4th CITIES AND MUNICIPALITIES COMPETITIVENESS INDEX ACADEMIC SYMPOSIUM

"***Transformational Leadership for Local Development in the New Normal***"

Research Title	Spatial Analysis of Local Competitiveness: Relationship of Economic Dynamism of Cities and Municipalities in Major Regional Metropolitan Areas
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ABSTRACT

The practice of measuring competitiveness indices and the consequential ranking of cities and municipalities in the Philippines has been put in place by the Department of Trade and Industry (DTI) since 2013. However, its importance as a spatial development planning parameter is not yet fully recognized in literature, and its use has to be explored and fully understood.

To understand the importance of the DTI Cities and Municipalities Competitive Index (CMCI) in regional planning, the paper reviewed relevant research on factors driving competitiveness. *"Economic dynamism"* appeared to be on top of the hierarchy, among other factors influencing regional development. Based on this information and the established urban and regional planning theories, metropolitan areas were chosen as the most appropriate laboratory sites to demonstrate economic dynamism.

The research introduced an approach to reprocess the "Economic Dynamism Index" (EDi) based on Tobler's first law on geography that everything is related to everything else and near things are more related than distant ones. This considers the assumption that the EDIs of cities and municipalities are spatially correlated, indicative of their clustering pattern in the economic space. The reprocessing treated EDi as a spatial attribute and utilized the same indicators and sub-indicators from the CMCI economic dynamism pillar. In reprocessing the EDi for all the cities and municipalities within the major metropolitan case study areas, patterns of spatial clustering surfaced, which cannot be generated under the current approach of grouping the cities and municipalities according to their income classes.

The occurrence of spatial clusters indicates the existence of "complementation" among the cities and municipalities in metropolitan areas. Using Moran's I spatial autocorrelation analysis, cluster patterns observed from the GIS map of cities and municipalities were validated by the 99% significance in the spatial statistics of the EDi dataset. Thus, the study confirmed the hypothesis that there is spatial relationship among the cities and municipalities in a regional metropolitan area.

This finding is in sync with the countrywide urban spatial hierarchies. The DTI, local government units (LGUs), and regional development councils (RDCs) should be encouraged to appropriately treat the calculation of the EDi as a means of establishing spatial strategies or models that expand development from the LGUs with higher EDi to the less endowed cities/municipalities at the periphery.

Keywords: *competitiveness, economic dynamism, metropolitan areas, spatial autocorrelation, spatial clusters, spatial competitiveness*

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I. Introduction

A. Background of the Study

In the past 80 years since Schumpeter (1942) introduced the Theory of Creative Destruction through constant innovation to maintain competitiveness, theoretical frameworks and empirical analyses have emerged in the economic geography of cities, towns, and regions. One of the frameworks is the CMCI framework, which viewed competitiveness alongside Porter's (2004) concept of location-based productivity or the conversion into productive assets of available resources in a city or municipality. One of the metrics used by the CMCI in expressing productivity within these administrative units is the "economic dynamism index" (EDi).

The application and usage of the EDi as a regional and urban planning analytical tool were not explored and covered in the literature. Through the EDi, the study explained the nature of competitiveness arising from the spatial hierarchies (growth poles) of cities/municipalities having a high index of competitiveness which has *"polarizing"* implications for less competitive LGUs.

These varying levels of competitiveness across space found resonance with Perroux' (1955) observation that "economic growth does not happen everywhere and all at once. Growth manifests itself into patches of "growth poles" across space at varying intensities.'' Consequently, the impact of concentration of growth in existing centers would often result in "backwash"/"polarization" as envisaged by Myrdal (1957) and Hirschman (1958).

Given the underlying theoretical concerns, it would be empirically practical to explain the implications of the geospatial clustering or dispersion in the competitiveness of cities and municipalities. By doing this, planners and policymakers can appropriately select urban and regional planning strategies such as growth pole, integrated area development, balanced countryside agro-industrial development, and dispersion through agglomeration, among others, that would appropriately support and sustain competitiveness.

B. Research Problem, Research Objectives and Assumption of the Study

According to Zinovyeva, et al. (2016), "numerous studies have been conducted in the sphere of regional development, and most are fragmented and focus on specific features of regional competitiveness." There is also no scientific proof of a causal relationship between various factors and levels of regional competitiveness. Further, the theoretical or methodological basis for increased regional competitiveness is lacking. In this context, the use of the competitiveness index among cities and municipalities as a planning tool for urban and regional development strategy formulation has to be explored.

Research Questions. The research answered the main question: *what is the correlation in space of "economic dynamism index" among cities and municipalities in metropolitan areas?* The specific questions that were answered are as follows:

1) What are the hierarchy and spatial association of competitiveness among cities and municipalities in terms of CMCI's EDi"?
2) How does the current spatial association of the EDi explain the competitiveness (either complementing or competing) across cities and municipalities within metropolitan areas?
3) How does the prevailing regional economic development strategy influence the current condition in the economic competitiveness of cities and municipalities in metropolitan areas?

4) What policy enhancements in regional development strategies can be recommended to support the prevailing spatial conditions of economic competitiveness of metropolitan areas?

Research Objectives. The general objective of the study is to examine the spatial relationship in the EDi of cities and municipalities in metropolitan areas as an approach to regional development planning. Specifically, the study intends to achieve the following specific objectives: 1) Examine the hierarchy and spatial association in the EDi of cities and municipalities in major metropolitan areas; 2) Asses the nature (competing or complementing) of economic competitiveness in regions based on the spatial association of EDi of cities and municipalities; and 3) Evaluate the influence of the prevailing regional spatial development strategy and economic development policy.

Given the research questions and objectives of the study, it is assumed that *spatial correlation exists in the economic dynamism indices of neighboring cities and municipalities within a metropolitan area*.

C. Significance of the Study

In terms of its significance to urban and regional planning literature, the research reinforces the theoretical assumptions of spatial dependence among entities following the theory of competitive advantage, growth pole theory, and theory of uneven growth. For local development planning, it serves in reformulating or enhancing regional development strategies introduced in the medium-term (every six years) by the central planning unit - National Economic and Development Authority (NEDA).

The spatial association in the EDi described in this study could serve as a guide to local planning offices of LGUs and regional units of national government agencies in preparing development plans. These plans will cushion the negative implication of "backwash/polarization" to less competitive cities and municipalities regardless of their income class.

II. Review of Related Literature

A. Regional Development Theories on Spatial and Hierarchical Competition

The study hinges on several theories on spatial and hierarchical competition. Primary to this is the Theory on Agglomeration of firms in space (Smith, 1776; Marshall, 1889; Isard, 1956) whereby businesses tend to cluster towards each other. This phenomenon is generally possible and observed in areas of high population, such as large metropolitan areas.

Porter (1998) theorizes that "competitive advantage" requires "clustering" as representation of the geographical concentrations of interconnected companies, specialist suppliers, service providers, and firms in related industries and associated institutions. In certain sectors or firms, the very nature of the process of spatial competition is oligopolistic and should be studied within a framework of interactive decision making (Hotelling, 1929). Increasing returns to scale are essential in explaining the geographical distribution of economic activities. The corresponding spatial equilibrium becomes the result of a complicated balance of forces that push and pull consumers and firms until no one can find a better location. This type of agglomeration arises when businesses with similar characteristics such as restaurants, movie theaters, or shops selling similar products are "clustered within the same neighborhood of a city".

B. Competitiveness and Clustering of Firms in Metropolitan Areas

Competitiveness in cities emerge because people, businesses, and organizations are attracted and experienced benefit from the accessibility and services they offer (Levinson and King, 2019). With firms and individuals attracted into cities, socio-economic specialization and spatial expansion occur leading to the formation of economic clusters. In the case of the Philippines, this economic clusters are typically formed among contiguous political administrative units that spatially organized into metropolitan districts. This spatial organization is implied in the Philippine Development Plan (PDP 2016 – 2022) when spreading growth by linking metropolitan areas with the lagging units to address socio-economic inequalities. Often this is done by means of inducing spatial interactions between economic clusters following inter-metropolitan complementation.

Economic Clusters in Metropolitan Areas. The general definition of an economic cluster refers to a geographically contiguous spatial units that have similar, interconnected and complementary firms that share infrastructure/services and a common institutional environment similar to a metropolitan authority set up. The contribution in economic development and urban growth of clusters and metropolitan areas has been studied extensively from different conceptualizations in North America, Europe and East Asia (Audirac, 2003; Cortright, 2006; Hallencreutz & Lundequist, 2003; Hospers, 2005; Rosenfeld, 2003). Giuliano et al. (2019) observed that different types of industry participants were more concentrated inside centers than outside centers, and the degree of clustering was higher for the larger, relatively dense centers. Smith and Florida (1994) observed that localization of economies has shaped the location choices of Japanese firms' automobile industry in the United States. Encarnacion (2021) and Chang et al. (1997) found clustering of bank branches in metropolitan areas of the National Capital Region and New York, respectively. These empirical studies resonate with Porter's (1990) concept that the path from these cluster growth to local economic competitiveness is through strengthening the connectedness of productive and non-productive factors driving economic development.

Size of Metropolitan Areas/Regions. The size of the urban extent reported for megacities in China and the United States varies over the past 50-year period since the 1970s (Kuang et. al, 2014). In Beijing China, the 20 Year (1970 – 1990) urbanization pattern has reached up to 22 kilometers from the city center and stretched as far as 30 kilometers in the 2000's. For Shanghai, the urban area size grew from 14 kilometers to 22 kilometers between 1970 – 2000 era. In Guangzhou, the urban area expanded to 24 kilometers in the 1980's advancing towards the 50 kilometer bandwidth during the 1990's which coincided with China's policy of opening-up the economy to global trade relations.

Elsewhere in the United States, the size of urban structure is much larger due to prior headway in terms of economic maturity. Observed urban extent sizes circa 2010 were in the range of 40 kilometers to 50 kilometers from the city enter in the areas of Chicago, Los Angeles, and New York. These urban land use expansion for the Chinese megacities were directed outward radiating from the Central Business District (CBD) to the periphery in concentric ring pattern, as observed in Beijing and Shanghai. On the other hand, the American megacities expansion were similar to densification as the inner cities open areas underwent filling-up patterns.

C. Hierarchy and Grouping of Factors Driving Regional Development and Competitiveness

Literature also recognizes that regional development and competitiveness are driven by hierarchy and the grouping of several factors. Development theorists such as Myrdal (1957) and Hirschman (1958) recognized geographical diversification as *growth reached localization stage*. Indeed cities, and more generally economic agglomerations, are considered as the

main institutions where both technological and social innovations are developed through market and nonmarket interactions.

It should also be noted that city specializations tend to change over time, thus creating a geographically diversified pattern of economic development. It seems therefore reasonable to say that growth is localized. The factors that often characterize regional development and competitiveness are enumerated below:

1. *Dynamic Factors*

The Pyramid of Factors of Regional Competitiveness examines three specific factors that are contributory to the competitiveness of a certain region: the *basic factors*, *supporting factors*, and *dynamic factors*. The top of the pyramid includes dynamic factors that are the most active and flexible (Zinovyeva et. al. 2016). In the middle of the pyramid, there are supporting factors that create a basis for regional development. The bottom of the pyramid is composed of basic factors that form initial peculiarities of a given region.

Figure 1 below illustrates how each factor builds up regional competitiveness in a pyramid fashion:

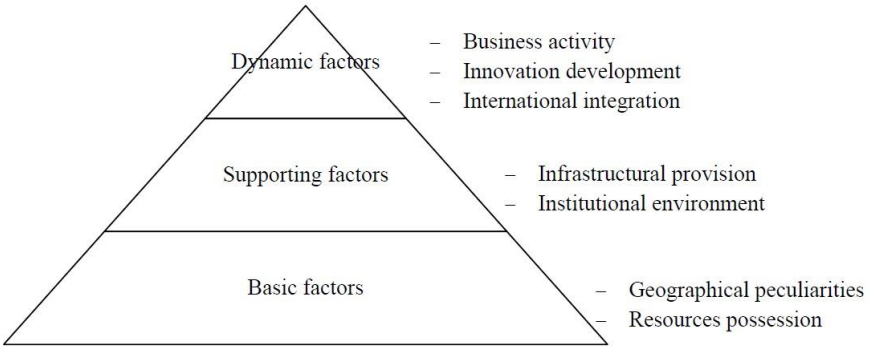


Figure 1. Pyramid of Factors of Regional Competitiveness

Source: [Irina S. Zinovyeva, Yuri A. Kozenko, Kirill B. Gerasimov, Yulia I. Dubova, Margarita S. Irizepova, Vizja Press&IT, Vol. 10, Issue 4, 2016 (333 – 342). DOI: 10.5709/ce.1897-9254.220)

2. *Static Factors*

Static or policy-driven factors are characterized by factors that influence or are influenced by policies/mandates. In terms of regional development, the National Framework on Physical Planning (NFPP) sets the parameters by which the spatial development directions of the country are laid out from the national down to the local level over a span of time, and periodically updated.

The NFPP establishes a countrywide direction for the judicious, sustainable, and strategic utilization of land alongside the medium-term and long-term economic development agenda. It serves as the reference document for physical planning at the regional, provincial, and local levels to ensure a wholistic and consistent actions across decision makers within the government bureaucracy.

The main direction of the NFPP is in support of fostering spatial agglomeration, interconnectivity, and resiliency. In operationalizing these directions, the NEDA has carved out three (3) metropolitan areas (Table 1), one for each major island group with the end view of achieving efficiency and economies of scale.

