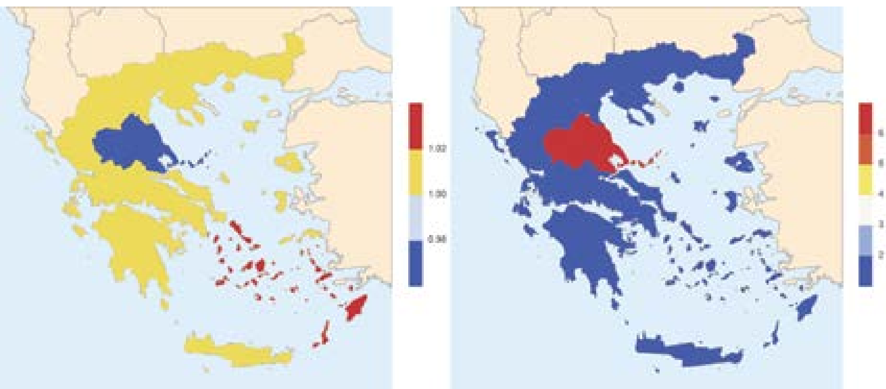
Source: Authors' own processing.

6.12. Real estate activities

Map 6.12 illustrates that the regions with the highest output multipliers in Real estate activities are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Dytiki Makedonia, and Kentriki Makedonia. The regions with the highest employment multipliers in Real estate activities are Thessalia, Anatoliki Makedonia and Thraki, Peloponnisos, and Attiki, while the regions with the lowest employment multipliers are Kentriki Makedonia, Dytiki Makedonia, Voreio Aigaio, and Notio Aigaio.

MAP 6.12
Regional multipliers for (a) output and (b) employment in Real estate activities

(a) (b)



Source: Authors' own processing.

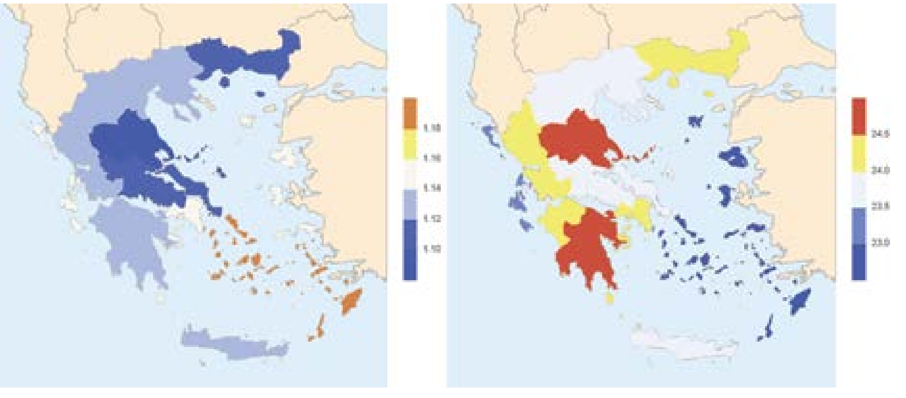
6.13. Professional, scientific, and technical activities

Map 6.13 indicates that the regions with the highest output multipliers in Professional, scientific, and technical activities are Notio Aigaio, Ionia Nisia, Attiki, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Professional, scientific, and technical activities are Thessalia, Anatoliki Makedonia and Thraki, Peloponnisos, and Sterea Ellada, while the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Dytiki Makedonia, and Ionia Nisia.

MAP 6.13

Regional multipliers for (a) output and (b) employment in Professional, scientific, and technical activities

(a) (b)



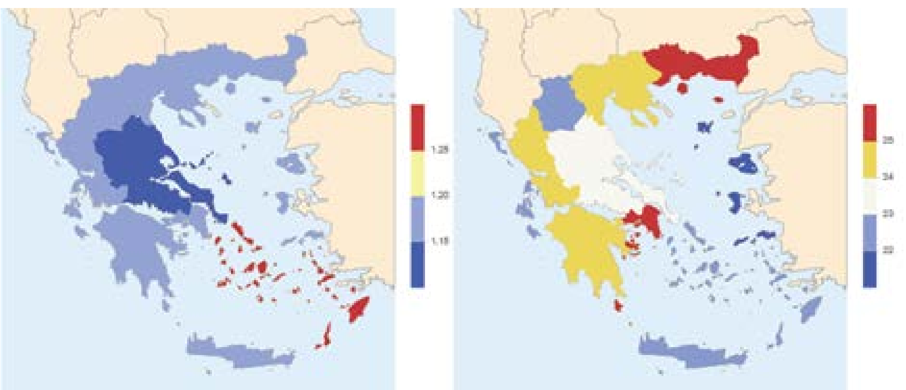
Source: Authors' own processing.

6.14. Administrative and support service activities

Map 6.14 shows that the regions with the highest output multipliers in Administrative and support service activities are Notio Aigaio, Ionia Nisia, Attiki, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Administrative and support service activities are Attiki, Anatoliki Makedonia and Thraki, Ipeiros, and Peloponnisos, while the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Dytiki Makedonia, and Ionia Nisia.

MAP 6.14
Regional multipliers for (a) output and (b) employment in Administrative and support service activities

(a) (b)



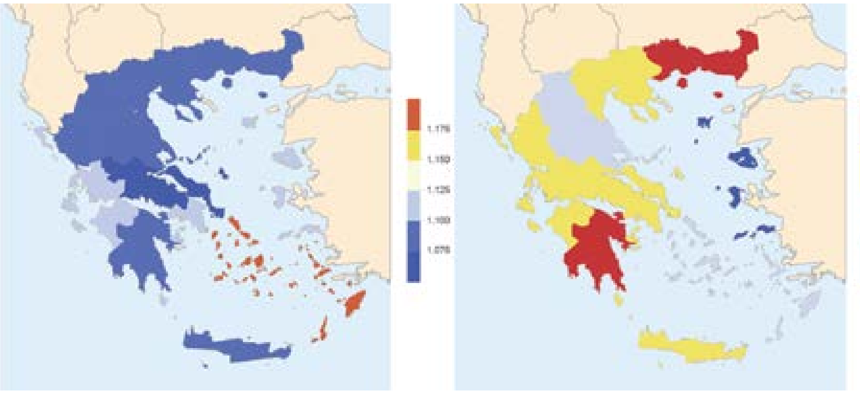
Source: Authors' own processing.

6.15. Public administration and defence; compulsory social security

Map 6.15 illustrates that the regions with the highest output multipliers in Public administration and defence; compulsory social security services are Notio Aigaio, Ionia Nisia, Attiki, and Dytiki Makedonia, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Public administration and defence; compulsory social security services are Peloponnisos, Anatoliki Makedonia and Thraki, Ipeiros, and Attiki, while the regions with the lowest employment multipliers are Voreio Aigaio, Dytiki Makedonia, Thessalia, and Kentriki Makedonia.

