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重罪空間外部性效應之政策分析-空間杜賓模型應用

Policy Analysis on Spatial Spillover Effects of Serious Crime-An Application of Spatial Durbin Model

Chich-Ping Hu[1]

Professor, Department of Urban Planning and Disaster Management, Ming Chuan University.

Abstract

There were significant declines in serious crime which is associated inversely with increases in gross domestic product in Taiwan over the period from 2005 to 2015. Misdemeanor policing derived from the Broken-Windows hypothesis suggested that along with the increase in arrest for minor offense, and then the increased social control in evil motivation would discourage the anti-social behaviour of individuals. This paper applies Spatial Durbin Model to estimate the serious crime affected by deterrence of anti-social events with application of spatial econometric techniques in Taiwan. This paper finds remarkable decline in serious criminal activity is attributable to improved economic condition and minor offense control. However, both economic incentive and social control by misdemeanor policing and their spatial lag terms are important in explaining this decline. Spatial Durbin model is the best one to fit this explanation for serious crime reduction in Taiwan. Additionally, spatial spillover effect from economic incentives and minor offense deterrence is a significant factor to consider when the public policy is formulated to crime reduction.

Keywords: Spillover effects, Spatial Durbin model, Misdemeanor policing, Serious crime, Spatial lag

[1] 銘傳大學都市規劃與防災學系教授。

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1. Introduction

There were significant declines in serious crimes in Taiwan over the period from 2005 to 2015. In these years, criminal rates fell by about 27.53 percent and violent crime rates fell by about 66.75 percent while average family current income increased by about 5.10 percent in Taipei city[2]. Many other cities experienced even better than capital trends in heavy offenses reduction. The decrease of violent crime rates in NewTaipei city, GaoXiong city, TaoYuan city, TaiZhong city, and TaiNan city ranged from 75.19 percent to 94.32 percent. The most significant paper proposed by Wilson and Keeling (1982) suggested that aiming at minor disorder could help reduce more serious crimes. The adoption of "Broken-Windows" hypothesis generated a revolution in policing and law enforcement practically. Furthermore, New York, Chicago, and Los Angeles have all adopted some recommended practices of Wilson and Keeling's Broken-Windows hypothesis with forceful enforcement of misdemeanor laws. In addition, literatures found that there were many social problems including vacancy especially arising from the inefficiency of housing market to influence social order to cities. One potential impact of increase in housing market inefficiency in a city is vacancy which has been proved to lead to high levels of crime empirically (Cui and Walsh, 2015). No matter ubiquitous policy influence over the cities of Wilson and Keeling's paper in 1982, still not yet is confirmed whether the direct effects as well as the spillover effects of Broken-Windows hypothesis are significant practically elsewhere. The new technique of geographical information system for investigation and spatial tools in statistics bring with it growing interest in spatial investigation on crime. This enhancement in practical analysis capability expands theory from the perspective of understanding the causes of criminal behavior, and practice from the perspective of proposing effective social control interventions to reduce serious crimes. The availability of spatial data and the ability on investigations for serious crimes reduction still remains to be demonstrated and depends on the nature of the relationship between criminal cases and geographical places. Since spatial attributes act as factors to commit serious crimes because that either individuals who or facilities that are located there interventions designed to alter those persons and activities would well affect criminal behaviors. If the spatial distribution of serious crimes is geographical random, then policy aiming at specific places is not likely to be an effective policy in serious crimes reduction. Literatures in opposites believe that reduction in serious crimes was influenced by other factors including economic growth enjoyed both in local cities and nationally and housing market efficiency deviated both in submarket locally and nationally. Whether misdemeanor policing and economic growth condition will be effective tools for crime reduction has become an important political issue in Taiwan. What is the spatial effects on crime reduction affected by minor offense deterrence and that from neighboring places.

[2] Serious criminal cases include violent crimes, serious larceny cases, motor vehicle theft cases.

The purposes of this paper are threefold. First, it measures the effects of economic incentives and misdemeanor policing on serious crime reduction in Taiwan. Spatial Durbin model is applied to comprise explaining variables and those of neighboring places jointly in a serious crime supply equation allows it to estimate the influence extent of economic incentives and misdemeanor policing on crime reduction. Secondly, it tests the significance of Broken-Windows hypothesis by using the cross-section data from Survey Research Data Archive which was founded in 2015 in Taiwan to construct the serious crimes supply equation with Spatial Durbin Model. Thirdly, it investigates the direct and indirect effects on serious crime reduction of relative housing economic variable including vacant housing to connect crime to housing market equilibrium.

