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SOCIAL WELFARE, PHANTOM VOTERS, AND INTERNAL MIGRATION IN TAIWAN — EVIDENCE FROM PANEL SPATIAL ANALYSIS

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This paper aims to investigate the following two issues related to internal migration in Taiwan: one is the widely discussed issue of the existence of magnetic effects induced by welfare benefits and the other is a rarely discussed issue of the existence of phantom voters. Using panel data for 23 counties and cities from 1995 to 2010 and estimating three fixed-effects spatial Durbin models, the primary findings of this study are that, by keeping other factors constant and considering the spatial dependence of migration, welfare migration is found to exist, particularly for females, and the number of phantom voters in an election year can significantly affect internal migration in Taiwan.

Keywords: Internal migration; phantom voters; spatial Durbin model; welfare migration; Taiwan.

JEL Classification: C21, H75, I38, J15

1. Introduction

For a long time, economists have been interested in seeking to determine why migration occurs and what its determinants are. In particular, the issue regarding whether immigrants are more likely to move to countries with generous welfare systems, or so-called "welfare migration", has generated substantial interest among scholars. A perception of how welfare generosity acts as a pull factor for migration, referred to as the welfare magnet hypothesis, was first proposed by Borjas (1999). It states that immigrants, including both skilled and unskilled, prefer to locate in regions with generous welfare provisions to insure themselves

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against labor market risks.[1] Although Borjas (1999) applied this idea in the case of international immigrants, it is also appropriate to apply it in the case of internal migration within a country.

Taiwan is a small and liberal country. There are now 22 counties and cities in Taiwan, but before 2011 when a jurisdiction adjustment took place,[2] there were 25. Each local government has the right to design its own social welfare scheme, and thus social welfare systems vary across regions. In Taiwan, to ensure a campaign win, candidates for county mayor or magistrate always propose a generous social welfare system to favor their voters. After being elected, they are willing to implement these generous social welfare policies not only to keep their promises, but also as an attempt to lure more immigrants to benefit the future development of their jurisdictions by means of more human resources and more financial transfers from the central government.[3]

The potential magnetic effects of welfare benefits might not be the only reason why people in Taiwan change their residential location. In the election years for county magistrate and mayor, some people may move their residences to other local areas four months before the election date for the sole purpose of being eligible to vote for specific candidates. These voters are so-called "phantom voters" because they have registered but possibly do not reside in the area anymore. The existence of phantom voters has been confirmed in Taiwan by Hsu (2001). Some of these voters are paid by people who support particular candidates to become a "voting machine" to sway the election outcome. Not surprisingly, some phantom voters belong to criminal organizations within Taiwan. However, the influence of these "phantom voters" on internal migration in Taiwan is still not clear.

The purpose of this study is to investigate the following two issues in the internal migration of Taiwan: one is the widely discussed issue of the existence of magnetic effects induced by welfare benefits, and the other is the rarely discussed issue of the existence of phantom voters. There are several advantages of using the example of Taiwan in this study. First, the importance of immigration policy can be ignored since there is no immigration policy for internal migration in Taiwan, although it has been thought of as an important factor for migration between countries. Secondly, any barriers to internal migration in

[1] Borjas (1999) argues that welfare could affect immigration through several channels. First, countries with more generous welfare might attract immigrants who would otherwise have not immigrated. Secondly, the existence of social safety nets might also lead to immigrants who would have otherwise returned to their country of origin deciding to remain.

[2] Prior to the jurisdiction adjustment in 2011, there were two municipalities, five county-level cities, and 18 counties. However, since 2011, there have been six municipalities, three county-level cities, and 13 counties due to the merger of the Kaohsiung Municipality with the surrounding Kaohsiung County, the Tainan City merger with the surrounding Tainan County, and the Taichung City merger with the surrounding Taichung County. The latter two cities and Taoyuan County were promoted to become municipalities in 2011, and Taipei County was also promoted to become a municipality but changed its name to New Taipei City in 2011.

