Spatial Autocorrelation and Crosscorrelation Analysis of Voting Participation in the Philippines

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Abstract

This study investigates and characterizes the presence of voting neighborhoods, or the tendency of neighboring cities and municipalities to have similar levels of voting participation, measured in terms of their respective voter turnouts. Using data from the 2013 Philippine elections and background variables related to cities' and municipalities' affluence, spatial autocorrelation and crosscorrelation analysis are used to determine if there is a tendency for neighboring areas to form voting neighborhoods. Results of the analysis show that levels of voting participation are not spatially random, and that voting neighborhoods indeed exist among the cities and municipalities of the Philippines. Voting participation hotspots, cold spots, and outliers are also detected in various parts across the country. Furthermore, the richness of cities and municipalities, measured in terms of local government revenue and poverty levels, is also found to be a significant driver in the formation of these voting neighborhoods.

Keywords: voting participation, spatial autocorrelation, spatial crosscorrelation, elections

Introduction

This study demonstrates the use of a geographically-oriented stance in performing statistical analysis of voting participation. This study performs this analysis using Philippine election data from the 2013 national elections, and corresponding local government revenue and poverty data at the city and municipal level. By taking a spatial perspective in understanding the phenomenon of voting participation, it can be determined whether there is a tendency among neighboring cities and municipalities to exhibit what can be termed as voting neighborhood effect. In contrast to the prevalent idea that voting is a result of an individual's rational behavior (Downs, 1957; Durden & Gaynor, 1987; Fain & Dworkin, 1993; Levine & Palfrey, 2007), it is argued that a better understanding of voting participation can be achieved by seeing it, not just as "an atomized and rational decision" of individuals, but as "a product of social interaction" among these individuals (Flint, 2000). This view of voting participation being at the context larger than the individual is in congruence with the main idea at the center of this study which is voting neighborhood effect. Flint's proposition of viewing elections as a social phenomenon operating within its spatial context, and the Downsian perspective of voting as a rationally-driven decision perfectly fit with the spatio-statistical approach being explored in this study.

Methodology

A few yet very insightful works on election studies have already taken advantage of spatio-statistical techniques (Wall and Lehoucq, 1987; Vilalta Perdomo, 2008; Teng, 2006; Lay et al., 2007). Taking into consideration the methods that have been employed in these related studies, and Flint's (2000) proposed framework in analyzing voting participation, Figure 1 illustrates a framework for how voting participation, expressed in terms of voter turnout (percentage of actual voters over registered voters), is analyzed in this study based on its relationship with two other related concepts of interest in this study. These relationships are:

1. The spatial segregation of voting participation
2. The spatial segregation of voting participation with respect to background variables

In congruence with the Downsian perspective, background variables to be analyzed together with voting participation are related to city's and municipality's affluence. These factors are 1) total local government revenue; 2) per-capita local government revenue, and 3) poverty level.

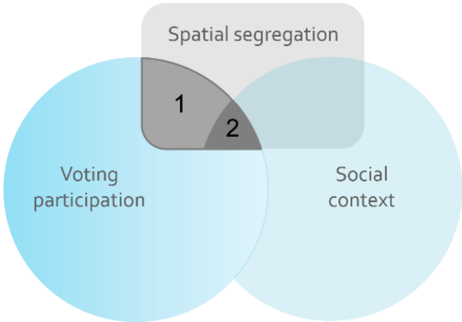

Figure 1. Analysis framework of voting neighborhood effect

These relationships provide a deconstructed view of the concept and shall correspond to separate spatio-statistical analysis techniques to be applied. These are:

1. Spatial autocorrelation – applied for the analysis of the spatial segregation of voting participation. Specific spatio-statistical techniques to be used include global univariate Moran's I, and local univariate Moran's I.
2. Spatial crosscorrelation – applied for the analysis of the spatial segregation of voting participation with respect to background variables. Specific spatio-statistical techniques to be used include global bivariate Moran's I, and local bivariate Moran's I

For the spatio-statistical techniques mentioned above, a contiguity-based spatial weight matrix shall be considered. In such configuration, cities and municipalities are considered neighbors when they share a portion of their boundaries with each other. In terms of its spatial weight matrix, this neighborhood configuration sets that the matrix elements can only have a binary value of either 1, if they are connected physically or by a transportation route; or 0 otherwise.

The datasets used in this study are sourced from official statistics published by the Philippine Commission of Elections, the Philippine Statistics Authority, the National Mapping and Resource Information Authority, and the Bureau of Local Government Finance.

Results and discussion

Choropleth maps are initially prepared for visualizing the voting participation-related variables to be analyzed. The maps show that areas with high number of registered voters also correspond to the same areas with high number of actual voters. These areas may have the potential of being local voting neighborhoods if the basis used is merely raw counts. However, when the choropleth display is changed from raw counts to proportions of actual vs. registered voters, the spatial distribution of the highs and lows levels of voting completely changes and diffuses to other areas. This shows, at least visually, that voter-rich areas is not necessarily synonymous to high voting participation areas. Consequently, the possibility of observing voting neighborhoods in other parts of the Philippines is possible, even in areas without considerably high number of registered and actual voters. This justifies the use of spatial autocorrelation and cross-regression analysis to detect the possible presence of voting neighborhoods.

