

# Spatial Variation of the DPP's Expansion between Taiwan's Presidential Elections\*

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*This study examines the aggregate change of the Democratic Progressive Party's (DPP) expansion between Taiwan's presidential elections from a spatial perspective. We find that the expansion of the DPP exhibited spatial clustering from 1996 to 2000. Its growth was clustered in southern Taiwan in this period, creating a considerable stronghold in the 2000 presidential election. From 2000 to 2004, however, the hot spots of DPP expansion shifted to central Taiwan and exhibited relatively dispersed patterns.*

*To explain the spatial variation of the DPP's expansion, we incorporate independent variables of income, education, and ethnicity into regression models. The result of non-spatial regression analyses reveals that demographic characteristics played a role in the DPP's expansion. After inserting a spatial lag term into spatial regression models, however, we*

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*find that the impacts of some demographic variables have been overridden by the neighborhood effect. This implies that in addition to social cleavages, some campaign mobilization efforts or the socialization of one's network in the context of a broadly defined neighborhood could also have prompted the regional variation of the DPP's expansion. Further research is required to specify the mechanisms that formed the neighborhood effect.*

**KEYWORDS:** Taiwan; Democratic Progressive Party (DPP); exploratory spatial data analysis (ESDA); spatial lag regression; political geography.

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Competition between the "pan-Blue" (泛藍) and "pan-Green" (泛綠) forces has become a critical feature of political rivalry in Taiwan. In the pan-Blue camp are the Kuomintang (KMT, 國民黨), the New Party (NP, 新黨), and the People First Party (PPF, 親民黨), while the pan-Green team is headed by the Democratic Progressive Party (DPP, 民主進步黨) and the Taiwan Solidarity Union (TSU, 台灣團結聯盟).

Many observers believe that the DPP candidate Chen Shui-bian (陳水扁) won the 2000 presidential election by capturing widespread support in southern Taiwan, hence ending the KMT's fifty-five years in power on Taiwan. Since then, "north Blue, south Green" (北藍南綠) has become a commonly-used term to describe the geographical dichotomy of party support in Taiwan. During the 2004 presidential election, the impression of a north-south divide was reinforced by the remarkable number of votes won by the pan-Green candidate in southern Taiwan. However, this north-south split is the only static feature of Taiwan's political geography between the 2000 and 2004 presidential elections. The impetus of this research is an interest in exploring the surge in the DPP's vote in presidential elections from 21 percent in 1996, to 39 percent in 2000, and 50 percent in 2004. In essence, we would like to know if the growth in the DPP's vote showed any spatial variation. If so, what were the geographical patterns of the DPP's expansion? What could have driven the formation of such patterns?

It is crucial to note that we are focusing on the net/aggregate change in the DPP's vote over time, not its transformation at the level of the elector

(i.e., gross/individual change). For instance, if the DPP vote increased by 10 percent in a specific region, this might be the aggregate result of 20 percent of pan-Blue electors switching their support to pan-Green, plus 10 percent of pan-Green supporters changing to pan-Blue. Other scenarios also could have engendered this aggregate result, but they are not our concern in this study. Rather, we concentrate solely on the aggregate result—the fact that the DPP vote increased by 10 percent in the region under study. This is not to say that we downplay the importance of studying voting behavior at the individual level. What we would like to highlight is first, that elections are essentially determined by the overall vote, and secondly, voter behavior is often intertwined with the aggregate voting orientations of regions. Therefore, aggregate analysis has its merit in electoral studies.

Regarding methodology, we introduce spatial analysis and spatial econometrics to complement previous studies that have normally ignored "spatial variation" when analyzing electoral behavior in Taiwan.<sup>1</sup> The application of spatial analysis in electoral studies is not novel; there are numerous examples in research into U.S., German, Italian, and Mexican electoral politics. One quintessential instance is Kim, Elliott, and Wang's 2003 study on the spatial distribution of votes in U.S. presidential elections between 1988 and 2000. These scholars use spatial analyses to detect a surging regional concentration of partisan support in the United States. The Democrats are drawing more votes from the East and the urban areas, while the Republicans are gaining more popularity in the West and the rural areas.<sup>2</sup>

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<sup>1</sup>Social scientists traditionally approached this theme through either cross-sectional analysis on individual voting behavior or longitudinal analysis on aggregate change of voting behavior. The most commonly adopted methodology is survey analysis, through which researchers interpret voters' behavior by examining socioeconomic factors inherent in the society in which the voters reside. For instance, see Chen Yi-yan, "Taiwan xuanju xingwei diaocha de huigu yu zhanwang" (Survey research of electoral behavior in Taiwan: retrospect and prospects), *Xuanju yanjiu* (Journal of Electoral Studies) 10, no. 1 (May 2003): 1-6; and John Fuh-sheng Hsieh and Emerson M.S. Niou, "Salient Issues in Taiwan's Electoral Politics," *Electoral Studies* 15, no. 2 (May 1996): 219-35. In a nutshell, conventional social science analyses rarely take into account spatial variation of voting behavior.