[3] In Taiwan, a county or city with a population of over 2 million can be promoted to a municipality and is then able to obtain a larger share of the centrally funded tax revenues being allocated. For example, before 2010, the allocation of the centrally funded tax revenues was about 43% for the two municipalities, 39% for 23 counties and cities and 12% for townships and villages. Since 2010, to cope with the additional four counties promoted to become municipalities, the allocation has become 61%, 24% and 9%.

Taiwan can be neglected as well.[4] Thirdly, the importance of social networks in immigration between countries proposed by Beine *et al.* (2011) can also be ignored because information regarding labor market opportunities and welfare benefits is very transparent and easy to access in Taiwan.[5]

This study employs a panel dataset for 23 counties and cities in Taiwan from 1995 to 2010 to examine these two hypotheses. Three fixed-effects models with the net migration rate (NMR), male net migration rate (MNMR) and female net migration rate (FNMR) as the dependent variable, respectively, are estimated. Moreover, to cope with the possible spatial dependence of internal migration, this study further estimates three fixed-effects spatial Durbin models (SDMs). Doing so can enable one to compare results from models both with and without considering the spatial dependence of internal migration on the one hand and confirming the conclusions on the other. The primary finding is that both welfare magnetic effects and phantom voters exist in internal migration in Taiwan. These conclusions hold in both models both with and without considering the spatial dependence of internal migration. Under the circumstances of restrictive policies of internal migration between urban and rural areas and a lack of democratic local government elections in China, it is impossible to investigate both hypotheses in China. However, conclusions drawn from Taiwan might be able to provide some implications for Chinese people in general, particularly those located in China.

The remainder of this study is organized as follows: Section 2 reviews the literature, and migration and social welfare in Taiwan are outlined in Section 3. Section 4 establishes an empirical model and defines all of the variables used in this study. Section 5 analyzes the estimated results and is followed by concluding remarks in Section 6.

2. Literature Review

People leave their places of origin and move to another destination for many reasons. Such behavior can be categorized into "movement from one country to another" and "the movement of residence between jurisdictions within a nation", with the latter being referred to as "internal migration". Some studies in the literature apply micro-data to analyze this phenomenon from a personal characteristics perspective (such as gender, wealth status, etc.), and others examine the causes of such movement by adopting various economic and environmental variables. This study aims to discuss the effects of social welfare expenditure and election years on internal migration in Taiwan while taking into consideration of the spatial dependency of internal migration. This section will thus merely focus on the literature that is related to the relationship between social welfare and migration and that which relates to internal migration.

[4] In addition to restrictive immigration policies between countries, some barriers discussed in the literature are language and physical distance.

[5] Beine *et al.* (2011) indicated that social networks provide information about labor market opportunities and thus reduce the cost of migration; they can also be a source of information on welfare benefits for potential immigrants who are still in the source country.

With respect to the relationship between social welfare and migration, a model proposed by Tiebout (1956) suggested that consumer voters "vote with their feet" and search for a community that essentially offers an optimal bundle of public goods and taxation for them. Tiebout's model has successfully influenced subsequent studies. Tullock (1971) extended Tiebout's model and argued that consumer voters will evaluate a bundle of tax, government goods and services of a potential destination while deciding where to dwell. In addition, Cebula and Clark (2013) extended Tiebout's model and estimated 2SLS by using net internal migration rates in the USA from 2000 to 2008 to support Tiebout's hypothesis of voting with one's feet and concluded that states with higher Medicaid benefits are more likely to attract migrants.

