

The labor market areas of Greece estimated from the 2021 commuting patterns

Prodromos Prodromidis
Centre for Planning & Economic Research
Athens, Greece
(pjprodr@kepe.gr)

Abstract:

The paper delineates the functional labor market areas of Greece based on contemporary commuting patterns. By algorithmically grouping localities using travel-to-work flows from the 2021 Census, the study identifies updated economic boundaries and compares them to those derived from the 2011 Census. Furthermore, it assesses Greece's spatial fragmentation based on these recovered configurations and evaluates how closely they align with current regional and subregional divisions. The findings suggest that where administrative and functional grids diverge, there is significant potential for more targeted policy interventions. Ultimately, this research advances our understanding of how labor market phenomena diffuse across the country, providing a robust framework for the formulation of evidence-based spatial policies.

Keywords: Travel-to-work flows, labor market areas, spatial fragmentation, microregional policy in Greece

JEL Classifications: J49, R12

1. Introduction

The purpose of this paper is to delineate and examine the functional labor market areas (LMAs) of Greece using commuting flow data from the 2021 population census, and to detect structural shifts since 2011. Prompted originally by methodological discussions and initiatives advanced under the aegis of the OECD and the European Union, this research builds upon a continuous three-census framework—extending prior analyses of the 2001 and 2011 censuses—to capture the long-term evolution of Greece's functional economic geography.

It is organized as follows: first, it reviews the evolution of the LMA dialogue within the European Union; second, it describes Greece's idiosyncratic terrain and the administrative layout; third, it details the methodological framework and empirical findings; fourth, it discusses regional context and spatial patterns; and finally, offers concluding remarks and discusses certain territorial development policy implications.

2. The state of discussion regarding LMAs in the EU

Around 2007, Eurostat sought to collect proposals and conduct analyses to define LMAs. Several such analyses were carried out independently using contrasting methods, leading to proposals for harmonized practices and concerns regarding the implementation of proposed criteria (Carausu et al., 2012; Coombes et al., 2012; Guérois et al., 2014). This was followed by a dialogue among interested national statistical offices (such as those of the UK, the Netherlands, and Italy) progressed under Eurostat's aegis. Method comparisons and testing were conducted based on data flows from the UK, Sweden, the Netherlands, Austria, and Hungary (e.g., Bates et al., 2015), which are countries structurally less fragmented than Greece. Within Eurostat, the view was openly expressed that identifying functional units at the EU level would serve the targeted implementation of economic and social policy (Radermacher, 2015)—policies traditionally funded and implemented at the administrative region level. Subsequent efforts focused on developing a common algorithm, devising a statistical toolbox, and running further cross-country comparisons (Franconi et al., 2016; Martínez-Bernabeu et al., 2020; Casado-Díaz et al., 2023).

3. Greece's terrain, administrative and statistical layout, and commuting infrastructure

Greece is dominated by high mountain chains, small valleys, narrow coastal strips, a multitude of islands, and a very jagged coastline (Map 1). These features heavily fragment the landscape, creating serious challenges concerning: (a) Economies of scale in production. (b) The operational scale of local public services, such as police, fire-protection staff, education, and healthcare. (c) Transportation costs relative to other EU countries.

These natural barriers to commuting are partially mitigated by national infrastructure networks, specifically the primary motorway system and maritime ferry routes (Maps 2-3). At the time of the 2021 Census, only the Athens metropolitan area possessed a subway system (with the port of Piraeus getting better linked to the broader underground rapid transit network a year later).