NEDA List 2007	NEDA List (PDP, 2017-2022)
1) Metro Manila (NCR) 2) Metro Cebu (Region VII) 3) Metro Davao (Region XI) 4) Metro Angeles (Region III) 5) Metro Bacolod (Region VI) 6) Metro Baguio (CAR) 7) Metro Batangas (Region 4A-CALABARZON) 8) Metro Cagayan de Oro (Region X) 9) Metro Dagupan (Region I) 10) Metro Iloiolo-Guimaras (Region VI) 11) Metro Naga (Region V) 12) Metro Olongapo (Region III)	1) Metro Manila (NCR) 2) Metro Cebu (Region VII) 3) Metro Davao (Region XI) 4) Metro Cagayan de Oro (Region X) /a

Note:

a) /a projected to reach metropolitan level in terms of population by 2025.

The NSS also established a hierarchy in the network of settlements, as shown in the table below:

Level of Hierarchy	Role	Indicator Functions	Population
Regional	Major center that service national and international companies.	Presence of international port, airport, commerce (***Ayala Mall; luxury brand auto dealership and BPO***)	1,200,000 and above
Sub-regional	Provide support services that serve beyond local boundaries.	National airport, Level 3 hospital Commerce (McDonalds, SM Mall, Deluxe Hotels, and auto dealership), National developers	120,000 – 1,2000,000
Provincial center	Provincial services and administration	Presence of tertiary level education, Level 2 hospital, commercial banks, commerce (other hotels, hardware, grocery, convenience store, IT store), other residential subdivision, auto repair shop, service forwarders (DHL/LBC), cable	50,000 – 120,000
Local center	Rural and agricultural services	Presence of food retail (carinderia), secondary school, primary health care (local health center); bus terminal, lodging inn.	50,000 and below

Source: National Spatial Strategy (NSS), 2015-2045

D. Tools on Spatial Analysis

Spatial Autocorrelation Analysis. This procedure is commonly defined in literature as the *spatial arrangement* in output, incidents, events or facilities such that the locations where such occur are *related* to each other, or are *not* statistically *independent* of one another. The field of spatial statistics is based on the non-independence of observations; it is based on Waldo Tobler's theoretical conceptualization of spatial relationship, i.e., that everything is related to everything else (Getis, 2005). Deviation from the assumption of independence happens when there are misspecification problems in spatial analysis that uses traditional statistics in lieu of spatial autocorrelation (Cliff & Ord, 1969).

The mathematical expression of spatial autocorrelation is the global concept that two attributes, say variables X and Y, have some average degree of alignment between the relative magnitudes of their respective values (Griffith & Chun, 2018). The correlation for a positive alignment presupposes that *large* values of X tend to align with *large* values of Y, *intermediate* values of X with *intermediate* values of Y, and *small* values of X with *small* values of Y. In contrast, for a negative alignment, *large* values of X tend to align with *small* values of Y, *intermediate* values of X with *intermediate* values of Y, and *small* values of X with *large* values of Y. When there is no alignment, the combination of X and Y value pairs is said to be random.

Moran's I Spatial Statistic. In dealing with spatial attributes, the appropriate test is the *global Moran's I spatial autocorrelation*. Moran's "i" statistic allows the research to reject the null hypothesis that there is complete spatial randomness. A negative "-1" value is represented by a checkered or dispersed pattern while a positive "+1" value is suggested by a clustering pattern of attributes or feature values. The coefficient is interpreted as the global result or a single statistic for the area under study. A coefficient value of "0" indicates random pattern and absence of spatial structure.

The "p" value is the probability that the observed spatial relationship between the feature points and the feature attribute is created by some random process. While the "z" value or the standard deviation of the observed pattern of the attribute values enables the study to generate a comparison among polygon areas for administrative units or point distribution for incidence/events/facilities.

Conceptualization of spatial relationships in measuring the clustering of a particular output generated for an area (in space), or type of urban service facility, or point feature. The inverse distance method following *distance decay* principles often used for point datasets while contiguity relationship is the measure that organizes administrative unit of analysis consistent with the principle that things that are *near* to each other are *more* related than distant ones.

III. Research Framework and Design

A. Research Framework

The framework of the research is mainly anchored on a quantitative approach. It utilizes the CMCI's EDi as the explanatory variable for the competitiveness among the cities and municipalities within the coverage of the identified major metropolitan case study areas such as Greater Metro Manila, Metropolitan Cebu, and Metropolitan Davao.

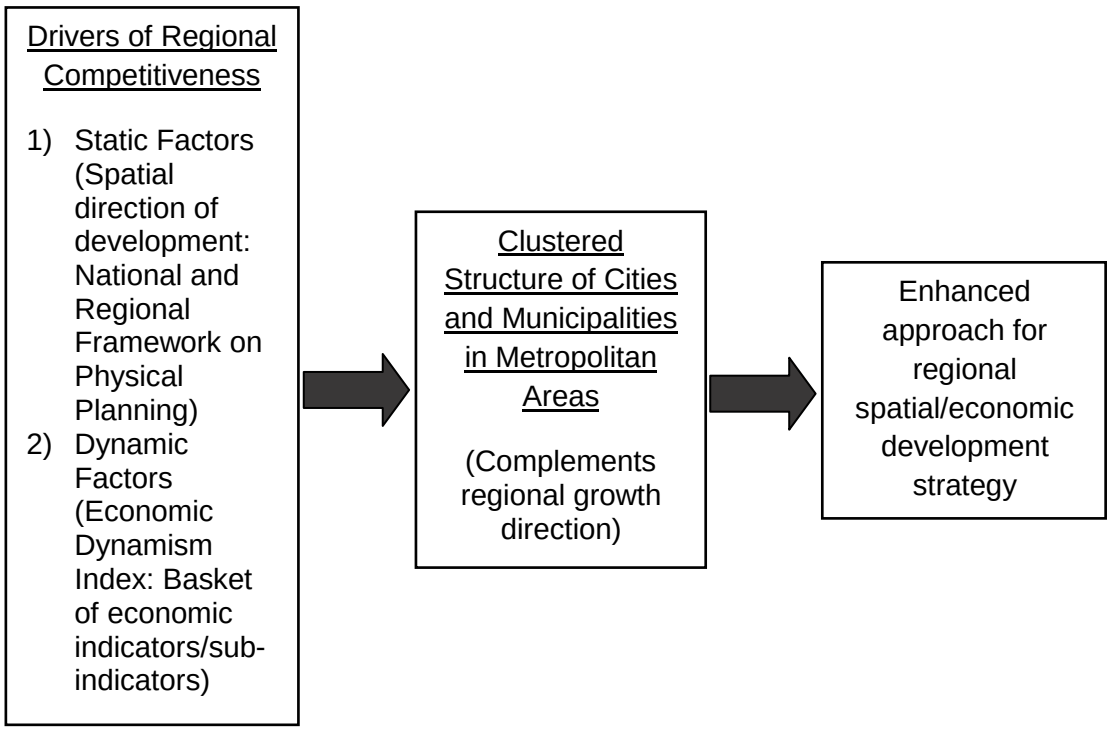
The discussions on *competitiveness* were done qualitatively through a descriptive elaboration of the relationship between the observed and measured pattern of economic dynamism. This is compared with the regional development strategies that drive competitiveness in metropolitan space.

The quantitative approach outlined in the Conceptual Framework features the theoretical and empirical constructs on *competitiveness* influential in forming a clustered pattern in the distribution of cities and municipalities in space. On the other hand, the analytical framework delineates the methods of analysis and the tools used to establish a spatial association (relationships) in the EDi values calculated for each city or municipality within the case study areas. The subsequent parts of the research design tackle the basis for selecting the case study areas, the EDi as a variable representative of its full range of indicators/sub-indicators, data collection methods, data analysis, statistical test protocols, and the standards in interpreting the results of the spatial statistics.

1. Conceptual Framework

From the review of the firm location theories and the empirical factors related to competitiveness, regional development is generally characterized by decisions/strategies that encourage metropolitanization resulting in the spatial agglomeration or clustering of related industries. Literature on local competitiveness also implied continuous efforts to build competition among entities/organizations to sustain their ranking. These spatial processes, over time, would eventually carve out spatial scenarios that are indicative of complementation or the clustering of economic activities as structural representations of geospatial processes. Expressed in logical relationship, this clustering pattern is the dependent variable, and their driving factors as independent variables (Figure 2).

Figure 2 presents the conceptual framework of the study.



Source: Authors' construct

Figure 2. Conceptual Framework

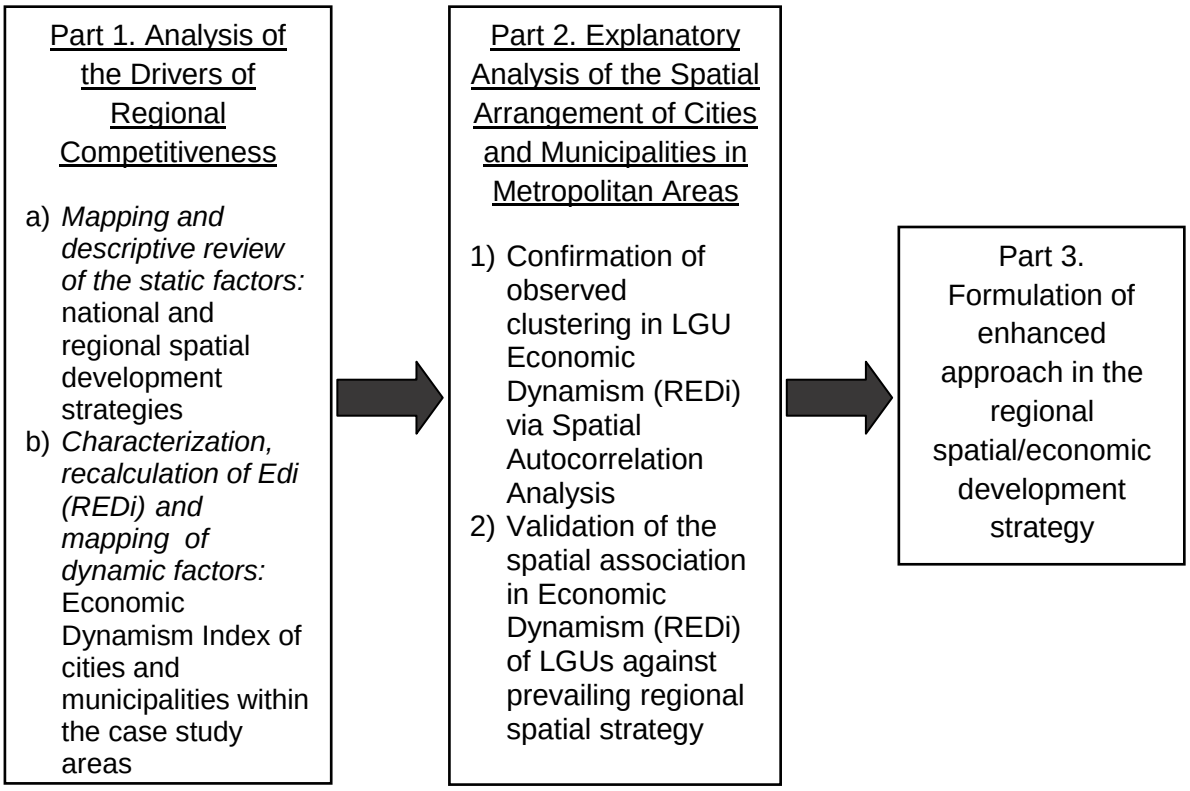
Independent variables are the static and dynamic drivers of regional competitiveness. The former is the established term-based (based on a planning horizon) spatial strategies, and the latter as the productivity indicators. The term-based strategies are considered policy

guidelines for spatial development imposed by the national government, while the dynamic factors are confined to the *CMCI EDi.* This index is considered the relatively most important productivity metric following the literature on the hierarchy of factors that influence regional competitiveness. The resulting spatial arrangement/pattern from the static and dynamic drivers can be analyzed to reach the appropriate (enhanced) spatial development strategy at the national, regional, and local planning levels.

2. Analytical Framework

The schematic diagram of the research analytical framework was sequentially organized (Figure 3) to test the assumption of the study and consequently establish the spatial clustering in the EDi values of cities and municipalities within each case study metropolitan area. This is in sync with the conceptual framework that takes into lens the theoretical constructs that competition results in uneven spatial development (Myrdal, 1957; Hirschman, 1958), and the concepts of agglomeration in the economic space manifested in growth poles (Perroux, 1955), which eventually leads in the clustering of firms to achieve competitive advantage (Porter, 2004). These key considerations are built within the three major parts of the analytical framework discussed as follows:

Part 1a - *Mapping and descriptive review of the static factors.* This part involves the collection of relevant spatial development strategies/plans at the national and administrative region levels of each metropolitan area. Spatial strategies indicative of hierarchical organization in the network of settlements were identified, described, compared, and mapped featuring the cities and municipalities using the Geographic Information System (GIS).



