Development of an Alternative Municipal and City Level Competitiveness Index in the Philippines

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The Philippine Cities and Municipalities Competitiveness Index (CMCI) by the National Competitiveness Council (NCC) measures the local government unit's competitiveness. This paper presents the results of a study that employed an alternative weighting method for the indicators through a statistical technique called principal component analysis and factor analysis. Moreover, the study utilized both national census data and administrative data from the government. Four factors were extracted from the available data. The four factors' compositions are: "Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services," "Establishments for Tourists Accommodation," Cost of Labor", and "Capacity of Local Government to Deliver Services." Unlike the distribution of the NCC's 2016 competitiveness level of municipalities and cities which is symmetric, the distribution of the proposed alternative competitiveness index is positively skewed. This suggests that only a few municipalities and cities can be considered highly competitive. Moran's *I* of 0.3457 proves that there exists positive spatial autocorrelation on the competitiveness level of Philippine municipalities and cities. Municipalities and cities in the Provinces of Bulacan, Pampanga, Cavite, Laguna, Rizal, and Cebu, and also in the National Capital Region are generally identified as those in the high-high cluster in terms of the proposed alternative 2016 competitiveness level. In contrast, municipalities and cities in the Provinces of Mindoro, Romblon, and Surigao del Norte, and those in the Cordillera Autonomous Region, Ilocos Region, Cagayan Valley Region, and Eastern Visayas Region are generally considered as those in the low-low cluster in terms of the proposed alternative 2016 competitiveness level. Statistical properties of the index such as consistency, accuracy, and precision were then assessed using the bootstrap resampling technique. Results showed that the proposed alternative CMCI is said to be unbiased and mean square error consistent. This indicates the proposed CMCI could be used as an alternative Municipality and City Level Competitiveness Index for the Philippines. This index concentrated on four factors with 33 indicators. These factors are weighted in the index based on their importance in their contribution to the variability of the index.

Keywords: statistical index, spatial analysis, factor analysis

1. Introduction

With the interests of researchers in the concept of competition, several definitions of competitiveness were proposed. Dukic et al. in 2012, discussed the various definitions of researchers in the theory of competitiveness. The authors of the said paper present a detailed comparison of Michael Porter's and Paul Krugman's views on competitiveness. Krugman (1994) criticized the obsession of economists and national leaders with international competitiveness. He said that the obsession with competitiveness at that time is both wrong and dangerous. According to Krugman, the definition of national competitiveness is a complex one. He opposed the analogy of the competitiveness of a corporation with that of a nation. Further, he rejected the idea that a country's economy is greatly dependent on the success of the world market. It cannot be said that a country's economic problem can be linked to its failure to compete in the world market. Dunn (1994) took a different view from that of Krugman's that the world's leading nations are not to any important degree in competition with one another. Countries are driven not only by economic factors but also by political and social factors. Political motives affect the economic policies of a country. That is, there is an underlying economic competition among countries to gain power and influence. Nevertheless, Dunn agrees with some of Krugman's views and even recognizes the latter's contributions in the field of new trade theory.

Competitiveness is measured by a country's productivity which in turn increases the standard of living of the people living in that country (Porter and Ketels 2003). The researchers investigated the competitiveness of the United Kingdom by using Porter's competitiveness framework. Based on the findings, the United Kingdom has competitive advantages of reducing government hindrances in the competitive processes. The country's business environment is highly open to international trade and investments, has low regulatory barriers to national level competition, and has sophisticated capital markets.

The concept of competitiveness does not only capture the interest of individual researchers but also organizations in general. International organizations such as, but not limited to, produce competitiveness index: European Commission, Economist Intelligence Unit, World Economic Forum, and International Institute for Management Development. The European Commission has developed the Regional Competitiveness Index (RCI) which measures the competitiveness of the member states of the EU at the regional level. The Commission defines regional competitiveness as the ability to offer an attractive and sustainable environment for firms and residents to live and work. Another competitiveness index constructed by the Commission is the Europe 2020 Competitiveness Index which captures EU countries' competitiveness towards becoming a smart, inclusive and sustainable economy. The Economist Intelligence Unit (2013) examined the competitiveness of 120 countries in the world in 2012 and by 2025 using the 2025 City Competitiveness Index. The organization defines a city's

competitiveness as the ability to attract capital, business, talent, and people. Based on the index, most competitive cities have a higher level of income, favorable demographics, and easy access to quality seaports. Moreover, a city's physical infrastructure, public transport, and telecommunications are strongly associated with its competitiveness ranking. Meanwhile, the International Institute for Management Development (IMD) in 2016, defines competitiveness as "the ability of a country to facilitate an environment in which enterprises can generate sustainable value", in which sustainable value creation is defined as "the capacity of enterprises to remain profitable over time while minimizing the environmental impact of their activities and providing an organizational context in which their workforce thrives." According to the published research of IMD, the common pattern among the most competitive countries is their focus on business-friendly regulations, physical and intangible infrastructure, and the promotion of inclusive institutions. Danon (2014) proposed a new definition of territorial competitiveness as the capacity of a locality to attract and retain mobile factors of production, by providing favorable conditions for sustainable and simultaneous growth of productivity and employment rate. The same pillars with that of RCI but a different set of variables within a pillar were used by Danon. Also, his methodological procedures slightly differ in terms of the weighting scheme in the construction of the index.

In the Philippines, the definition of local competitiveness is based on the framework developed by Michael Porter. He defined competitiveness as based on location and is essentially the productivity that companies located there can achieve (Porter 2004). He explains location as a country's underlying source of its resources and productivity as how the country uses these resources. Using the same lens, local competitiveness is how a city or municipality knows its resources and how it uses these to improve its standard of living (National Competitiveness Council, 2016). The Cities and Municipalities Competitiveness Index (CMCI) by the National Competitiveness Council measures the local government unit's competitiveness based on three pillars, namely, economic dynamism, government efficiency, and infrastructure. Economic dynamism refers to the productive capacity of the local economy in creating and sustaining businesses which leads to an increase in employment. Government efficiency, on the other hand, refers to the effectiveness of the local government units in providing quality and reliable government services. Lastly, infrastructure refers to physical building blocks that help the local government units provide goods and services.

Interconnected studies were done by researchers, government institutions, private institutions, and even non-government organizations resulted in a relatively new concept: clusters. Clusters are groups of interconnected companies and institutions in a particular field. These have impacts on competitiveness in the sense that these increase the productivity and innovation of companies and help the formation of new businesses. Also, these become factors for the

transition of middle-income countries to being advanced economies. Because of the importance of clusters in economic development, the promotion of cluster formation in developing countries is necessary. The government should address the fundamental aspects of development which include improvement of education, skill levels and institutions, technological capacity building, and opening access to capital markets (Porter 1998).

Understanding clusters has been an important issue in modern economics because of its link to economic performance. Different stakeholders such as companies, countries, regions, and cities play a vital role in the cluster-based economic policy approach. On the part of companies, they need to choose a strategic location for which they have a competitive advantage over the others. In contrast, the government needs to understand competitiveness to attract companies beyond providing low factor costs and subsidies (Ketels and Memedovic 2008).