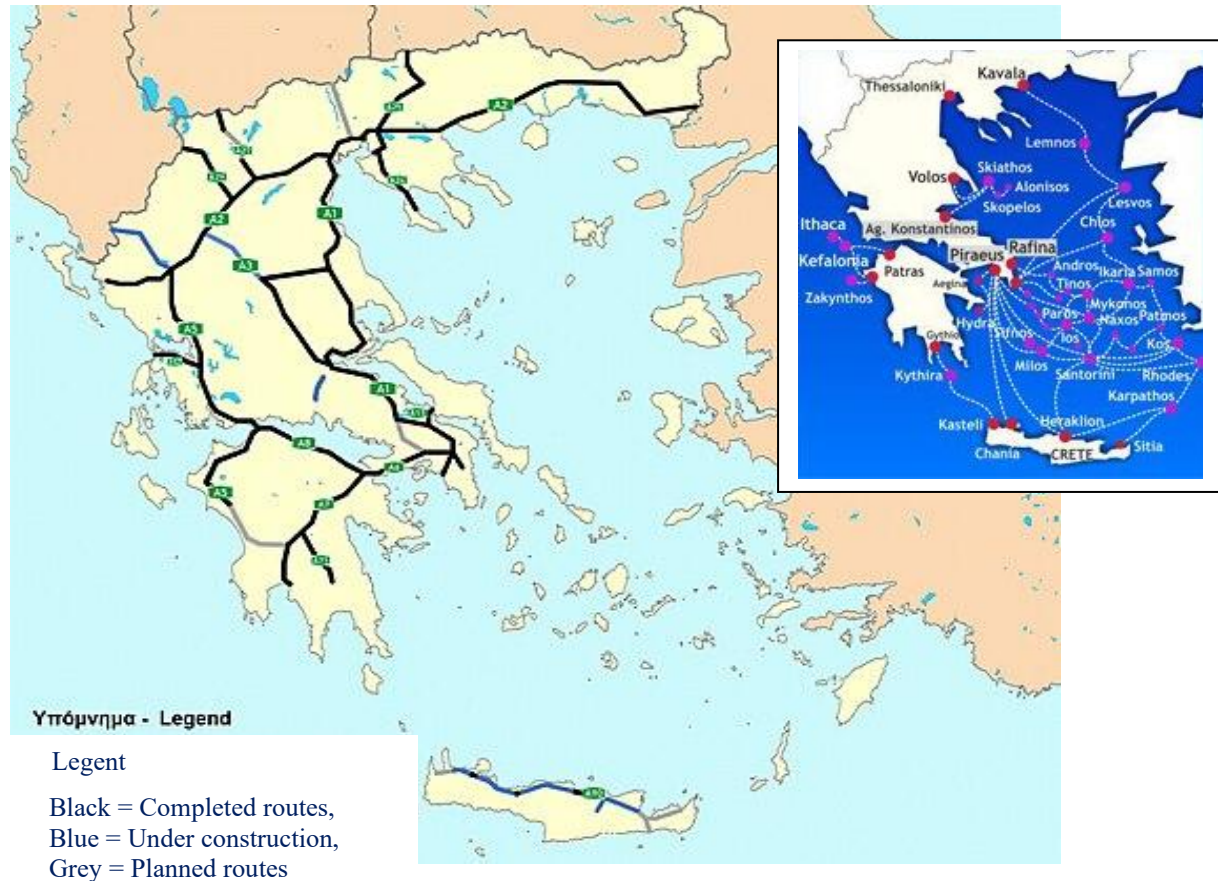
Map 1: The terrain relief and coastal outline of Greece



Source: <https://commons.wikimedia.org/wiki/File:Greece.A2003085.0920.250m.jpg>

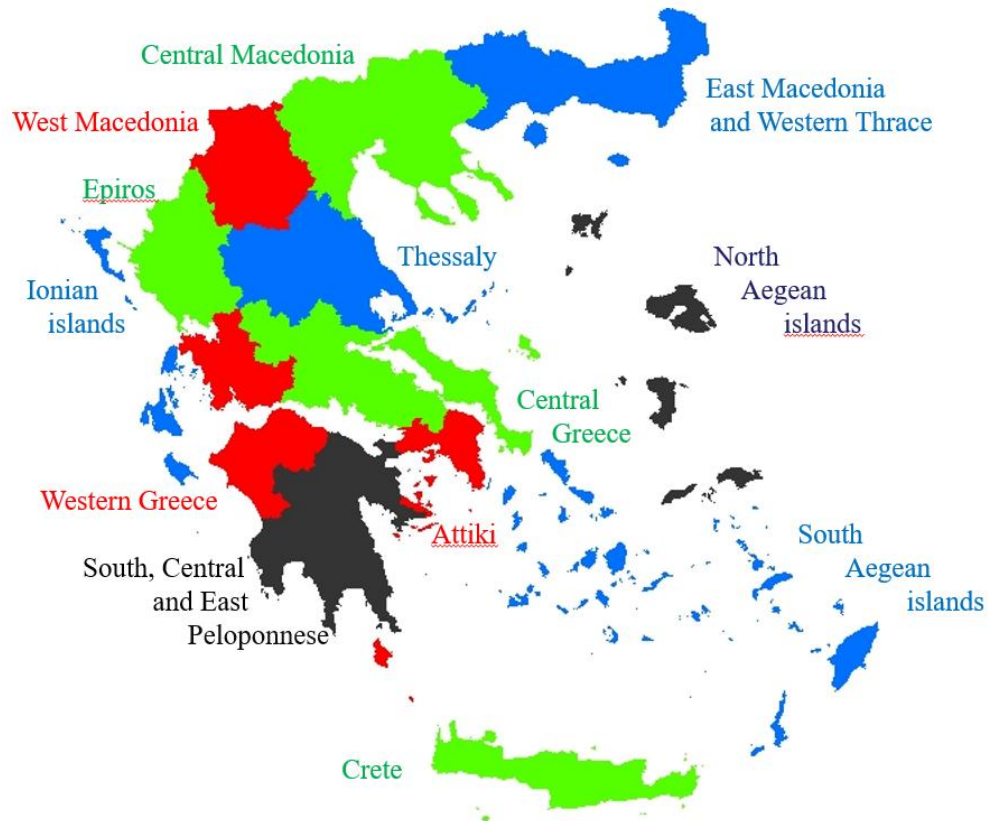
Administratively, the country is organized into 13 NUTS level 2 regions (Map 4), 332 municipalities, and a self-governing monastic community (Mt. Athos). According to the 2021 Census (total population: 10.5 million), these local authorities vary widely in scale—ranging from tiny island populations of 140–205 residents (e.g., Gavdos and Agathonisi) to major urban centers like Thessaloniki (319,000 residents) and Athens (644,000 residents). These are further subdivided into 1,037 lower-level municipal units (individual settlements or clusters of settlements) that may or may not represent internally cohesive functional areas. See Maps 5-6.