2. Literatures

In the literatures of Levitt (1996, 1997, 1998), Corman and Mocan (2000), Mocan and Gittings (2003), Mustard (2003), Devia and Weber (2013) and He et al. (2017) concluded a significant effect of reductions on serious crimes by misdemeanor policing. Although varied in both of variables and econometric methods, all of the literatures found that variables associated with expected reduction are more significantly connected to serious crimes than those results investigated in previous literatures as a result of minor offense deterrence policy. For other discussions on the topics of serious crimes which is influenced by unemployment, wages, public finance, and demographics this paper refers researchers to Corman et al. (1987), Grogger (1998), Raphael and Winter- Ebmer (2001), Gould et al. (2002), and Armytage (2010) and these references have suggested a strong effect of economic incentive policy on serious crimes reduction. Broken-Windows hypothesis indicated that along with the increase in arrest for misdemeanor, the increased social control and the economic incentives for reduction in evil motivation would change the behavior of individuals. Researches of serious crimes in recent years appeared to concern about spatial interaction with regression models by using cross-sectional and panel data (Paelinck and Klaassen, 1979; Anselin, 1988). Spatial econometric model which focused on location and spatial interaction has recently gained a visualized technique knowledge not only in applied but also theoretical econometrics. Spatial econometric techniques have increasingly been applied in a wide range to research empirically in traditional fields of economics including demand analysis, international economics, labor economics, public economics and local public finance, and agricultural and environmental economics (Anselin, 1992; Anselin and Florax, 1995; Anselin and Rey, 1991; Pace and Barry 1998). Guerry (1833) and Quetelet (1842) initiated spatial approaches to the theory of crime and other researches using spatial econometrics on crime originated their roots from the study of Shaw et al. (1929) and Shaw and Mackay (1942). Research which appeared to concern about crime in space increased over this last decade. Roncek and Maier (1991) found a positive correlation between the levels of serious crimes and the number of taverns and lounges located at blocks in Cleveland. Roncek and Maier (1991) whose research examined the spatial distribution of serious crimes clearly found that certain land uses and population characteristics were associated with serious crimes hot spots. The identification of serious crimes hot spots was a dividing line in paying attention to spatial properties of serious crimes (Sherman et al., 1989). Skogan and Maxfield (1981) stated that housing market efficiency, public insecurity including fights and other social disorders would increase citizens' mental burdens and community serious crimes. To what extent locational analysis of hot spot as well as cold spots contribute to determine whether serious crimes concentrates or not depends on the spatial autocorrelation levels of serious crimes observed between hot spots and neighbors. Hot spot clusters with high serious crimes indicates location with concentration of criminal activities, those of cold spot with low serious crimes indicates location whose criminal activities decentralizes spatially. However, outlier cluster with opposite trend between this location and neighbors indicates spatial heterogeneity of serious crimes.

Is it an effective tool to employ misdemeanor policing to reduce serious crimes and improve social safety for Taiwan? What is the measurement of spatial externality from misdemeanor policing and economic growth condition on serious crime reduction?

3. Hypothesis

This paper applies spatial econometric techniques and criminal data in Taiwan to test the Broken-Windows hypothesis for policy making and social security network guides. Spatial regression model provides not only an estimation by traditional ordinary least square technique but also a spatial spillover effect from neighboring places by estimating those explanatory variables levels for effective resources allocation. Cross-city defense by either city consolidation or government coalition becomes the method to internalize spatial externality from serious crimes. Spatial consideration of Broken-Windows hypothesis, which helps to deal with interaction effects among geographical units by adding lags of the dependent variable and the explanatory variables provides a useful tool to estimate the magnitude of direct and indirect effects. This paper examines the effects of serious crime reduction affected by economic growth condition and misdemeanor policing to test the following hypotheses. (refer to Figure 1)

(1) Hypothesis I: economic growth condition has a significant effect on serious crime reduction.

(2) Hypothesis II: misdemeanor policing has a significant effect on serious crime reduction.

(3) Hypothesis III: serious crime reduction is influenced by economic growth condition and misdemeanor policing and those of neighboring places.