The dynamics of regional development require the understanding of trade and geography, known as the new economic geography. The notion of space must be taken seriously in economic, social, and institutional analysis. In the Philippine context, one of the interests in determining whether regional (sub-national) competition is likely to improve local-level governance quality (Balisacan et al. 2006). Due to the importance of space, the association of competitiveness across space may be considered an important aspect of studying competitiveness. In the Philippine setting, possible clustering of competitiveness across neighboring municipalities and cities is of interest. This is based on Tobler's (1979) First Law of Geography, according to which "everything is related to everything else, but near things are more related than distant things." Thus, it is ideal to explore the spatial analysis of Philippine municipalities and cities' competitiveness. In a similar study by Lim in 2003, applied exploratory spatial analysis on innovative activity of U.S. metropolitan areas for the period 1990-1999. Patent statistics were used as a proxy for the innovativeness of a region. Based on the Moran's I spatial autocorrelation statistic, it was found that metropolitan patent grants per 100,000 workers shows a significant positive autocorrelation; that is, metropolitan areas with high innovative activity are clustered with other neighbouring metropolitan areas with high innovative activity.

Given the importance of understanding the concept of competitiveness, this paper generally aims to present an alternative competitiveness index at the municipal and city level in the Philippines by exploring the use of a statistical weighting technique and utilizing other readily available administrative data such as census data. The use of this data set focuses on measuring the standards of living of the residents in a municipality or city. This was based on the understanding that local competitiveness is how a city or municipality utilizes its resources to improve its standard of living. Specifically, this paper presents the results of a study that aimed to (1) identify spatial clusters of competitiveness in the municipality and city level; (2) determine the factors that affect the competitiveness level of a

municipality or city other than those identified by the National Competitiveness Council; (3) evaluate the statistical properties of the developed index; and (4) assess the economic policy implications of the developed index. The proposed index will help the local government units, especially those which are lagging on competitiveness level, on which indicators to focus which would improve their competitiveness. The index will also serve as a guide for the private sector on where to locate businesses.

2. Methodology

2.1. Data sources

The Philippine map of municipalities and cities was retrieved from the PhilGIS website *https://www.philgis.org*, a single-access, data-sharing portal of free Philippine geospatial data on city, province, and country levels. In terms of competitiveness data, the 2016 Cities and Municipalities Competitiveness index was retrieved from the website of the National Competitiveness Council *http:// www.competitive.org.ph /cmcindex/ pages/rankings*. The data consist of the overall competitiveness index as well as the individual score for each of the three major pillars of competitiveness: economic dynamism, government efficiency, and infrastructure. For the construction of an alternative Cities and Municipalities Competitiveness Index, individual indicators used in the 2016 CMCI were personally requested from the Competitiveness Bureau. The complete list of major indicators together with specific individual sub-indicators is found in Appendix A.

Cities in the Philippines can be classified as highly urbanized, component cities independent of the province, and component cities that are part of the provinces where they are located. Municipalities, on the other hand, are subsidiaries of the province which consists of barangays within its territorial boundaries. According to the Philippine Standard Geographic Code (PSGC), there are 1,489 municipalities and 145 cities in the Philippines as of December 2016. However, because of data limitations, only 1,245 municipalities and 144 cities with corresponding 2016 competitiveness index were considered in the study.

Lastly, 2010 Census of Population and Housing (CPH) data gathered by the former National Statistics Office (NSO), now part of the Philippine Statistics Authority (PSA), were considered in the study as a possible source of variables associated with the 2016 competitiveness level of municipalities and cities in the Philippines. The CPH, which is conducted every ten years, contains information on the composition of the population and housing characteristics. It covers all areas under the jurisdiction of the Philippines as defined by the 1987 Constitution. The 2015 Census of Population (POPCEN) data was initially considered by the researchers. However, the said data was not yet available at the time the research was conducted.

2.2. Statistical analysis

Descriptive statistics were employed in the 2016 competitiveness index of cities and municipalities in the Philippines. The distribution of the competitiveness level of the municipalities and cities in the Philippines was identified. Twenty municipalities with the highest and lowest competitiveness level were tabulated. This was also done for the Philippine cities.

The competitiveness index was mapped in the Philippine map retrieved from the PhilGIS website using GeoDa® and QGIS. *GeoDa*®, a software developed by Anselin, is geared towards the analysis of geospatial data, that is, data characterized by their location in space either as point coordinates or polygon boundary coordinates (Anselin et al. 2005).

After the preliminary analysis of visualizing the competitiveness level in the Philippines, Moran's *I*, a spatial autocorrelation test statistic, was computed. In the literature, Moran's *I* is said to be a combination of an attribute similarity and locational similarity. Locational similarity refers to the neighbouring characteristics of the observations. A choice of neighbourhood classification is an important aspect in the spatial analysis as it contributes to the computation of Moran's *I*. Different neighbourhood classifications were considered in the study: *Queen's contiguity* with orders of contiguity 1 and 2, *Rook's contiguity* with orders of contiguity 1 and 2, *distance-based measure* with cut-offs 10 km, 15 km, 20 km, 25 km, 30 km, 35 km, 40 km, 45 km, and 50 km, and *k-nearest* with 1, 2, 3, 4, and 5 neighbours. The standardized values of global Moran's *I* were compared across the different methods. Also, the number of neighbours was put into consideration in choosing the best neighbourhood classification. Local Moran's *I* was computed for each municipality or city and its significance was tested. Moran's scatterplot was constructed to determine the category for which a municipality or city belongs to high-high, low-high, high-low, or low-low clusters.

In the construction of the competitiveness index, indicators in the 2016 CMCI were requested from the National Competitiveness Council. Other than the data used by the Council, indicators in the 2010 CPH were also considered. The data in the 2010 CPH were disaggregated at the lowest level, that is, individual level, the values of the variables were aggregated at the municipal or city level. Since the data for the municipal and city level competitiveness was observed in 2016 while census data was collected in 2010, ambiguity in the relationship to be observed may arise. Thus, to address this problem, only significant predictors of the 2016 competitiveness index derived from the 2010 CPH were included in the analysis. In addition to the 2010 CPH data, an indicator for spatial dimension was considered. The number of neighbouring municipalities or cities which are identified as spatial clusters or hot spots with a cut-off distance of 35 km was used as the proxy variable of spatial dimension. Normalization of data values was applied to these indicators as they often have different measurement units.

The normalized indicators were then subjected to Factor Analysis with Principal Component Analysis as the extraction method for factors. The weighting procedure used by Nicoletti et al., (2000) was adopted in the paper. Individual indicators with the highest factor loadings are grouped into intermediate composite indicators. Each indicator is weighted based on the proportion of its variance that is explained by the factor it is associated with, while each factor is weighted according to its contribution to the percentage of explained variability in the original data set.

The distribution of the proposed alternative competitiveness level was compared with that of NCC's CMCI. The competitiveness index was mapped to visualize its spatial pattern. After the preliminary analysis of visualizing the competitiveness level in the Philippines, Moran's *I*, a spatial autocorrelation test statistic, was computed using a distance-based measure with a cut-off of 35 km. Local Moran's *I* was computed for each municipality or city and its significance was tested. Moran's scatterplot was constructed to determine the category for which a municipality or city belongs to high-high, low-high, high-low, or low-low clusters.

To assess the statistical properties of the proposed alternative index, the bootstrap resampling technique was applied. The mean value of the constructed indices across Philippine municipalities and cities was computed to serve as the parameter of interest in the study. Samples of size *n* (5%, 10%, 15%, 20%, 25%, and 30%) were repeatedly drawn from the population of the constructed statistical indices across Philippine municipalities and cities for a specified number of bootstrap resamples, *B*, 500, 750, 1000, 1500, and 2000. Based on the bootstrap samples, statistical properties of the index such as precision, accuracy, and consistency were checked.