Source: Authors' construct

Figure 3. Analytical Framework

Part 1b – *Characterization, Reprocessing of EDi (REDi), and Mapping of Dynamic Factors.* Descriptive information about the Economic Dynamism Index (EDi) of cities and municipalities within the case study areas were obtained from the Department of Trade and Industry (DTI) and characterized. The characterization includes database preparation, processing, and the recalculation of the EDi, termed as REDi which is discussed separately in the subsequent sections of the paper. Processing the REDi primarily entailed the collection of the raw EDi data and recalculating the index regardless of the income classification of the LGUs covered by the metropolitan case study areas. The design of calculating the "indices" (economic dynamism, government efficiency, infrastructure, resiliency, and innovation) from the CMCI operations manual follows the concept of competitive ranking where the individual index is expressed as a function of the part (individual LGU) to the whole (entire group of LGUs) by considering the actual value against the minimum and maximum values within the dataset per indicator or sub-indicator being analyzed. The spatial clustering was visualized via GIS mapping with the corresponding REDi values assigned to each city and municipality.

Part 2 - *Explanatory Analysis of the Spatial Arrangement of Cities and Municipalities in Metropolitan Areas.* This part of the research involved the analysis of the spatial structure (clustering) formed by the driving factors indicated in Part 1.

The numerical measurements using the Moran's I spatial autocorrelation analysis using ArcGIS software was applied in this study. It provided the "*test statistics*" and generated the spatial and attribute similarity in the REDi dataset. It means that the similarity in REDi values between observations (cities and municipalities) in the dataset for the whole metropolitan case study area is related to the similarity in locations of such observations. This spatial association across the dataset is further explained and validated by the spatial development strategy that assigns hierarchical functions to each city and municipality according to their rank in the network of settlements within the case study area.

The matching of the spatial statistics with the established settlement hierarchies tested the assumption that complementation influenced spatial interaction which is manifested in the clustering of the REDi values in across LGUs in major metropolitan case study areas.

Part 3 - *Formulation of enhanced approach in the regional spatial/economic development strategy.* This is based on the general observations on the influence of the explanatory variables established in Part 2. The research formulated enhancements towards planning approaches in the spatial/economic development strategies that can be adopted prospectively in land use planning, formulating regulatory policy to create and expand metropolitan areas, and broadening spatial complementation.

B. Selection of Case Study Areas

Metropolitan areas are considered representations of variability in the levels of competitiveness between the center and its surrounding political and administrative units. The growth pole theory by Perroux (1955) demonstrates spatial concentration and expansion of the central city, causing *"polarization effects"* and leading to uneven development (Myrdal, 1957; Hirschman, 1958) between the center and the periphery.

NEDA established the same conceptualizations in achieving the long-term aspirations (Ambisyon Natin 2040) under the Philippine Development Plan (PDP) and in operationalizing the National Spatial Strategy (NSS). Both PDP and NSS imply that the economic, social, and political interactions should originate in the major metropolitan areas and trickle down to the regional, sub-regional, provincial, and local centers in a network of hierarchically arranged interconnected settlements.

This interconnection network outlines the fabric for spatial interaction within the market of goods and services to be *"complementary"* between the larger order settlements and the subsequent rank settlement or administrative area.

In light of these conceptualizations, the research has aligned the selection of the case study areas alongside NEDA's designation of Davao, Cebu, and the greater (extended) Metro Manila as major metropolitan areas appropriate for explaining "*spatial complementation*" demonstrated through the clustering of economic dynamism index.

C. Measurement of Variables and Indicators

For consistency with the sphere of factors mentioned in the conceptual and analytical frameworks, "variables" shall refer to the static and dynamic elements that are known drivers of competitiveness.

The static factors are the term-based (horizon follow the approved planning period) national and regional spatial development strategies considered as policy mandates for the local planning office and decision makers at the city/municipality level and the regional development councils. The broad-based conceptualization outlined in any of the regional spatial development strategy for the case study areas is aimed at fostering regional socio-economic interactions within the established hierarchy in the network of urban settlements. Comparatively, the dynamic factors are active and flexible factors such as business activities, innovation development, and international integration, among others.

The selection of the EDi as explanatory variable in the spatial arrangement and relationship of LGUs within the metropolitan case study areas hinges on the findings in literature that productivity and competitiveness is primarily a function of business and economic activities (Zinovyeva et. al. 2016).

The research treats the EDi as a collective measure indicative of a particular administrative area's business and economic output following the discussions in the DTI-CMCI Operations Manual (2021). Thus, the EDi is treated as a consolidated representation of the Economic Dynamism Pillar comprised of the following indicators and sub-indicators from the DTI-CMCI Operations Manual:

1. Size of Economy
   - ♦ Gross Sales of Registered Firms
   - ♦ Total Capitalization of NEW Businesses
2. Growth of Economy
   - ♦ Growth of Gross Sales of Registered Firms
   - ♦ Growth of Total Capitalization of New Businesses
3. Structure of Local Economy
   - ♦ Total No. of approved business permits for new business applications
   - ♦ Total No. of approved business renewals
4. Safety Compliant
   - ♦ Number of Occupancy Permits Approved
   - ♦ Number of approved fire safety inspection
7. Cost of Doing Business
   - d. Daily Minimum Wage Rate
     - ♦ Agricultural
       - i. Agricultural Plantation
       - ii. Agricultural Non-Plantation
     - ♦ Non-Agricultural
       - iii. Non-Agricultural Establishments with more than 10 workers
       - iv. Non-Agricultural Establishments with 10 workers or below
   - e. Cost of Land in a Central Business District
   - f. Cost of Rent
8. Financial Deepening
   - ♦ Number of Universal/Commercial Banks
   - ♦ Number of Thrift and Savings Banks
   - ♦ Number of Rural Banks
   - ♦ Number of Finance Cooperatives

5. Increase Employment
   - ♦ No. of declared employees for new business applications
   - ♦ No. of declared employees for business renewals
6. Cost of Living
   - ♦ Local Inflation Rate
7. Cost of Doing Business
   a. Cost of Electricity
   - ♦ Commercial Users
   - ♦ Industrial firms/customers

   b. Cost of Water
   - ♦ Commercial Users
   - ♦ Industrial firms/customers

   c. Price of Diesel (on 31 Dec of the preceding year)
   - ♦ Number of Savings and Loans Association with Quasi-Banking Functions
   - ♦ Number of Pawnshops
   - ♦ Number of Money Changers / Foreign Exchange Dealer
   - ♦ Number of Remittance Center
9. Productivity
   - ♦ Gross Sales of Registered Firms
   - ♦ Number of declared employees for business RENEWALS
10. Total Number of Business and Professional Organization
   - ♦ Total Number of LGU Recognized Business Groups
   - ♦ Total number of other business groups

Source: DTI-CMCI Operations Manual (2021)

D. Data Collection, Sampling Methods, Statistical Tests and Parameters, and Analysis

This section is sequentially organized according to the parts of the analytical framework to establish an immediate connection between the research objectives and the analytical processes. The discussion on each part of the analytical framework combines data gathering, sampling methods, and statistical testing outlined in the CMCI's suggested methodology. The data analysis and corresponding output were added to build visual and conceptual connections needed to understand the findings of the study.

1) Analysis of the drivers of regional competitiveness. Alongside Part 1 of the analytical framework, an exploratory and descriptive review of the static factors and dynamic factors was carried out and discussed as follows:

a. Mapping and descriptive review of the static factors

Data Collection, Sampling Methods, and Parameters. Published information about the national spatial strategy (NSS), the spatial development strategies for the major islands of Luzon, Visayas, and Mindanao, the regional framework on physical planning (RFPP), and the legislative approvals creating the metropolitan areas were gathered from either the websites or the public domain of NEDA, regional development councils, and the major metropolitan LGUs. Specific information in the spatial strategies/framework documents that the research took note of are in the following areas: a) NSS thrust and directions e.g., agglomeration, interconnection, and resiliency; b) RFPP established Hierarchy in the Network of Settlements (metropolitan, regional, sub-regional, provincial, and local centers); and c) Regional development spatial strategies (integrated area development, balanced agro-industrial development, growth pole, hub and spoke, etc.).

The review of the hierarchies in the network of urban settlements aided in establishing consistency or possible differentiation between the NSS and RFPP. These functional hierarchies assigned for a particular LGU are visually reflected and anchored in a GIS map.

Data Input and Analysis. The locations of the city/municipal halls and the shapefiles of the administrative boundaries of the LGUs obtained from the Open Street Map of the United

Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) was used in creating the GIS map on the Hierarchy in the Network of Settlements.

A descriptive review of the functional hierarchies in the network of settlements was discussed by means of comparing the current role of the LGU indicated in the RFPP against the default/standard function prescribed in the NSS. A similar but broad-based comparison among the significant metropolitan case study area was also highlighted.

Data Output. Spatial strategies indicative of hierarchical organization in the network of settlements were identified, described, compared, and mapped featuring the cities and municipalities using ARC Geographic Information System (ArcGIS).

b. Characterization of Cities and Municipalities EDi, Reprocessing of EDi, and Mapping of Dynamic Factors

Descriptive information about the EDi of cities and municipalities within the case study areas was obtained from the DTI and characterized. The characterization includes database preparation, processing, and the reprocessing of EDi. Reprocessing of the EDi primarily entailed the collection of the EDi indicators and sub-indicators raw data and carrying out index reprocessing regardless of the LGU income classifications that belong to the metropolitan case study area. Visualization of the spatial structure/arrangement formed by the REDi was accomplished via GIS mapping.

Data Collection, Statistical Tests, and Parameters. The raw data on the indicators and sub-indicators under the economic dynamism pillar for 2020 were sourced from the DTI-CMCI and processed following the 2021 Operations Manual. The latter served as reference in deriving the EDi following the established assumptions and formulas applicable for each indicator and sub-indicators. Using the raw indicator/sub-indicator data, a reprocessed EDi, termed in this paper as “REDi” value was generated for each LGU within the case study area. This reprocessing in the entire LGU dataset is necessary to surface out the presence of clustering pattern alongside the established theoretical constructs that spatial interaction is associated with competitiveness in space. The current approach in the DTI-CMCI operations manual of grouping and ranking the EDi according to the LGU income classification cannot surface out such spatial pattern apart from being disconnected with the firm level/economic agent spatial interaction concept introduced by Porter (1998) within competitive clusters.

The grouping of LGUs according to income classification is also counterintuitive to Tobler’s first law in geography that everything is related to everything else, but nearer things are more connected than distant ones. The rule generally applied in economic geography assumes that regardless of the income class, the LGU administrative units (spatial representations) are more likely to engage in spatial interaction (socio-economic and political) as neighbors than those distant ones. A neighbor in spatial analysis is conceptualized to be contiguous or shares a boundary or one that belongs to a specific distance bandwidth within an established unit of analysis (case study area).

The decision to drop the current methodology of grouping LGUs according to income class is made to avoid having spatially scattered LGUs from all over the country or regions. Such spatial disconnection is unlikely to meet/test the research hypothesis and theoretical ideas outlined in the conceptual framework alongside Porter’s (1998) notion of competitiveness through clustering firms in the economic space.

In the reprocessing of the EDi (REDi), the CMCI mathematical formula prescribed for each indicator and sub-indicators was followed. The result of the reprocessing is an individual (LGU level) EDi value expressed as a function of the entire EDi dataset (cities and municipalities)

within the case study area. This is in contrast with the prevailing approach of deriving the EDi value based on grouping the LGUs according to their income class.

Sampling Methods. The indicators and sub-indicators dataset collected accounts for 100% of the total number of cities and municipalities (collectively referred to in this research as LGUs) in each case study area. For metropolitan Davao there are 49 datasets; metropolitan Cebu has 53 LGUs under the administrative province, while the extended metropolitan Manila area includes 49 datasets. These numbers satisfy the minimum prescribed 30 datasets/attributes fit for Spatial Autocorrelation analysis using ArcGIS software.

Data Input and Analysis. Data inputs for the mapping include the: (a) Shapefiles of the administrative boundaries of the LGUs in each case study area sourced from the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) Open Street Map; and (b) Attribute value or the reprocessed EDi (REDi) using the 2020 economic dynamism pillar raw data of indicators and sub-indicators that the DTI-CMCI provided upon the request of the research team.

The REDi was organized in a spreadsheet database, also referred to in GIS language as "attribute table." The attribute table contained the names of the cities and municipalities for each case study area with their corresponding REDi values. The mapping process entailed selecting and assigning color symbology to a specific range of REDi values. This was accomplished by sorting the REDi dataset from highest to lowest to mark or establish the full range in the REDi values.

Across the case study areas, the lowest common REDi value is above 2, while the maximum is approximately 15 for the metropolitan Davao area. The grouping in the REDi range of values that was standardized across the case study areas starts from the 2 – 4 bandwidth. It gradually increases in equal spread/range until it reaches the maximum REDi value within the dataset. By grouping the REDi values into buckets/range, the intensity levels or differentiation across space can be visualized, as shown in Figure 4.

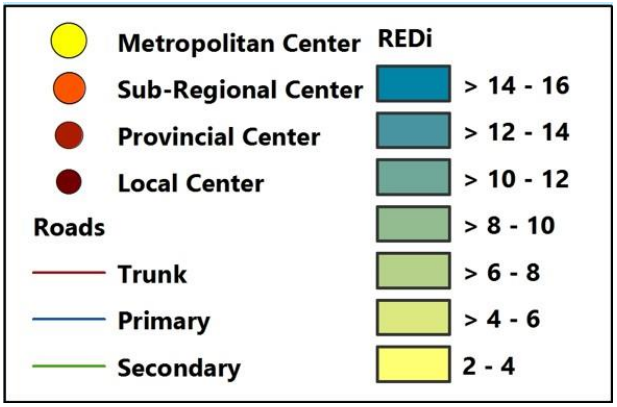


Figure 4. Standardized Symbology used in Grouping the REDi Values

Such color differentiation (color symbology) was applied to the scale in grouping REDi values using the ArcMap tool in ArcGIS. The result is a GIS map of LGUs (administrative area) with higher REDi values shaded in a darker color and tapering gradually in the shade for the LGUs with lower REDi values. The GIS map facilitates visualization and analysis in terms of the occurrence of clustering, the size of the spatial structure, and the spatial association of LGUs with the metropolitan area. The examination for spatial association provides for the scrutiny

between the list of LGUs officially included in the metropolitan area against the LGUs reflected in the GIS map that exhibits a degree of similarities in their REDi values indicative of clustering.