Maps 2-3: The primary motorway, maritime ferry routes & inter-island transportation system of Greece

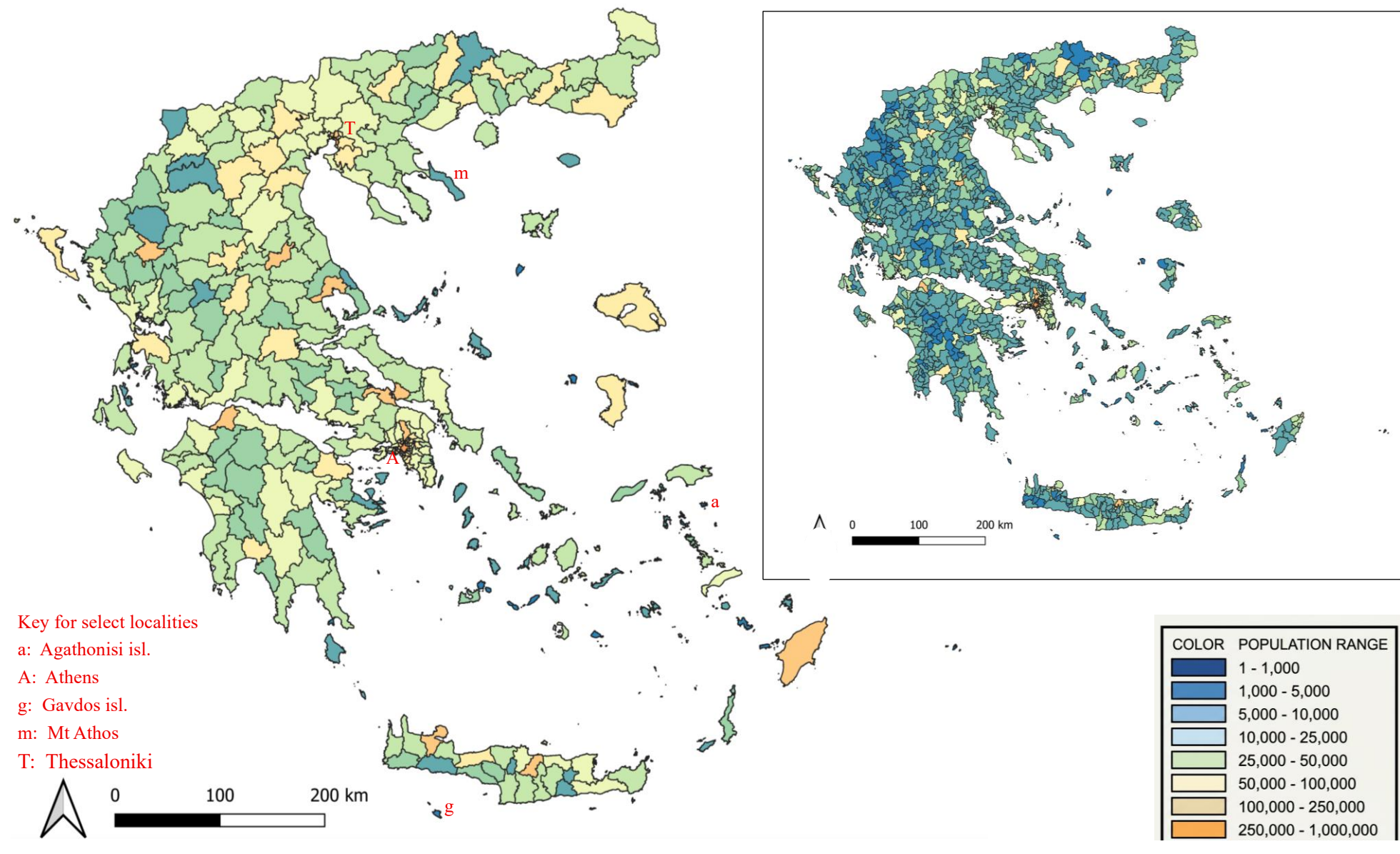


Sources: https://en.wikipedia.org/wiki/Highways_in_Greece, <https://uk.pinterest.com/pin/1055599901674017/>

Map 4: The administrative and statistical regions of Greece



Maps 5 -6: Spatial distribution of municipal and municipal unit population sizes across Greece, 2021 Census



3. The delineation of LMAs

To determine the travel-to-work areas we rely on the flows of the active workforce at a 20% incoming and outgoing threshold. Using this threshold, 661 lower-level units are grouped into 87 multi-unit LMAs.

The approach employed is as follows:

- Two areas (*A* and *B*) are grouped into the same LMA if a strong commuting connection exists, defined by a high percentage of residents in *A* working in *B* or a high percentage of workers in *B* living in *A*.
- The hierarchical clustering algorithm initiates at a 100% commuting ratio and steps down iteratively to the 20% threshold.
- Every unit across the country is evaluated under an identical procedure; units failing to meet the cutoff remain independent or link elsewhere.
- In instances where a unit shows identical commuting percentages to multiple markets, it is assigned to the physically closest market.

The process is not entirely automated; as in 2011 manual checks proved essential to detect and rectify data-entry errors (such as misrouted flows between distinct villages sharing identical names) that automated routines failed to catch.

As daily cross-border commuters (residents working abroad or foreign workers entering Greece) were unrecorded, no cross-border labor market is identified. This omission may slightly inflate domestic travel metrics and local non-commuter shares, causing border areas to group at marginally different cutoff levels.

4. Empirical findings

This way we identify 463 distinct LMAs, with populations spanning from 21 to 2,782,161 residents (Map 7), and expect labor market and social interventions taking place in one LMA to be unlikely to spill over to others, necessitating distinct or replicated policy actions across separate functional territories.

First and foremost we notice that administrative municipal boundaries diverge from functional LMAs. Specifically:

- 12 municipalities form an LMA dominated by a unit of the municipality itself.
- 30 municipalities form an LMA dominated by a unit extending to encompass parts of other municipalities.
- 101 municipalities are dominated by a unit belonging to another municipality.
- 78 municipalities feature mixed units (locally dominated, externally dominated, or displaying weak commuting flows).
- 60 municipalities comprise units with low internal and external commuting flows.
- 52 single-unit municipalities (mostly remote islands) plus Mt. Athos are characterized by minimal commuting flows.

