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Cooperation and competition: a GIS pilot study of Taichung's district Bookstart programme

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Policy innovation and diffusion are vital for ensuring the well-being of the general public by providing the services they need. Cooperation and competition between jurisdictions are seen as important mechanisms for the diffusion of innovation. This study examines cooperation and competition in the innovation diffusion process and presents a case study of the Bookstart programme in the libraries of Taichung County, Taiwan. Using a geographic information system (GIS), it examines whether cooperation and competition are spatially dependent. The findings demonstrate that the level of cooperation is not autocorrelated with neighbouring districts, and that there are limited examples of competition. We argue the case for the use of GIS in studies of policy diffusion.

Keywords: Bookstart; policy innovation; policy diffusion; geographic information system

Introduction

Policy innovation and diffusion are vital to organizational competitiveness and the well-being of the general public (Rogers 2003). Public bureaucracies need to create innovative cultures to nurture new ideas, and a facilitative diffusion mechanism must be designed to enhance policy-learning activities (Walker 2008). The Bookstart programme, which was initiated in the UK, is an interesting example of international policy innovation and diffusion. The importance of family education and developing skills for the next generation is increasingly recognized by many countries. The Bookstart programme was implemented by the national independent charity Booktrust in 1992, with joint effort from the School of Education at the University of Birmingham and several medical and library organizations in the city of Birmingham. Drawing on a range of qualitative and quantitative evidence, subsequent research has shown the effectiveness of Bookstart as an intervention strategy to facilitate literacy learning in the early years. Studies have found that households that enrol in the programme show an increased interest in reading books, buying books and visiting libraries (Moore and Wade 1997, 2003).

The successful experience of encouraging children's early reading habits in the UK attracted the attention of the Hsin-Yi Foundation in Taiwan. The foundation, in collaboration with the Shen-Po District Library in Taichung County, was the first to adopt the Bookstart programme in Taiwan in 2003. By 2008, all district libraries in Taichung County had adopted the programme as part of their services, and it has gradually diffused to other jurisdictions in Taiwan.[1] In 2009, the Ministry of Education officially announced

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Bookstart as a nationwide policy, through which funding was competitively provided to support five libraries a year in each local government.

There is abundant evidence that public policies diffuse across, between and within countries (see Berry and Berry 1990, Mooney and Lee 1995, Rogers 2003). These studies often enquire why one jurisdiction's policymakers are influenced by the policy choices of others. Although several explanations have been proposed, two of the most common suggestions are policy learning and economic competition (Boehmke and Witmer 2004). Learning theory posits that state officials tend to draw on the experiences of nearby neighbours when considering whether they should adopt a policy. Economic competition explains policy diffusion as a response to pressures from other jurisdictions in the form of lost business and tax revenues (Berry and Berry 1990, 1992, Eadington 1999). Although learning and economic competition are fundamentally different forms of intergovernmental relations, both result in the diffusion of policy across different areas. The policy choices of one state are influenced by the choices made by others in the process of policy diffusion. A vast majority of empirical tests of such models have relied on a similar specification of influence – one that assumes that states are equally affected by all of their neighbours and unaffected by more distant states (Berry and Baybeck 2005).

We present a case study of the diffusion of Taichung's Bookstart policy and analyse whether the level of cooperation or competition between libraries is spatially dependent. Spatial dependence may arise when a library's cooperation or competition levels are correlated with those of neighbouring areas. Although such correlations can be a statistical artefact, they can also be grounded in the spatial diffusion of public policy learning. In this study, we use a geographic information system (GIS) to examine this question because, although GIS is a promising tool for examining questions of policy diffusion, it has rarely been used in the study of public administration and policy and, to the best of our knowledge, has not been previously used in such studies in Taiwan. The remainder of this article is organized as follows. The 'Literature review' section briefly summarizes the policy diffusion literature on cooperation and competition. The data, methods and analyses are then outlined before the presentation of the empirical analysis. In conclusion, the value of GIS systems as a methodological tool is discussed.

Literature review

Scholars have argued that units of government administration are influenced by the policy choices of others because policymakers learn from the experiences of other public organizations. Glick and Hays' (1991) study on policy reinvention demonstrated that later-adopting states learn from earlier-adopting states and that states adapt innovations to their own circumstances as they diffuse. Mooney and Lee (1995) similarly found evidence that public policy spreads from neighbour to neighbour or across similar states. It has been suggested that when confronted with a problem, decision makers simplify the task of finding a solution by choosing an alternative that has proven successful elsewhere (Walker 1969, Berry and Baybeck 2005, p. 505). Most scholars who identify learning as the cause of influence between public organizations argue that the diffusion of policy tends to be regional, with states looking primarily towards their neighbours or other nearby localities for policies to emulate. Proximate states tend to share cultural, socioeconomic and political characteristics that make them excellent 'laboratories' for observing the likely effect of a policy choice (Berry and Baybeck 2005, p. 505).