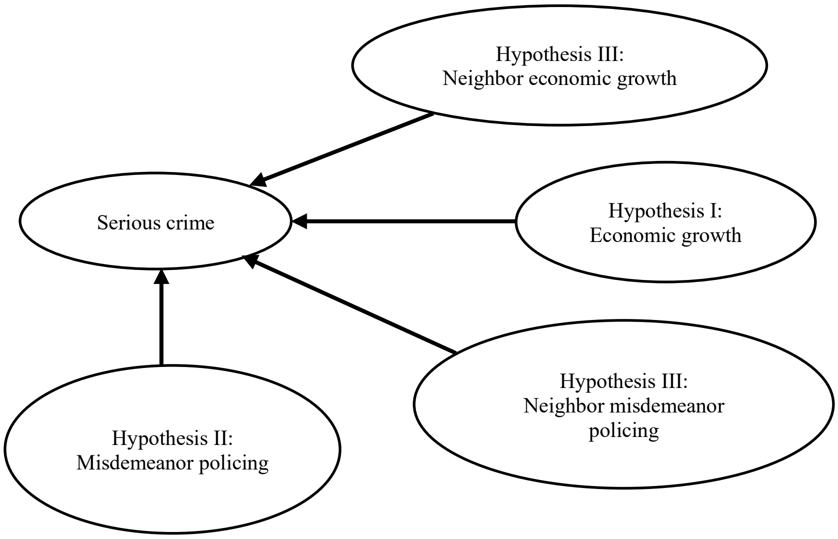

Figure 1. Research hypothesis

Source: Organized by this research

4. Spatial Econometric Model

There is a spread effect of serious crimes when a policy to reduce criminal activity has occurred in a place and in addition there are reduction benefits in places closed to that district where are not targeted for reduction. In contrast, a reduction may lead to spatial displacement of serious crimes which refers to relocation of such criminal activity form one place to another. However, displacement can be regarded as the opposite spread effect, some report still recognizes benefits due to decreases in total serious crimes prior to reduction and minor criminal activities instead. Negative effects of displacement from concentration of serious crimes can’t help but focus either on harm from serious crimes on vulnerable groups or those relocation to districts where they have even more impact. Spatial autocorrelation can be divided into cluster, dispersion, and random by estimating feature similarity with Moran’s index whose value ranges from -1 to +1 (Moran, 1948; Cliff and Ord, 1973). In general, Moran’s Index value near -1 indicates dispersion while an Index value near +1 indicates clustering. However, without statistical significance for researchers to find if observed pattern is just one of possible version of random. In this paper, Moran’s I^t statistic of variable x at time t for Taiwan is expressed as:

$$I^t = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}^t} \times \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}^t\left(x_i^t - \overline{x^t}\right)\left(x_j^t - \overline{x^t}\right)}{\sum_{i=1}^{n}\left(x_i^t - \overline{x^t}\right)^2}, \quad (1)$$

Where n as the number of observation, w_{ij}^t as a spatial distance weight between city i and city j, x_i^t as the level of variable x of city i at time t, $\overline{x^t}$ as the expected value of variable x at time t. Moran's I^t which provides a global value of spatial autocorrelation index is used to test if the cities are spatial autocorrelation (Lee and Wong, 2001). There is no spatial autocorrelation if $I^t = 0$. The value of I^t ranges from -1 to +1. Value of $I^t > 0$ indicates positive autocorrelation while $I^t < 0$ indicates negative autocorrelation for activities occurred among cities.

As an operational definition, the local indicator of spatial association (LISA) is suggested to investigate the relationship between city i and its' neighboring cities. The local Moran's I_i^t statistics for city i is expressed as:

$$I_i^t = \frac{x_i^t - \overline{x^t}}{\sigma^t} \times \sum_{j=1}^{n} \left[w_{ij}^t \times \frac{x_j^t - \overline{x^t}}{\sigma^t} \right], \quad (2)$$

Where σ^t as standard deviation of variable x at time t, access a null hypothesis of spatial randomness by comparing the values of each city with the values of neighbors. It is useful as it allows decomposition of spatial autocorrelation into four quadrants: when a city with an above average value is surrounded by neighbors whose value are all above average value (high-high; HH), when a city with below average value is surrounded by all neighbors with below average value (low-low; LL). The other two decompositions may be: when a city with an above average value is surrounded by all neighbors with below average value (high-low; HL), and vice versa (low-high; LH). A scatterplot of w_x which is a spatial lag of x, $\sum_j w_{ij} x_j$, on x, with the linear regression line fitted, provides insight into the extent to which individual (x, w_x) pairs influence the global measure, exert leverage, or may be interpreted as outliers, according to the extensive set of standard regression diagnostics. The use of standardized values also allows the Moran scatterplots for different variables to be comparable. The four quadrants in coordinate system of (x, w_x) correspond to the four types of spatial association. The lower left and upper right quadrants indicate spatial clustering of similar values: low values (that is, less than the mean) in the lower left and high values in the upper right. Stated differently, the lower left pairs would correspond to negative values, and the upper right pairs to positive values. The upper left and lower right quadrants indicate spatial association of dissimilar values: low values surrounded by high neighboring values for the former, and high values surrounded by low values for the latter.