3. Results and Discussions

3.1 Spatial analysis of the NCC's CMCI

The competitiveness level of NCC's CMCI was mapped to visualize and understand if there exists a spatial pattern on the said variable. GeoDa® and QGIS®, which are both Geographic Information Systems (GIS), were used to map the 2016 competitiveness index. Based on Figure 1, competitiveness levels of neighbouring municipalities and cities in CALABARZON, National Capital Region, SOCCSKSARGEN, and Davao Region were found to be similarly high. On the other hand, competitiveness levels of neighbouring municipalities and cities in the Bicol Region, Zamboanga Peninsula, Central Luzon, Western Visayas, and Cagayan Valley Region were found to be similarly low.

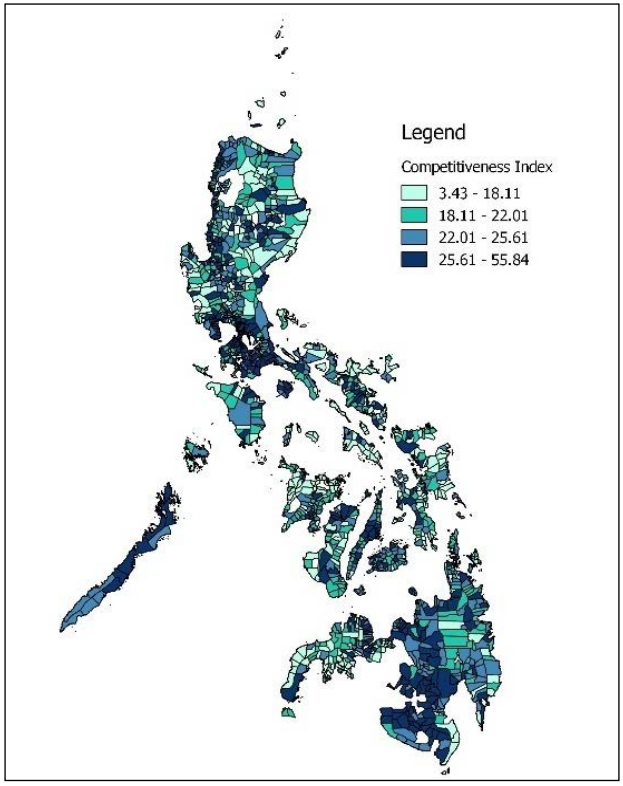

Figure 1. Choropleth Map of the NCC's CMCI in the Philippines

After the preliminary analysis of visualizing the competitiveness level in the Philippines, Moran's *I*, a spatial autocorrelation test statistic, was computed. A significant positive autocorrelation was observed on the competitiveness level of Philippine municipalities and cities. This indicates that spatial clustering of similar values, either low or high values, are more likely than dissimilar values between neighbours. As illustrated in Figure 2, Cities in Metro Manila and municipalities and cities in Rizal have high competitiveness levels with its neighbouring municipalities and cities also having high competitiveness levels. Meanwhile, municipalities and cities in Masbate were found to have low competitiveness levels with its neighbouring municipalities and cities also having low competitiveness levels.

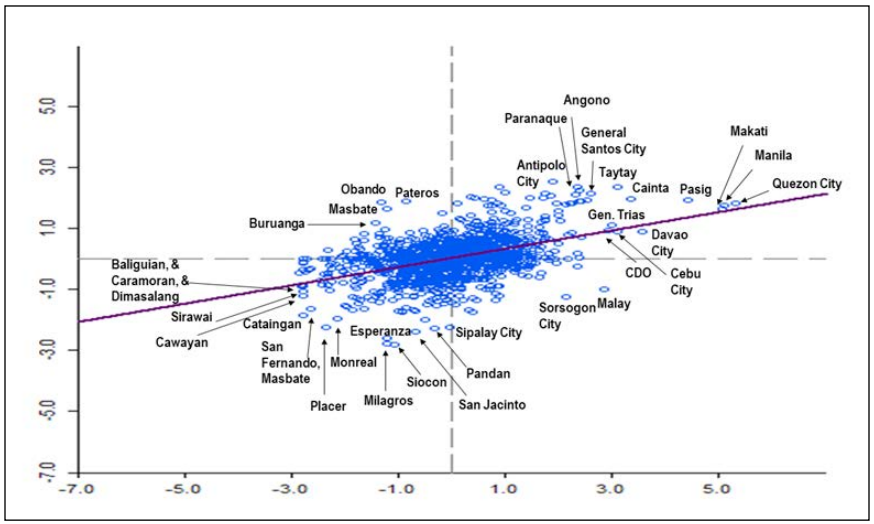

Figure 2. Moran's Scatterplot of NCC's CMCI using Distance-based Neighbourhood Classification with a 35 km Cut-off

3.2. Factors of competitiveness

Twenty-nine indicators from the NCC data were included as initial variables in the analysis. Other than these indicators, 19 indicators that are significant predictors of the 2016 NCC competitiveness index were also included. Together with these indicators, the number of neighbors that are considered hotspots was taken into consideration. With the results of the initial factor analysis with principal component analysis as the extraction method of factors, variables with high loadings of 0.60 were retained. These indicators were again analyzed using factor analysis with 6 factors extracted from it. These six factors account for about 89 percent of the total variation in the data set.

Based on the weight of the indicators, Factor 1 has high loadings on the 2010 CPH indicators which reflects the economic state of households. Moreover, the first factor also has high loadings on the indicators which measure the capacity of the public and private sector in terms of health services, and economic dynamism with the number of banks and financial institutions as proxy variables. Thus, Factor 1 may be interpreted as "*Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services.*" The second factor has high loadings on the daily minimum wage rates of agricultural and non-agricultural workers. These variables are used as a proxy variable for the cost of labor in the locality. Thus, Factor 2 may be interpreted as "*Cost of Labour*." The third factor has high loadings on the Department of Tourism (DOT) accredited tourist accommodations, such as tourist inn, pension house rooms, and hotels. Factor 3 may be interpreted as "*Establishments for Tourists Accommodation*."

Variables that are manifestations of the government's investment on the barangay level were found to have high loadings on the fourth factor. Factor 4 may be interpreted as "*Capacity of Local Government to Deliver Services*. The number of money changers and remittance centers have high loadings on the fifth factor, thus, Factor 5 may be interpreted as "*Non-bank Financial Institutions*." The same with Factor 3, Factor 6 also has high loadings on DOT accredited facilities for tourism accommodations. Thus, it was noted that the extracted factors (Factors 3 and 6) have variables that are highly associated and measure the same dimension. Besides, indicators with high loadings in Factor 5 only account for less than 20% of each of the variations. Moreover, the requirement on the minimum number of indicators per factor was not satisfied since the *Non-Bank Financial Institutions* factor has only two indicators on it. Taking into consideration these results, the number of factors was reduced to four (4).

The new factor solution (4 factors) yielded a better structure. Indicators that previously have high loadings on the fifth factor were transferred to the first factor. Also, the two factors which measure the capacity of a local government unit to accommodate tourists were summarized into just one factor. As a summary, the four factors' composition is: "*Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services*," *"Establishments for Tourists Accommodation," Cost of Labor," and "Capacity of Local Government to Deliver Services."* These factors were used as main pillars of the locality's competitiveness. Table 1 shows the loadings of each indicator obtained using factor analysis and such factor loadings are further considered as weights in the construction of the proposed CMCI.