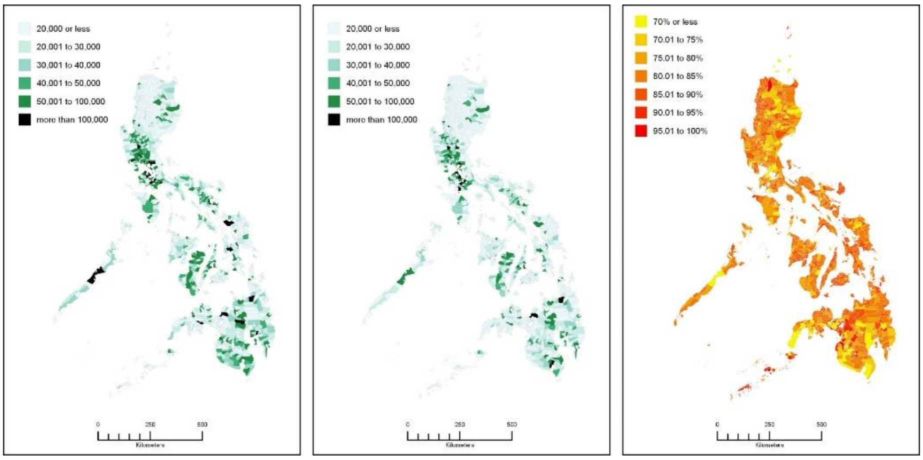

Figure 1. Registered (left), actual voters (middle), and voter turnout by city and municipality

Overall spatial autocorrelation and spatial crosscorrelation based on the univariate and bivariate Moran's I statistics respectively, are quantified separately for both the global and local levels. The generated univariate global Moran's I statistic values ($I = 0.3586$, p-value ≤ 0.05), show that areas of similar voter turnouts are significantly detectable at the overall level.

For the overall spatial crosscorrelation, Table 1 shows the summary of the computed bivariate global Moran's I statistic for the background variables.

Background variable	Bivar. Moran's *I*	p-value
Total local gov. revenue	-0.1886	0.001*
Per capita local gov. revenue	-0.1124	0.001*
Poverty level	0.0707	0.001*

Table 1. Bivariate global Moran's I statistic

The table shows that the government-revenue-related variables consistently exhibit significant negative spatial crosscorrelation with respect to voting participation. This shows initial evidence that areas with high voting participation tend to be in propinquity with low government-revenue-earning neighbors. Poverty also manifests significant spatial propinquity with voter turnout. However, unlike the revenue-related variables, there is a positive spatial crosscorrelation, which means that high voting participation tends to be in propinquity with neighbors with high poverty levels.

Local spatial autocorrelation and crosscorrelation indices are also computed, and the results are presented in the form of cluster maps in Figure 2 and 3. The map reveals pockets of areas where voting participation hotspots, cold spots, and outliers are detected. Local spatial crosscorrelation analysis show that poverty covers the largest extent of tagged hotspots and cold spots among the background variables.

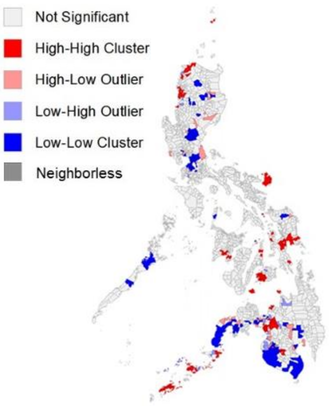

Figure 2. Univariate voting participation hotspots, cold spots, and outliers

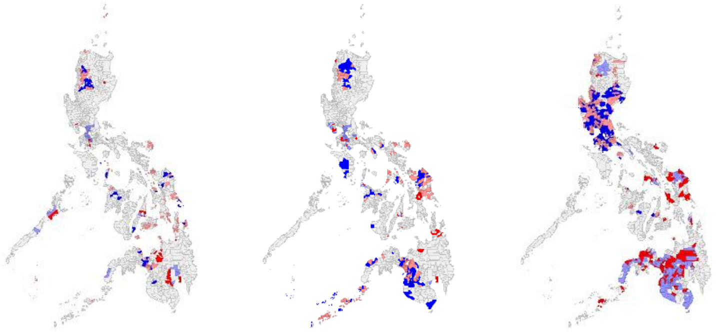

Figure 3. Bivariate voting participation hotspots, cold spots, and outliers for total local government revenue (left), per capita gov. revenue (middle), and poverty levels (right)

Conclusion

The use of various spatial autocorrelation and crosscorrelation methods has quantitatively substantiated the proposition that voting participation in the Philippines is a spatially-driven phenomenon influenced not by neighboring levels of voter turnout, but also by the richness (and poverty) of the neighboring cities and municipalities. This study comes up with the following specific conclusions:

1. The univariate global spatial autocorrelation analysis shows that voting neighborhood effect is observable at the overall level. When the univariate spatial autocorrelation analysis is brought down to the local level, many voting neighborhoods are located among cities and municipalities, specific neighborhoods being either a voting participation hotspot, or a voting participation cold spot.
2. Both the global- and local-level bivariate spatial crosscorrelation analysis show that the revenue generated by local governments and poverty levels is a strong influencer for the formation of voting neighborhoods in the Philippines. Because of the varying levels of local government wealth across the Philippines, a significant level of variation in voting participation can be attributed to this variation in wealth among local government units.

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