$$y = X\beta + u, \quad (3)$$

With y as a vector of a serious crime, X as a matrix of explanatory variables, β as a parameter, and u as a vector of random disturbance terms. In the standard linear regression model, spatial dependence can be incorporated in three distinct ways: as an additional regressor in the form of a spatially lag dependent variable (spatial lag model; SLM), additional regressors in the form of spatially lag explanatory variables (spatial Durbin model; SDM), and in the error structure (spatial error model; SEM). Formally, a SLM of a serious crime is expressed as:

$$y = \rho Wy + X\beta + u, \quad (4)$$

Where ρ is a spatial autoregressive coefficient, Wy is a vector of spatial lag term of a serious crime. A SEM which treats spatial correlation primarily as a nuisance is expressed as:

$$y = X\beta + \lambda W\xi + u, \quad (5)$$

Where ξ is a vector of spatial component of error term, λ is a coefficient which indicates the extent to which the spatial component of the errors are correlated with one another for nearby cities. A SDM is a generalization of a SLM which also includes spatially weighted variables as explanatory variables, and the equation is as:

$$y = \rho Wy + X\beta + WX\theta + u, \quad (6)$$

Where WX is a matrix of spatially weighted regressors, and θ is a coefficient of spatially weighted variable.

The spillover effects corresponding to these models are reported in Table 1. In terms of special association, a OLS model does not allow for spillovers since it makes the implicit assumption that outcomes for different units are independent of each other, which is restrictive especially when dealing with spatial data. Even though a SEM takes into account spatial dependence in the disturbance process, it also provides no information about spillovers, as shown in Table 1. This is clearly a major limitation of a SEM if measuring the effects of spillovers is of great interest. The direct effect, which is the effect of a change of a particular explanatory variable in a particular unit on the dependent variable of the same unit, is the only information provided. Therefore, if researchers want to obtain inference on spillovers, alternative spatial econometric models need to be considered. A SLM including a spatial lag dependent variable provides an empirical assessment of the magnitude and significance of spillover effects. This is clearly an advantage compared to the other widely used SEM. If the SLM model is rewritten to its reduced form, the direct and spillover effects can be obtained as:

$$y = (I - \rho W)^{-1} X\beta + (I - \rho W)^{-1} u, \quad (7)$$

Where the matrix of partial derivatives of the expectation of y with respect to the explanatory variable X is as:

$$\frac{\partial y}{\partial X} = (I - \rho W)^{-1}\beta, \quad (8)$$

Where the diagonal elements above equation represent the direct effects, while the off-diagonal elements contain the spillover effects. To obtain the direct and spillover effects shown in Table 1, the SDM can be expressed in its reduced form as:

$$y = (I - \rho W)^{-1}(X\beta + WX\theta) + (I - \rho W)^{-1}u, \quad (9)$$

Where the matrix of partial derivatives of y with respect to the explanatory variable X is obtained as:

$$\frac{\partial y}{\partial X} = (I - \rho W)^{-1}(I\beta + W\theta), \tag{10}$$

Where the diagonal elements of the matrix represent the direct effects and the off-diagonal elements indicates the spillover effects. (refer to Table 1). Table 1 provides the estimation of direct effect and spillover effect for spatial regression model and non-spatial regression model.

Table 1. Direct effect and spillover effect of spatial regression model and non-spatial regression model

Model	Direct effect	Spillover effect
OLS/SEM	β	0
SLM	Diagonal elements of $(I - \rho W)^{-1}\beta$	Off-diagonal elements of $(I - \rho W)^{-1}\beta$
SDM	Diagonal elements of $(I - \rho W)^{-1}(I\beta + W\theta)$	Off-diagonal elements of $(I - \rho W)^{-1}(I\beta + W\theta)$

Source: Organized by this research

5. Regression Results

In order to investigate the spatial distribution and effect of criminal cases, this paper uses the data of fourteen counties and cities and six municipalities in Taiwan from 2005 to 2015 on the web of Directorate-General of Budget, Accounting and Statistics (Table 2). Table 2 shows definitions of variables and lists measurement units and hyperlinks of data bases on the web in this study. It has been hypothesized that “Broken-Windows” hypothesis, formulated by Wilson and Kelling, targeting minor disorder inhibition could help reduce serious crimes. Dependent variable used in this study is criminal case which contributes substantially to the burden of death in Taiwan. According to the variables used in Corman and Mocan(2005), the explanatory variables in this paper including misdemeanor policing and economic growth condition and those of neighboring places are introduced to investigate direct and indirect effects on serious crime. The data used in this study is from the Directorate-General of Budget, Accounting, and Statistics, Executive Yuan and National Statistics. Descriptive statistics of variables are presented in Table 3. Table 3 is obtained from data bases used in Table 1 and reports information with cities and counties in Taiwan.