<sup>2</sup>Jeongdae Kim, Euell Elliott, and Ding-ming Wang, "A Spatial Analysis of County-Level Outcomes in U.S. Presidential Elections: 1988-2000," *Electoral Studies* 22, no. 4 (December 2003): 741-61.

Similarly, utilizing exploratory spatial data analyses (ESDA), Shin and Agnew discover a complex transformation at play in contemporary Italian electoral politics. Over time, the Northern League (*Lega Nord*, LN) has successfully dominated northern Italy where the Christian Democrats (*Democrazia Cristiana*, DC) once were influential. Also, the Democratic Party of the Left (*Partito Democratico della Sinistra*, PDS) and the Re-founded Communists (*Rifondazione Comunista*, RC) have replaced the Italian Communist Party (*Partito Comunista Italiano*, PCI) as the dominant political parties in many sub-regions of central Italy.<sup>3</sup>

Spatial analysis of electoral outcomes is at a nascent stage in Taiwan. This deficiency contrasts with the widespread recognition of the geographical dichotomy of party support in Taiwan's political arena. Lee and Hsu's 2002 study is a rare example of research on the regional differentiation of party competition in Taiwan. From an examination of Taiwan's six elections, they discover that both the DPP and the KMT have loyal voters in southern Taiwan. That is to say, southern voters have more distinct and stable partisan positions, while non-southern electors exhibit less partisan loyalty.<sup>4</sup> The regions in their studies, however, are artificially pre-divided. They may not precisely correspond to the genuine geographical distribution of electoral results, and thus raise concern about the "modifiable areal unit problem" (MAUP).<sup>5</sup>

It is also worth noting that in 2006, Lin, Wu, and Lee conducted an original study using spatial econometrics to uncover the impact of the "neighborhood effect" on the formation of a person's national identity in Taiwan. Recognizing that national identity is commonly known to be connected to (sub-)ethnic identification and that it varies across regions in Taiwan, these authors ask why voters with the same sub-ethnic origin who dwell in different geographical locations have different levels of

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<sup>3</sup>Michael E. Shin and John Agnew, "The Geography of Party Replacement in Italy, 1987-1996," *Political Geography* 21 (2002): 221-42.

<sup>4</sup>Lee Pei-shan and Hsu Yung-ming, "Southern Politics? Regional Trajectories of Party Development," *Issues & Studies* 38, no. 2 (June 2002): 61-84.

<sup>5</sup>Stan Openshaw, *The Modifiable Areal Unit Problem (Concepts and Techniques in Modern Geography)* (Norwich: Geo Books, 1983).

national identity. With the assistance of spatial econometrics, they discover that the formation of a person's national identity is subject to the influences of his or her residential neighbors and occupational peers.<sup>6</sup>

This paper examines the spatial variation of the expansion of the DPP's vote between presidential elections, from 1996 to 2004. Ultimately, we are interested in exploring whether this expansion exhibited any spatial variation at all. And if it did, what could have driven such spatial variation? An ESDA in the next section will enable us to analyze and compare the geographical changes in the DPP's expansion over two periods: between the presidential elections of 1996 and 2000, and between those of 2000 and 2004. In the third section, we will incorporate demographic variables and variables pertaining to the neighborhood effect into spatial regression models to explain the spatial variation of the DPP's growth. In the fourth part we will discuss the empirical findings of our research and add some concluding remarks.

### **The Spatial Variation of the DPP's Expansion**

With the assistance of ESDA, in this section we identify the spatial variation of the DPP's expansion from 1996 to 2004. ESDA contains a set of descriptive and graphical tools that allows researchers to detect patterns of spatial association (spatial cluster) and spatial outliers. What is highly relevant in ESDA to the purpose of our study is the concept of spatial autocorrelation, namely, the correlation of a variable between neighborhoods.

Normally, two scenarios of spatial autocorrelation may emerge. If the variation among neighboring observations is small and that among non-neighboring areas is huge, there is positive spatial autocorrelation. If the variation among neighboring observations is considerable and the

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<sup>6</sup>Lin Tse-min, Wu Chin-en, and Lee Feng-yu, "Neighborhood Influence on the Formation of National Identity in Taiwan: Spatial Regression with Disjoint Neighborhoods," *Political Research Quarterly* 59, no. 1 (March 2006): 35-46.

variation among non-neighboring areas is minor, there is negative spatial autocorrelation.<sup>7</sup>

The most representative index for spatial autocorrelations is Moran's I. It is computed as follows:<sup>8</sup>

$$I = \frac{n}{\sum_{i=1}^n \sum_{j=1}^n W_{ji}} \times \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

$W_{ij}$  is an element of a spatial weights matrix. It records whether a neighboring relationship exists between area unit  $i$  and area unit  $j$ . For a randomly distributed pattern, the expected value for Moran's I is:

$$E(I) = \frac{-1}{n-1}$$

The relationship between  $(x_i - \bar{x})$  and  $(x_j - \bar{x})$  could have three possible scenarios: the values of both sets are positive; both are negative; or one is positive and the other negative. The first two scenarios would result in a positive value of Moran's I (i.e., positive spatial autocorrelation), while the third scenario would generate a negative value of Moran's I (i.e., negative spatial autocorrelation).