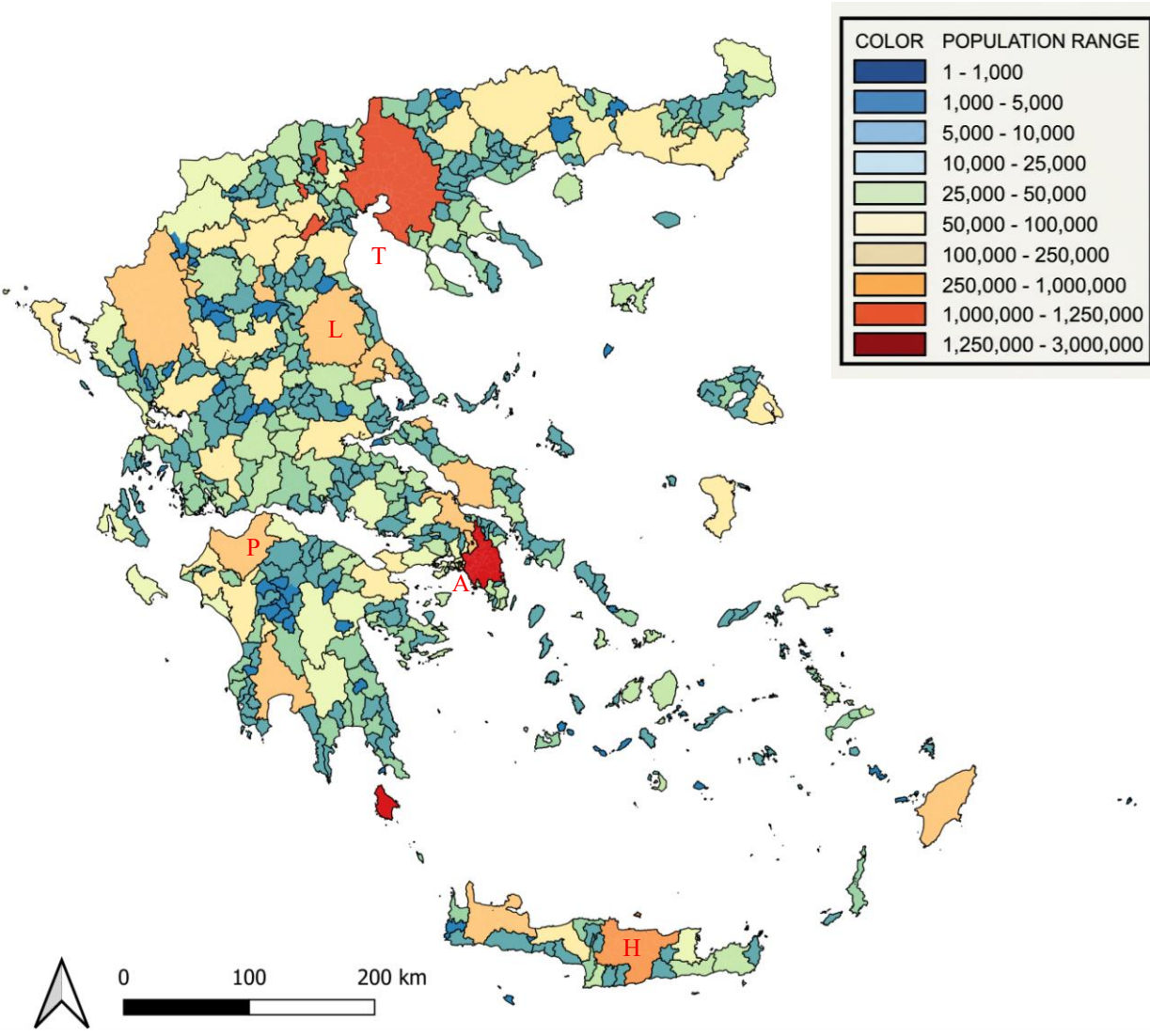
In view of the above, the administrative grid may be inadequate for socio-economic data collection and targeted funding. Misaligned administrative units are likely to generate sub-optimal resource allocation and diminished policy impacts. Aligning public policy boundaries with empirically defined LMAs offers substantial scope to optimize the distribution of public funds and maximize intervention effectiveness.

We also notice several spatial non-contiguities —where functional integration overrides physical contiguity— most notably in West Macedonia, Central Macedonia (around Thessaloniki), Euboea, and Kythira (linked to Athens). These patterns reflect the reality that individuals may undertake long-distance commutes, shaped by the distribution of population and industrial characteristics —a complex set of factors. Consequently, the methodology deliberately avoids imposing spatial contiguity

Interestingly, the LMA of Athens (27% of the population), which used to be more extensive and included Piraeus in the 2011 run (Prodromidis, 2018; evaluated at the identical threshold using more disaggregated data from 6.132 settlements), now appears to have contracted. Conversely, the other major urban centers —

Thessaloniki (11%), Heraklion (3%), Patras, and Larisa (2% each)— have generally expanded their functional footprints.

Map 7: Functional LMAs of Greece delineated at the 20% incoming and outgoing commuting threshold, 2021 Census



The panels below illustrate the estimated extent of the country's top LMAs compared with their 2011 configurations at the same threshold.