Table 2. Definition and measurement unit of dependent and independent variables in spatial econometric model

Measures	Variable	Definition/Unit	Hyperlinks for Data
dependent variable	criminal	Total criminal cases/case	https://ba.npa.gov.tw/npa/stmain.jsp?sys=100
economic growth condition	vacant houses	Total units of housing with low electricity consumption/dwelling unit	http://pip.moi.gov.tw/V2/E/SCRE0104.aspx
	employed persons	Total employed persons/thousand person	http://statdb.dgbas.gov.tw/pxweb/Dialog/statfile9.asp
	disposal income per household	Average disposal income per household/ten thousand dollars	
misdemeanor policing	public safety	Total clearance cases of offense against public safety/case	https://ba.npa.gov.tw/npa/stmain.jsp?sys=100
	gambling	Total gambling clearance cases/case	
	drunk driving	Total drunk driving clearance cases/case	
	larceny	Total larceny clearance cases/case	
	drag racing	Total drag racing clearance cases/case	

Source: Organized by this research

Table 3. Descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
criminal	14492.15	13674.57	1017	48911
vacant houses	42975.90	35615.99	3808	118713
employed persons	559.80	540.84	44	1945
disposal income per household	89.07	18.01	66.79	129.26
public safety	3345.15	2700.87	281	9282
gambling	347.60	408.70	30	1456
drunk driving	3079.75	2453.37	267	8522
larceny	1704.10	1650.51	99	6310
drag racing	295.60	361.08	3	1329

Source: Organized by this research

Figure 1 provides Moran's I statistics of "disposal income per household", "vacant houses" and "criminal". It is found that there is a strong degree of positive spatial autocorrelation for disposal income per household significantly, which means that the similar income level households aggregated (high income households are surrounded by each other, low income households are adjacent to each other). In contrast, the trend of “criminal” in Figure 1 depicts tends to increase gradually, which means that the similar criminal cases concentrated increasingly from 2012. Additionally, vacant houses lines below the horizontal axis, which means that vacancies distribute heterogeneously (high amounts of vacant houses are adjacent to those of low amounts, the low amounts of vacant houses are adjacent to those of high amounts). Figure 2 depicts that “disposal income per household” and “criminal” concentrates together, while “vacant houses” disperses separately.

Figures 3 through 13 depict the LISA (local indicators of spatial association) clusters, the significant locations classified by type of spatial autocorrelation, of dependent variable used in this empirical research. The maps below provide p<0.001 and 999 permutations. “high-high” and “low-low” in the maps indicate the hot zone and cold zone. The cluster is classified as such when the value at a location (either high or low) is more similar to its neighbors (as summarized by the weighted average of the neighboring values, the spatial lag) than would be the case under spatial randomness. The cluster itself extends to its neighbors. However, “high-low” and “low-high” in the map indicate the spatial outliers. Figures 3 through 13 depict that “low-high” cluster of spatial-temporal distribution of criminal cases began to disperse around the area of Ji Long city from 2005.

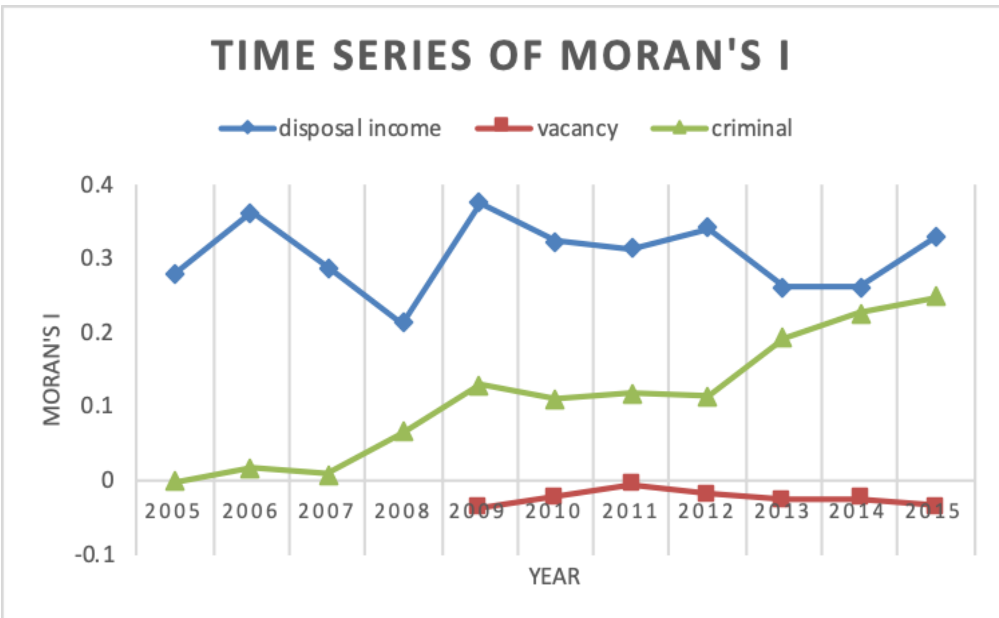

Figure2. Statistics of Moran’s i of disposal income per household, vacancy, and serious crimes in Taiwan from 2005 to 2015.