This visualization enhancement is a fundamental mapping technique that aims to translate the REDi values into spatial arrangements reflective of either differentiation (dispersion), similarities (clustering), or the absence of any pattern.

Data Output. Once the data inputs are loaded into the ArcGIS software, it generates a GIS map of the case study areas bearing the color scheme that provides a visual indication of the occurrence of clustering as a spatial pattern. These areas were differentiated in terms of sizes and intensity, which were reflective of the functions assumed by the LGU in line with the regional spatial development strategy.

2) *Explanatory Analysis of the Spatial Arrangement of Cities and Municipalities in Metropolitan Areas*

A spatial autocorrelation analysis based on the REDi values was carried out to validate the spatial clustering of LGUs observed from the GIS map in Part 1. The output of the spatial autocorrelation analysis is spatial statistics that confirm clustering and explain the nature of economic competitiveness.

a. Spatial autocorrelation analysis

The study used the REDi values as the attribute fit for spatial autocorrelation that can validate the nature of spatial interaction/relationship across settlement hierarchies and facilitate the comparison among the case study areas. This statement was met by testing the research assumption that the *"Economic dynamism indices of cities and municipalities in the case study areas are correlated in space."*

The study used the global Moran's I spatial autocorrelation tool in ArcGIS due to its suitability in dealing with spatial attributes for polygon shapes such as administrative boundaries (https://pro.arcgis.com/en/tool-reference/spatial-statistics/spatial-autocorrelation.htm). Given a set of LGUs (cities and municipalities within the case study areas) and an associated attribute such as the REDi, this procedure evaluates whether the pattern expressed by the attribute indicates clustering, dispersion, or complete spatial randomness.

The variables analyzed are the attributes relative to their geospatial coordinates, thus, making the analysis different from the bivariate Pearson correlation and similar correlation statistics. The statistical concept of spatial autocorrelation treats the attribute not to be statistically independent of one another, which lend the concept of independence and randomness from traditional statistics irrelevant to Tobler's (2004) proposition that everything is related to everything else.

Data Inputs and Analysis. The data inputs were the: a) shapefiles of the administrative boundaries of the LGUs in each case study area sourced from the Open Street Map of the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA); and (b) attribute value or the REDi value generated in Part 1 of the exploratory analysis.

Analytical procedures follow the ArcGIS command on Spatial Autocorrelation:

1) Selection of Moran's I tool from ArcMap in ArcGIS to generate the spatial statistics based on the REDi dataset;

2) Conceptualization of spatial relationship through *"contiguity edges or rook contiguity"* or expressed as LGUs sharing administrative boundaries are treated as neighbors.

This conceptualization in spatial relationships is considered the "*first order contiguity principle,"* consistent with Tobler's law that near things are more relevant than distant things. This conceptualization assigns a shared/contiguous administrative boundary as the organizing requirement to be considered a neighbor (spatial similarity) based on a dataset that exhibits attribute similarity (REDi). A clustering of dataset values relative to a specific range of *"high and high values"* or a *"low and low values"* would validate attribute similarity;

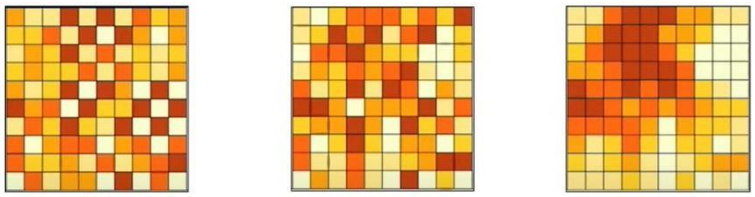
3) Euclidean measurement as the unit in measuring the distance between LGU administrative areas (polygons); and

4) ArcGIS software runs the result of the Moran's I processed by the ArcMap tool based on the standard manual formula shown below.

$$\frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i-\bar{x})(x_j-\bar{x}) \Big/ \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}}{\sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}}\sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}}}$$

Outputs were (i) Moran's "i" coefficient; (ii) "p" value; and (iii) "z" value, each of which are explained as follows:

(i) Moran's "i" coefficient is a test of correlation between feature polygons (spatial clustering pattern as dependent variable) and available feature attribute (REDi dataset as independent variables). A coefficient value of "0" indicates a random pattern not worthy to pursue inquiry, analysis, modeling or predictive study. A negative one (-1) value represents checkered or dispersed pattern, and a positive one (+1) value suggests clustered pattern (Figure 5). The coefficient is interpreted as the global result for the case of the metropolitan area under study.



Source: https://spatial.uchicago.edu/content/lectures-luc-anselin

Figure 5. Probability of Spatial Autocorrelation Patterns

(ii) The "p" value indicates the probability that the observed spatial relationship between feature polygons (administrative/areas of production) and feature attribute (REDi values) was created by some random process.

(iii) The "z" value reflects the standard deviations of the observed pattern of LGU administrative area spatial distribution and its attribute. Very high (positive) or very low

(negative) z-scores, associated with very small p-values, are found in the tails of the normal distribution. This allows the study to generate comparison and generalization across the metropolitan case study areas in relation to the null hypothesis.

Data Output. Once the data inputs are loaded, and the conceptualization conditions are assigned to the ArcGIS software, it generates the Moran's I and the graph of the spatial statistics confirming whether the clustering pattern observed is significant or due to some random form. The standard level for accepting significance is 90% confidence level in the "p" value with the corresponding critical standard values in "z scores" shown in Table 1.

Table 1. Standard Range of Spatial Autocorrelation Statistics

Significance Level (p-value in %)	Critical Value (z-score)
1	<-2.58
5	-2.58 – -1.96
10	-1.96 – -1.65
-	-1.65 – 1.65
10	1.65 – 1.96
5	1.96 – 2.58
1	> 2.58

b. Validation of spatial association in the LGUs (cities and municipalities) Economic Dynamism against prevailing regional spatial and development strategy

A comparison between the Moran's I spatial statistics obtained in the previous section against the established/prevailing spatial development strategy for the metropolitan case study area was carried out to validate consistency between the measured significant spatial pattern versus the spatial pattern envisioned for the area in the NSS and/or RFPP.

Through validation, the research could point out or benchmark the influence of the national and regional spatial development plan in the development directions of the case study areas. Since the study areas are the major metropolitan centers in the Philippines, then the result of the validation can be generally considered applicable to the rest of the regions.

Part of the validation discussions emphasizes the degree to which LGUs are similarly arranged in space. This is done by denoting the count of clustered LGUs or similar REDi values with high-and-high or low-and-low similarities based on the REDi bandwidth scale.

3) Formulation of enhanced approach in the regional spatial/economic development strategy

The researchers reviewed the spatial development strategy and defined the areas of refinements following the results of the explanatory analysis and the validation obtained from the spatial statistics. This formulation examines how the national and regional planning authorities can reshape and implement the current spatial development models (Integrated Area Development, Balanced Agro-Industrial Development, Growth Pole, Hub, and Spoke) prepared by the national and regional planning authorities for inducing further complementation (operationalizing directives for clustering) of economic agents in space. The enhancements also include recommendations regarding the possibility of setting up a competitiveness framework that links together the competitiveness policy, development policy, and fiscal policy based on key operating elements driven by the findings of the study.

IV. Results and Discussion

1. Hierarchy and Spatial Association of LGUs in Major Metropolitan Areas

a. Hierarchy of LGUs within the Network of Settlements

All LGUs within the identified metropolitan case study areas follow the hierarchy in the network of settlements established by NEDA in the spatial development (NSS) and physical framework plans (NFPP) for the region. The assigned hierarchy of a particular LGU within the established national settlement hierarchy is shown in Figure 6 for the identified metropolitan case study areas (Metro Davao, Metro Cebu, and Greater Metro Manila).

This classification in the network of settlements is based on the population movements over time and the strategic roles these settlements assume in support of regional development. On top of the hierarchy are the metropolitan centers, which collectively account for 44 LGUs (cities and municipalities) within the entire case study areas (Table 2).

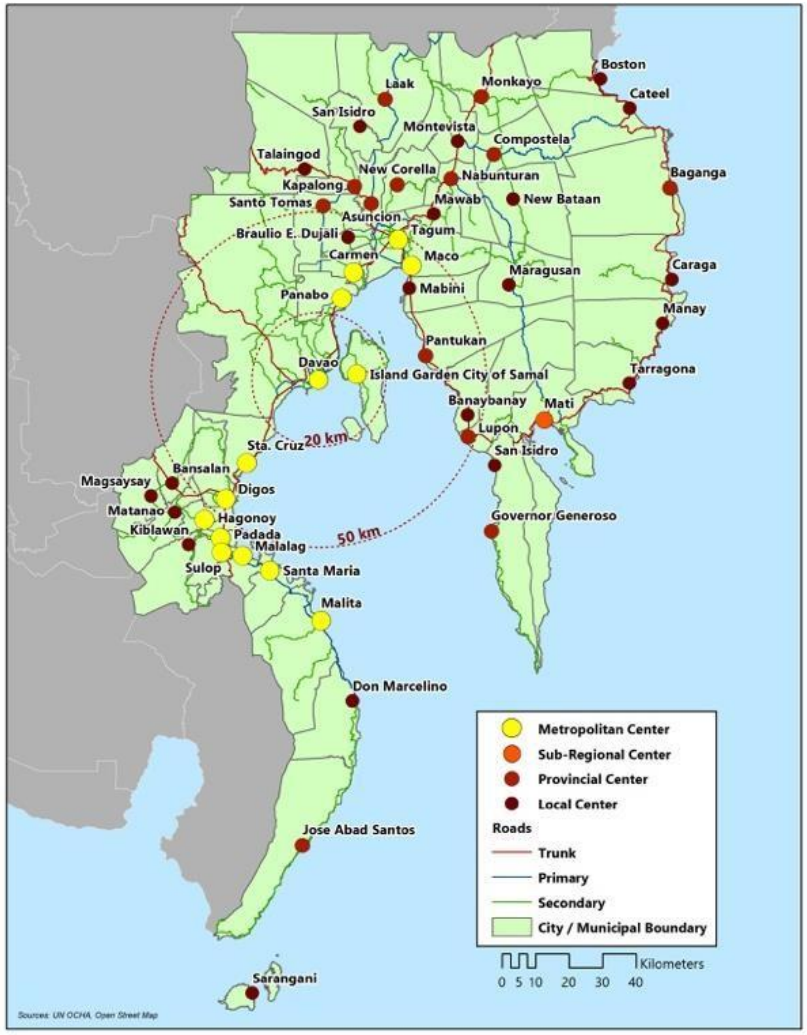
Table 2. Count of LGUs Based on Settlement Hierarchy Classification

Hierarchical Class	Indicative Population Size (In '000)	Count of LGUs (Cities and Municipalities)			
		Greater Metro Manila	Metro Cebu	Metro Davao	Total
1. Metropolitan Centers	~4,000	17	13	14	44
2. Regional Centers	>1,200	3	0	0	3
3. Sub-regional Centers	<120 – 1,200	15	4	1	20
4. Provincial Centers	50 – 120	9	5	13	27
5. Local Centers	< 50	5	31	21	57
Total		49	53	49	151

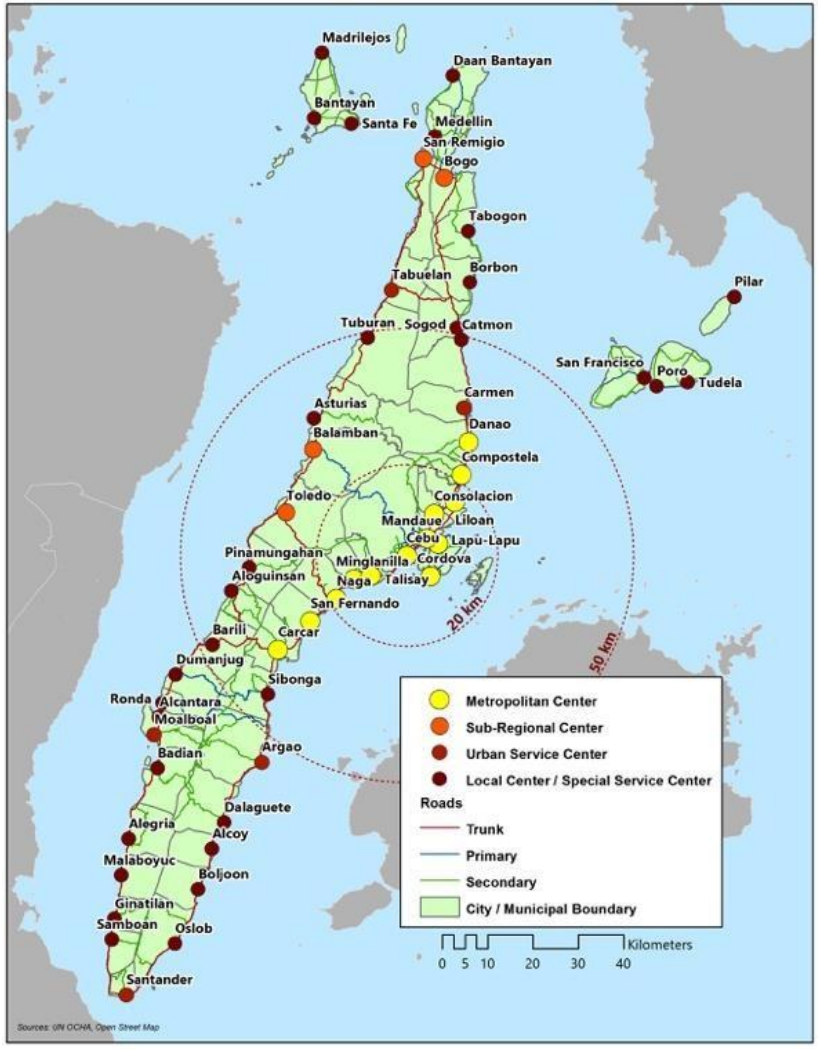
Source of Basic Data: NSS; Mindanao Spatial Strategy/Development Framework Plan (2015 – 2045); Central Visayas Regional Spatial Development Framework (2016 – 2045); Luzon Spatial Development Framework (2015 – 2045).