If Moran's I is positive, there is a high degree of spatial clustering of similar values. In this paper, this would mean spatial clustering of similar extents of growth for the DPP. If Moran's I is close to 0, the DPP's expansion would tend to be randomly distributed and therefore exhibit no spatial autocorrelation. A Moran's I of less than 0 indicates a checkerboard-like spatial pattern in which high values are next to low values. This

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<sup>7</sup>Peter Haggett, Andrew D. Cliff, and Allan E. Frey, *Locational Methods* (New York: John Wiley & Sons, 1977).

<sup>8</sup>Andrew D. Cliff and J. Keith Ord, *Spatial Autocorrelation* (London: Pion, 1973), 1-2; and Jay Lee and David W. S. Wong, *Statistical Analysis with ArcView GIS* (New York: John Wiley & Sons, 2001), 132-89.

**Table 1**  
**Spatial Autocorrelation of the DPP's Expansion at the National Level**

	Moran's I	p
1996~2000	0.6922	< 0.001
2000~2004	0.4614	< 0.001

is referred to as a negative spatial autocorrelation, although such situations occur rarely in social science studies.

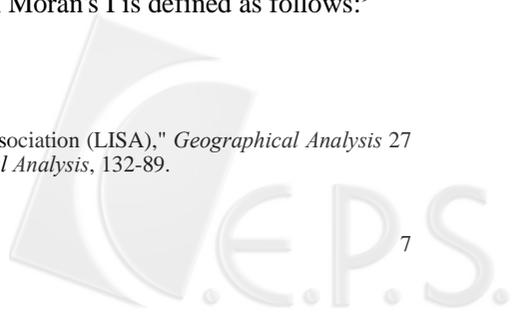
The area units under study are the 358 townships of Taiwan. To avoid distortion caused by aggregating area units, we should use the smallest area unit possible, and in Taiwan this would be the "village" (村里). The problem is, however, that the boundaries of villages change from time to time and therefore the village cannot be a reliable area unit for analysis. Consequently, we have decided to use the second smallest administrative area unit—the "township" (鄉鎮)—as the area unit for analysis. This area unit is subject to less change over time.

Next, we calculate the percentage difference in votes that the DPP received between the 1996 and 2000 presidential elections, and between the 2000 and 2004 elections. The result of our spatial analysis (shown in table 1) indicates that, between 1996 and 2000, the expansion in support for the DPP exhibited significant spatial clustering. The DPP's support base experienced more growth in some regions than in others. Similarly, the expansion of the DPP exhibited spatial clustering between 2000 and 2004, but it was much more dispersed than the growth during the previous phase.

Spatial autocorrelation at the national level (global scale) is not sufficient to identify a pattern in the DPP's expansion. We can obtain more detail by examining the "Local Indicators of Spatial Association" (LISA), developed by Luc Anselin. The local Moran's I is defined as follows:<sup>9</sup>

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<sup>9</sup>Luc Anselin, "Local Indicators of Spatial Association (LISA)," *Geographical Analysis* 27 (1995): 91-115; and Lee and Wong, *Statistical Analysis*, 132-89.



$$I_i = \frac{(x_i - \bar{x})}{\sum_{i=1}^n (x_i - \bar{x})^2} \sum_{j=1}^n W_{ij} (x_j - \bar{x})$$

The average of all  $I_i$  is Moran's I. After normalization,<sup>10</sup> if the z-score of the area units'  $I_i$  is larger than 1.96, there is significant spatial clustering. This implies that an area's attribute is similar to that of its neighboring areas. Two scenarios count as spatial clustering. The first is the "hot spot" phenomenon; this occurs when the values of the observed area itself as well as the surrounding areas are high. The second is the "cold spot" phenomenon, a situation in which the values of the observed area and its neighboring areas are all low. In this research, we use the Moran Scatter Plot developed by Anselin to identify hot spots and cold spots.<sup>11</sup>

If the z-score of the area units'  $I_i$  is under  $-1.96$ , there is a significant spatial outlier. This indicates that the attribute of an area is dissimilar to that of its neighboring areas. If it is between 1.96 and  $-1.96$ , there is no significant spatial autocorrelation.

Using the above method, we are able to classify the DPP's expansion in all townships into four categories: hot spots, cold spots, spatial outliers, and no spatial autocorrelation (shown in figure 1). Figure 1 (A) displays the spatial variation of the DPP's expansion from 1996 to 2000. As we can see, the hot spots were situated in southern Taiwan, in such counties as Yunlin (雲林縣), Chiayi (嘉義縣), Tainan (台南縣), and Kaohsiung (高雄縣; excluding aboriginal areas). The DPP had minor growth in eastern Taiwan, in Hsinchu County (新竹縣), Miaoli County (苗栗縣), the aboriginal townships, and the Taipei metropolitan area. This clustering caused southern Taiwan to become the heartland of the pan-Green coalition.