Table 1. Weight in Terms of Percent of the Individual Indicator in Each of the Factor Components

Indicator	Factor			
	Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services	Establishments for Tourists Accommodation	Cost of Labor	The Capacity of Local Government to Deliver Services
Number of housing units which are classified as a duplex[b]	6.08	0.24	1.23	0.61
Number of housing units with walls made of strong materials[b]	5.73	0.35	1.30	2.14
Number of housing units with a floor area between 30 to 49 sq meters[b]	5.33	0.18	1.07	2.25
Number of housing units with floor area between 50 to 69 sq meters[b]	5.25	0.25	0.91	2.82
Number of household heads who are at least college graduate[b]	5.94	0.69	0.70	0.83
Number of household heads who are divorced[b]	5.80	0.23	1.30	1.69

Indicator	Factor			
	Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services	Establishments for Tourists Accommodation	Cost of Labor	The Capacity of Local Government to Deliver Services
Number of household heads with spouse at least high school education[b]	5.65	0.39	1.16	2.20
Number of household heads who are OFWs[b]	5.12	0.13	1.48	2.71
Number of household heads with at least a college diploma[b]	4.62	2.66	0.42	0.00
Number of household heads with other types of marital status[b]	4.72	0.34	1.83	2.50
Number of universal / commercial banks[a]	5.29	1.88	0.53	0.05
Number of money changers / foreign exchange dealers[a]	4.50	2.51	0.41	0.06
Number of pawnshops[a]	5.78	0.75	0.44	0.87
Number of thrift and savings banks[a]	4.46	0.61	1.15	0.00
Number of remittance centers[a]	4.33	1.92	0.42	0.73
Number of private hospital beds[a]	4.64	1.57	0.09	1.19
Number of private hospitals[a]	3.83	1.24	0.15	3.55
Number of barangays which have hospital[b]	3.35	0.72	0.23	5.66
Number of barangays which have a market place or building where trading activities are carried on at least once a week[b]	2.98	0.43	0.94	6.23
Number of DOT-accredited apartelles[a]	0.22	14.28	0.22	0.01
Number of DOT-accredited apartelle rooms[a]	0.41	12.25	0.49	0.75
Number of DOT-accredited tourist inn rooms[a]	0.12	13.28	0.00	1.83
Number of DOT-accredited tourist inns[a]	0.02	10.83	0.04	2.63
Number of DOT-accredited pension house rooms[a]	0.27	11.22	0.00	1.19
Number of DOT-accredited hotel rooms[a]	0.50	10.02	1.05	0.03
Number of DOT-accredited hotels[a]	0.78	8.96	0.04	1.23
Daily minimum wage rate non-agricultural with at most 10 workers[a]	0.21	0.09	20.74	0.01
Daily minimum wage rate agricultural (plantation)[a]	0.54	0.09	20.73	0.04
Daily minimum wage rate non-agricultural with more than 10 workers[a]	0.61	0.08	20.51	0.04
Daily minimum wage rate agricultural (non-plantation)[a]	0.56	0.21	20.39	0.00
Number of barangays which have church, chapel or mosque with religious service at least once a month[b]	0.70	0.42	0.02	20.26

Indicator	Factor			
	Housing and Household Characteristics, Financial Institutions and Capacity of Government for Health Services	Establishments for Tourists Accommodation	Cost of Labor	The Capacity of Local Government to Deliver Services
Number of barangays which have puericulture/barangay heath center[b]	0.51	0.77	0.00	20.11
Number of barangays which have access to the national highway[b]	1.18	0.39	0.00	15.78
Weight of Each Factor	52.84	19.45	14.50	13.21

[a] *indicators from the NCC data*

[b] *indicators from the 2010 CPH*

3.3. Empirical distribution of the proposed CMCI

Unlike the distribution of NCC's 2016 competitiveness level of municipalities and cities which is symmetric, the distribution of the proposed alternative competitiveness index is positively skewed. The lowest computed proposed alternative competitiveness index is -0.53 while the highest is 13.28. The sign of the proposed alternative CMCI is an indicator of whether a local government unit has a lower measure of competitiveness than the average competitiveness across municipalities and cities. A negative competitiveness index implies that municipalities and cities have low competitiveness levels on most of their indicators. The majority of the cities and municipalities (826) have a negative competitiveness index while only 293 have a positive competitiveness index. Most of the municipalities and cities which were found to have high competitiveness level are from the National Capital Region, and in the Provinces of Cavite, and Rizal of the CALABARZON Region.

Differences in the income classification of the local government unit based on NCC's CMCI and the proposed alternative CMCI were observed. Among the top 100 most competitive municipalities based on NCC's CMCI, 78 are first class municipalities, 8 are second class municipalities, 10 are third class municipalities, 3 are fourth class municipalities, and 1 is a fifth-class municipality. On the contrary, based on the proposed alternative CMCI, 91 are first-class municipalities, 8 are second class municipalities, and only 1 is a third class municipality. No fourth class and fifth class municipality were observed in the top 100 most competitive municipalities.

The most competitive municipality for 2016 is Malay, Aklan which ranked 4th as the most competitive municipality based on NCC's CMCI. This first-class coastal town in the Western Visayas which ranked 1st in *Establishments for Tourists Accommodation*, posted an extremely high value for this factor. Based on economic information, Malay, Aklan relies heavily on tourism as its major

Table 2. Top 20 Municipalities with the Highest Proposed CMCI

Rank	Municipality	Ranking of the Municipality in Each Factor				CMCI
		Factor 1	Factor 2	Factor 3	Factor 4	
1	Malay, Aklan (Region VI)	53	1	323	127	1.186
2	Cainta, Rizal (Region IV-A)	1	41	4	335	1.013
3	General Trias, Cavite (Region IV-A)	2	65	75	43	0.918
4	Silang, Cavite (Region IV-A)	7	48	82	2	0.794
5	Santa Maria, Bulacan (Region III)	6	20	5	84	0.786
6	Taytay, Rizal (Region IV-A)	3	74	8	437	0.763
7	Binangonan, Rizal (Region IV-A)	5	88	226	21	0.699
8	Rodriguez, Rizal (Region IV-A)	4	102	76	312	0.688
9	Tanza, Cavite (Region IV-A)	8	95	81	28	0.637
10	Marilao, Bulacan (Region III)	9	68	6	221	0.594
11	Pateros, Metro Manila (NCR)	67	196	1	808	0.530
12	Lubao, Pampanga (Region III)	18	138	9	20	0.489
13	Guagua, Pampanga (Region III)	15	103	10	54	0.462
14	Daet, Camarines Norte (Region V)	17	4	608	88	0.442
15	San Mateo, Rizal (Region IV-A)	10	94	281	289	0.440
16	Guimba, Nueva Ecija (Region III)	55	23	27	18	0.440
17	Concepcion, Tarlac (Region III)	25	135	15	31	0.429
18	Macabebe, Pampanga (Region III)	89	3	26	253	0.428
19	Gen. Mariano Alvarez, Cavite (Region IV-A)	11	155	85	162	0.423
20	Santo Tomas, Batangas (Region IV-A)	12	120	106	81	0.406

source of income. Caticlan Airport, Caticlan Jetty Port, and Ro-Ro Port which are gateways to Boracay Island are proof of its robust tourism economy. However, even with a high competitiveness level in tourism, Malay, Aklan failed to be at par with the other competitive municipalities in terms of *Cost of Labor*. Meanwhile, Cainta, in the Province of Rizal, which was awarded as the 2016 most competitive municipality by the NCC ranked 2nd, while General Trias, in Cavite, remained as the 3rd most competitive municipality. Cainta, Rizal topped the list of competitive municipalities in terms of the factor *Housing and Household Characteristics*, *Financial Institutions, and Capacity of Government for Health* Services. The presence of multiple banking and financial institutions in the municipality is a validation of its high competitiveness level. More than 300 financial institutions are located here. However, in terms of the *Capacity of Local Government to Deliver Services*, it ranked 335th. General Trias in Cavite has a very high competitiveness level in terms *of Housing and Household Characteristics*, *Financial Institutions, and the Capacity of Government for Health Services* and *Establishments for*