MAP 6.15
Regional multipliers for (a) output and (b) employment in Public administration and defence; compulsory social security

(a) (b)



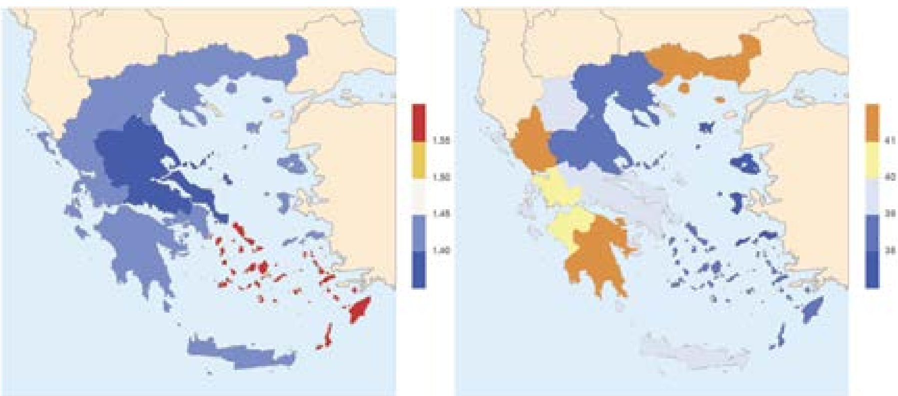
Source: Authors' own processing.

6.16. Education

From Map 6.16, we observe that the regions with the highest output multipliers in Education are Notio Aigaio, Ionia Nisia, Attiki, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Education are Anatoliki Makedonia and Thraki, Peloponnisos, Ipeiros, and Sterea Ellada, while the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Kentriki Makedonia, and Dytiki Makedonia.

MAP 6.16
Regional multipliers for (a) output and (b) employment in Education

(a) (b)



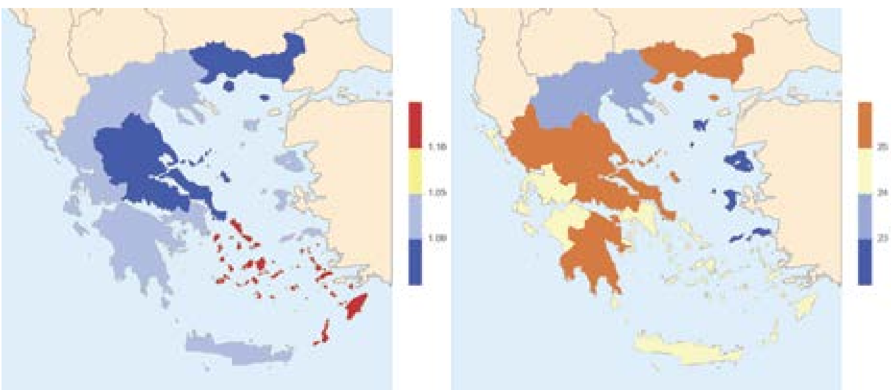
Source: Authors' own processing.

6.17. Human health and social work activities

Map 6.17 illustrates that the regions with the highest output multipliers in Human health and social work activities are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Dytiki Ellada, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Human health and social work activities are Anatoliki Makedonia and Thraki, Ipeiros, Sterea Ellada, and Peloponnisos, while the regions with the lowest employment multipliers are Voreio Aigaio, Kentriki Makedonia, Notio Aigaio, and Ionia Nisia.

MAP 6.17
Regional multipliers for (a) output and (b) employment in Human health and social work activities

(a) (b)



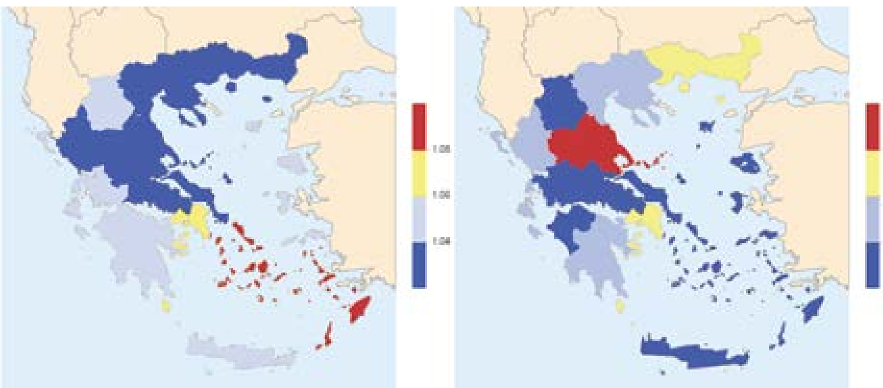
Source: Authors' own processing.

6.18. Arts, entertainment, and recreation

From Map 6.18, we observe that the regions with the highest output multipliers in Arts, entertainment, and recreation are Notio Aigaio, Ionia Nisia, Attiki, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Kentriki Makedonia. The regions with the highest employment multipliers in Arts, entertainment, and recreation are Thessalia, Attiki, Anatoliki Makedonia and Thraki, and Ipeiros, while the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Dytiki Ellada, and Dytiki Makedonia

MAP 6.18
Regional multipliers for (a) output and (b) employment in Arts, entertainment, and recreation

(a) (b)



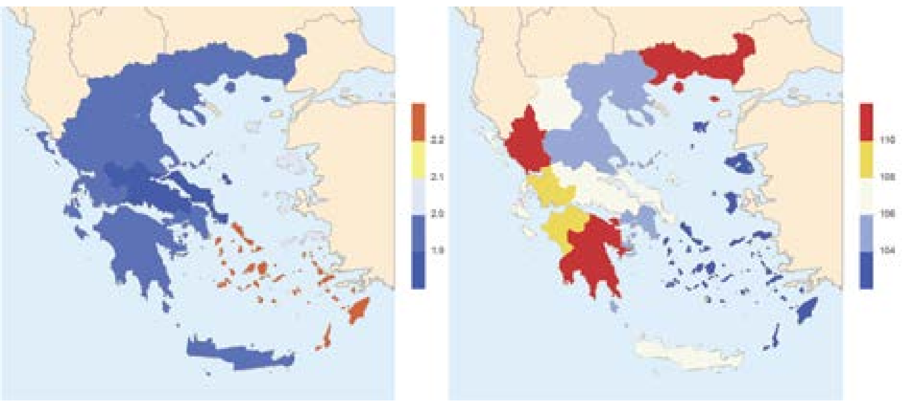
Source: Authors' own processing.

6.19. Activities of households as employers

Map 6.19 illustrates that the regions with the highest output multipliers in Activities of households as employers are Notio Aigaio, Ionia Nisia, Voreio Aigaio, and Attiki, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Activities of households as employers are Anatoliki Makedonia and Thraki, Peloponnisos, Ipeiros, and Sterea Ellada, while the regions with the lowest employment multipliers are Voreio Aigaio, Attiki, Kentriki Makedonia, and Thessalia.