The welfare magnet hypothesis proposed by Borjas (1999) assumes that favorable welfare acts as a pull force for immigrants. The theory implies that potential immigrants would rather live in countries or states that provide relatively generous welfare and that people seek security against risks faced in the labor market. However, using the example of the US, Borjas (1999) claimed that the welfare magnet effect only occurs in migrations between countries and has rarely been found to occur in relation to internal migrations. Some empirical studies have supported Borjas's assertion, such as Levine and Zimmerman (1999) and Barrett and McCarthy (2008).[6]

On the contrary, numerous empirical studies have supported the welfare magnet effect in relation to internal migration. By employing the Panel Study of Income Dynamics (PSID) and the US Census of 1980, Gramlich and Laren (1984) proved that the recipients of the 1979 Aid to Families with Dependent Children (AFDC) tended to move to states with more generous benefits. In addition, Enchautegui (1997) applied cross-sectional data from the 1980 Census of the Public Micro Samples and concluded that welfare benefits play a key role among single mothers' migration choices. Moreover, Gelbach (2004) employed data from the 1980–1990 censuses to estimate probit models and indicated that a welfare magnet effect exists among internal migrants, particularly among females who raise young children. Although the empirical evidence for the welfare magnet is relatively mixed as concluded by Nannestad (2006), it is still generalized that females seem to be more likely to move to regions with more generous welfare provisions.

In addition to the welfare magnet hypothesis, the literature related to internal migration is also important in this study. Grigg (1977) considered Ravenstein's "*laws of migration*" to be the first scientific work on demography and to provide a strong basis for subsequent studies.[7] Huy and Walter (2012) indicated that Ravenstein's laws imply a possibly

[6] Levine and Zimmerman (1999) adopted National Longitudinal Survey of Youth (NLSY) data from 1979 to 1992 and showed that there is no evidence of internal welfare migration in the US. Barrett and McCarthy (2008) compared the cases of the UK and Ireland and showed that international immigrants were more prone to the welfare effect than internal immigrants, but that the opposite was true in the case of Ireland.

[7] Ravenstein (1885), published in the *Statistical Journal*, initially generalized the laws proposed by Ravenstein (1876), an earlier research published in the *Geography Magazine*. Later, Ravenstein (1889) rearranged these principles. The 8th law is "*Large towns grow more by migration than by natural increase*" and the 10th law is "*The major direction of migration is from agricultural areas to the centres of industries and commerce*". These two laws imply that people are more likely to move to the commercial or industrial centers of large cities, indicating that the magnitude of migration to a modernized city could be negatively correlated with its satellite cities. Other laws are available in Grigg (1977).

interactive migration flow for adjacent regions and are thus considered to serve as a basis for both the push–pull theory of migration and the gravity model. The push–pull theory of migration proposed by Bagne (1969) explained the causes of migration flow resulting from the push forces of outflow areas and the pull forces of origins and destinations.[8] The gravity model constructed by Lee (1966) assumed that flows of bilateral places are independent and count on the push and pull forces of two regions.

Although Greenwood and Hunt (2003) asserted that the gravity model is considered to be the most frequently used theoretical framework for empirical migration research, LeSage and Pace (2008) argued that the assumption of bilateral independence of the model can be misleading and concluded that the dependency of bilateral flows can be caused either by geographical proximity or by any other factors.[9] Nevertheless, Cushing and Poot (2004) indicated that there are relatively few studies that concentrate on the potential presence of the spatial dependency of migratory flows, and Maza and Villaverde (2008) argued that spatial interaction between regions has been omitted in most discussions on migration, and this misspecification would result in illusory results.[10] This implies that empirical works using traditional econometric methods can be misleading.

Therefore, in order to avoid potentially illusory results, this study applies a spatial econometric approach to examine the effect of social welfare expenditure and phantom voters on the NMR (as a whole and for different genders) of cities and counties in Taiwan.