In contrast, the process of diffusion through economic forces develops from competition between nearby localities for business and tax dollars. In the United States, states

may compete over citizens by offering different mixes of taxes, expenditure and public policies (Tiebout 1956). Different policies, however, may produce different patterns of diffusion as a result of economic competition. Scholars argue that welfare policies may produce a race to provide ever-decreasing benefits to avoid being a magnet for welfare recipients (Volden 2002). Conversely, competition over policies that provide financial resources, such as gambling, may provide an incentive to increase the extent of the policy as neighbouring states compete over business and tax revenues (Berry and Berry 1990, 1992, Eadington 1999). For example, Boehmke and Witmer (2004) explored the adoption of Indian gaming compacts among states, and argued that learning and economic competition are both important factors in explaining initial adoption. In their findings, only economic competition explains subsequent compacts because previous experience with one's own compacts removes the need to learn from the experiences of others. Berry and Baybeck (2005) argued that learning can happen across states, whereas economic competition is typically confined to individuals living near state borders. Using GIS technology, they tested the effects of learning and competition to explain lottery adoptions and welfare benefit levels.

All of the works described above emphasize the role of spatial context and proximity, exemplifying an acute awareness of the role of space in policy diffusion. The methods used may not be perfectly aligned with the theory, but the spatial component in the theories themselves could not be clearer. Advances in GIS are relatively recent, and the earliest foundational studies were not able to take advantage of the GIS tools that have become available over the past decade. At present, we are in the midst of another wave of research centred on the same substantive questions, but using tools that are more finely tuned for answering them.

In general, regardless of whether scholars point to learning or competition (or both) to justify their models of interstate influence, the vast majority of empirical tests of such models have relied on a similar specification of influence, one that assumes that states are affected equally by all of their neighbours and unaffected by more distant states. We test these ideas using GIS systems in Taichung County, Taiwan.

Methods

Data and measures

The data for this analysis were drawn from 29 survey interviews completed in the 32 district libraries of Taichung City in 2011. These district libraries implemented the Bookstart programme several years ago, and thus the survey respondents were experienced in the promotion of Bookstart. The section of the questionnaire used in this study asked respondents about learning, coordination and competition.

The empirical analysis uses the two dependent variables of the cooperation and competition levels across Taichung district libraries. The first two questions asked were 'Has your library cooperated with other libraries for the programme?' and 'Has your library competed with other libraries for the programme?' No cooperation or competition was recoded as 0. The following two questions were 'How do you think the cooperation levels between your library and other libraries in the Bookstart programme?' and 'How do you think the competition levels between your library and other libraries in the Bookstart programme?' These two variables measured the self-rated cooperation and competition levels with other libraries and were scored from 1 (weak) to 5 (strong). Table 1 summarizes the cooperation and competition levels among the 29 libraries. Ten libraries answered that they had cooperated with others in the programme. Figure 1 shows that the librarians of West, Wuqi, Longjing and Fengyuan

Table 1. Cooperation and competition level among Taichung's district libraries.

Libraries	Cooperation	Competition	Cooperation level	Competition level
South	No	Yes	0	5
East	Yes	No	3	0
West	Yes	No	3	0
BeiTun	Yes	No	1	0
Dajia	Yes	Yes	2	4
Wuqi	Yes	Yes	4	4
Longjing	Yes	No	4	0
Waipu	Yes	Yes	3	5
Fengyuan	Yes	No	4	0
Dali	Yes	Yes	3	1
Central	No	Yes	0	5
North	No	Yes	0	1
NanTun	No	Yes	0	1
Daan	No	No	0	0
Shalu	No	No	0	0
Houli	No	No	0	0
Wuri	No	No	0	0
Tanzi	No	No	0	0
Taiping	No	Yes	0	1
Wufeng	No	No	0	0
Xinshe	No	No	0	0
XiTun	No	No	0	0
Qingshui	Yes	No	3	0
Dadu	No	No	0	0
Shengang	No	No	0	0
Daya	No	No	0	0
Dengshi	No	No	0	0
Shigang	No	No	0	0
Heping	No	No	0	0