<sup>10</sup>The expected value and standard deviation of  $I_i$  are obtained on the basis of 999 permutations. That is to say, we randomly redistribute the x value of every township and recalculate  $I_i$ . This procedure is performed 999 times.

<sup>11</sup>Luc Anselin, "The Moran Scatter Plot as an ESDA Tool to Assess Local Instability in Spatial Association," in *Spatial Analytical Perspectives on GIS*, ed. Manfred M. Fischer, Hank J. Scholten, and David Unwin (London: Taylor & Francis, 1996), 111-25.

**Figure 1**  
**Spatial Variation of the DPP's Expansion**

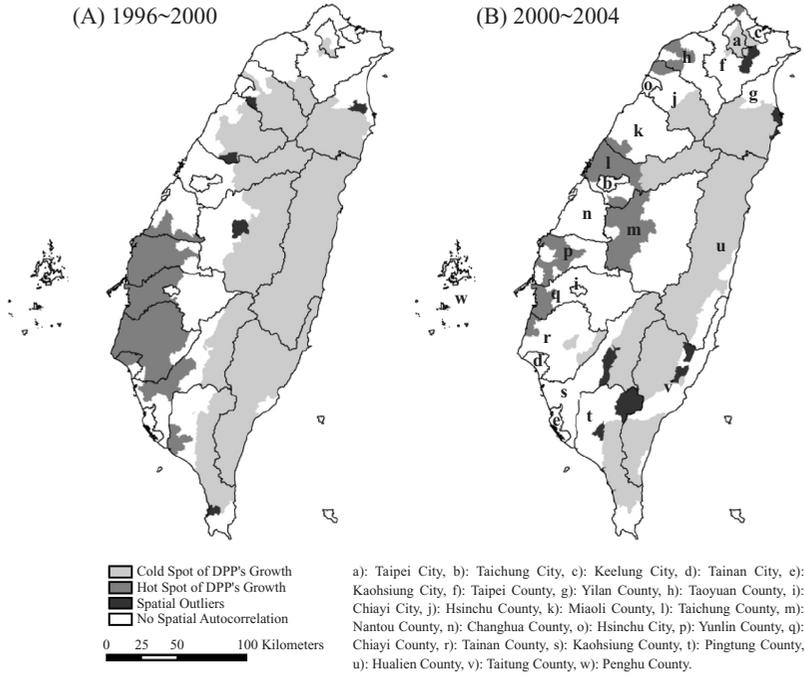


Figure 1 (B) shows the spatial variation of the DPP's expansion from 2000 to 2004. During this period, the hot spots spread to other regions. The largest growth center was located in Taichung County (台中縣) and Nantou County (南投縣; excluding aboriginal areas). The second largest core of growth was situated in the coastal areas of Yunlin and Chiayi counties, as well as certain part of Taoyuan County (桃園縣). Growth in support for the DPP in eastern Taiwan, aboriginal townships, and the Taipei metropolitan area was still the smallest. It is worth noting that, in comparison with the slow expansion in Hsinchu and Miaoli counties during the period 1996-2000, the DPP appears to have made a minor breakthrough in these two counties from 2000 to 2004.

## Searching for the Causes of the Spatial Variation of the DPP's Expansion

The above spatial analysis shows that the DPP's expansion of votes is spatially differentiated. However, what could have generated such spatial variations? One might surmise that the demographic features of the electorates might covary with locations, or alternatively, the observed spatial pattern might be attributed to a more pure spatial process, such as the neighborhood effect. In this section, we will elaborate these two arguments and further establish spatial regression models to test their validity in explaining the aforementioned spatial patterns.

### *Hypothesis 1*

The first candidate explanation arises from a classical perspective on political behaviors in social science. That is, the pluralist perspective on the formation of cleavages and factions in society. In almost all societies, there exist cleavages that divide people along crosscutting socioeconomic features, such as ethnicity, religion, and class. As long as there are cleavages, there are conflicts of interest, and hence the potential for individuals to associate in order to defend their common interests through collective action. Political parties and interest groups are typical examples of collective efforts to safeguard different interests.<sup>12</sup>

Although cleavages exist in diverse forms, their presence is often reflected in the demographic features of different societies. Since demo-

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<sup>12</sup>In the West European context, Lipset and Rokkan assert that cleavages originate from four sources: the conflicts between the dominant elites and the subordinates, the state and the church, those representing agricultural interests and those representing industrial interests, and lastly employers and employees. Inglehart further notes the emergence of a new political cleavage in advanced industrialized societies, where a younger and wealthier generation upholds post-materialist values, such as women's rights and environmental protection, in contrast to the older generation's emphasis on economic and security objectives. See Seymour M. Lipset and Stein Rokkan, "Cleavage Structures, Party Systems, and Voter Alignment: An Introduction," in Seymour M. Lipset and Stein Rokkan, *Party Systems and Voter Alignment* (New York: The Free Press, 1967), 1-64; and Ronald Inglehart, *Cultural Shift in Advanced Industrial Society* (Princeton, N.J.: Princeton University Press, 1990), 258-64.