3. Internal Migration and Social Welfare Expenditure

In the past two decades, Taiwan's social welfare system has expanded rapidly. The increasing democratization in the 1990s and the election-driven party politics in the 2000s have contributed the most to both the achievements and the problems of Taiwan's social welfare system.[11] Local governments in Taiwan are empowered to plan their own welfare policies. These social welfare programs are primarily financed by social insurance funds, government budgets and financial support from central government as well as by money borrowed from public banks[12] and only rarely by user fees. In addition, the public welfare lottery surplus also partly finances some specific social welfare programs. As noted before, a positive net inflow of migration can be regarded as an increase in the labor force, further stimulating the growth of the economy. As a result, it is believed that local governments in

[8] The push forces of an outflow area can be an unfavorable economic environment, higher living costs, a lower employment rate, etc. In contrast, the pull forces of an inflow zone can be generous taxation policies, better education policies, fine infrastructure etc. Pull forces dominate push forces in inflow areas, and pull forces exceed push forces in inflow regions.

[9] They assumed that bilateral migration flows are correlated and further examined the dependency of two-way interstate migration flows in the US via a spatial lag process.

[10] They discovered that some important economic variables in traditional migration models, such as the rate of unemployment and income per capita, appeared to have no effect on the flow of internal migration in Spain after considering a spatial econometric application.

[11] There are five major pillars for Taiwan's social welfare system: social insurance and pension programs, social assistance programs, social welfare service programs, health care programs and programs for improving employment, no matter at what level of government.

[12] If local governments cannot return money to the bank, they will ask the central government for help. For political considerations, the central government will eventually give a big hand to local governments. That is the reason why much better and more generous social welfare programs are proposed by local governments in Taiwan.

Taiwan have incentives to attract potential migrants through better and more generous social welfare programs.

Due to different financial situations, some social welfare programs differ in different counties and cities in terms of the amounts of benefits and/or eligibility, examples being two popular social welfare programs, namely, the governmental maternity allowance and allowance programs for registered elderly.[13] Therefore, the amount of social welfare expenditure of a local government can vary across jurisdictions and over time in Taiwan. In order to understand the diversity of social welfare across counties and cities in Taiwan, this study adopts social welfare spending per capita in real terms instead of social welfare as a percentage of gross domestic product (GDP) due to the unavailability of GDP data for local government in Taiwan. Figure 1 illustrates social welfare spending per capita across counties and cities in Taiwan in 2010. It is shown that Taipei City, Penghu County, Taitung County, Kaohsiung City and Keelung City were ranked as the top five jurisdictions with higher real social welfare per capita, whereas Taoyuan County, Taichung City, Taichung County, Tainan City and Changhua County were the bottom five jurisdictions.