Table 3. Bottom 20 Municipalities with the Lowest Proposed CMCI

Rank	Municipality	Ranking of the Municipality in Each Factor				CMCI
		Factor 1	Factor 2	Factor 3	Factor 4	
1	Pinabacdao, Samar (Region VIII)	939	949	993	792	-0.527
2	Santa Rita, Samar (Region VIII)	784	551	994	430	-0.488
3	Adams, Ilocos Norte (Region I)	994	994	928	994	-0.475
4	Dumalneg, Ilocos Norte (Region I)	993	993	923	993	-0.471
5	Carasi, Ilocos Norte (Region I)	985	987	927	990	-0.458
6	Gregorio del Pilar, Ilocos Sur (Region I)	986	992	920	988	-0.457
7	Lapaz, Leyte (Region VIII)	881	703	992	340	-0.457
8	Ivana, Batanes (Region II)	992	990	798	991	-0.456
9	Sigay, Ilocos Sur (Region I)	991	991	922	986	-0.456
10	Sugpon, Ilocos Sur (Region I)	990	986	925	978	-0.450
11	Mahatao, Batanes (Region II)	987	985	796	989	-0.449
12	Nagbukel, Ilocos Sur (Region I)	988	989	924	975	-0.448
13	Villareal, Samar (Region VIII)	834	801	989	368	-0.445
14	Santa Maria, Romblon (MIMAROPA)	973	981	963	976	-0.443
15	San Emilio, Ilocos Sur (Region I)	980	988	918	979	-0.442
16	Sabtang, Batanes (Region II)	989	982	799	980	-0.440
17	San Vicente, Northern Samar (Region VIII)	979	980	910	977	-0.440
18	Mercedes, Eastern Samar (Region VIII)	965	923	976	772	-0.438
19	Alilem, Ilocos Sur (Region I)	983	983	921	971	-0.437
20	Capoocan, Leyte (Region I)	707	719	987	477	-0.436

Tourists Accommodation. It is interesting to note that Municipalities of Pateros in NCR, Guagua in Pampanga, Concepcion in Tarlac, Macabebe in Pampanga, and Santo Tomas in Batangas, which lagged in the 2016 competitiveness ranking by the NCC, are considered in the top 20 most competitive municipalities in the Philippines by the proposed alternative CMCI. See Table 2 for the list of the top 20 municipalities with the highest competitiveness level based on the proposed CMCI.

Based on the proposed alternative CMCI, the least competitive municipality is Pinabacdao in the Province of Samar. In general, based on the proposed alternative CMCI, municipalities in Ilocos Region and Eastern Visayas Region are considered as least competitive. Table 3 presents the list of the bottom 20 municipalities with the lowest competitiveness level based on the proposed CMCI.

Similar to the result of NCC's CMCI, Quezon City is still the 2016 most competitive city in the Philippines. Quezon City ranked 1st on the *Housing*

Household Characteristics, *Financial Institutions* and *Capacity of Government for Health Services*, and *Cost of Labor*. However, in terms of *Establishments for Tourists Accommodation*, it was not even included in the top 5 spots. Davao City, which is the 2nd most competitive city based on the proposed alternative CMCI, grabbed the top spot for *Establishments for Tourists Accommodation* and *Capacity of Local Government to Deliver Services* but it lagged for the *Cost of Labor*. Muntinlupa City which is the 11th most competitive city has a high competitiveness level on the factors identified except on the *Capacity of Local Government to Deliver Services*, as it was ranked almost 100th on this factor.

Nine out of the ten most competitive cities based on NCC's CMCI were also considered as the most competitive cities as per the result of the computation based on the proposed alternative CMCI. General Santos City, in the Province of South Cotabato, was not able to retain its position among the most competitive Philippine cities. It ranked fairly well in *Housing and Household Characteristics*, *Financial Institutions,* and *Capacity of Government for Health Services* but it failed to be competitive in terms of *Cost of Labor* and *Capacity of Local Government to Deliver Services*. As expected, the majority of the cities from the National Capital Region (12 out of 16) are considered the most competitive cities. Mandaluyong City considered the shopping mall capital of the country, almost made it to the top 20 most competitive cities. It ranked very high in terms of *Cost of Labor*, but low in terms of *Capacity of Local Government to Deliver Services Establishments*. Likewise, the Cities of Malabon and Navotas have very high competitiveness levels in the *Cost of Labor* but have very low competitiveness levels in *Establishments for Tourists Accommodation*, and *Capacity of Local Government to Deliver Services*. Among the cities in the National Capital Region, San Juan City is the lone city that does not have a computed value of the proposed competitiveness index due to the unavailability of some indicators. Table 4 shows the list of the top 20 cities with the highest competitiveness level based on the proposed CMCI.

Sipalay City, Negros Occidental is the least competitive Philippine city in the year 2016. Located in this 4th class city are two major mining corporations which had been nonoperational: Maricalum Mining Corporation and Philex Gold Mining Corporation. Other than Sipalay City, it was observed that most of the least competitive cities are from the Negros Island Region (NIR). Among the cities in NIR, San Carlos, in the Province Negros Occidental, and Tanjay, in the Province of Negros Oriental have better rankings in *Establishments for Tourists Accommodation* compared to the cities which are considered as least competitive. Considering the *Cost of Labor*, El Salvador City, in Misamis Oriental, Canlaon City, in Negros Oriental, and Tanjay City, in Negros Oriental ranked better. See Table 5 for the list of the bottom 20 cities with the lowest competitiveness level based on the proposed CMCI.

Table 4. Top 20 Cities with the Highest Proposed CMCI

Rank	City	Ranking of the City in Each Factor				CMCI
		Factor 1	Factor 2	Factor 3	Factor 4	
1	Quezon, Metro Manila (NCR)	1	7	1	2	13.285
2	Davao, Davao del Sur (Region XI)	4	1	17	1	8.849
3	Manila, Metro Manila (NCR)	3	5	4	4	6.760
4	Caloocan, Metro Manila (NCR)	2	22	2	3	6.594
5	Makati, Metro Manila (NCR)	6	3	3	26	6.435
6	Pasig, Metro Manila (NCR)	7	2	5	15	6.177
7	Cebu, Cebu (Region VII)	5	4	16	5	6.108
8	Taguig, Metro Manila (NCR)	8	20	6	41	3.366
9	Pasay, Metro Manila (NCR)	18	10	8	6	3.293
10	Parañaque, Metro Manila (NCR)	9	17	7	57	3.176
11	Muntinlupa, Metro Manila (NCR)	13	16	9	95	2.856
12	Cagayan De Oro, Misamis Oriental (Region X)	10	18	27	14	2.813
13	Las Piñas, Metro Manila (NCR)	15	24	11	45	2.701
14	Bacoor, Cavite (Region IV-A)	12	43	18	10	2.545
15	Dasmariñas, Cavite (Region IV-A)	11	49	31	8	2.531
16	Valenzuela, Metro Manila (NCR)	17	52	10	35	2.511
17	Baguio, Benguet (CAR)	19	13	72	7	2.324
18	Bacolod, Negros Occidental (Region VI)	14	35	71	21	2.206
19	Angeles, Pampanga (Region III)	25	12	22	37	2.174
20	Marikina, Metro Manila (NCR)	20	29	12	72	2.151

To have an idea of the association between the competitiveness rankings of municipalities and cities based on the proposed alternative index and that based on NCC's CMCI, Spearman rank correlation analysis was performed. Based on the analysis, there is a moderate degree of similarities between the ranking of cities and municipalities based on the proposed alternative index and the ranking based on NCC's CMCI.