MAP 6.19
Regional multipliers for (a) output and (b) employment in Activities of households as employers

(a) (b)



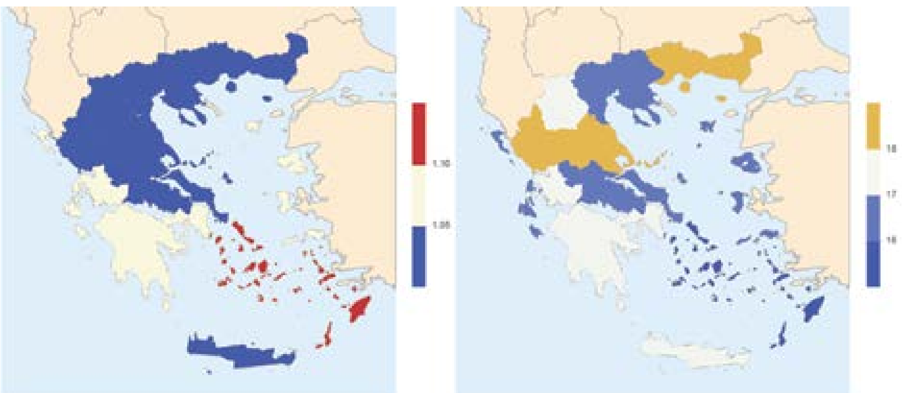
Source: Authors' own processing.

6.20. Other service activities

Finally, Map 6.20 shows that the regions with the highest output multipliers in Other service activities are Notio Aigaio, Ionia Nisia, Attiki, and Voreio Aigaio, while the regions with the lowest output multipliers are Thessalia, Sterea Ellada, Anatoliki Makedonia and Thraki, and Ipeiros. The regions with the highest employment multipliers in Other service activities are Anatoliki Makedonia and Thraki, Ipeiros, Peloponnisos, and Thessalia; the regions with the lowest employment multipliers are Voreio Aigaio, Notio Aigaio, Kentriki Makedonia, and Ionia Nisia.

MAP 6.20
Regional multipliers for (a) output and (b) employment
in Other service activities

(a) (b)



Source: Authors' own processing.

6.21. Discussion about the regional multipliers by industry

Based on the estimated output and employment multipliers across the 20 industries for the 13 regions in Greece, several notable patterns and insights emerge. The regions of Notio Aigaio, Ionia Nisia, and Attiki are consistently found to have the highest output multipliers across most industries. This outcome suggests that these regions, when subject to an economic stimulus, would tend to produce more significant ripple effects in their local economies compared to the remaining regions. This effect could arguably be attributed to the presence of robust and interconnected supply chains, higher economic diversification, and superior infrastructure in the region of Attiki as well as the strong economies of concentration (around tourism-related activities) in the island regions of Notio Aigaio and Ionia Nisia (Papaioannou et al., 2017).

On the other end of the spectrum, regions such as Thessalia, Sterea Ellada, and Anatoliki Makedonia and Thraki regularly exhibit the lowest output multipliers. The latter outcome indicates that investments or economic stimuli in these regions might yield lower returns compared to the other regions. These patterns may arise from such factors as economic and/or geographical insularity, less diversification or interconnectedness among industries, and potential inefficiencies in the local business environment. In turn, this outcome shows that an effective demand management policy can have a positive impact on the growth potential of the economic system only in the short term. Therefore, a careful orchestration of economic levers, based on the current structure of the economy, is required to facilitate optimal decisions aimed at creating a ripple effect that steadily enhances overall economic health and employment. In this respect, a long-term structural policy can be deployed to enhance the overall productivity of the Greek economy by prioritizing industries that are characterised by high productivity indices.

Nevertheless, not all sectors behave the same way in all regions and may have dissimilar impacts on the local economies. In particular, a high multiplier in a small sector of a region may have a lesser overall economic impact than a smaller multiplier in a more dominant sector of that region. Therefore, from a policymaking perspective, understanding the output multipliers is crucial since the investment in regions with high multipliers can potentially yield high economic returns. However, it is also important to address the reasons behind the low multipliers in underperforming regions and, in turn, deploy proper interventions to support equitable and inclusive development, e.g., through enhancing infrastructure, promoting industry diversification, and improving business processes.

Next, looking at the employment multipliers, the region of Anatoliki Makedonia and Thraki consistently demonstrates high employment multipliers in many sectors. This fact indicates that an increase in economic activity in these sectors could lead to a substantial rise in employment within the region. This impact can be attributed to the region's strategic economic positioning, its diversified workforce, and possibly the existence of robust industry clusters. Conversely, the region of Voreio Aigaio presents the lowest employment multipliers. This finding may suggest that, despite economic activities or investments in these sectors, the corresponding employment growth might be subdued. The reasons could encompass a higher reliance on physical capital or the existence of more capital-intensive industries, increased inefficiencies in the labour market, and a mismatch of skills in the workforce.

Another interesting finding concerns the dominance of the region of Thessalia in sectors related to trade, transportation, and accommodation and food services. This outcome could hint at the region's central position (in the middle of the main development axis of the country) and strategic importance for trade and tourism, while it may also indicate a historically evolved competency in these sectors. Thus, these multipliers can serve as a roadmap for decision-makers. On the one side, investing in sectors with high employment multipliers in regions such as Anatoliki Makedonia and Thraki can amplify job creation. On the other side, it is essential to understand and address the reasons behind the low multipliers in regions such as Voreio Aigaio in order to support balanced regional development and regional convergence.

CHAPTER 7

CONCLUSION AND POLICY PROPOSALS

7.1. Concluding remarks

The sectoral and regional multiplier values provide a comprehensive lens through which we can understand the intricate structure of the Greek economy. By delving into the regionalisation of the national input-output table and employing a model that encompasses more than just the technical conditions of production, we gain a clearer perspective on the multifaceted economic relationships that exist in the various regions of Greece.

Our research has led us to categorise the Greek regions into four distinct groups, each characterised by the magnitude of their output multipliers when considering imports. The first group, which includes the island regions of Notio Aigaio, Voreio Aigaio, and Ionia Nisia, stands out as a unique economic cluster with increased output multiplier values. The second group, in terms of the order of magnitude of the output multipliers, encompasses the regions of Dytiki Ellada, Attiki, Peloponnisos, and Kriti. The third and fourth groups, with lower output multiplier values, including the regions of Anatoliki Makedonia and Thraki, Kentriki Makedonia, Dytiki Makedonia, and Ipeiros, and Thessalia and Sterea Ellada, respectively, further highlight the varied economic landscape that Greece boasts.

Furthermore, the comparison of the output multipliers with and without imports suggests that, with the given regional structure of the Greek economy, the sole reliance of regions on local production – excluding imports – would further exacerbate core-periphery disparities between Attiki and most of the remaining regions (except for Notio Aigaio, Peloponnisos, and Thessalia). This outcome implies that policies targeted at the substitution of imports with domestically produced goods and services should have both sectoral and regional dimensions, so that the overall competitiveness and resilience keep pace with a balanced regional growth and convergence.

One of the most salient findings obtained from the current study is the inverse relationship that exists between the dominance of Primary and Industrial sectors in the economic activity of a region and the average output multipliers in said region. In simpler terms, regions that heavily rely on these sectors tend to exhibit lower output multipliers. This relationship can be interpreted in a dual manner. Firstly, regions with high output multipliers are those with low import multipliers. Conversely, regions with high import multipliers tend to have lower output multipliers. This relationship is not just an academic observation; it has profound real-world policy implications, highlighting the inherent trade-offs regions face between bolstering domestic production and relying on imports.