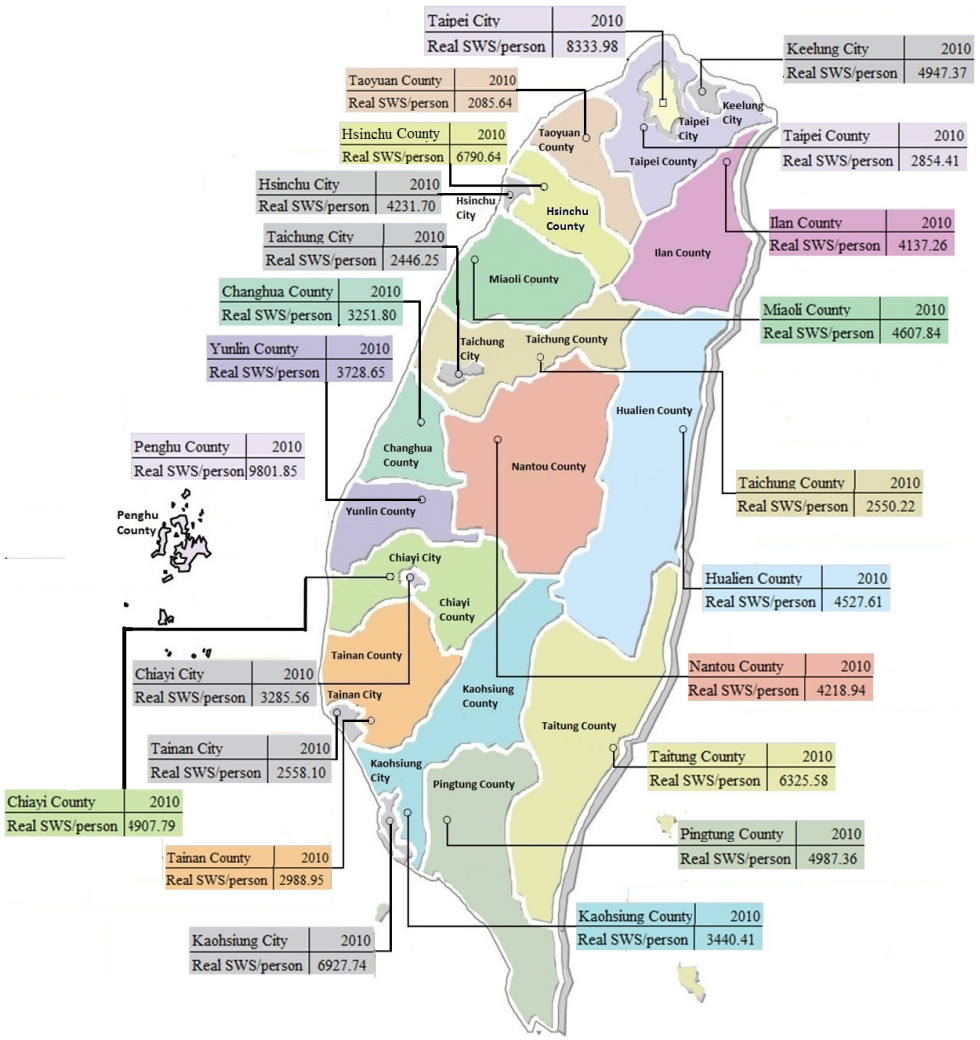
As for the internal migration in election years, this study employs the NMR to describe it. The NMR is defined as the difference between immigrants and emigrants of an area in a specific year per 1000 mid-term registered inhabitants.[14] An area with a positive (negative) NMR represents more (less) people entering the area than leaving it in terms of registration. Table 1 presents the NMR according to the counties and cities of Taiwan in selected years. The gray lattices imply county magistrate or mayoral elections taking place. County magistrate and county-level city mayoral elections were held in 1997, 2001, 2005 and 2009, and municipality mayoral elections were held in 1998, 2002, 2006 and 2010.

According to Table 1, in the case of two municipalities, Taipei City and Kaohsiung City, NMR is higher in election years than in other years. Some counties and cities share a similar situation, such as Ilan County, Nantou County, Yunlin County, Chiayi County, Kaohsiung County and Penghu County. Other counties and cities share a similar situation in most of their election years. This study uses a dummy variable to represent the election year. After controlling for other factors, if the coefficient of the election dummy variable in the NMR regression is statistically and significantly positive, it is implied that a significant phantom voter effect on internal migration exists in Taiwan.

In addition, the spatial distribution of the NMR, the NMR for males (MNMR) and that for females (FNMR) among counties and cities in 1995 and 2010 are depicted in Figure 2. The darker the shaded area, the higher the level of the NMR. It is shown that counties and cities with a higher NMR are clustered in northern Taiwan, whereas those with a negative NMR are located in central, southern and eastern Taiwan. This is also true for MNMR and FNMR. It seems that all three variables have a pattern of spatial dependence, but need

[13] For example, the governmental maternity allowance was NT$20,000 per infant in Taipei City, but ranged from NT$2000 to NT$20,000 among the different districts in Taipei County in 2010. In addition, Hsinchu County and Hsinchu City have paid allowances to their elderly aged 65 and above since 1994. Later, almost all counties and cities launched similar allowance programs for their elderly who are not rich. Each county and city sets different criteria for what it defines as rich.

[14] In this study, internal migration applies only to people with Taiwanese nationality who can enjoy social welfare and have the right to vote. International immigrants are not included in this study.



Source: Various years of *Annual Report on Audited Financial Statements*, National Audit Office R.O.C.