Source: Organized by this research

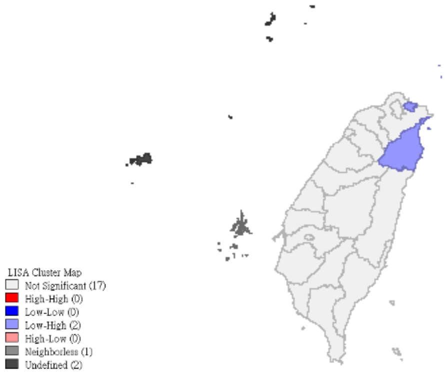

Figure3. LISA cluster of criminal cases in Taiwan 2005

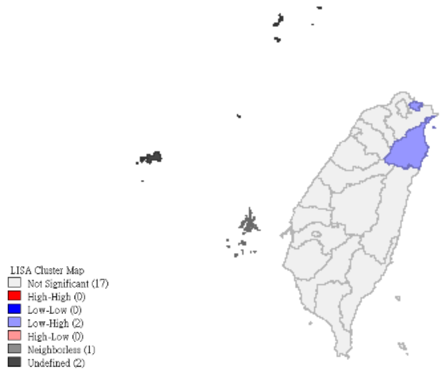

Figure4. LISA cluster of criminal cases in Taiwan 2006

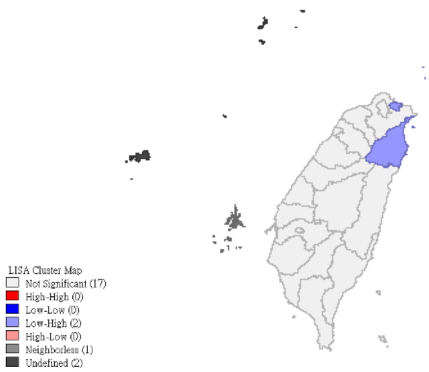

Figure5. LISA cluster of criminal cases in Taiwan 2007

Figure6.LISA cluster of criminal cases in Taiwan 2008

Figure7. LISA cluster of criminal cases in Taiwan 2009

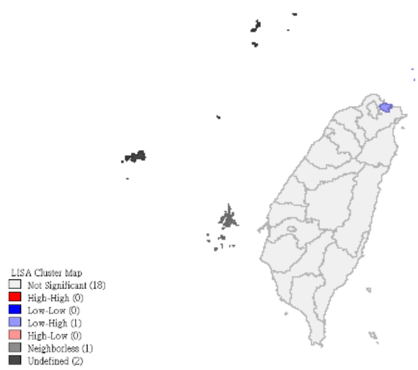

Figure8. LISA cluster of criminal cases in Taiwan 2010

Figure9. LISA cluster of criminal cases in Taiwan 2011

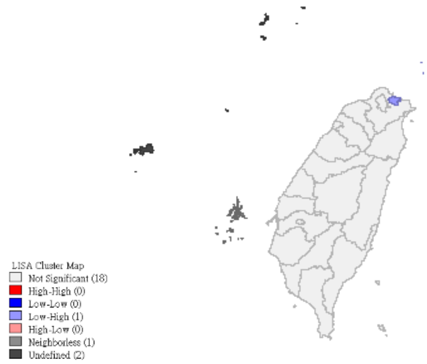

Figure10. LISA cluster of criminal cases in Taiwan 2012

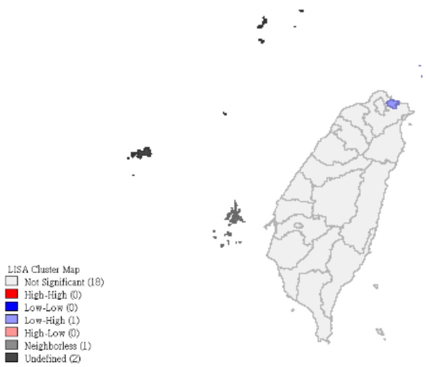

Figure11. LISA cluster of criminal cases in Taiwan 2013

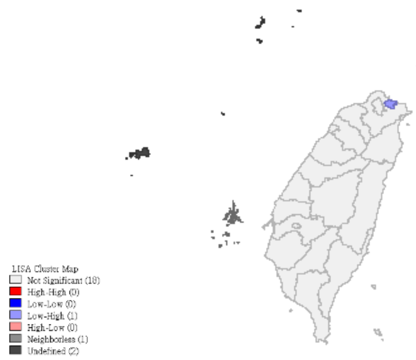

Figure12. LISA cluster of criminal cases in Taiwan 2014

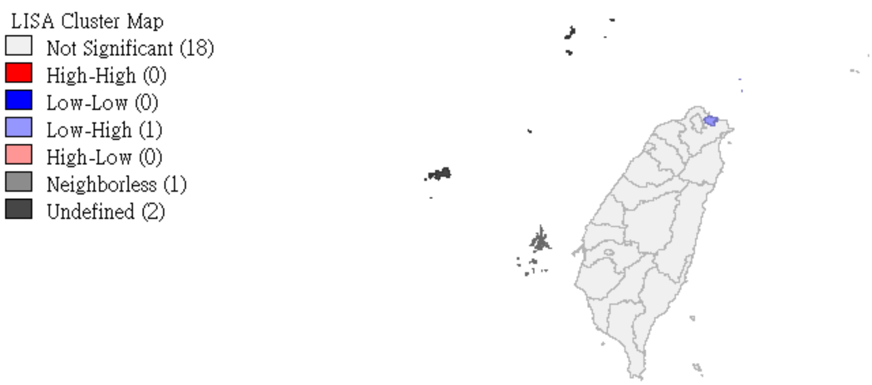

Figure13. LISA cluster of criminal cases in Taiwan 2015

Source: Organized by this research

Table 4 reports the estimation of spatial regression models on serious crimes cases in Taiwan. All of models with spatial weight added shown in Table 4 are more effective than non-spatial model (ordinary least square; OLS) in estimation according to LR test (vs. OLS indicating $\rho = 0$). Table 4 shows that estimates of SDM whose value of log-likelihood is the highest of all, which suggests that SDM is the best model of all for the verification of statistical test on Broken-Windows hypothesis in Taiwan. SDM in Table 4 illustrate that coefficients of vacant houses and employed persons are significant not equal to zero at the level of 5 percent of significance, which provides estimation for a support that economic growth condition is negatively correlated to serious criminal activities. This provides some support, except for disposal income per household, for the Hypothesis I: economic growth condition has a significant effect on serious crime reduction. Vacant houses is positively correlated with serious crimes, but employed persons is negatively correlated with serious crime. This finding and observed significant effects of vacant houses and employed persons on serious crimes demonstrate not only how a housing economic market equilibrium exerts a negative effect on a city