The succeeding tiers in the settlement hierarchy have relatively smaller population size and have limited market functions than the larger ones in servicing the requirements of the surrounding LGUs. Differences in the use of the specific classification name against the standard terms indicated in the NSS were observed in the regional spatial framework plan for the Metropolitan Cebu study area. The use of the terms *Urban Service Center* and *Special Service Center* was noted, with the latter referring to the LGUs located in smaller islands detached from the mainland province. In reconciling this deviation, the population size was used consistent with the NSS/NEDA criteria in classifying functional roles in the network of growth areas.

The general equivalent of *Urban Service Center* is a Provincial Center (city and/or municipality), while a *Special Service Center* refers to a Local Center (municipality). Similarly, no minimum population count was indicated for a metropolitan center in any of the NEDA planning guidelines. There were mentions of the term *Metro* when describing the existing highly urbanized centers and the emerging urban areas, but no population count is prescribed. Thus, for differentiation, the Ekistics Logarithmic Scale (ELS) introduced by Doxiadis (1968) for a Metropolis was adopted, as shown in Table 2.



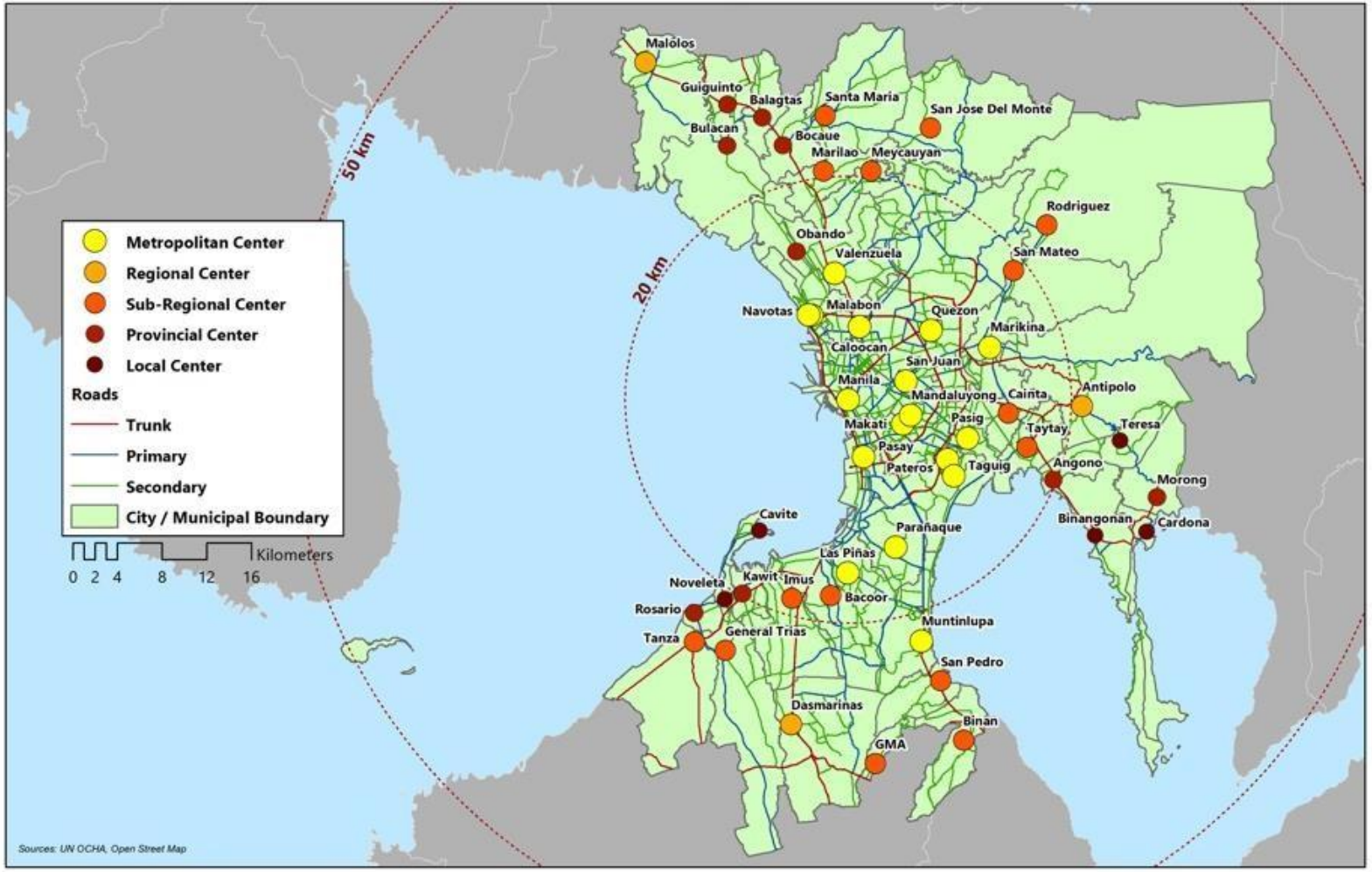
(a)



(b)

Source of basic data: NSS 2015-2045

Figure 6. Network of Urban Settlement Hierarchies for (a) Metropolitan Davao (left) and (b) Metropolitan Cebu (right) and (c) Greater Metropolitan Manila (next page)



Source of basic data: NSS 2015-2045

(c)

Figure 6. (c) Greater Metropolitan Manila

Case Study Area 1: Metropolitan Davao. The unit of analysis for Metro Davao covers the entire Davao administrative region or Region XII. Comprising the study area are the five (5) administrative provinces of Davao del Norte, Davao del Sur, Davao Oriental, Davao Occidental, and Davao de Oro. All 49 cities and municipalities that belong to these provinces were grouped according to their assigned hierarchy shown in Table 3**.** From this count, 14 cities and municipalities were created by law to be part of Metro Davao (Republic Act 11708, 13 April 2022).

Case Study Area 2: Metropolitan Cebu. The entire island province of Cebu, including Camotes Islands and Bantayan Island, was treated as the unit of analysis. Roads and bridges generally connect the mainland province, while the two (2) smaller islets are detached and are only accessible via sea/marine transport from the mainland. These island LGUs include Madrilejos, Bantayan, Santa Fe, San Francisco, Puro, Tudela, and Pilar.

The area defined for Metro Cebu geospatially covers the 13 LGUs within the 25-kilometer radial distance from Cebu City. Seven (7) are municipalities, and the rest are cities. The Regional Spatial Development Framework for Central Visayas (2016 – 2045) has expanded the existing metropolitan area to a greater metropolitan area with the addition of 23 LGUs radiating beyond the existing 25-kilometer band toward the 50-Kilometer distance.

A total of 53 cities and municipalities were mapped together with their assigned functional hierarchy in the network of settlements and are listed in Table 4 for the whole study area.

Table 3. Hierarchy and Administrative Composition of Metro Davao

Metropolitan Centers	Sub-Regional/ Provincial Centers	Local Centers	
1. Carmen (DN)	15. Mati (DO) /a	29. Bansalan (DS)	41. Matanao (DS)
2. Davao City (DS)	16. Asuncion (DN)	30. Boston (DOR)	42. Mawab (DDO)
3. Digos City (DS)	17. Baganga (DOR)	31. Braulio Dujali (DN)	43. Montevista (DDO)
4. Hagonoy (DS)	18. Compostela (DDO)	32. Caraga (DOR)	44. Manay (DOR)
5. City of Samal (DN)	19. Gov. Generoso (DOR)	33. Cateel (DOR)	45. San Isidro (DN)
6. Maco (DDO)	20. Jose Abad Santos (DO)	34. Kiblawan (DS)	46. San Isidro (DO)
7. Malalag (DS)	21. Kapalong (DN)	35. Mabini (DDO)	47. Sarangani (DO)
8. Malita (DO)	22. Laak (DDO)	36. Magsaysay (DS)	48. Talaingod (DN)
9. Padada (DS)	23. Lupon (DOR)	37. Maragusan (DDO)	49. Tarragona (DOR)
10. Panabo City (DN)	24. Monkayo (DDO)	38. Banaybanay (DOR)	
11. Sta. Cruz (DS)	25. Nabunturan (DDO)	39. Don Marcelino (DO)	
12. Santa Maria (DS)	26. New Corella (DN)	40. New Bataan (DDO)	
13. Sulop (DS)	27. Pantukan (DDO)		
14. Tagum City (DN)	28. Santo Tomas (DN)		
Total: 14	Total: 14	Total: 21	

Note: /a – Designated as sub-regional center in the 2015 – 2045 Davao Regional Physical Framework Plan: DN – Davao del Norte; DS – Davao del Sur; DO – Davao Occidental; DDO – Davao de Oro; DOR – Davao Oriental

Source of Basic Data: National Spatial Strategy (NSS) and Mindanao Spatial Strategy/Development Framework 2015 - 2045

Table 4. Hierarchy and Administrative Composition of Metro Cebu

Metropolitan Centers	Sub-Regional/Urban Service Centers	Local Centers/ Special Service Centers	
1. Carcar City 2. Cebu City 3. Compostela 4. Consolacion 5. Cordova 6. Danao City 7. Lapu-Lapu City 8. Liloan 9. Mandaue City 10. Minglanilia 11. Naga City 12. San Fernando 13. Talisay City	14. Balamban /a 15. Bogo City /a 16. San Remigio /a 17. Toledo City /a 18. Argao 19. Carmen 20. Moalboal 21. Santander 22. Tabuelan	23. Alcantara 24. Alcoy 25. Alegria 26. Aloguinsan 27. Asturias 28. Badian 29. Barili 30. Boljoon 31. Borbon 32. Catmon 33. Daan Bantayan 34. Dalaguete 35. Dumanjug 36. Ginatilan 37. Malabuyoc 38. Medellin	39. Oslob 40. Pinamungahan 41. Ronda 42. Samboan 43. Sibonga 44. Sogod 45. Tabogon 46. Tuburan 47. Bantayan /b 48. Madrilejos /b 49. Pilar /b 50. Poro /b 51. San Francisco /b 52. Santa Fe /b 53. Tudela /b
Total: 13	Total: 9	Total: 31	

Note: /a – Designated urban service center and /b - Designated special service center in the 2015 - 2045 Regional Physical Framework Plan

Source of Basic Data: NSS; Central Visayas Regional Development Plan 2017 – 2022; and Central Visayas Regional Spatial Development Framework 2016 - 2045

Case Study Area 3: Greater Metropolitan Manila. The case study area extends past the present LGU composition of the National Capital Region (NCR), stretching up to a minimum 20-kilometer radial distance reckoned from “Km 0” reference point located in the City of Manila. The research has to establish this minimum radial bandwidth to ensure that the count of spatial administrative units (indicated as area polygon) satisfies the minimum 30 datasets acceptable for spatial statistics processing.

The choice of the 20-km minimum distance measure is found in the literature for a typical (minimum) size of metropolitan districts in China (Kuang et. al, 2014). Regarding accessibility, the 20-km distance would fall within the indicative acceptable distance for *long* travels in the NCR using a public jeepney as a representation of the mode of *inter-city* commute (Regidor et al. 2009). Further, the NEDA Luzon Regional Development Committee (RDCOM) document for 2015 to 2045 has described the current spatial size of Metro Manila under the same radial coverage.

Given such considerations, the Greater Metropolitan Manila case study area is a spatial extension beyond the 20-kilometer radial bandwidth, covering the nearest LGUs until the minimum number of datasets acceptable for spatial statistics interpretation is exceeded or met. Thus, there are 49 LGUs composed of the 17 cities and municipalities of Metro Manila (which is the National Capital Region); 10 LGUs each are from the Provinces of Bulacan, Cavite, and Rizal, with San Pedro City and Biñan City completing the remaining two LGUs (Table 5). These LGUs were included based on the contiguity of their administrative boundary as nearest/adjacent neighbors to Metro Manila.