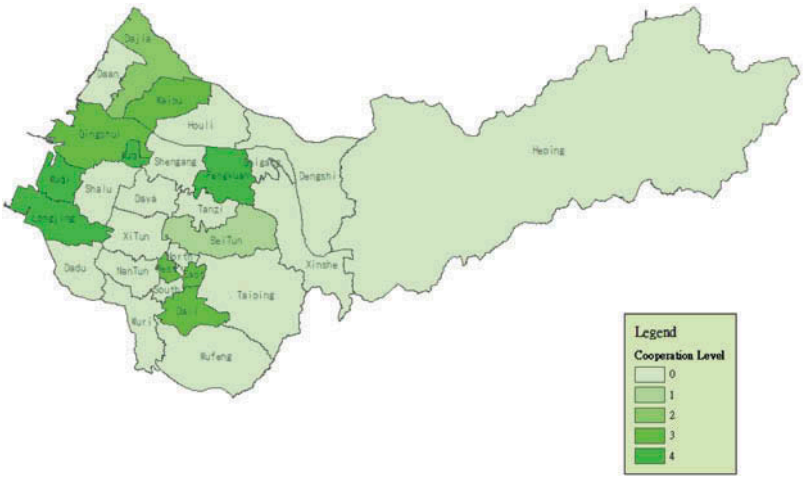

Figure 1. Taichung's district library cooperation level.

perceived their cooperation levels to be higher than those of other libraries. Nine libraries reported that they had competed with others. The librarians of Waipu and South rated their competition levels as the highest among Taichung's public libraries (Figure 2). The responses to these questions are used in the GIS analysis reported in the following.

Following the GIS results, we present the results of a regression model used to identify the factors that could influence the levels of competition and cooperation. Income, education, cultural expenditure, infant numbers and degree of urbanization are included as control variables. Districts with high-income populations may promote innovative education programmes more vigorously, which may force a library to cooperate or compete with other libraries. Cultural expenditure and infant numbers are included because they are directly related to Bookstart performance. People who reside in urban areas may value education more than those in rural areas, so urbanization may affect the libraries' levels of cooperation and competition with others in the Bookstart programme. Therefore, we also control for urbanization.

All of these control variables are measured at the district level. Table 2 summarizes the data sources and descriptive statistics. Income is measured as the percentage of people

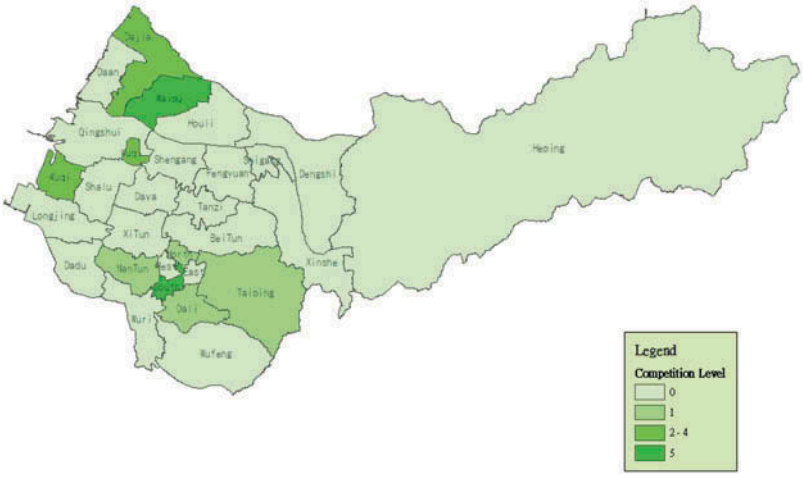

Figure 2. Taichung's district library competition level.

Table 2. Variable definitions and descriptive statistics.

Variable	Definition	Mean	Standard deviation	Minimum	Maximum
Income*	Average per cent of people below the poverty level, 2009–2011	7.1276	2.20166	2.85	12.74
Education*	Average per cent of people with a college degree, 2009–2011	15.799	5.46922	6.57	28.76
Cultural expenditure*	Average district's cultural budget, 2009–2011 (thousand NT dollars)	8490.1503	6759.94686	592.71	21,954.67
Infant*	Average number of infants, 2009–2011	4071.4703	2740.32173	476	10,443.67
Rurality	Liu *et al*. (2006)	1	7	3.1	1552

Note: *Department of Budget, Accounting and Statistics in Taichung City.

below the poverty level and education is measured as the percentage of the adult district population with at least a bachelor's degree. Cultural expenditure is measured as the cultural affairs budget for each district. The level of urbanization of the cities/towns within which parturient women resided at the time of delivery is stratified into seven classifications (from 1 indicating the most urbanized to 7 indicating the least urbanized). This widely adopted classification method was proposed by Liu *et al.* (2006) of the Taiwan National Health Research Institute based on 2000 Taiwan census data. All 359 cities/towns in Taiwan are stratified into the seven levels based on a composite score obtained by calculating the population density (people/km^2), population ratio of people with a college-level education or above (%), ratio of people over 65 years (%), ratio of agricultural workers (%) and number of physicians per 100,000 people.