3.4. Spatial analysis of competitiveness based on the proposed CMCI

The competitiveness index was mapped to visualize its spatial pattern. Based on Figure 3, competitiveness levels of neighbouring municipalities and cities in CALABARZON, National Capital Region, Central Luzon, and Central Visayas were found to be similarly high. On the other hand, competitiveness levels of neighbouring municipalities and cities in MIMAROPA, Cordillera

Table 5. Bottom 20 Cities with the Lowest Proposed CMCI

Rank	City	Ranking of the Cityin Each Factor				CMCI
		Factor 1	Factor 2	Factor 3	Factor 4	
1	Sipalay, Negros Occidental (Region VI)	123	124	86	119	-0.127
2	La Carlota, Negros Occidental (Region VI)	122	80	85	124	-0.069
3	Tandag, Surigao del Sur (Region XIII)	121	112	90	113	-0.065
4	El Salvador, Misamis Oriental (Region X)	125	125	65	123	-0.057
5	Batac, Ilocos Norte (Region I)	108	113	123	103	-0.050
6	Canlaon, Negros Oriental (Region VII)	124	107	67	125	-0.038
7	Victorias, Negros Occidental (Region VI)	114	123	81	117	-0.035
8	Escalante, Negros Occidental (Region VI)	117	106	82	112	-0.029
9	Cabadbaran, Agusan del Norte (Region XIII)	116	120	89	109	-0.018
10	Talisay, Negros Occidental (Region VI)	112	122	80	118	-0.017
11	Silay, Negros Occidental (Region VI)	106	109	78	120	0.011
12	Passi, Iloilo (Region VI)	118	118	83	77	0.050
13	Catbalogan, Samar (Region VIII)	103	85	115	82	0.051
14	Candon, Ilocos Sur (Region I)	96	108	122	70	0.066
15	San Carlos, Negros Occidental (Region VI)	105	56	79	116	0.073
16	Sagay, Negros Occidental (Region VI)	101	115	77	107	0.074
17	Alaminos, Pangasinan (Region I)	93	88	120	80	0.089
18	Tanjay, Negros Oriental (Region VII)	119	67	63	114	0.106
19	Tayabas, Quezon (Region IV-A)	97	117	93	88	0.107
20	Isabela, Isabela (Region II)	95	110	100	78	0.126

Autonomous Region, Eastern Visayas Region, and Cagayan Valley Region, and Ilocos Region were found to be similarly low. In comparison with the spatial pattern of competitiveness using NCC's CMCI, the proposed alternative competitiveness index confirms that competitiveness levels of neighbouring cities and municipalities in the National Capital Region and CALABARZON Region were found to be similarly high.

Overall Moran's *I* of 0.3457 still proves that there exists positive spatial autocorrelation on the competitiveness level of Philippine municipalities and cities. Municipalities and cities in the Provinces of Bulacan, Pampanga, Cavite, Laguna, Rizal, and Cebu, and also in Metro Manila are generally identified as those in the high-high cluster in terms of the proposed alternative 2016 competitiveness level. In contrast, municipalities and cities in the Provinces of Mindoro, Romblon, and Surigao del Norte, and also in the Cordillera Autonomous Region, Ilocos

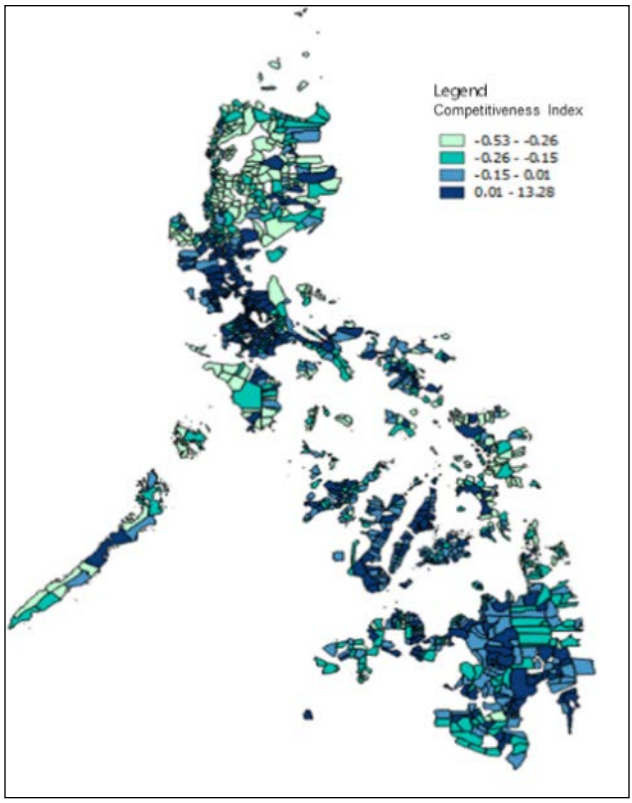

Figure 3. Choropleth Map of the Proposed Alternative 2016 Municipal and City Level Competitiveness in the Philippines

Region, Cagayan Valley Region, and Eastern Visayas Region are generally considered as those in the low-low cluster in terms of the proposed alternative 2016 competitiveness level. (See Figure 4)

Comparison of the clustering based on NCC's CMCI and proposed alternative 2016 CMCI showed that the number of highly competitive municipalities and cities with highly competitive neighbors using the proposed alternative CMCI is less than that of using NCC's CMCI. One can think that the proposed alternative index is more conservative in identifying competitiveness levels of neighboring municipalities and cities having similarly high values. On the contrary, the number of municipalities which have low competitiveness level with neighboring municipalities or cities also having low competitiveness level is higher in the proposed alternative CMCI than in NCC's CMCI. Among the noteworthy differences observed, municipalities and cities in the Ilocos Region which were found to have high competitiveness levels with its neighboring municipalities and