Moreover, the distinction between productivity indicators and output multipliers emerges as a critical point of discussion. While it might be tempting to assume that regions with high productivity would naturally possess high output multipliers, our findings challenge this notion. They suggest that a demand management policy that focuses solely on regions with the highest output multipliers might not be the silver bullet for long-term growth. Instead, such a strategy might only offer a transient boost, a short-lived economic uptick. This conclusion underscores the need for a more comprehensive and nuanced approach to economic policymaking. While output multipliers can offer invaluable insights, they should not be the sole benchmark guiding economic strategies. A holistic consideration of various factors, including productivity indicators and import multipliers, is imperative to ensure that the growth achieved is not just ephemeral but sustainable and resilient in the long run.

The findings also showed that the Greek economy can offer a rich and enlightening case study for examining multiplier values, as it comprises a mosaic of regions, each boasting unique economic characteristics. The regional multiplier values, as elucidated in this study, equip policymakers, economists, and stakeholders with a deeper understanding of the underlying economic dynamics. They underscore the need for policies that are not only informed by a single metric but are the result of a comprehensive understanding of the myriad factors at play. By recognising the unique strengths, challenges, and potentials of each region, policymakers can craft strategies that cater to the specific needs of each area, fostering an environment where every region can thrive.

Building upon the insights garnered from the regional multiplier values, it is essential to delve deeper into the broader implications for Greece's economic future and the potential strategies that could be employed. The categorisation of regions into four distinct groups based on product multipliers underscores the inherent disparities in economic activities across Greece. Such disparities can lead to uneven development, where certain regions surge ahead economically while others lag. This unevenness can result in social and economic challenges, including migration from less prosperous regions to those with better opportunities, leading to negative externalities like urban congestion and environmental burden, strain on infrastructure, and potential socio-cultural tensions. Some major conclusions for policy insights can be defined as follows:

- *The Role of Policy Interventions*: Given the disparities, targeted policy interventions become crucial. For regions with lower product multipliers, policies could focus on enhancing domestic production capabilities, reducing reliance on imports, and fostering innovation. For those with higher product multipliers, the emphasis could be on diversifying the economic base, ensuring that growth is not overly reliant on a few sectors.
- *The Interplay of Productivity and Multipliers*: The divergence between productivity indicators and output multipliers is particularly intriguing. It suggests that while certain regions might be highly productive, they might not necessarily have the most significant impact on the broader economy when considering multiplier values. This distinction is crucial for policymakers. It means that while boosting productivity is essential, it is equally vital to ensure that the benefits of this productivity are felt more broadly across the economy. This can be achieved by promoting interregional trade, fostering collaborations, and ensuring that supply chains are robust and resilient.
- *The Need for a Holistic Approach*: The findings also emphasise the importance of a holistic approach to economic development strategy. Relying solely on one metric or indicator can lead to myopic policies that might achieve short-term gains but could be detrimental in the long run. For instance, focusing only on regions with high product multipliers for demand management might lead to short-lived eco-

nomic growth, but it could also result in overheating in specific sectors or regions, leading to potential economic bubbles.

- *Future Directions*: As Greece navigates its economic future, it is crucial to consider the regional multiplier values in conjunction with other economic indicators, such as those included in the sustainable development goals. This approach would ensure a more balanced and sustainable growth trajectory. Future research could also delve into the reasons behind the disparities in output and employment multipliers across regions. Understanding the root causes can lead to more targeted and effective policy interventions. Finally, the methodology used for the construction of regional IO tables could offer the 'core' part of a generalised framework for the estimation of an interregional or multiregional IO matrix, where its diagonal matrices are the region-specific input-output tables. This framework can employ multiregional and interregional models as a separate study for a more comprehensive analysis of the regional economy at the national level. Among others, the use of a multiregional matrix would enable us to calculate the (direct and indirect) values of a new or improved interregional transport infrastructure on the economies of the regions, due to reductions in generalised transport costs and enhancements in accessibility among regions (Polyzos and Tsiotas, 2023).

Moreover, as the global economic landscape evolves, with increasing emphasis on digitalisation, sustainability, and innovation, it is essential for Greece to ensure that its regions are not just keeping pace but are at the forefront of these changes. This requires continuous monitoring, adaptation, and a willingness to innovate in policymaking.

To sum up, the regional multiplier values in the Greek economy provide a rich tapestry of insights, highlighting both challenges and opportunities. By understanding these dynamics, Greece can chart a path forward that ensures prosperity, inclusiveness, and resilience in an ever-evolving global economic landscape. In light of the intricate regional multiplier values present in the Greek economy, there emerge a wealth of actionable insights that underscore the prevailing challenges, while simultaneously spotlighting potential opportunities. Drawing from this nuanced understanding, it becomes imperative for policymakers to craft well-informed strategies, as specified in the next section.

7.2. Specification of policy recommendations

7.2.1. Targeted economic development plans for regional growth

Economic development is a multifaceted endeavour that requires tailored strategies based on the unique characteristics and needs of different regions. The following paragraphs delve into targeted economic development programmes for regions with varying output, import, and employment multipliers, thereby offering a comprehensive approach and guidance to foster growth and sustainability in the country.

For regions with lower output multipliers:

Local industries in regions with lower output multipliers can benefit significantly from government intervention. The central and lower-tier governments can play a pivotal role in nurturing these industries by offering tiered subsidies (Porter, 1998). Smaller industries, which often face challenges in the initial stages, can benefit from these subsidies, while larger industries can be incentivised through tax breaks contingent on employment generation or export potential (World Bank, 2019). Infrastructure development should be tailored to the needs of predominant industries, as their multipliers may vary considerably among each other and within regions. For instance, regions with a strong agricultural base can benefit from investments in 'cold' logistics or storage facilities or efficient and reliable transportation systems (World Bank, 2019).

In the realm of research and development (R&D), tax credits can be a potent tool to encourage companies to invest in R&D services, driving innovation and competitiveness (Hall and Van Reenen, 2000). Collaborations between local industries and academic and research institutions can lead to practical research outcomes, bridging the gap among theory and application (Etzkowitz and Leydesdorff, 2000). Furthermore, the establishment of research parks can provide industries with state-of-the-art facilities, fostering an environment of innovation and development (Link and Scott, 2003). Innovation, education, and training are also paramount. Grants can be pivotal in supporting startups and businesses that address local or global challenges with innovative solutions (Lerner, 2010). Collaborative efforts with educational institutions can ensure a steady supply of skilled labour tailored to the regional needs (Marginson, 2000). Fostering entrepreneurship can lead to localised solutions, driving growth and addressing regional challenges (Shane, 2000).

For regions with higher output multipliers:

Regions with higher output multipliers should focus on economic diversification. Identifying emerging sectors can help these regions strengthen their resilience and align with global trends and capitalise on their inherent strengths (Turok, 2004). Investment summits can be instrumental in showcasing opportunities and attracting both domestic and foreign investors (UNCTAD, 2018). Public-Private Partnerships (PPP) models can be effective in sectors requiring significant initial investments, ensuring shared risks and rewards (Hart and Moore, 1996).