Analysis

The level of cooperation and competition are analysed using spatial autocorrelation in GeoDa. We test the global spatial autocorrelations for cooperation and competition levels using Moran's I statistic, $I = \frac{n\sum\sum wij_{(x_i-\bar{x})(x_j-\bar{x})}}{\sum\sum wij\sum(x_i-\bar{x})^2}$, where n is the number of cases, x_i is the variable value for a particular district, x_j is the variable value for another district and wij is a weight applied to the comparison between district i and district j. $wij = 1$ when i and j share common boundaries and = 0 when i and j do not share common boundaries (Anselin 1995). For example, in this study, the district (a polygon) is used as the research unit, and when one district shares a common boundary with another district, the weight equals 1; otherwise it is 0. Similar to a correlation coefficient, it varies between –1.0 and +1.0. When the autocorrelation is high, the coefficient has a high value, and a high I value indicates a positive autocorrelation. When the p-value is less than .05, the statistic is significant. The results reveal whether a statistically significant degree of positive spatial dependence exists in the distribution of competition or cooperation levels among the districts in Taichung County.

Moran's I is calculated by standardizing the spatial autocovariance and is classified as either a global Moran's I or local Moran's I, depending on whether a single measure of the spatial autocorrelation of an attribute is for the whole region (global autocorrelation) or the effect of each unit within the region on nearby units (local autocorrelation). The results of the local Moran's I distinguish between a statistically significant (.05 level) cluster of high values (HH), a cluster of low values (LL), an outlier in which a high value is surrounded primarily by low values (HL) and an outlier in which a low value is surrounded primarily by high values (LH).

A regression model is used to examine the effects of cooperation and competition. We model the cooperation or competition level as a linear function of the predictor variables. If the residuals are spatially autocorrelated, we correct for the spatial autocorrelation by using maximum likelihood techniques to estimate either a spatial error or spatial lag model.

Results

The results are presented in two parts. The GIS results that tease out the role of competition and cooperation in innovation diffusion are examined, followed by the regression results. Table 3 reports the Moran's I and associated p-values for the outcome variables included in the analysis. Overall, the outcome variables – cooperation level and competition level – show little spatial autocorrelation. The global spatial autocorrelation of cooperation level in

different neighbourhoods is not significant, with a Moran's I of –0.0548. This means that cooperation level is not autocorrelated with the cooperation level in neighbouring districts. Therefore, the spatial distribution of cooperation level is random and is not highly clustered. Similar patterns are shown in the level of competition (Moran's I = –0.0297). This means that competition level is not highly clustered among Taichung's districts.

The local spatial autocorrelation explores the relationships between districts in terms of cooperation and competition levels. The local spatial autocorrelation analysis of cooperation levels in Taichung City shows high–low autocorrelations for Fengyuan and West. This means that these two areas with higher cooperation level scores are adjacent to areas with lower cooperation level scores. In contrast, Wuqi shows a high–high autocorrelation, as it has a higher cooperation level score and is adjacent to other areas that have high cooperation level scores (Figure 3). In contrast, the local spatial autocorrelation analysis of competition level in Taichung City shows that there are no high–high, low–low, low–high or high–low spatial autocorrelations among Taichung's districts (Figure 4).

Table 4 summarizes the estimation results for cooperation and competition levels. The results of the LM lag and LM error tests show that spatial dependence is not significant, and these results are similar to the global spatial autocorrelation results. Therefore, we run the regression model without controlling for spatial dependency. The only significant finding is that cultural expenditure has a positive effect on libraries' cooperation levels. District libraries with higher cultural affairs expenditures are more likely to cooperate with other libraries in the Bookstart programme. When libraries face budget pressure, they are more likely to cooperate with others to reduce the cost of the programme.

Table 3. Spatial autocorrelation of the variables across Taichung districts.