graphic characteristics vary across regions, we hypothesize that spatial variation of the DPP's expansion is a result of the aggregate demographic cleavages representing in space. If we examine the demographic components of a particular region, we might be able to explain why this specific region exhibits a certain political inclination and voting tendency.<sup>13</sup>

Scholars in the United States have followed this strand of argument in analyzing American electoral politics. For instance, Gimpel, Morris, and Armstrong identify a connection between voter turnout in U.S. presidential elections and the local electorate's age distribution.<sup>14</sup> Gimpel and Cho find that European ancestry has a great impact on the regional divide in presidential elections in the New England towns.<sup>15</sup> Also, Kohfeld and Sprague discover that the geographical distribution of race (blacks in the north and whites in the south) has influenced voter turnout in St. Louis.<sup>16</sup> Likewise, in the United Kingdom, MacAllister, Fieldhouse, and Russell found that the British Liberal Party long maintained an electoral advantage in regions where nonconformists predominated.<sup>17</sup>

In Taiwan, ethnic and sub-ethnic division (and the extending problem over national identity) is considered as the prime cleavage in society.<sup>18</sup>

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<sup>13</sup>Iain McAllister, "Social Context, Turnout, and the Vote: Australian and British Comparisons," *Political Geography Quarterly* 6 (1987): 17-30; and Iain McAllister and Donley T. Studlar, "Region and Voting in Britain, 1979-87: Territorial Polarization or Artifact?" *American Journal of Political Science* 36, no. 1 (February 1992): 168-99.

<sup>14</sup>James G. Gimpel, Irwin L. Morris, and David R. Armstrong, "Turnout and the Local Age Distribution: Examining Political Participation across Space and Time," *Political Geography* 23 (2004): 71-95.

<sup>15</sup>James G. Gimpel and Wendy K. Tam Cho, "The Persistence of White Ethnicity in New England Politics," *Political Geography* 23 (2004): 987-1008.

<sup>16</sup>Carol W. Kohfeld and John Sprague, "Race, Space and Turnout," *Political Geography* 21 (2002): 175-93.

<sup>17</sup>Iain MacAllister, Edward Fieldhouse, and Andrew Russell, "Yellow Fever? The Political Geography of Liberal Voting in Great Britain," *Political Geography* 21 (2002): 421-47.

<sup>18</sup>Chen Yi-yan and Sheng Shing-yuan, "Zhengzhi fenqi yu zhengdang jingzheng: 2001 nian lifa weiyuan xuanju de fenxi" (Political cleavage and party competition: an analysis of the 2001 legislative election), *Xuanju yanjiu* 10, no. 1 (May 2003): 7-40; Wu Nai-teh, "Rentong chongtu han zhengzhi xinren: xian jieduan Taiwan zuqun zhengzhi de hexin nanti" (Identity conflict and political trust: core dilemmas of current ethnic politics in Taiwan), *Taiwan shehuixue* (Taiwan Sociology) 4 (December 2002): 75-118; and Yu Ching-hsin, "The Evolving Party System in Taiwan, 1995-2004," *Journal of Asian and African Studies* 40, nos. 1-2 (April 2005): 105-23.

This ethnic cleavage is manifested in political and party rivalry. In his 2002 analysis, Wang identifies a potential linkage between ethnic distribution and electors' political behavior. He observes that the pattern of geographical distribution of ethnic groups resembles that of the distribution of votes for the two main parties in the 2000 presidential election, although he does not go on to apply statistical analysis to test the relation between ethnic distribution and voter behavior in this election.<sup>19</sup> We intend to complete his work in this paper.

Apart from ethnicity, other demographic factors such as income and education have also been scientifically proven to be key sources of social cleavages in Taiwan. Scholars have pointed out that education has an impact on voting behavior in Taiwan.<sup>20</sup> As for the factor of income, since it reflects a region's economic situation, it could play a part in regional political transformation too. In the latter part of this paper, we will incorporate the factors of ethnicity, income, and education into regression models to test if they have contributed to the spatial variation of the DPP's expansion.

### *Hypothesis 2*

Alternatively, we may contend that electors from similar demographic backgrounds do not necessarily have similar voting preferences. Rather, the behavior of voters may be determined by conditions in their neighborhoods,<sup>21</sup> and voters living adjacent to each other may tend to show similar voting preferences. This is the neighborhood effect hypothesis.<sup>22</sup>

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<sup>19</sup>Wang Fu-chang, "Zuqun jiechu jihui haishi zuqun jingzheng? Bensheng Minnanren zuqun yishi neihan yu diqu chayi moushi zhi jieshi" (Ethnic contact or ethnic competition? Explaining regional differences in ethnic consciousness among Hohlos in Taiwan," *Taiwan shehuixue* 4 (December 2002): 11-74.