Workforce training and skills development are crucial for these regions. A thorough analysis of required skills for emerging sectors can guide training initiatives, ensuring relevance and effectiveness (Becker, 1964). Specialised training centres can play a crucial role in equipping the workforce with necessary skills (Mincer, 1974). Collaborations with EdTech companies can democratise access to training, ensuring wide-reaching impact (Bresnahan et al., 2002).

Lastly, innovation hubs and clusters can drive growth and development in these regions and facilitate knowledge transfer and spillovers among sectors. Designating areas as innovation districts can foster a culture of innovation (Katz and Wagner, 2014). Clustering can lead to synergies, shared resources, collaborative growth, reduced production costs and higher value-added products, driving competitiveness and innovation (Porter, 1998). Mentorship can be instrumental in guiding startups, ensuring they have the direction and support needed for success (St-Jean and Audet, 2012).

7.2.2. Strengthening interregional trade: A comprehensive approach

Interregional trade is a cornerstone for balanced economic growth and development. By establishing trade corridors and enhancing transportation infrastructure, the movement of goods between regions can be significantly facilitated (Limão and Venables, 2001). Developing specific routes optimised for interregional trade ensures the smooth and efficient transportation of goods (Anderson and van Wincoop, 2004). Additionally, the establishment of logistics hubs at strategic points along these corridors can further streamline the trade process, offering facilities for storage, repackaging, and redistribution of goods (Tsekeris, 2016). Ports, being pivotal in this ecosystem, need to be upgraded or newly established with modern terminal facilities to handle the anticipated increase in interregional trade. Furthermore, investing in rail infrastructure, especially cargo trains, can ensure the rapid and efficient movement of goods between regions and the efficient intermodal connections with their hinterland (Limão and Venables, 2001).

In order to ensure a balanced economic growth trajectory, it is imperative to offer incentives for businesses that prioritise sourcing products from regions with lower output multipliers. Tax incentives can be a potent tool in this regard, providing breaks or reductions for businesses that align with this objective (Harrison and Rodríguez-Clare, 2010). Additionally, subsidising transportation costs for businesses that source from economically weaker regions can further tilt the balance in favour of equitable growth (Freund and Rocha, 2011). A relevant subsidisation policy is the 'Transport Equivalent' for firms, where beneficiaries are enterprises established on Greek islands in order to harmonise the cost of transporting goods to and from the islands with the corresponding land transport cost across the mainland country. Financial grants can also be extended to businesses that engage in partnerships or joint ventures with entities in these regions, promoting collaboration and mutual growth.

Trade facilitation measures are equally crucial. Streamlining customs and inspection procedures can significantly reduce trade delays and associated costs (WTO, 2015). Additionally, the advent of digital trade platforms can revolutionise interregional trade, offering a seamless platform for businesses to engage, understand regional offerings, and facilitate transactions. Capacity building and training initiatives can further bolster interregional trade. Organising interregional business forums provides a platform for businesses to network, understand offerings from different regions, and explore potential trade opportunities. Training programmes tailored to interregional trade can equip businesses with the necessary knowledge and best practices, ensuring they are well-prepared to engage in trade.

Finally, financial instruments specifically designed for interregional trade can provide the necessary financial backbone. Establishing credit facilities with favourable terms can support businesses engaged in interregional trade. Moreover, insurance products tailored to cover risks associated with such trade can instil confidence in businesses, encouraging them to expand their trade activities.

7.2.3. Education, skills development, and expanded R&D strategies

In the realm of economic development, education and skills development play a pivotal role. For regions that exhibit high productivity indices but suffer from lower employment multipliers, there is a pressing need to invest in education and training programmes. This can be achieved through lifelong learning programmes, vocational training, forging partnerships with universities, and initiating apprenticeship programmes (Marginson, 2000). Furthermore, as the world rapidly transitions into a digital age, promoting digital literacy and upskilling becomes paramount. Ensuring the technological readiness and participation of all regions in the digital economy is essential for addressing automation risks and achieving balanced growth (Bresnahan et al., 2002).

Research and Development (R&D) tax credits can be a potent tool to incentivise companies to invest more in innovation. Implementing a sliding scale tax credit system, where the percentage of the tax credit increases with the proportion of profits invested in R&D, can motivate companies to allocate more resources to research (Hall and Van Reenen, 2000). Additionally, provisions that allow companies to carry forward unused R&D tax credits to future tax years can ensure that businesses, irrespective of their profitability, benefit over time. Recognising the unique challenges faced by small and medium enterprises (SMEs), it is essential to offer them higher tax credit percentages, thereby encouraging grassroots-level innovation. To ensure the authenticity of R&D claims, a certification process could be established to evaluate and verify genuine R&D activities.

Collaborative research initiatives can bridge the gap between academia and industry. Organising industry-academia conclaves can foster dialogue, enabling industry leaders and academic researchers to identify areas of collaboration (Etzkowitz and Leydesdorff, 2000). Joint funding pools can be established to support collaborative projects with high potential impact. Exchange programmes can further enhance this collaboration, allowing industry professionals, universities, and research organisations to gain insights into each other's environments. Incentives for collaborative teams, especially those resulting in research publications or patents, can further drive outcome-oriented research.

Research parks stand as a testament to the synergy between research and practical application. Beyond providing physical space, these parks should be equipped with state-of-the-art labs and facilities tailored to the region's predominant industries (Link and Scott, 2003). Business incubation centres within these parks can nurture startups emerging from R&D activities, offering them a comprehensive support system. Regular networking events can foster a vibrant ecosystem, promoting collaboration and idea exchange. Flexible lease terms can cater to the unpredictable nature of R&D activities, and global partnerships can open doors to international collaborations and insights (Katz and Wagner, 2014).

7.2.4. Infrastructure development and strategies for economic growth

Infrastructure development is a critical driver of economic growth, especially in regions with lower output multipliers. Prioritising infrastructure projects in these regions can stimulate economic activity, encompassing both physical infrastructure like roads, ports, and utilities, as well as digital infrastructure (Aschauer, 1989). For regions with lower output multipliers, a multifaceted approach to the development of physical infrastructure, particularly transportation, is fundamental. Developing and upgrading road infrastructure can enhance connectivity and accessibility between urban and rural areas, facilitating smoother transportation of goods and people (Banister and Berechman, 2000). Ports, being pivotal for trade and tourism, need enhancements in cargo handling and passenger transit capabilities. Rail networks, especially high-speed rail options where feasible, can ensure efficient cargo and passenger movement (Rodrigue et al., 2016). Airports can further boost connectivity and tourism at the regional level (Button and Stough, 2002). Utilities, including water and electricity, are equally crucial. Comprehensive water supply and treatment facilities can ensure consistent water supply, while upgrading power systems with a focus on renewable energy can ensure sustainable power supply (Grubler, 2010).

Digital infrastructure is the bedrock of the modern economy. Expanding high-speed broadband networks, especially in remote areas, bridges the digital divide (Kenny, 2002). Subsidies or incentives can motivate telecom companies to invest in these regions. Data centres, especially sustainable ones leveraging renewable energy and smart grids, can serve as hubs for digital businesses (Koomey, 2008). Digital training centres can empower individuals with digital skills, fostering a digitally literate population and encouraging digital entrepreneurship.