H: Heraklion



L: Larisa



P: Patras



T: Thessaloniki



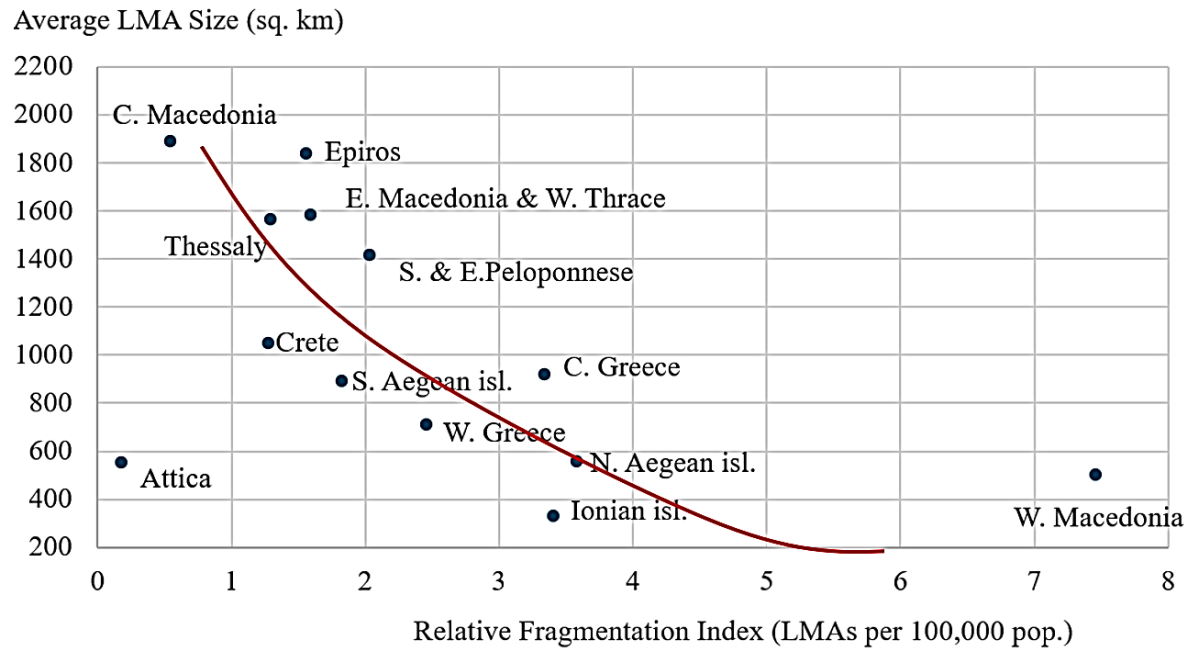
A: Athens



5. Regional Context and Spatial Patterns

Evaluating the LMAs across Greece's 13 administrative regions reveals that smaller LMA land area corresponds to higher (population-adjusted) fragmentation (Graph 1). These patterns are governed by terrain and insularity.. For instance, West Macedonia features a rugged terrain that isolates settlements, producing a highly polycentric spatial structure. Similarly, in the North and South Aegean islands, insularity fosters numerous, geographically smaller LMAs confined within island communities. At the same time, Attica is an outlier comprising a rather small landmass dominated by an urban core.

Graph 1: Average LMA size and regional fragmentation across Greece



5. Conclusions

This study delineates and examines the functional LMAs of Greece using commuting flow data from the 2021 population census. By applying a 20% incoming and outgoing commuting threshold across lower-level administrative units, the empirical analysis identifies 463 distinct LMAs, characterized by profound structural and demographic diversity.

The findings reveal a pronounced divergence between Greece's formal administrative layout and its functional economic reality. Over 60% of the country's municipalities do not align neatly with self-contained functional labor basins, indicating that rigid administrative boundaries are frequently inadequate for regional economic tracking, public resource allocation, and targeted policy intervention.

A comparative evaluation against the 2011 baseline highlights significant evolutionary shifts. Most notably, while secondary urban poles such as Thessaloniki, Heraklion, Patras, and Larisa have expanded their functional footprints, the metropolitan area of Athens has contracted, separating structurally from the port of Piraeus. Furthermore, regional analysis demonstrates that Greece's mountainous terrain and extensive insularity heavily dictate local spatial integration. High relative fragmentation and smaller LMA land areas characterize topographically isolated regions and island clusters, whereas mainland cores exhibit broader functional catchments constrained by natural physical barriers.

Ultimately, these empirical insights underscore the necessity of moving beyond traditional administrative divisions when designing regional policies. Aligning public investments, infrastructure planning, and labor

market strategies with functionally defined LMAs offers substantial scope to optimize the delivery of public services, mitigate the frictions of geographical fragmentation, and enhance the efficacy of territorial development policy across Greece.

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