Table 5. Hierarchy and Administrative Composition of Greater Metro Manila

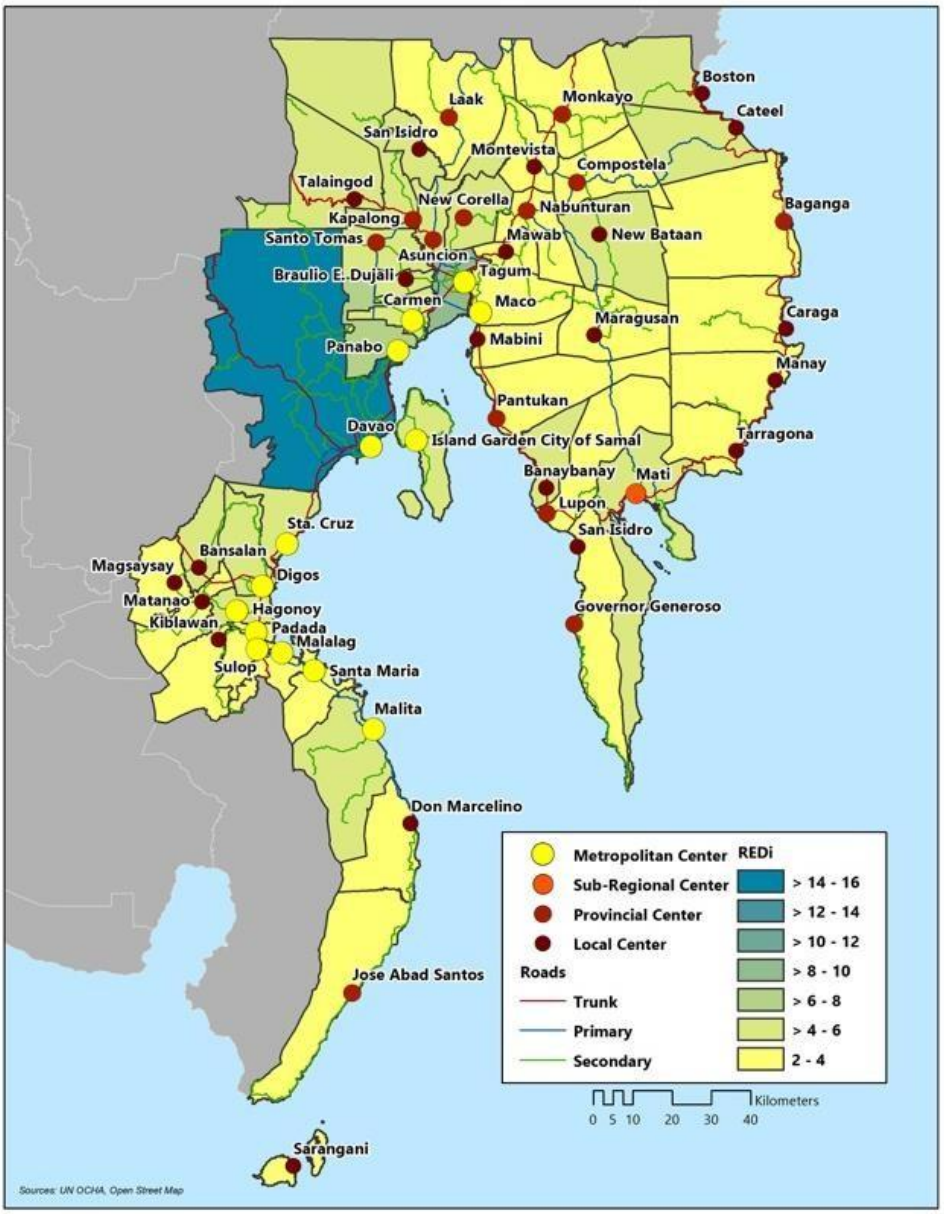
Metropolitan Centers	Regional/Sub-Regional Centers	Provincial Centers	Local Centers
1. Caloocan City	18. Antipolo City /a	36. Angono	45. Binangonan
2. Las Piñas City	19. Dasmariñas City /a	37. Balagtas	46. Cardona
3. Makati City	20. Malolos City /a	38. Bocaue	47. Cavite City
4. Malabon City	21. Bacoor City	39. Bulakan	48. Noveleta
5. Mandaluyong City	22. Biñan City	40. Guiguinto	49. Teresa
6. Manila City	23. Cainta City	41. Kawit	
7. Marikina City	24. General Trias City	42. Morong	
8. Muntinlupa City	25. General Mariano Alvarez	43. Obando	
9. Navotas City	26. Imus City	44. Rosario	
10. Parañaque City	27. Marilao		
11. Pasay City	28. Meycauyan City		
12. Pasig City	29. Rodriguez		
13. Pateros	30. San Jose del Monte City		
14. Quezon City	31. San Mateo		
15. San Juan City	32. San Pedro City		
16. Taguig City	33. Santa Maria		
17. Muntinlupa City	34. Tanza		
	35. Taytay		
Total: 17	Total: 18	Total: 9	Total: 5

Note: /a – Designated as regional center in the 2015 - 2045 Luzon Spatial Development Framework

Source of Basic Data: NSS; Metro Manila Urban Green Print Project 2030; Luzon Spatial Development Framework 2015 - 2045 (RDCOm and NEDA); and Region IV-A CALABARZON Physical Framework Plan 2004 - 2030 (RLUC, NEDA)

b. Spatial Association of LGUs based on the REDi

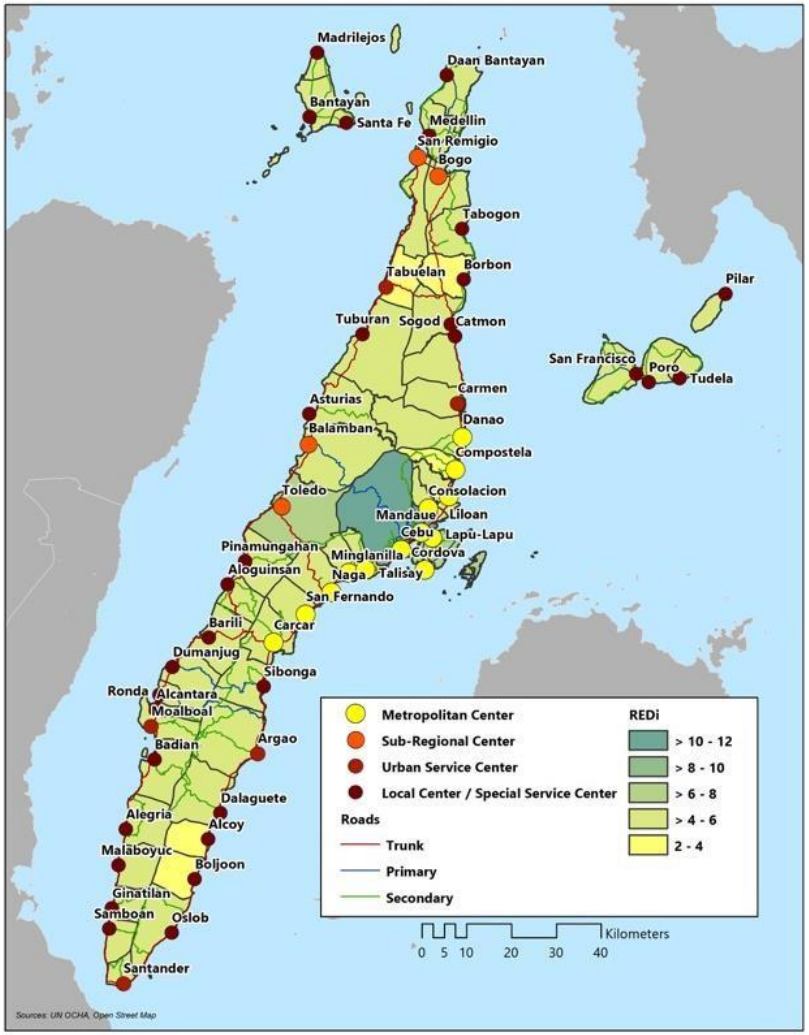
Several clusterings of LGUs were observed across the metropolitan case study areas using REDi values as the organizing spatial attribute. This implies that economic dynamism drives spatial interactions reflective of the spatial association in the REDi values. Such spatial association in economic dynamism is denoted in the GIS map (Figure 7) through the spatial clustering of dark-color shade administrative units and light-colored areas. The spatial analysis generally describes the clustering of darker shaded contiguous administrative areas as features having *high-high* REDi values. In comparison, the grouping among lighter shaded administrative areas indicates *low-low* clustering in the spatial attribute (REDi).



(a)

Source: Authors' construct

Figure 7. Spatial Pattern in REDi of LGUs for (a) Davao Metropolitan Case Study Area



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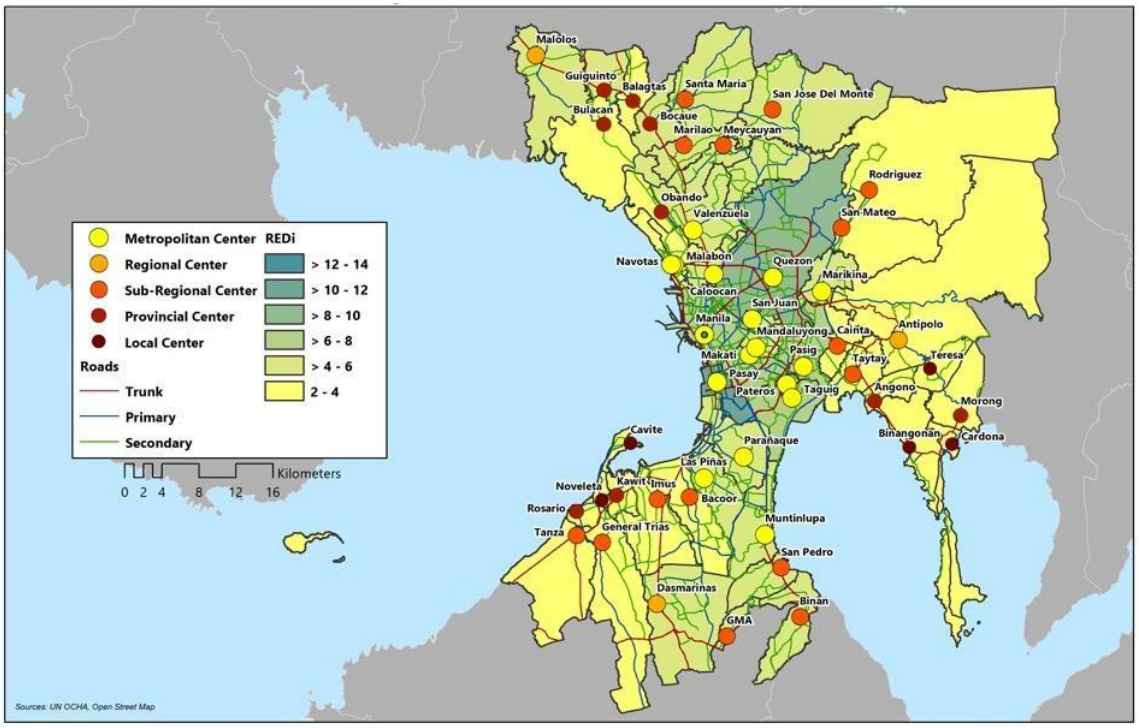


Source: Authors' construct

(c)

Figure 7. Spatial Pattern in REDi of LGUs for (b) Cebu Metropolitan Case Study Area (Left) and (c) Greater Metropolitan Manila Case Study Area (Right)

The comparison of the case study areas also showed that the levels of economic dynamism is highly concentrated (intensity in the spatial spread of darker shaded areas) in the Metropolitan Davao area than in Metropolitan Cebu and Greater Metropolitan Manila area. A stark gap in Davao City's REDi values (14.65) compared to the next rank Tagum City (8.73), and the third rank Panabo City (6.75), validates the primacy in economic dynamism (Table 6).

Table 6. Top 10 LGUs (Cities and Municipalities) in the Metropolitan Case Study Areas based on REDi

REDi Range	Greater Metropolitan Manila Study Area		Metropolitan Cebu Study Area		Metropolitan Davao Study Area	
	LGU Name	REDi Value	LGU Name	REDi Value	LGU Name	REDi Value
> 14 - 16	-	-	-	-	Davao	14.65
> 12 - 14	-	-	Mandaue	11.65	-	-
> 10 - 12	Pasay	11.11	Cebu	10.16	Tagum	8.73
> 8 - 10	Quezon	9.87	-	-	-	-
> 6 - 8	Makati Pasig Manila Taguig	7.67 7.48 7.26 6.59	Lapu-Lapu Toledo	6.86 6.24	Panabo	6.75
> 4 - 6	Mandaluyong Pateros Parañaque Muntinlupa	5.96 5.80 5.51 5.43	Argao Tuburan San Francisco Pinamungajan Tudela Talisay	5.64 5.44 5.43 5.22 5.10 5.00	IGACOS Carmen B. Dujali Sta. Cruz New Corella Bansalan Kapalong	5.80 5.68 5.48 5.47 5.43 5.36 5.32

Note: IGACOS – Island Garden City of Samal

Such dominance is typically characterized in the economic space by a significant gap in the variation and count of higher order goods and services offered at the city center as oppose to its neighbors - a scenario that the research found to be prevailing in Davao City in terms of *financial deepening* and the *size of the local economy* posted for 2020. This nature of primacy has a similar explanation in the literature on the clustering of financial services, particularly bank branches where the size of deposit act as the primary driver of location decisions. Meaning, that for the size of bank deposits to be reached, the availability of customers must be present in space.

For Davao City, it appears that there are more customers clustering in space, whether individual or institutional, driving the variability and availability of complementary economic services. This variability in the economic functions is a rational impression because the CMCI indicator involving the *number of business registrations* is unable to provide. The disaggregation of information on the number and types of business registrations could have provided salient industry details on what sectors or economic activities is driving spatial interactions and causing the clustering of LGUs across space.