disorder, but also how it can be mitigated by labor market employment conditions improvement. A hundred vacant dwellings increase in this county would lead to five criminal cases increase as well as the same amount of vacancy increase in other counties would create five criminal cases increase simultaneously, while a thousand employed persons increase on both this county and other counties would each create eleven criminal cases decline (Table 4). Public safety, gambling, drunk driving, larceny, and drag racing are used as explanatory variables indicating misdemeanor policy of SDM in Table 4 are all significantly correlated with serious crimes. This provides support for the Hypothesis II: misdemeanor policing has a significant effect on serious crime reduction. It is found that these misdemeanor policing variables affect dependent variables negatively, which supports validity of Broken-Windows policing in Taiwan. SDM shows that each additional total clearance case of social control against public safety in this county would lead to fifteen criminal cases decrease as well as the same amounts of increase of total clearance cases of social control against public safety from other counties would result in six criminal cases decline (Table 4). Spatial lag dependent variables including W_criminal, W_burglary, and W_violence which are used as explanatory variables in spatial regression model are all significantly to influence serious crimes as shown in Table 4. This provides support for Hypothesis III: serious crime reduction is influenced by economic growth condition and misdemeanor policing and those of neighboring places. Tables 5 shows the direct effect and spillover effect of serious crimes. Total effect of employed persons is equal to -10.5056, which can be divided into -6.7929 of direct effect and -10.5056 of indirect effect (Table 5). Table 6 shows the influence on serious crimes from economic growth condition and misdemeanor policing variables and those of neighboring places with application of elasticity analysis. This paper finds that the top three variables to influence criminal cases are W_public safety, public safety, and W_drunk driving. As a whole, this paper suggests that the contribution of misdemeanor policing is larger than those of economic growth condition for crime reduction.