<sup>20</sup>See note 6 above; Wang Fu-chang, ""Zuqun tonghua yu dongyuan: Taiwan minzhong zhengdang zhichi zhi fenxi" (Ethnic assimilation and mobilization: an analysis of party support in Taiwan), *Zhongyang yanjiuyuan minzuxue yanjiusuo jikan* (Bulletin of the Institute of Ethnology, Academia Sinica) 77 (1994): 1-34; and Wu Nai-teh, "Guojia rentong yu zhengdang zhichi" (National identity and party support), *ibid.* 74 (1993): 33-61.

<sup>21</sup>Kim, Elliott, and Wang, "A Spatial Analysis of County-Level Outcomes in U.S. Presidential Elections," 743.

<sup>22</sup>Wendy K. Tam Cho, "Contagion Effects and Ethnic Contribution Networks," *American*

There are two kinds of processes that contribute to the neighborhood effect. The first is the acquaintance-circle process. A person might have a minority voting preference in the beginning, but after receiving information about the majority's position within his/her social network (friends, colleagues, relatives, neighbors), this person might gradually modify his/her preference to match mainstream ideas, in order to gain recognition and friendship within his/her circle of acquaintanceship.<sup>23</sup> The second is the forced-field process, through which electors are mobilized by election campaigns to adopt a particular voting preference.<sup>24</sup>

Tingsten's research on Swedish elections in the 1920s is one early study of the neighborhood effect. Tingsten discovers that laborers residing in working-class neighborhoods are more likely to vote for socialist candidates than their counterparts in middle-class districts.<sup>25</sup> Folandare as well as Valen and Katz confirm Tingsten's findings in their respective studies on the U.S. and Norwegian cases.<sup>26</sup> In the case of Taiwan, Lin, Wu, and Lee identified the effect of neighbors, namely those living in proximity and occupational peers in constructing a person's national identity in their 2006 study.<sup>27</sup>

Many factors could have contributed to the spatial variation of the DPP's expansion. It may be due to the neighborhood effect or the aggregate effect of demographic cleavages representing in space, or both. In this study, we are interested in detecting the presence of the neighborhood

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*Journal of Political Science* 47, no. 2 (April 2003): 368-87; and C. J. Vilalta y Perdomo, "The Local Context and the Spatial Diffusion of Multiparty Competition in Urban Mexico, 1994-2000," *Political Geography* 23 (2004): 408-10.

<sup>23</sup>K. R. Cox, "The Voting Decision in a Spatial Context," in *Progress in Geography: International Reviews of Current Research*, ed. Christopher Board, Peter Hagggett, Richard J. Chorley, and David R. Stoddart (London: Edward Arnold, 1969), 1:81-117.

<sup>24</sup>Ibid.

<sup>25</sup>Herbert Tingsten, *Political Behavior: Studies in Election Statistics* (London: P. S. King and Son, 1937).

<sup>26</sup>Irving S. Folandare, "The Effect of Neighborhood on Voting Behavior," *Political Science Quarterly* 83, no. 4 (December 1968): 516-29; and Henry Valen and Daniel Katz, *Political Parties in Norway: A Community Study* (Oslo: Universitetsforlaget, 1964).

<sup>27</sup>See note 6 above.

effect in the formation of the observed spatial patterns. The discovery of a neighborhood effect in this context, however, does not exclude the possibility that other effects are at work, since they could all exist simultaneously, resulting in the clear spatial patterning of the DPP's expansion.

### *Research Design*

We treat the difference in the percentage of votes that the DPP obtained between the two researched periods (1996-2000 and 2000-2004) as the dependent variable. The independent variables are demographic components of the studied population: education, income, and ethnicity.

The data on education is obtained from the 2000 government census. Two indicators are used for the education variable. One is the value of the population of mid-level education background divided by the population of education background under elementary level (abbreviated as MEDU in this paper). Another is the value of the population of higher education background divided by the population of education background under elementary level (abbreviated as HEDU).<sup>28</sup>

The variable of income is the average annual income of residents in each township in 2000. That is, the total annual income of township residents divided by the population of that township. The data has been obtained from the Ministry of Finance (財政部) of Taiwan.