Public-Private Partnerships (PPP) can be instrumental in infrastructure development. Collaborative projects can leverage the expertise and resources of the private sector while safeguarding public interests (Hart and Moore, 1996). Incentives, such as tax breaks or land grants, can motivate private entities to invest in these regions. Lastly, sustainable infrastructure, encompassing green building standards and modern waste management facilities, ensures that development is both economically and environmentally sustainable (Pearce, 2003). In a nutshell, comprehensive infrastructure development in regions with lower output multipliers can lay the foundation for sustainable, long-term growth. Infrastructure, both physical and digital, is the backbone of economic development, and targeted investments can catalyse transformative changes.

7.2.5. Promoting sustainable economic practices for a greener future

In the current global landscape, there is a pronounced emphasis on sustainability. Regions are increasingly encouraged to adopt green practices, including renewable energy, sustainable farming, and eco-tourism initiatives (WCED, 1987). For renewable energy adoption, financial incentives such as subsidies and grants can be pivotal in motivating businesses and households to install systems like solar panels or wind turbines (Jacobsson and Lauber, 2006). Feed-in tariffs, which allow for the sale of excess renewable energy back to the grid, can create an enticing revenue stream for adopters (Mendonça, 2007). Coupled with training programmes and public awareness campaigns, these strategies can foster a culture of sustainability and renewable energy adoption.

Sustainable farming practices are another cornerstone of green economic practices. Strengthening agricultural extension services can educate farmers about sustainable techniques, from crop rotation to organic farming (Swanson, 2008). Financial incentives, market access, and investments in R&D, especially for innovations like drought-resistant crops or efficient irrigation systems, can further promote sustainable agriculture (Pretty, 2008). Community seed banks can play a role in preserving biodiversity and ensuring resilience against climatic changes (Pautasso et al., 2013).

Eco-tourism, when done right, can be both an economic boon and an environmental safeguard. Destination management and certification programmes can ensure eco-tourism operators adhere to suitable sustainable practices (Honey, 2008). Infrastructure development, local community involvement, and training can ensure that eco-tourism is both sustainable and beneficial for local communities. Collaborative marketing efforts can further promote these destinations, emphasising their unique and sustainable experiences.

Green business incentives, such as tax breaks for sustainable practices or the promotion of green bonds, can motivate businesses to adopt greener operations (Schaltegger and Wagner, 2011). Encouraging sustainable supply/value chains and responsible sourcing can further amplify the green impact of businesses (Seuring and Müller, 2008). The above strategies can particularly help the regions which had been highly dependent on lignite (Dytiki Makedonia and, to a lesser extent, Peloponnisos) to follow a more sustainable development path towards carbon neutrality and the use of renewables.

Finally, public awareness and education are foundational. Integrating sustainability into school curriculums ensures that future generations are equipped with the knowledge of its importance (Tilbury, 1995). Public campaigns and community workshops can further drive home the message, fostering a culture of sustainability at the grassroots level. Promoting sustainable economic practices is both an environmental and economic imperative. As global consciousness shifts towards sustainability, regions adopting these practices can reap ecological and economic benefits, positioning themselves as leaders in the green revolution.

7.2.6. Enhancing financial instruments for regional economic growth

Financial instruments, when tailored to the specific needs of regions, can play a pivotal role in stimulating economic activity. For instance, regions with lower product multipliers might particularly benefit from financial mechanisms like low-interest loans or grants (Berger and Udell, 2006). Tailored loan programmes can be transformative for such regions. Introducing low-interest loan programmes, especially for startups and SMEs, can alleviate the burden of high interest rates, enabling businesses to commence or expand their operations (Ayyagari et al., 2008). Deferred payment plans, where loan repayments are postponed until businesses achieve a certain revenue threshold, can further ease the initial financial pressures on entrepreneurs. Additionally, microfinance initiatives can be instrumental in regions dominated by micro-enterprises, offering small loans without traditional collateral requirements (Yunus, 2007), and the role of the Hellenic Development Bank could be crucial in this direction.

Grant programmes can further bolster regional economic activity. Innovation grants can support businesses focusing on novel solutions, especially those addressing regional challenges. Infrastructure development grants can incentivise businesses to invest in community-beneficial infrastructure, while sustainability grants can back eco-friendly business initiatives (Pisano and Teece, 2007). Equity financing, through regional venture funds or ANGEL networks, can provide startups with the necessary capital for growth, especially in regions with lower product multipliers (Lerner, 2010). Bond issuance, be it municipal bonds for large-scale projects or green bonds for eco-friendly initiatives, can raise essential capital (Baker and Wurgler, 2012).

Risk mitigation instruments, such as credit guarantee schemes or tailored insurance products, can reduce the financial risks for businesses and lenders alike (Holmstrom and Tirole, 1997). Lastly, savings instruments, like regional savings bonds or community investment platforms, ensure that local financial resources are channelled back into the region's development (Shiller, 1993). Therefore, by enhancing and tailoring financial instruments to regional needs, regions can harness their inherent potential, address unique challenges, and foster sustainable economic growth. Such strategies ensure efficient resource allocation, robust business support, and a trajectory towards regional prosperity.

7.2.7. Revising import policies for strengthened local economies

In regions with high import multipliers, there is a pressing need to reconsider import policies to bolster local production. This can be achieved through a combination of tariffs, quotas, and incentives for local producers (Krugman and Obstfeld, 2009). The provision of tax reductions or exemptions for local businesses producing high import-multiplier goods can further incentivise local production (Harrison, 1996), but the relevant impact on the output possibilities of each region per sector should also be considered. Financial assistance, especially in the form of low-interest loans, can be pivotal for local industries to reduce their production costs and compete more effectively against imports (Amiti and Konings, 2007). Additionally, grants focused on research and development can empower local businesses to innovate and align their production techniques with international standards. The extension of bi- or multilateral trade agreements and non-tariff barriers, such as stringent quality and safety standards for imports, can level the playing field, ensuring that imported goods meet the same benchmarks as local products (Mansfield and Reinhardt, 2008). Licensing requirements can further regulate the influx of imports, ensuring that only necessary goods are imported to foster local production.

Trade agreements, particularly bilateral ones, can also be tailored to favour local production by strengthening regional trade blocs to offer leverage in negotiating terms that benefit local producers and limit imports (Baier and Bergstrand, 2007). Consumer awareness campaigns, like

"Buy Local" initiatives, can educate consumers about the myriad benefits of supporting local industries. Labelling and certification for locally produced goods can further guide consumers in their purchasing decisions (Grier and Bryant, 2005).

Finally, capacity building, through training programmes and technology transfer, can equip local producers with the latest production techniques and market strategies, ensuring they remain competitive and updated (Lall, 2000). Summing up, by revising import policies tailored to the Greek regions with high import multipliers, local production can be stimulated, budding industries protected, and economic growth channelled to benefit local communities. While avoiding excessive protectionism is crucial, these strategies may ensure that regions maximise their production potential and reduce their dependency on imports, without inhibiting their competitiveness and catching-up process with the frontier regions.