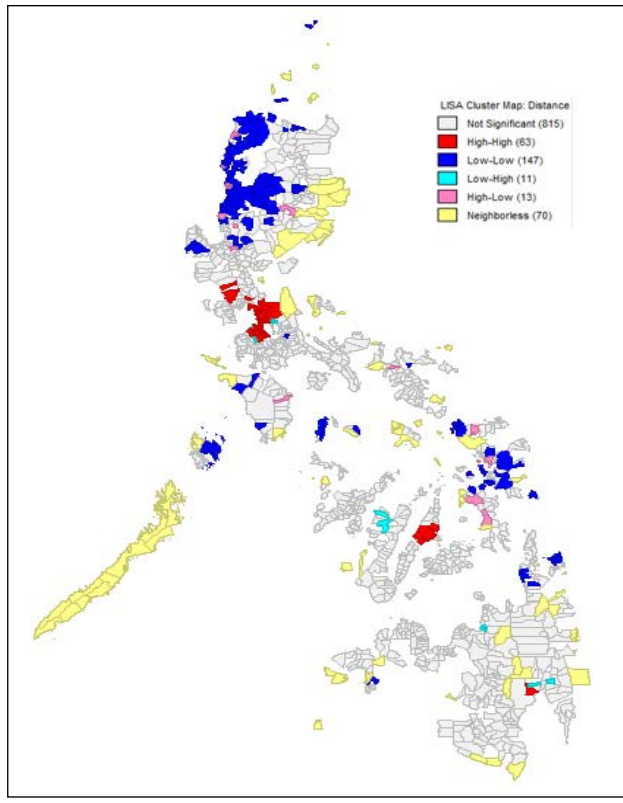

Figure 4. Clustering of the Proposed Alternative 2016 CMCI in the Philippines Based on Moran's Scatterplot using Distance-based Neighborhood Classification with a 35 km cut-off

cities also having high competitiveness levels based on NCC's 2016 CMCI have been categorized in the low-low category by the proposed alternative index.

3.5. Statistical properties of the proposed CMCI

Bootstrap resamples, *B*, of size 500, 750, 1000, 1500, and 2000 and sampling fraction of 5%, 10%, 15%, 20%, 25%, and 30% were considered in the study. The distribution of the mean competitiveness level based on the proposed alternative CMCI for each combination of the number of bootstrap resamples and sampling fraction was determined. Figure 5 shows the behavior of the estimated mean competitiveness level based on the proposed alternative Cities and Municipalities Competitiveness index for different combinations of sampling fractions and number of bootstrap resamples. It can be observed that as the sample size increases, the estimated mean approaches the mean of the pseudo population. The standard deviation of the mean competitiveness level for different bootstrap

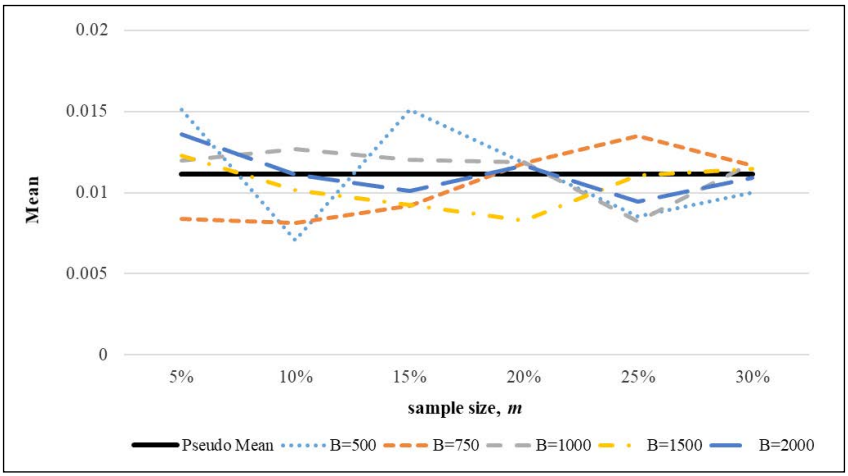

Figure 5. Estimated Mean Proposed Alternative CMCI as the Number of Samples, *m*, Increases at the Different Number of Bootstrap Resamples, *B*

resamples decreases as the sample size increases. Moreover, a few extremely high values of competitiveness were observed at all combinations.

The accuracy of the proposed alternative CMCI was measured through its bias. The bias for each combination of the number of samples and the number of bootstrap samples seems to be small enough for the estimates to be considered accurate. Based on the p-values of the Student's t-test on one population mean with the null hypothesis that the mean bias is zero, all of the biases except on bootstrap resamples of 1500 with a sampling fraction of 20% is not significantly different from zero at 5% level of significance. Hence, the proposed alternative CMCI is generally said to be unbiased. Figure 6 supports this observation as it shows that the bias approaches zero as the sample size increases.

In terms of precision, the most precise estimate was observed for a sample size of 30 percent and with bootstrap resamples of 2000 as seen in Table 6. In contrast, the least precise estimate was observed for a sample size of 5 percent and with bootstrap resamples of 500 using the computed standard error.

Figure 7 shows the behavior of the standard error of the estimated mean competitiveness level as the sample size increases. The standard error has a decreasing trend and is approaching zero as the sample size increases. Since both the bias and standard error of the estimated mean competitiveness level approach zero as the sample size increases, then the proposed alternative CMCI is said to be mean square error consistent.

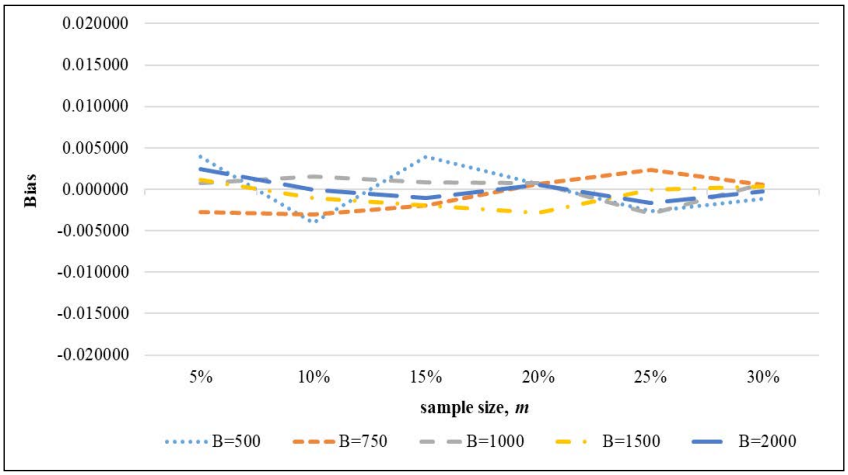

Figure 6. Bias of the Estimated Mean Proposed Index as the Number of Samples, *m*, Increases at Different Number of Bootstrap Resamples, *B*

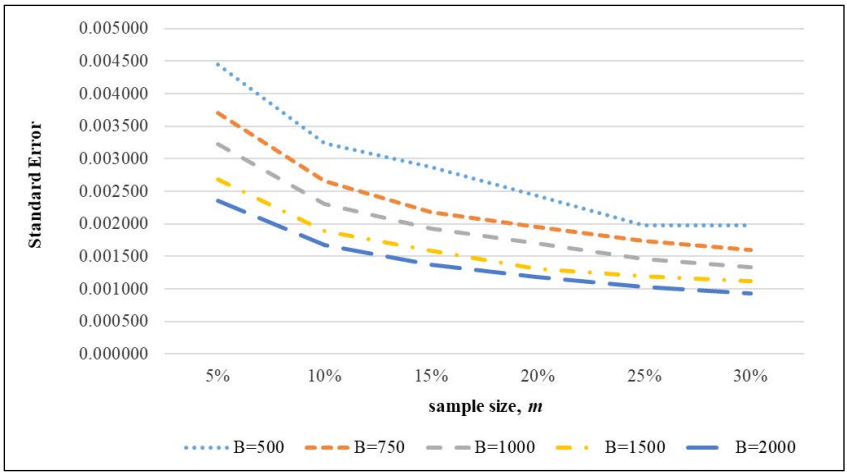

Figure 7. The Standard Error of the Estimated Mean Proposed Index as the Number of Samples, *m*, increases at the Different Number of Bootstrap Resamples, *B*