Lastly, the data on ethnicity comes from the 2004 survey of the Council of Hakka Affairs (客家委員會). This survey was conducted on the basis of a random sample of 100 interviewees in each township. Interviewees were asked about their ethnic identity, and multiple identities were possible. For instance, one person could simultaneously identify him/herself as Hohlo (or Minnanren, 閩南人) and Hakka. The percentages of respondents who identified themselves as Hakka, mainlander, and indigenous peoples are treated as independent variables respectively. We use the percentage of interviewees who identified themselves solely as Hohlo in each

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<sup>28</sup>Mid-level education refers to junior high school, junior vocational high school, high school, and vocational high school education. Higher education refers to education at and above the college and university levels.

township as the reference category.<sup>29</sup>

We incorporate the variables into four regression models. Two are non-spatial regression models for the periods 1996-2000 and 2000-2004 respectively. We use the ordinary least square (OLS) method to estimate them. The aim is to examine the impact of regional demography on the spatial patterns under examination. We also establish two spatial lag regression models, one for the period 1996-2000 and one for 2000-2004. The aim of these is to test for the existence of the neighborhood effect, after controlling for demographic variables. The spatial lag model is defined as follows:<sup>30</sup>

$$y = \rho W y + X \beta + \varepsilon$$

Where  $y$  is the dependent variable,  $X$  is the demographic variable, and  $\varepsilon$  is the error term. The spatial lag regression model treats the mean value of dependent variables of neighboring areas,  $W y$ , as a spatial lag term. The notation  $\rho$  is the spatial autoregressive coefficient. After controlling for demographic variables, if  $\rho$  still has statistical significance, then we have evidence that the spatial pattern under examination is consistent with a neighborhood effect.

Before commencing the following regression analysis, it is vital to note that we should not use the statistical result of aggregate study to make inferences about the behavior of individual voters. For example, when support for the DPP grows in a township where Hohlo are the dominant population, we can only infer that in a Hohlo-dominated township, the DPP's electoral support will tend to expand. We should not assume that

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<sup>29</sup>As the survey allows multiple identities, the sum of the percentages of different ethnic identifications is more than 100 percent, but only slightly so. Therefore, if we treat the percentage of respondents who have identified themselves as Hohlo as an independent variable, the problem of collinearity will emerge (i.e., the multi-collinearity condition number reaches 45.1). We hence decided to exclude the percentage of respondents who have identified themselves as Hohlo as an independent variable, and treat the percentage of respondents with a single Hohlo identity as the reference category.

<sup>30</sup>Anselin, "Local Indicators of Spatial Autocorrelation (LISA)," 91-115; and Luc Anselin, *Spatial Econometrics: Methods and Models* (Boston: Kluwer Academic, 1988).

Hohlo tend to support the DPP.<sup>31</sup>

### *Regression Analysis*

Let us first look at the result of the regression analysis of the period 1996-2000 (see table 2). When the neighborhood effect is excluded, we find that first of all, the impact of education level on the DPP's expansion was not linear. The more inhabitants with mid-level educational background (compared to those with less than elementary-level education) there were in a township, the more disadvantageous it was for the DPP's expansion. However, when the population with higher education background increased, this favored the DPP's expansion. Secondly, the higher annual income per capita a township had, the more unfavorable it was for the DPP's expansion. Thirdly, the higher the percentage of residents identifying themselves as Hakka, mainlander, or indigenous peoples in a township (compared to those who identify themselves solely as Hohlo), the more disadvantageous it was for the DPP's expansion. Since Hohlo predominate in southern Taiwan, we postulate that the spatial clustering of Hohlo might be one of the factors that led to the DPP's clustered expansion in the south during the period 1996-2000.

The r-square of the spatial lag regression model is larger than that of the non-spatial regression model for the period 1996-2000. The Akaike's information criterion (AIC) of the spatial lag regression model, conversely, was smaller than that of the non-spatial regression model. This implies that the inclusion of the spatial lag term could elevate the goodness-of-fit of the model. After taking into account the neighborhood effect, we surprisingly discover that this effect overrides the impact of mainlander identity. This implies that the effect of mainlander identity as shown in the OLS results is either completely due to the neighborhood effect or at least indistinguishable from the neighborhood effect.<sup>32</sup> We should therefore caution against

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<sup>31</sup>For more information, see W. S. Robinson, "Ecological Correlations and the Behavior of Individuals," *American Sociological Review* 15, no. 3 (June 1950): 351-57.

<sup>32</sup>In contrast, the effects of Hakka and indigenous identities are not completely explained by the neighborhood effect.

**Table 2**  
**Regression Analysis**

Variables	1996~2000	1996~2000	2000~2004	2000~2004
	Non-Spatial <sup>a</sup>	Spatial <sup>b</sup>	Non-Spatial <sup>a</sup>	Spatial <sup>b</sup>
MEDU	-0.036*** (-3.96)	-0.035*** (-5.31)	0.000 (0.02)	-0.005 (-1.24)
HEDU	0.024* (2.32)	0.014 (1.85)	-0.012* (-2.35)	-0.008 (-1.64)
Annual income per capita (100,000 NTD/person)	-0.043*** (-4.84)	-0.024*** (-3.70)	-0.010* (-2.12)	-0.008 (-1.96)
Percentage of Hakka identity	-0.100*** (-8.48)	-0.041*** (-4.52)	0.014* (2.39)	0.012* (2.11)
Percentage of mainlander identity	-0.153** (-3.37)	-0.004 (-0.13)	-0.070** (-3.00)	-0.038 (-1.69)
Percentage of indigenous identity	-0.300*** (-25.17)	-0.183*** (-16.67)	-0.095*** (-15.50)	-0.081*** (-12.59)
Spatial lag		0.580*** (18.60)		0.273*** (5.61)
Constant	0.361*** (28.21)	0.185*** (13.81)	0.155*** (23.62)	0.122*** (13.33)
F-test	127.2***		58.0***	
AIC	-1184	-1384	-1662	-1687
R <sup>2</sup>	0.685	0.831	0.498	0.538
N	358	358	358	358