7.2.8. Fostering interregional collaboration for mutual growth

Collaboration between regions, especially those with complementary economic strengths, can be a catalyst for mutual growth and development. Encouraging partnerships between high productivity regions and those with high product multipliers can lead to synergistic outcomes, whether in business, research, infrastructure, or finance (Porter, 1998).

Business partnerships can be fostered through interregional business summits, where entities from different regions can network, explore potential collaborations, and showcase their offerings (Saxenian, 1994). Financial incentives, such as collaborative grants, can further motivate businesses to form interregional partnerships, especially if they lead to innovative solutions. Moreover, integrating supply chains by encouraging businesses in high productivity regions to source from high product multiplier regions can create economic interdependence (Gereffi et al., 2005).

Research collaborations can be facilitated through the establishment of joint research centres, co-funded and managed by multiple regions. Such centres can focus on areas of mutual interest, leading to innovations that benefit all involved regions (Etzkowitz and Leydesdorff, 2000). Academic/research exchange programmes can promote shared knowledge and collaborative research projects, while interregional research grants can incentivise institutions from different regions to work together.

Shared infrastructure projects can be another avenue for collaboration. Developing shared logistics hubs, such as ports or transportation hub facilities, can ensure the efficient movement of goods and services across regions (Rodrigue et al. 2016). Joint energy projects, like shared power production plants or renewable energy initiatives, can also be mutually beneficial. Collaborating on digital infrastructure, such as broadband networks, can foster digital integration and connectivity (Frieden, 2005).

Financial collaborations, like joint investment funds or shared credit facilities, can pool resources from multiple regions, ensuring that projects with mutual benefits receive adequate funding (Schäfer et al., 2004). Hence, fostering collaboration between regions can lead to shared growth, mutual benefits, and a more integrated economic landscape. By leveraging the strengths of each region and working together on shared challenges, regions can achieve more than they would in isolation.

7.2.9. Ensuring effective policy implementation through monitoring, feedback, and public engagement

For any policy or strategy to be effective, it is imperative to have a robust monitoring and feedback mechanism in place. Regular assessments of the impact of policies can ensure their continued relevance and effectiveness (Moore, 1995). By establishing a comprehensive monitoring mechanism, policymakers can gauge the real-world outcomes of their national and regional strategies and make necessary adjustments. This dynamic approach ensures that policies remain adaptive and responsive to changing circumstances (Andrews et al., 2017).

Feedback loops are equally crucial. Engagement with local stakeholders, businesses, and communities provides invaluable insights into challenges on the ground and the practical implications of policies (Bovens et al., 2014). Such feedback, e.g., through participatory planning, questionnaire-based research, and public consultation processes, can be instrumental in refining strategies, ensuring they are both effective and aligned with the needs and aspirations of the communities they aim to serve.

Moreover, public awareness and engagement play a pivotal role in the successful implementation of economic policies. By educating the public about regional economic dynamics, people can make informed decisions that align with broader economic objectives (Fung, 2006). Whether it is selected to embark on entrepreneurial ventures or make consumption choices, a well-informed public can significantly contribute to achieving regional economic goals. While crafting policies is essential, their success hinges on regular monitoring, feedback, and public engagement. These mechanisms ensure that strategies are not only well-implemented but also remain adaptive, responsive, and in tune with the needs of the regions they serve.

APPENDIX

TABLE A1
NUTS-2 codes and description of the 13 regions of Greece

NUTS-2 (2016)	Regions (in original language)	Regions (translated into English)
EL11	Anatoliki Makedonia and Thraki	Eastern Macedonia and Thrace
EL12	Kentriki Makedonia	Central Macedonia
EL13	Dytiki Makedonia	Western Macedonia
EL21	Ipeiros	Epirus
EL14	Thessalia	Thessaly
EL22	Ionia Nisia	Ionian Islands
EL23	Dytiki Ellada	Western Greece
EL24	Sterea Ellada	Central Greece
EL30	Attiki	Attica
EL25	Peloponnisos	Peloponnese
EL41	Voreio Aigaio	North Aegean
EL42	Notio Aigaio	South Aegean
EL43	Kriti	Crete

Source: Eurostat (Accessed online at: https://publications.europa.eu/code/en/en-5001000.htm).

TABLE A2
Letter code and description of the 20 sectors of economic activity

Letter code	Description
A	Agriculture, forestry, and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam, and air conditioning supply
E	Water supply; sewerage, waste management, and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific, and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment, and recreation
S	Activities of households as employers
T	Other service activities

Note: The description refers to the statistical classification of economic activities of Eurostat, European Commission, abbreviated as NACE (revision 2).

TABLE A3
Descriptive statistics for the output (with and without imports), import, and employment multipliers of the Greek regions

Regions	Descriptive Statistics
Anatoliki Makedonia and Thraki	*Output Multipliers (With Imports)* Mean: 1.0045389 Median: 1.035285 Standard Deviation: 0.340458 Minimum: 0.1502 Maximum: 1.92757 *Output Multipliers (Without Imports)* Mean: 1.342079 Median: 1.27737 Standard Deviation: 0.244919 Minimum: 1.04652 Maximum: 2.22772 *Import Multipliers* Mean: 0.26465545 Median: 0.222084 Standard Deviation: 0.191463 Minimum: 0.026732 Maximum: 0.89073 *Employment Multipliers* Mean: 24.4852485 Median: 18.84185 Standard Deviation: 22.914289 Minimum: 1.99887 Maximum: 111.515
Kentriki Makedonia	*Output Multipliers (With Imports)* Mean: 1.005512 Median: 1.04165 Standard Deviation: 0.347039 Minimum: 0.15436 Maximum: 1.95197 *Output Multipliers (Without Imports)* Mean: 1.3508295 Median: 1.29566 Standard Deviation: 0.238818 Minimum: 1.0393 Maximum: 2.21053

TABLE A3 (continued)

Regions	Descriptive Statistics
Kentriki Makedonia (continued)	*Import Multipliers* Mean: 0.267262 Median: 0.21884 Standard Deviation: 0.196651 Minimum: 0.02008 Maximum: 0.9091 *Employment Multipliers* Mean: 23.230691 Median: 17.7089 Standard Deviation: 21.576075 Minimum: 1.35687 Maximum: 104.276
Dytiki Makedonia	*Output Multipliers (With Imports)* Mean: 1.016136 Median: 1.04287 Standard Deviation: 0.344661 Minimum: 0.16183 Maximum: 1.96508 *Output Multipliers (Without Imports)* Mean: 1.32738 Median: 1.280195 Standard Deviation: 0.244590 Minimum: 1.03532 Maximum: 2.20915 *Import Multipliers* Mean: 0.245051 Median: 0.19723 Standard Deviation: 0.186628 Minimum: 0.01963 Maximum: 0.84999 *Employment Multipliers* Mean: 22.8586085 Median: 17.2987 Standard Deviation: 22.207966 Minimum: 1.31554 Maximum: 106.643

TABLE A3 (continued)