Variable	Moran's I	p-Value
Cooperation level	−0.0548	.54
Competition level	−0.0297	.57

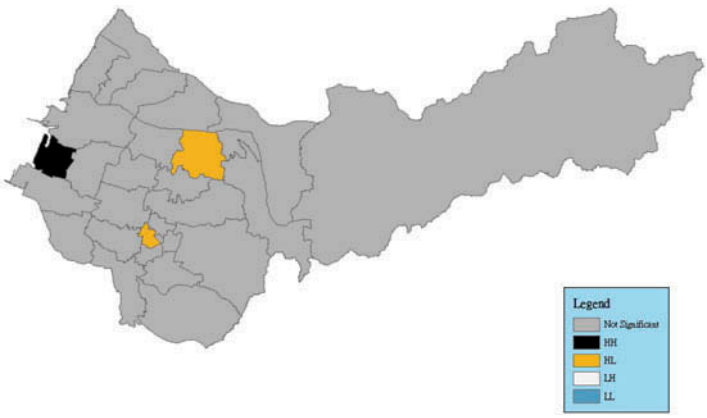

Figure 3. Map of the cooperation level–local spatial autocorrelation in Taichung.

Note: HH, high values surrounded by high values; LL, low values surrounded by low values; LH, low values surrounded by high values; HL, high values surrounded by low values.

Figure 4. Map of the competition level–local spatial autocorrelation in Taichung.

Note: Not significant, areas that are not significant at a default pseudo significance level of .05; HH, high values surrounded by high values; LL, low values surrounded by low values; LH, low values surrounded by high values; HL, high values surrounded by low values.

Table 4. Outcomes as cooperation and competition levels.

Variable	Cooperation	Competition
Intercept	−1.179	0.029
Income	−0.021	0.168
Education	0.089	0.076
Cultural expenditure	9.836e–005*	4.333e–005
Infant	1.813e–006	−0.0002
Rurality	0.034	−0.297
R^2	0.149	0.190
LM lag	0.403	0.530
LM error	0.542	1.013

Note: *Significance at the .10 level.

Discussion

This study explores whether the levels of cooperation and competition among Taichung's public libraries are spatially autocorrelated. The global autocorrelation findings show that the cooperation level of a district is not autocorrelated with the cooperation level in neighbouring districts. Similar results are found for competition levels. The local spatial autocorrelation analysis of competition levels in Taichung City shows that Fengyuan and West have high–low autocorrelations, meaning that these three areas with lower competition level scores are adjacent to areas with higher competition level scores. In contrast, a high–low autocorrelation is found for Wuqi, which has a higher competition level score and is adjacent to areas with higher competition level scores. The ordinary least squares (OLS) analysis shows that budget has an effect on cooperation levels. Thus, more financial resources may trigger greater cooperation among the libraries in the Bookstart programme.

In this pilot study, no specific spatial pattern of policy diffusion could be identified, and one of the likely explanations is that the sample size was not large enough to provide the more in-depth information demanded by techniques such as GIS. Another possible reason is that the survey was completed by the head librarians, and subjective self-reported information may include bias.

Although the results are not highly significant, there are still some important implications for policy diffusion. First, Taichung County was the first local government in Taiwan to adopt the Bookstart programme, and Taichung City followed this approach. The policy diffusion pattern in Taichung County followed a kind of bottom-up style, whereas the Bookstart diffusion pattern in Taichung City was somewhat top-down. The time lag and different incentive mechanisms or cultures imbedded in different local governments may play a role in the policy diffusion process, and these factors need to be examined carefully in the future.

Second, the major function of the GIS method is to provide the spatial distribution of data collected by researchers. Therefore, the richness of the data bank is critical to future studies. In addition to socioeconomic factors, variables such as institution, culture, leadership, collaborative activities and network relationships need to be included in the GIS data bank. Third, financial resources affected the cooperation among libraries. This indicates that except for voluntary policy-learning activities, it is necessary to design a well-structured incentive system to facilitate policy diffusion.

Innovation is 'a process through which new ideas, objects, and practices are created, developed, or reinvented, and which are new for the unit of adoption' (Walker 2008, p. 592). Innovation diffusion is 'the process by which an innovation is communicated through certain channels over time among the members of a social system' (Rogers 1995, p. 35). Bookstart is a new idea to librarians and was initially a policy innovation for Taichung County. Gradually, the Bookstart programme was adopted by other local governments and finally became a nationwide policy. This certainly provides evidence of policy diffusion. GIS is a useful tool, but needs a well-organized data bank, and future studies on policy diffusion need to be aware of the data demands of the technique. GIS offers a powerful visual tool to check policy diffusion patterns over space and time. A *space-time* cluster *analysis* examines location at the *time* of policy diffusion. In addition, a spatial autocorrelation and spatial regression model can help researchers to examine whether a policy significantly spills over to or is imported from neighbours while controlling for other factors.

Note

1. In 2011, Taichung County was merged with Taichung City, after which there were 29 district libraries in Taichung City.

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