Table 4. Estimation of spatial regression models of criminal cases

Variable	Model SLM Coefficient	SLM Standard error	SEM Coefficient	SEM Standard error	SDM Coefficient	SDM Standard error
criminal vacant houses	0.1571***	0.0439	0.0772*	0.0416	0.0536**	0.0251
employed persons	20.3466***	7.6085	7.2926	6.6468	-10.9454***	2.8560
disposal income per household	11.2891*	6.1577	44.0482***	11.7066	1.8124	1.1180
public safety	11.0926***	2.0137	12.1536***	1.7819	-15.1815***	0.6374
gambling	0.4718	1.5321	1.8361	1.3241	-5.9748***	0.8479
drunk driving	-10.1486***	2.0911	-10.7346***	1.8311	-15.0816***	0.7381
larceny	0.8553	1.5002	1.8994	1.2502	-5.5161***	0.4223
drag racing	3.3985	2.1554	5.6770***	1.8504	-8.8128***	0.6128
W_ criminal	0.0270***	0.0081	0.0671*	0.0353	0.1051*	0.0622
W_ vacant houses					0.0516***	0.0133
W_ employed persons					-10.9011***	1.6601
W_ disposal income per household					-4.3862***	1.4849
W_ public safety					-5.6644***	0.8636
W_ gambling					0.2274	0.1702
W_ drunk driving					4.6507***	0.6684
W_ larceny					4.6653***	0.3115
W_ drag racing					-3.0713***	0.4125
F	324.6027***		389.6680***		3663.0096***	
Log-Likelihood	-164.4956		-161.3325		-124.0049	
R^2 adjust	0.5927		0.6944		0.7997	
LR Test vs. OLS($\rho = 0$)	4.2115**		6.2353**		3.8481**	

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Organized by this research

Table 5. Direct effect and spillover effect of criminal case in Taiwan

Variable	SDM Total effect	Direct effect	Spillover effect
criminal vacant houses	0.0515	0.0333	0.0182
employed persons	-10.5056	-6.7929	-3.7127
disposal income per household	1.7396	1.1248	0.6148
public safety	-14.5715	-9.4219	-5.1496
gambling	-5.7347	-3.7081	-2.0267
drunk driving	-14.4756	-9.3599	-5.1157
larceny	-5.2944	-3.4234	-1.8711
drag racing	-8.4587	-5.4694	-2.9893
W_ vacant houses	0.0495	0.0320	0.0175
W_ employed persons	-10.4631	-6.7654	-3.6977
W_ disposal income per household	-4.2099	-2.7221	-1.4878

Table 5. Direct effect and spillover effect of criminal case in Taiwan

	SDM		
Variable	Total effect	Direct effect	Spillover effect
W_ public safety	-5.5468	-3.5154	-1.9214
W_ gambling	0.2183	0.1411	0.0771
W_ drunk driving	4.4638	2.8863	1.5775
W_ larceny	4.4779	2.8954	1.5825
W_ drag racing	-2.9479	-1.9061	-1.0418

Source: Organized by this research

Table 6. Total elasticity, direct elasticity, and indirect elasticity of serious crimes for SDM in Taiwan

	Criminal		
Variable	Total elasticity	Direct elasticity	Indirect elasticity
vacant houses	0.1527	0.0987	0.0539
employed persons	-0.4058	-0.2624	-0.1434
disposal income per household	0.0107	0.0069	0.0038
public safety	-3.3635	-2.1748	-1.1887
gambling	-0.1375	-0.0889	-0.0486
drunk driving	-3.0762	-1.9891	-1.0871
larceny	-0.6226	-0.4025	-0.2200
drag racing	-0.1725	-0.1116	-0.0610
W_ vacant houses	0.5501	0.3557	0.1944
W_ employed persons	-1.4769	-0.9550	-0.5219
W_ disposal income per household	-0.0864	-0.0558	-0.0305
W_ public safety	-4.3473	-2.8110	-1.5364
W_ gambling	0.0183	0.0118	0.0065
W_ drunk driving	3.2833	2.1229	1.1603
W_ larceny	1.9221	1.2428	0.6793
W_ drag racing	-0.2380	-0.1539	-0.0841

Source: Organized by this research

6. Conclusion

Scholars and policy makers try to understand the relative importance of economic incentive for crime prevention and control and social control policy on criminal activity. Serious crimes during the period from 2005 to 2015 declined in Taiwan. This paper finds the remarkable decline in serious criminal activity is attributable to improved economic incentive for crime prevention and control as well as social control deterrence measures. Consistent with the statements of Wilson and Kelling (1982), in this paper it uses misdemeanors reduction as measures of social control policy and investigates their effects, along with economic incentive for crime prevention and control as well as social control policy on three serious criminal activities. However, both of them are important in explaining the decline, while the contribution of social control policy is larger than that of economic incentives. One important point that needs to be considered is that significant increases in minor criminal reduction may be costly not only in terms of police resources but also because of the social costs. In theory, the improvement of economic conditions and misdemeanor policies should have a time lag effect, that is, the number of serious crimes is declining that year, which may be derived from the improvement of economic conditions and misdemeanor policies a few years ago. The model established in this paper uses a cross-section data, which cannot be analyzed by time lag statistics.

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