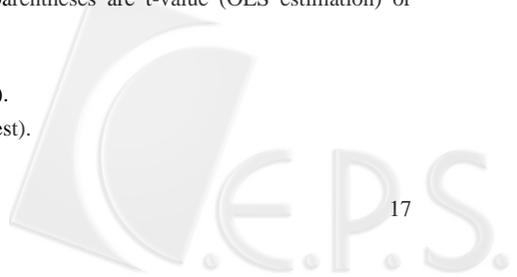
**Notes:**

<sup>a</sup>OLS estimation; <sup>b</sup>maximum likelihood estimation. Numbers shown in the table are unstandardized coefficients; numbers in the parentheses are t-value (OLS estimation) or z-value (maximum likelihood estimation).

\*Significant at the 0.05 level (two-tailed test).

\*\*Significant at the 0.01 level (two-tailed test).

\*\*\*Significant at the 0.001 level (two-tailed test).



exaggerating the effect of mainlander identity on the spatial variation of the DPP's expansion.<sup>33</sup>

Next, we examine the period 2000-2004. When excluding the neighborhood effect, we find that first of all, the more residents with higher education there were in a township (compared to those with less than elementary level education), the more unfavorable it was for the DPP's expansion. This is in stark contrast to the situation in the previous phase. Secondly, as with the period 1996-2000, the higher the annual income per capita a township had, the more disadvantageous it was for the DPP's growth. Also, the higher the percentage of residents identifying themselves as mainlander or indigenous peoples in a township (compared to those who identify solely as Hohlo), the more disadvantageous it was for the DPP's expansion. The impact of Hakka identity underwent a dramatic change during this phase too. The higher the percentage of inhabitants identifying themselves as Hakka in a township, the more likely it was that this township would be favorable for the DPP's expansion.

Moreover, the r-square of the spatial lag regression model is larger than that of the non-spatial regression model for the period 2000-2004. Conversely, the AIC of the spatial lag regression model is smaller than that of the non-spatial regression model. This once again shows that the spatial lag term can boost the goodness-of-fit of the model. After including the neighborhood effect in our analysis, we find that this effect has prevailed over the impacts of education, income, and mainlander identity, implying the importance of the neighborhood effect in prompting the spatial variation of the DPP's expansion.

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<sup>33</sup>Here we would like to make a brief distinction between our research and that of Lin, Wu, and Lee referred to in note 6 above. We find that the neighborhood effect could have played a role in shaping the spatial variation of the DPP's expansion, and that the existence of the neighborhood effect could have made the effect of mainlander identity less significant in shaping the observed spatial patterns. The fact that ethnic identity might be mitigated by the neighborhood effect is what inspired Lin, Wu, and Lee's 2006 article. Readers can refer to their paper for further discussion.

### **Concluding Remarks**

In the course of this paper we have traced the DPP's expansion through the 1996, 2000, and 2004 presidential elections. We have identified a significant regional disparity in the DPP's expansion over time. Through regression analyses, we further find that the effect of "neighbors" in a broadly defined sense and the aggregate effect of regional demographic features have contributed to such spatial patterns.

During the period 1996-2000, the DPP was successful in mobilizing the electorate in Hohlo-dominated townships. Since these townships were most numerous in southern Taiwan, the DPP's expansion exhibited a remarkably high degree of clustering there. This southern bloc of the DPP helped stimulate the public's impression of a "north Blue, south Green" divide.

From 2000 to 2004, the DPP continued to grow in Hohlo-dominated townships, while at the same time it obtained success in mobilizing Hakka-dominated townships. The consequence was that the DPP was able to expand in a large part of western Taiwan, and hence exhibited a rather dispersed pattern of expansion.

From the analysis presented thus far, we can see that the story is partly about the aggregate social cleavages representing in space, and partly about the influence of more broadly defined neighborhoods, that resulted in the spatial variation of the DPP's expansion. The first part of the finding complements a plethora of studies dedicated to the exploration of socio-economic and demographic factors in the outcomes of national level elections in Taiwan. The interesting discovery of the neighborhood effect in the second part of the story directs us to a more complex and involved network model of behavior. It is possible that some campaign mobilization efforts or the socialization of one's network contributed to the spatial patterns that we are interested in exploring. The spatial lag regression models employed here, however, cannot identify the specific mechanisms that caused the neighborhood effect. These remain to be discovered through future research. At best we can only conclude that a comprehensive grasp of local demographic components, as well as skillful use of social networks

and campaign mobilizations to create the neighborhood effect, would give an electoral candidate a strategic advantage.

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