The level of primacy observed in Davao City is not the same case happening in the greater Metropolitan Manila based on the gap in the *high-high* REDi value bandwidth between the first rank Pasay City (11.11) with the next rank Quezon City (9.87), or against the third rank Makati City (7.67), or the fourth rank Pasig City (7.48), and the fifth rank Manila City (7.26) (Table 6). These relative similarities in REDi values for contiguous LGUs (Makati, Pasig, Manila) generally indicate clustering.

Another important observation that differentiates the clustering of LGUs in the Greater Metro Manila from the Metro Davao and Metro Cebu is the relatively smaller proportion (approximately 88%) of REDi dataset that belongs to the *low-low* bandwidth range between 2 to 6 (Table 7).

Table 7 Number of LGUs (Cities and Municipalities) according to REDi Range

REDi Range	REDi Spatial Range	Greater Metropolitan Manila Study Area		Metropolitan Cebu Study Area		Metropolitan Davao Study Area	
		LGU Count	% Count vs. Total	LGU Count	% Count vs. Total	LGU Count	% Count vs. Total
> 14 - 16	High-High	0	0	0	0	1	2.04
> 12 - 14		0	0	0	0	0	0
> 10 - 12		1	2.04	2	3.77	0	0
> 8 - 10		1	2.04	0	0	1	2.04
> 6 - 8		4	8.16	2	3.77	1	2.04
> 4 - 6	Low-Low	20	40.22	43	81.13	19	38.78
2 - 4		23	46.94	6	11.32	27	55.10
Total		49	100	53	100	49	100

For Metropolitan Davao case study area, this group accounts for approximately 94% and 92% for the Metropolitan Cebu case study area. The LGUs that are under this group have narrower differences in REDi values and for the Greater Manila Area this could possibly indicate broader spatial diffusion in economic dynamism. Stated in spatial terms, attribute similarities of nearest neighbors or contiguous administrative areas within a broader economic space indicate complementation rather than competition. The spatial structure for such representation features softer edges in the zone of transition between *high-high* area clusters and that of its periphery, as shown in the GIS map for Greater Metropolitan Manila (Figure 7c).

One possible reason for the broader complementation (spatial diffusion) in economic dynamism among the LGUs within the Greater Metropolitan Manila is the presence of multiple nodes of growth centers represented by the spatial distribution of commercial business districts. These centers functions as the hub and the nearby emerging and lower rank growth centers alongside the settlement hierarchy as spokes that illustrate spatial interaction.

The case of clustering among LGUs in Metropolitan Cebu case study area has similarities with that of Metropolitan Davao case study area with regard to having a dominant center as shown in the GIS Map (Figure 7b). The visual presentation revealed that complementation originates centrally from the contiguous area formed by Cebu City and Mandaue City spreading linearly following the shape of the mainland province. Having a linear shape can assist in maximizing spatial interaction by minimizing accessibility to reach the next nearest neighbor via the shortest linear path. While there is no means for the research using the CMCI data to reinforce this observation of achieving shortest access, the overlay of the trunk, primary, and secondary road network as shown in the GIS map could support such a claim.

2. Nature of Economic Competitiveness in Major Metropolitan Areas

Confirmation of Cluster Pattern of LGU Economic Dynamism through GIS Analysis. While the earlier section generated the visual basis that clustering of LGUs exist within the identified metropolitan areas, there is a need to confirm the validity through spatial statistics. The application of the global Moran's I spatial autocorrelation validated numerically that clustering pattern exists based on the spatial statistics in the REDi datasets for the three metropolitan case study areas (Table 8).

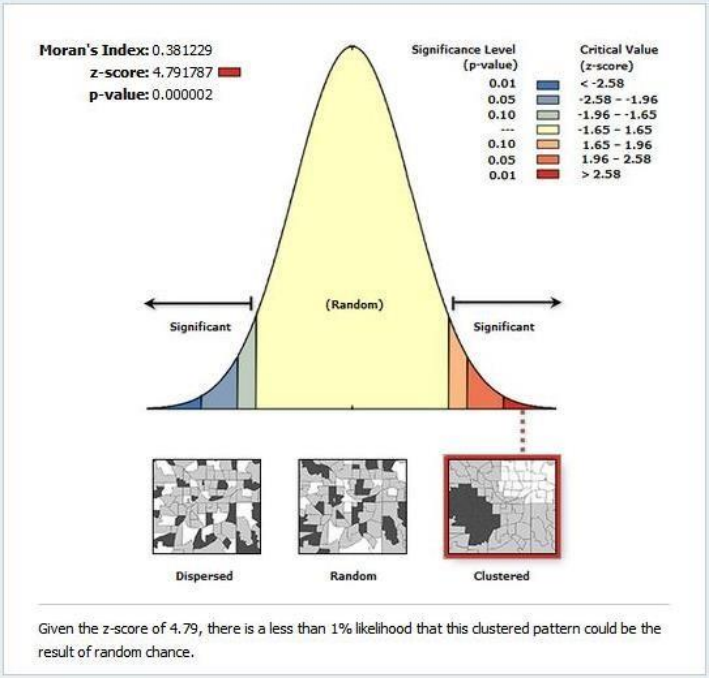
Table 8. Global Moran's I of Economic Dynamism (REDi) Spatial Statistics

Spatial Autocorrelation Parameters	Metropolitan Case Study Areas		
	Greater Manila	Cebu	Davao
Spatial Association of REDi	Clustered	Clustered	Clustered
Moran's I	0.497175	0.236037	0.381229
z-score	5.745155	2.844300	4.791787
p-value	0.000000	0.004451	0.000002
Distance Method	Euclidean	Euclidean	Euclidean
Conceptualization	Contiguity Edges	Contiguity Edges	Contiguity Edges
Standardization	Row	Row	Row

The generated spatial statistics indicated that resulting z-scores and p-values justified to reject the null hypothesis (of Moran's I Global spatial autocorrelation) that the spatial clustering in LGU economic dynamism was randomly distributed.

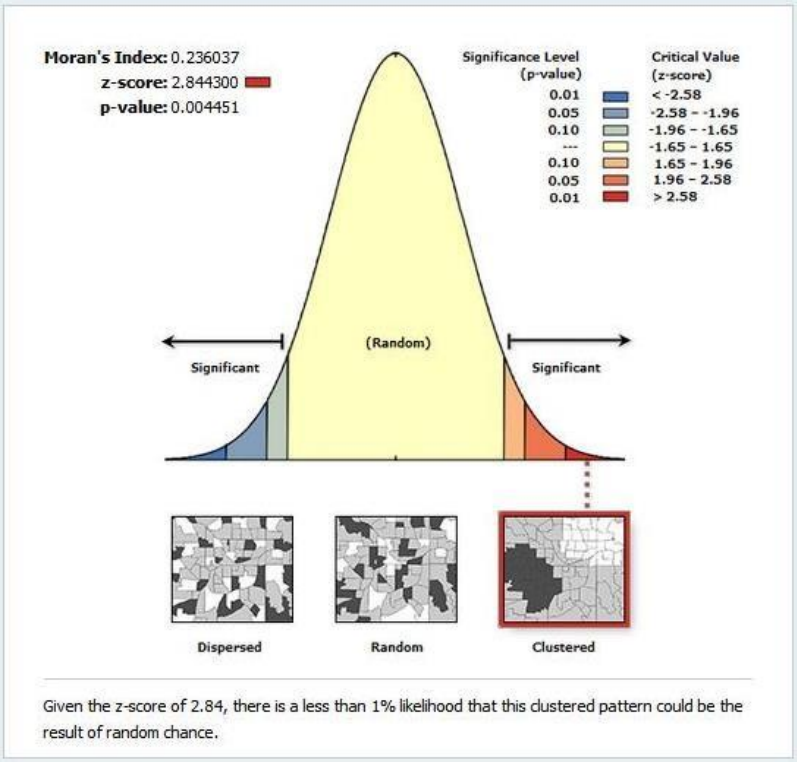
Across the three metropolitan case study areas, the Moran's Index were positive or greater than zero "0", which indicated clustering pattern. This validates the earlier observations in part 1b that REDi values show aggregation or groupings in *high-and-high* values and *low-and-low* values. The statistics further suggest that the spatial association in the economic dynamism (REDi) describes complementation among LGUs. Had competition existed, Moran's I would be negative "-1" value, and extreme differences in the REDi values would be seen as markedly separated by alternating intensity in the color shade of LGUs in the GIS map similar to a checkerboard pattern. A coefficient (index) value of "0" would indicate random pattern and absence of spatial structure.

Thus, findings accepted the research hypothesis that a spatial correlation (in this case, a positive relationship) exists in LGU economic dynamism. The normal curve is displayed together with global Moran's I statistics derived from the datasets, with p values and z scores that the clustering pattern is 99% unlikely to be from random observations (Figure 8).

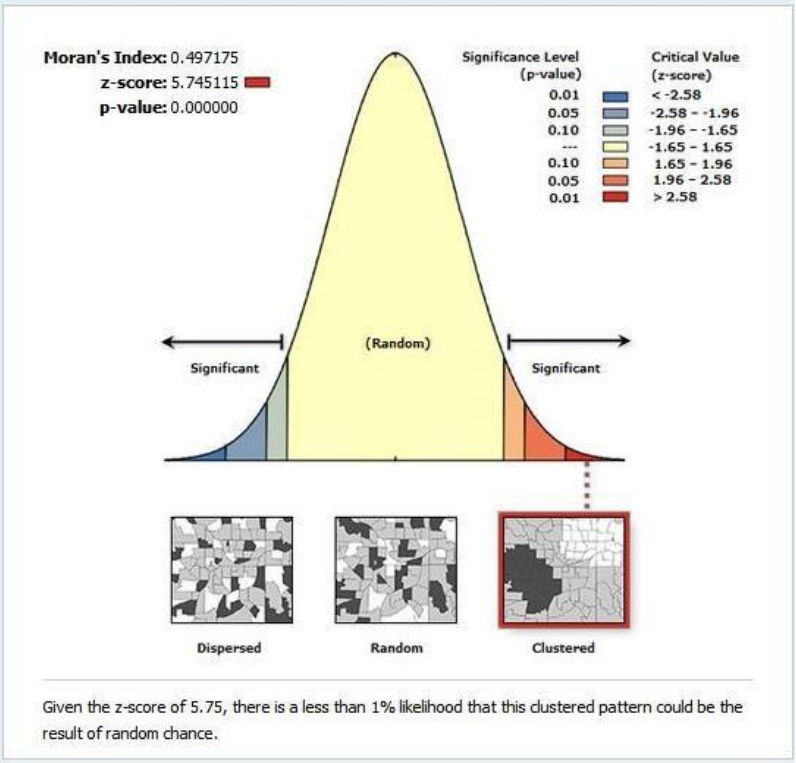


(a)

Figure 8 Spatial Statistics in REDi datasets for (a) Davao Metropolitan Case Study Area



(b)



(c)

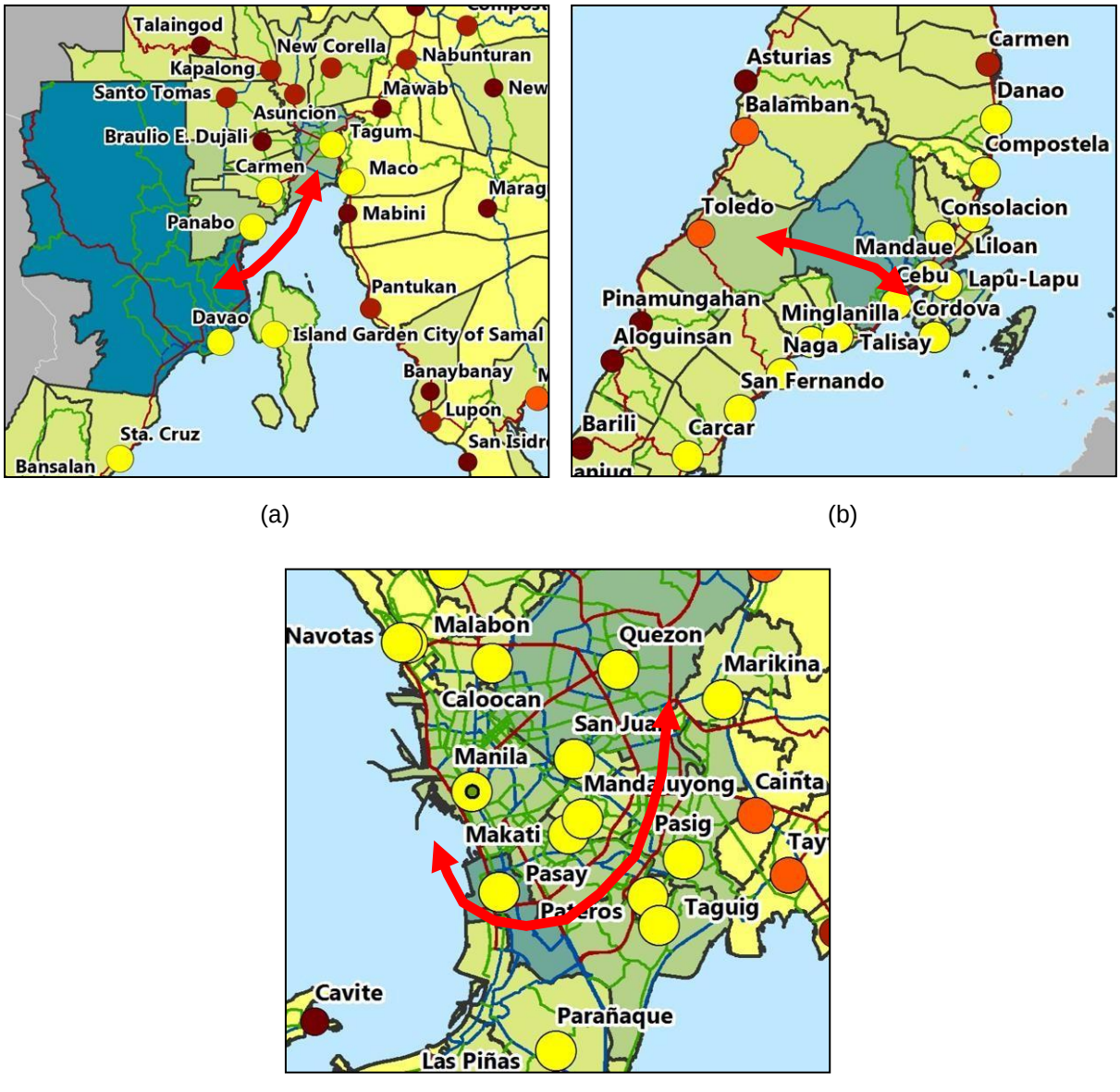
Figure 8 Spatial Statistics in REDi datasets for (b) Cebu Metropolitan Case Study Area (Top) and (c) Greater Metropolitan Manila Case Study Area (Bottom)

3. Influence of Economic Dynamism of Cities and Municipalities in Metropolitan Areas

a. Influence on Regional Development Strategy

The clustering of economic dynamism revealed two important findings for planning metropolitan districts and the larger regional economic space.