Regions	Descriptive Statistics
Ipeiros	*Output Multipliers (With Imports)* Mean: 1.009922 Median: 1.039405 Standard Deviation: 0.340276 Minimum: 0.15828 Maximum: 1.9397 *Output Multipliers (Without Imports)* Mean: 1.3332145 Median: 1.2782 Standard Deviation: 0.248233 Minimum: 1.04478 Maximum: 2.22484 *Import Multipliers* Mean: 0.257763 Median: 0.22164 Standard Deviation: 0.193216 Minimum: 0.0254 Maximum: 0.91585 *Employment Multipliers* Mean: 24.196909 Median: 18.682 Standard Deviation: 22.680064 Minimum: 1.95778 Maximum: 110.241
Thessalia	*Output Multipliers (With Imports)* Mean: 0.9791515 Median: 1.01183 Standard Deviation: 0.346674 Minimum: 0.15215 Maximum: 1.91787 *Output Multipliers (Without Imports)* Mean: 1.3592795 Median: 1.303195 Standard Deviation: 0.232803 Minimum: 1.11951 Maximum: 2.20313

TABLE A3 (continued)

Regions	Descriptive Statistics
Thessalia (continued)	*Import Multipliers* Mean: 0.2934875 Median: 0.22146 Standard Deviation: 0.190586 Minimum: 0.07964 Maximum: 0.85675 *Employment Multipliers* Mean: 23.990219 Median: 18.16465 Standard Deviation: 21.297087 Minimum: 6.04171 Maximum: 104.284
Ionia Nisia	*Output Multipliers (With Imports)* Mean: 1.036768 Median: 1.06221 Standard Deviation: 0.342989 Minimum: 0.17511 Maximum: 1.98443 *Output Multipliers (Without Imports)* Mean: 1.3257045 Median: 1.281545 Standard Deviation: 0.246049 Minimum: 1.04054 Maximum: 2.20559 *Import Multipliers* Mean: 0.2293165 Median: 0.184055 Standard Deviation: 0.193806 Minimum: 0.01873 Maximum: 0.89564 *Employment Multipliers* Mean: 22.8339505 Median: 16.40165 Standard Deviation: 21.95195 Minimum: 1.59901 Maximum: 106.03

TABLE A3 (continued)

Regions	Descriptive Statistics
Dytiki Ellada	*Output Multipliers (With Imports)* Mean: 1.02803 Median: 1.055635 Standard Deviation: 0.342949 Minimum: 0.17008 Maximum: 1.97762 *Output Multipliers (Without Imports)* Mean: 1.3227405 Median: 1.28524 Standard Deviation: 0.244557 Minimum: 1.03887 Maximum: 2.19827 *Import Multipliers* Mean: 0.2344485 Median: 0.181485 Standard Deviation: 0.192882 Minimum: 0.01871 Maximum: 0.90039 *Employment Multipliers* Mean: 23.4379735 Median: 16.95145 Standard Deviation: 22.48351 Minimum: 1.58459 Maximum: 108.491
Sterea Ellada	*Output Multipliers (With Imports)* Mean: 0.984289 Median: 1.02145 Standard Deviation: 0.338402 Minimum: 0.12795 Maximum: 1.88095 *Output Multipliers (Without Imports)* Mean: 1.343427 Median: 1.293285 Standard Deviation: 0.240924 Minimum: 1.03812 Maximum: 2.2145

TABLE A3 (continued)

Regions	Descriptive Statistics
Sterea Ellada (continued)	*Import Multipliers* Mean: 0.2789235 Median: 0.247605 Standard Deviation: 0.192981 Minimum: 0.02238 Maximum: 0.89641 *Employment Multipliers* Mean: 23.2218925 Median: 17.41775 Standard Deviation: 22.093625 Minimum: 1.35615 Maximum: 106.348
Attiki	*Output Multipliers (With Imports)* Mean: 1.029714 Median: 1.06459 Standard Deviation: 0.351207 Minimum: 0.17511 Maximum: 1.99946 *Output Multipliers (Without Imports)* Mean: 1.3658125 Median: 1.31156 Standard Deviation: 0.249382 Minimum: 1.04847 Maximum: 2.25502 *Import Multipliers* Mean: 0.260973 Median: 0.21178 Standard Deviation: 0.194780 Minimum: 0.02507 Maximum: 0.91056 *Employment Multipliers* Mean: 23.2722345 Median: 17.4161 Standard Deviation: 21.497792 Minimum: 1.75027 Maximum: 104.609

TABLE A3 (continued)

Regions	Descriptive Statistics
Peloponnisos	*Output Multipliers (With Imports)* Mean: 1.026445 Median: 1.05265 Standard Deviation: 0.341557 Minimum: 0.16793 Maximum: 1.96855 *Output Multipliers (Without Imports)* Mean: 1.41591 Median: 1.35613 Standard Deviation: 0.248273 Minimum: 1.05546 Maximum: 2.3037 *Import Multipliers* Mean: 0.235258 Median: 0.18599 Standard Deviation: 0.193234 Minimum: 0.02251 Maximum: 0.90213 *Employment Multipliers* Mean: 24.000207 Median: 17.68875 Standard Deviation: 23.05704 Minimum: 1.88492 Maximum: 111.453
Voreio Aigaio	*Output Multipliers (With Imports)* Mean: 1.0390485 Median: 1.063145 Standard Deviation: 0.346409 Minimum: 0.17824 Maximum: 2.00446 *Output Multipliers (Without Imports)* Mean: 1.314192 Median: 1.27715 Standard Deviation: 0.237106 Minimum: 1.03231 Maximum: 2.16065

TABLE A3 (continued)

Regions	Descriptive Statistics
Voreio Aigaio (continued)	*Import Multipliers* Mean: 0.216955 Median: 0.156905 Standard Deviation: 0.196003 Minimum: 0.01058 Maximum: 0.88553 *Employment Multipliers* Mean: 21.9605525 Median: 16.1224 Standard Deviation: 21.398895 Minimum: 1.04952 Maximum: 102.382
Notio Aigaio	*Output Multipliers (With Imports)* Mean: 1.09891 Median: 1.13321 Standard Deviation: 0.388192 Minimum: 0.20173 Maximum: 2.24745 *Output Multipliers (Without Imports)* Mean: 1.3958795 Median: 1.32918 Standard Deviation: 0.292321 Minimum: 1.03926 Maximum: 2.44666 *Import Multipliers* Mean: 0.2259085 Median: 0.16967 Standard Deviation: 0.194401 Minimum: 0.01142 Maximum: 0.88982 *Employment Multipliers* Mean: 22.1292465 Median: 15.64375 Standard Deviation: 21.416640 Minimum: 1.04993 Maximum: 103.16

TABLE A3 (continued)

Regions	Descriptive Statistics
Kriti	*Output Multipliers (With Imports)* Mean: 1.0390485 Median: 1.063145 Standard Deviation: 0.346409 Minimum: 0.16401 Maximum: 1.95552 *Output Multipliers (Without Imports)* Mean: 1.314192 Median: 1.27715 Standard Deviation: 0.237106 Minimum: 1.03231 Maximum: 2.1917 *Import Multipliers* Mean: 0.216955 Median: 0.156905 Standard Deviation: 0.196003 Minimum: 0.01058 Maximum: 0.90402 *Employment Multipliers* Mean: 21.9605525 Median: 16.1224 Standard Deviation: 21.398895 Minimum: 1.04952 Maximum: 106.447

Source: Authors' own calculations.

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