Table 6. Measure of Precision as Given by the Standard Error of the Estimated Mean Competitiveness Level for each Combination of the Number of Samples and Number of Bootstrap Resamples

Number of samples, m	Number of bootstrap resamples, B				
	B = 500	B = 750	B = 1000	B = 1500	B = 2000
5%	0.0044	0.0037	0.0032	0.0027	0.0024
10%	0.0032	0.0027	0.0023	0.0019	0.0017
15%	0.0029	0.0022	0.0019	0.0016	0.0014
20%	0.0024	0.0019	0.0017	0.0013	0.0018
25%	0.0020	0.0017	0.0015	0.0012	0.0010
30%	0.0020	0.0016	0.0013	0.0011	0.0009

4. Lessons Learned

Factor analysis with principal component analysis as the factor extraction method may be used as an alternative weighting method in the construction of the competitiveness index in the Philippines. The results of the study as presented in this paper may serve as a take-off point for future researches which involve alternative weighting method of statistical indices. The practicality of using this statistical methodology may not be a problem anymore as there is an improvement in the government's capacity in collecting reliable data and an increase in the number of high processing computers that can handle large data sets. Aside from the alternative weighting method, the study also looked into other possible drivers of competitiveness from administrative data and census data, specifically the Census of Population and Housing. Some of the variables from the CPH proved to be a good set of additional indicators of competitiveness as these measure the standards of living at the household level.

The proposed alternative CMCI used the empirical distribution of the indicators as the basis for the weighting of the indicators. This may help the National Competitiveness Council assess the statistical soundness of their methodological framework for the construction of CMCI. Also, the proposed alternative CMCI is said to measure competitiveness in consideration of the standards of living of people residing in a certain municipality or city. Hence, the proposed alternative CMCI, the same as NCC's CMCI, may be used by the local government units, especially those which are lagging on competitiveness level, on which indicators to focus that would improve their competitiveness. The CMCI may also serve as a guide for the private sector on where to locate their business.

5. Recommendations

This paper focuses on developing an alternative municipal and city level competitiveness index in the Philippines by exploring the use of principal component analysis as the weighting method of the indicators. For future

researches, it is recommended to explore other weighting techniques and utilize other administrative data that may capture a city or municipality's competitiveness. Moreover, it is recommended to study ways of computing provincial competitiveness index in terms of aggregating the city and municipality indexes for the cities/municipalities in the province. Lastly, sensitivity analysis is recommended to better understand the variation in the CMCI rankings based on the different sources of variation in the input factors (e.g., data selection, choice of aggregation method such as additive aggregation and geometric aggregation, normalization method, among others).

Acknowledgement

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APPENDIX A: Indicators of NCC's CMCI

Pillar / Indicator	Sub-indicator
Economic Dynamism	
Size and Growth of the Local	Gross sales of registered firms
Economy	Growth of gross sales of registered firms
	Total number of business registrations
	Number of approved business permits for new business applications
	Number of approved business renewals
	Total capitalization of new businesses
	Number of occupancy permits approved
	Number of declared employees for new business applications
	Number of declared employees for business renewals
Capacity to Generate Employment	Number of declared employees for new business applications
	Number of declared employees for business renewals
Cost of Living	Local inflation rate
Cost of Doing Business	Cost of electricity (Php, per KwH)
	Cost of water (Php, per cubic meter)
	Price of diesel as of December 31 per year (Php per liter)
	Regional daily minimum wage rate agricultural (amount in peso)
	Regional daily minimum wage rate non-agricultural (amount in peso)
	Cost of rent for commercial/office space (in Php, per square meter per month)
	Cost of land in a central business district (purchased in Php per square meter)
Number of Banks and Financial	Number of universal/commercial banks
Institutions	Number of thrift and savings banks

Pillar / Indicator	Sub-indicator
	Number of rural banks
	Number of finance cooperatives
	Number of savings and loans associations with quasi-banking functions
	Number of pawnshops
	Number of money changers/foreign exchange dealers
	Number of remittance centers
	Number of microfinance institutions
Productivity	Gross sales of registered firms
Number of declared employees for business renewals	
Presence of Business and Professional Organizations	Total number of LGU recognized/registered business groups
	Total number of other business groups
Government Efficiency	
Capacity of Health Services	Total number of public doctors, nurses, and wives
	Total number of private doctors, nurses, and wives
Capacity of Schools	Number of teachers and students in public secondary education
	Ratio of teachers to students in public secondary education
	Number of teachers and students in private secondary education
	Ratio of teachers to students in private secondary education
Security	Number of policemen in the locality
	Police to population ratio
Business Registration Efficiency	Number of days and steps in getting building permits
	Number of days and steps in getting occupancy permits
Compliance to Business Permits	Number of days and steps in getting Mayors permit
and Licensing System (BPLS)	for new business applications
Standards	Number of days and steps in getting business renewal permits
Presence of Investment Promotion	Presence of the local investment incentives code
Unit (IPU)	Presence of the equivalent of an investment promotions unit (physical office)
	Presence of staff manning the IPU
	Presence of local executive order or ordinance that mandates the implementation of the LIIC or the setting up of an IPU
Compliance to National Directives	Presence of a comprehensive land use plan (CLUP)
	Presence of a local disaster risk reduction and management program plan (DRRMP)
Ratio of LGU collected tax to total	Business tax collected by the LGU (in Php)
LGU revenues	Real property tax collected by the LGU (in Php)
	Total revenues of the LGU
Most Competitive LGU awardee	Number of DILG awards garnered from past year
	Other regional, national, and international awards
Social Protection	Number of local citizens with PhilHealth registration

Pillar / Indicator	Sub-indicator
Infrastructure	
Existing Road Network	Total road network (in km)
	Road density
Distance of City/Municipal Hall to	Distance to operating airport (in km)
Major Ports	Distance to land transport terminal (in km)
	Distance to seaport/local public wharf (in km)
Number of DOT Accredited Accommodations	Number of DOT accredited hotels, resorts, inns, apartelles, pension houses
	Number of rooms in DOT accredited hotels, resorts, inns, apartelles, pension houses
Availability of Basic Utilities	Average hours of utility services (water and electricity) per day at the Central Business District
	Percentage of households with utility service (water and electricity)
Annual Investments in	Investment in infrastructure
Infrastructure by LGU	Total LGU budget
Connection to ICT (cable and	Number of cable, internet, mobile service providers
internet)	Number of Public Transportation Vehicles
	Number of buses, passenger vans, jeepneys, tricycles, taxis, ferries
Health Infrastructure	Public health facilities and corresponding bed capacities
	Private health facilities and corresponding bed capacities
Education Infrastructure	Public secondary schools and classrooms
	Private secondary schools and classrooms
	Public tertiary schools and classrooms (for cities, highly urbanized cities and chartered cities only)
	Private tertiary schools and classrooms (for cities, highly urbanized cities and chartered cities only)
	Public technical vocational education and training schools and classrooms (for cities, highly urbanized cities and chartered cities only)
	Private technical vocational education and training schools and classrooms (for cities, highly urbanized cities and chartered cities only)
Number of Automated Teller	Number of on-site ATMs
Machines (ATMs)	Number of off-site ATMs