First, economic dynamism is a result of spatial interaction of nearest neighbor LGUs that are spatially structured, similar to cluster corridors. This was the observation from the clustering of *high-high* REDi values for Davao City, Panabo City, and Tagum City (Figure 9a) as well as for Lapu-Lapu City, Mandaue City, Cebu City, and Toledo City (Figure 9b) and for Pasay City, Manila City, Makati City, Taguig City, Pasig City, and Quezon City (Figure 9c).



(a) (b)

(c)

Figure 9. Cluster Corridors based on Economic Dynamism within the Study Areas (a) Metropolitan Davao (top left), (b) Metropolitan Cebu (top right) and (c) Greater Metropolitan Manila (bottom)

Matching this contiguity in *high-high* REDi values with the regional spatial development strategy shows that these LGUs (cities and municipalities) are in the top rank metropolitan center or regional center following the national spatial settlement hierarchy. Thus, metropolitanization is the likely route to pursue and spread regional development.

This can be operationalized by the clustering of contiguous LGUs into growth corridors to foster specialization and drive spatial interactions that will support economic dynamism. Under a budget/capital constrained economy, planning authorities at the national and local levels can take advantage of the benefits of the economies of scale and efficiency of building these clusters.

The second important finding is related to the clustering (contiguity) of administrative areas with *low-low* REDi values (below 6) because of their sheer size/count versus the *high-high* cluster group (REDi of 6 and above). Table 7 indicates that the *high-high* group accounts for approximately 10% versus the 90% count for the *low-low* REDi group. These proportions pre-suppose a larger area with lagging economic conditions. Planning authorities could then formulate regional economic development plans by encouraging investments that will induce spatial interactions between the LGUs bearing *high-high* REDi values with settlements (LGUs) that are lagging.

A *local spatial autocorrelation test* has to be carried out separately to identify specific clusters among the *low-low* REDi group of LGUs for targeted functional interventions. The research confirmed through the global Moran's I spatial statistics the occurrence of clustering in the REDi dataset indicative of contiguity of LGUs with *high-high* and *low-low* values. The local spatial autocorrelation statistic identifies local clusters or local outliers that can establish the contribution of these clusters to the *global* clustering statistic. Specifically, prioritization and initializing of smaller clusters can be targeted for economies of scale and efficiency in the delivery of service/interventions.

These numerical confirmation in clustering REDi values are valid justifications for influencing decision makers in adopting Integrated Area Development (IAD) Planning as a spatial and economic development strategy instead of formulating off-the-shelf qualitative conceptualizations. Others in the menu of spatial planning approaches can take the signal or can be derived from the IAD. One example of this variant (derivation) is the integration of agro-industrial areas in regions where economic output mainly comes from the agriculture and agri-business sectors.

b. Influence on Regional Economic Development Policy

The key spatial points in the preceding section can be summarized into the following *competitiveness operating elements*: 1) complementation across administrative space; 2) metropolitanization of economic areas; and 3) clustering of Firms.

Competitiveness Operating Element 1: Complementation across administrative space. This is derived from the spatial association in the REDi values. Complementation has a stimulative effect, particularly on the lagging LGUs, and facilitates the rethinking of their spatial interactions by LGU officials and planning authorities. This is beneficial in managing fiscal space through participatory convergence programs.

Competitiveness Operating Element 2: Metropolitanization of economic areas. This spatial point was drawn from the GIS map of REDi values distributed in space alongside the national settlement hierarchy. The study noted the presence of growth corridors that were generally an amalgamation of cities categorized as metropolitan or regional centers with dominant (high-high) REDi values. These economic areas functionally serve as growth anchors due to their

fundamental role as consuming centers and their contribution to continuous specialization (innovation). The confirmation in clustering administrative areas with spatially similar REDi values has implications in the local planning and in the approvals by the higher authorities of new or the expansion of the metropolitan area. While the research recognized other considerations affecting the creation of a metropolitan area, the procedure introduced through this study can serve as a numerical reference for other qualitative decision factors to build upon.

Competitiveness Operating Element 3: Clustering of firms. This can be viewed as the clustering of economic agents or firms within the LGU administrative space. This is based on the confirmation of clustering in economic dynamism through Moran's I spatial statistics observed on the REDi dataset. As such, industry-level clustering is not just about establishing the market center and lagging center's forward and backward linkages but, more importantly, contemplating the delivery/installation of shared services by the government in areas where the scale for private sector entry is not attractive or absent.

These key operating elements are the mechanisms that fit into the gap between competitiveness policy and regional development policy targets. Once these key research findings are set into motion, it could reinforce the attainment of fiscal and developmental targets and consequently reduce the budget deficit.

V. Conclusions and Recommendations

In summary, there is alignment and consistency between economic dynamism represented by the reprocessed EDi's or REDi values and the LGU classification based on established urban settlement hierarchy. LGUs that belong to the *high-high* group are either classified as metropolitan, regional, or sub-regional centers while those in the *low-low* REDi bucket list are in the provincial or local center classification.

Second, complementation rather than competition defined the prevailing nature of competitiveness in the metropolitan case study areas. The spatial clustering in the REDi values firmed up this claim as visualized in the GIS map showing contiguity among cities and municipalities. The attribute similarities in economic dynamism (REDi) are representations of the economic agents' spatial interactions among contiguous/adjacent LGUs in major metropolitan areas. The separate/distinct clustering represents such spatial organization among *high-high* and *low-low* REDi values suggestive of *complementation* instead of competition.

The higher values in attribute similarities in terms of economic dynamism observed for cities and municipalities that belong to the metropolitan, regional, and sub-regional center settlement hierarchy conforms to the theories on agglomeration happening in central places. The continuous specialization, the availability of higher-order goods and services, and the settlement hierarchy drive demand to keep the economic dynamism in these areas relatively apart from the rest of the LGUs in the region. This spatial diffusion in economic dynamism observed in the Greater Metropolitan Manila area suggests the spread of growth indicative of complementation and lesser dominance by a single LGU. With the continued innovation and appropriate planning of the space, the gap between the LGUs in the *high-high* group versus those in the *low-low* economic dynamism group will likely narrow down.

Lastly, the presence of economic clusters or group of contiguous LGUs with similarities in terms of *high-high* REDi values has an important connection or influence in the existing framework on regional spatial strategy and economic development policy.

The *s*patial autocorrelation analysis using global Morans I statistics which has validated at 99% confidence level the occurrence of clustering through the spatial similarities and attributes similarities across the reprocessed *Economic Dynamism* dataset served as the take off point in shaping or reshaping regional spatial strategy and economic development. Through the spatial autocorrelation analysis, the research operationalized Porter's concept of competitiveness with the fundamental theories (Tobler's Law, Agglomeration, Uneven Development, Gravity or Spatial Interaction) appropriate for planning the use of economic space.

Given this confirmation (in the spatial pattern and spatial statistics) indicative of complementation between the *high-high* and *low-low* administrative clusters, planning initiatives on enhancing competitiveness and spread of growth can be re-examined alongside geospatial interconnection of companies, service providers, government, and institutions that are within, from, and across the metropolitan region.

By making efficient the interconnection or linkage between dynamic economic clusters (LGUs with *high-high* REDi values) found in metropolitan areas and the areas that are lagging (*low-low* REDi values), cities and municipalities that are less endowed or with limited resources would be able to benefit from the economic spread effects. In pursuing connectivity and efficiency, the research recommended further complementary analysis/research on the following:

1) To induce competitiveness within the metropolitan region and narrow down the spatial separation between the *high-high* cluster group with the *low-low* cluster of LGUs, complementary study on Information Communication Technology (ICT) initiatives which are generally accepted to have positive implications on efficiency, may be explored;

2) In planning for the urban condition, the spatial interconnection may be researched under the lens of Transit Oriented Development (TOD) within the transport network shared by the *high-high* REDi clusters of LGUs and the lagging (*low-low* REDi values) areas. Through TOD, movement of goods, services, and labor would likely have a direct benefit on the LGUs in the *low-low* REDi cluster; and

3) The location of spatial clusters in REDi values generated from this study can be further extended towards its practical application on urban "shared-services" such as the bus rapid transit system schedule automation, heuristic routing automation of waste management collection services, and mobile app real-time reporting and mapping of neighborhood crime incidents, to cite a few common areas of interest in a metropolitan region.

Collectively, the study has shown that *Economic Dynamism* (clustering and contiguity) can be used by the LGUs, legislative and the executive branches of government in carving out planning or approvals related to the expansion in the outreach (size/coverage) of existing metropolitan areas. This claim can be generalized to Philippine conditions because the chosen metropolitan areas are the only officially classified metropolitan regions/areas by NEDA. Notwithstanding this, temporal analysis of future datasets has to be carried out following the research methodology to timely capture and reflect the developing trends in economic dynamism. This way, the static output from processing the dataset via spatial autocorrelation analysis can be updated. Building the trend over the medium-term horizon (6 years) may be adopted to match and review the implications of the PDP in metropolitan regions.

The planning authorities at the local and national agencies have to revisit existing strategies for LGUs under the *low-low* economic dynamism cluster. This is necessary to identify appropriate spatial interactions (political, economic, and investments) similar to the Integrated Area Development (IAD) strategy. The strategy can aid refine further the agro-industrial development plans for Metro Davao, the major logistics hub function for Metro Cebu, and the

peri-urban areas to complement the function of Metro Manila as the political, administrative, and economic capital.

Preparatory to the refinements is the need to carry out a *local spatial autocorrelation test* to identify priority clusters (locations) in the *low-low* REDi group for relevant functional interventions. A local spatial autocorrelation statistic can be used to identify local clusters or outliers, establishing its contribution to *global* clustering for economies of scale and efficiency.

The planning authorities (in the legislative, executive, and local offices) can craft a framework that links competitiveness, development, and fiscal policy. The operating elements for competitiveness can be operationalized in the planned unit space. The connection of these elements to the comprehensive development plan at the LGU level is as follows: 1) *Spatial Component*. The first operating element on complementation is supportive of local spatial interactions using the economic dynamism REDi values as planning inputs; 2) *Economic Component.* By directing growth in metropolitan areas, economies of scale and efficiency can translate to predictable economic output for the region; and 3) *Investment Component.* The clustering in the economic dynamism of contiguous LGUs indicates economic agents/firms distributed in space. The unbundling and sorting of business registrations in the CMCI economic dynamism pillar databank will help establish centrality and assist the planner chart linkages among industry sectors to keep their existence viable in space.

These spatial, economic, and investment components bring to bear how innovation can be mainstreamed in the planning approaches and processes. Innovation is recognized as a catalyst of economic growth in the future comprised of systems and technologies and how these should be governed. The availability of creative arts, institutions, and industries as well as the initiatives to strengthen them in metropolitan regions, should open interest on potential disruptive innovation to arrest friction from spatial separation among clusters, thereby possibly inducing or accelerating the delivery of public service and directly impacting the quality of life of metropolitan citizens.

Planners, local chief executives, and regional development councils may align interoperability of development plans using innovations (disruptive innovations/technologies) to lay the groundwork for smart urban governance. The *high-high* clusters among administrative/economic centers can serve as a strategic nucleus or laboratory for further research in optimizing existing Transport Network Vehicle Systems (TNVS) operations and the possibility of introducing autonomous bus/vehicle systems. This can be explored by characterizing and modeling the road network linking the different CBDs within the central city (*high-high* REDi cluster) using big data from institutional/individual/customer level transit origin, destination, and road congestion time which are significant in managing inter-metropolitan traffic.

These recommendations have significant implications in setting the LGUs' performance targets under the backdrop of a de-globalized world where food self-sufficiency has become a priority and where a federal form of government remains a lingering topic of interest.

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