Figure 1. Real Social Welfare Spending Per Capita by Counties and Cities in 2010

to be further confirmed statistically by Moran's I, a spatial correlation index proposed by Moran (1950).[15]

[15] Moran's I is widely used to test for the presence of spatial dependence in observations taken on a lattice. As asserted by Mobley *et al.* (2009), Moran's I is a reliable statistic and is useful for testing for the spatial correlation and spatial heterogeneity. The formula for Moran's I can be expressed as follows:

$$I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}} \times \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{n}(y_i - \bar{y})^2},$$

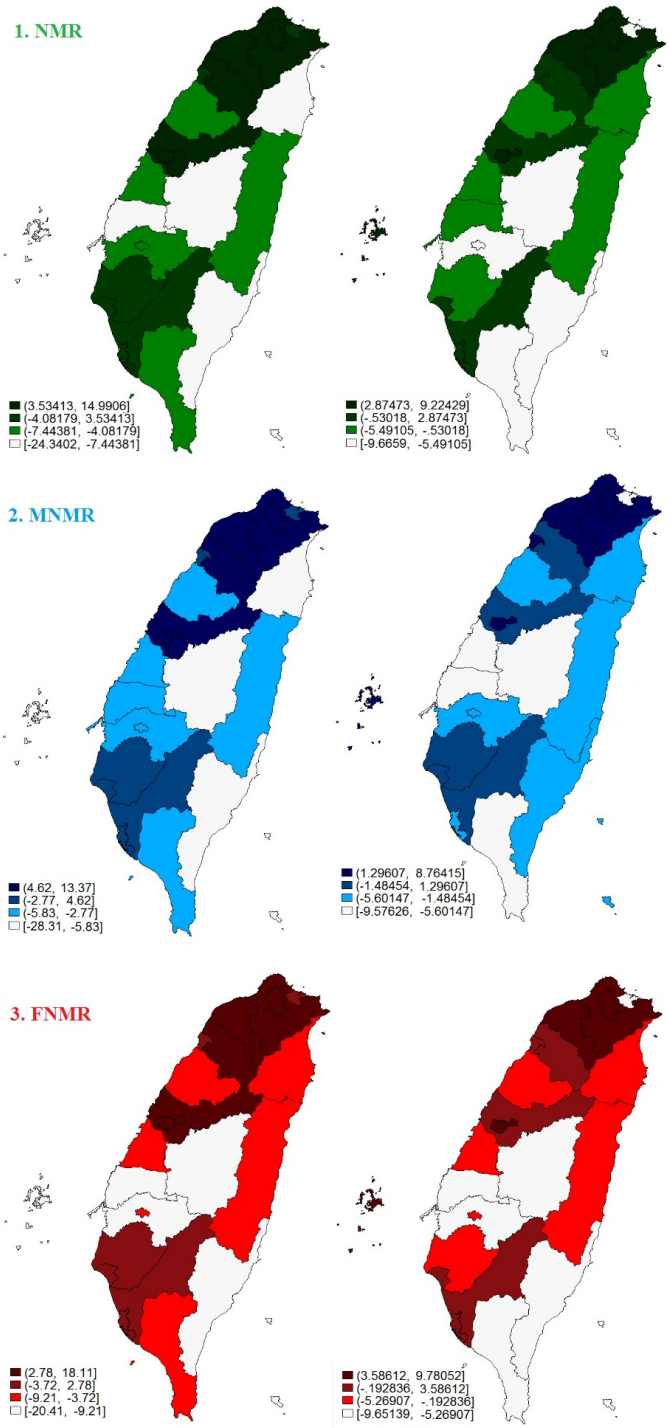
where $i \neq j$, and $w_{i,j}$ is an element in the ith row and jth column of a spatial weight matrix W that equals 1 if regions i and j are adjacent and equals 0 if regions i and j are non-adjacent. The numbers in the spatial weight matrix W will be row-standardized, that is, the sum of the elements in each row will be equal to 1. If the test results reject the null hypothesis of no spatial correlation, it may be implied that the observations are characterized by spatial correlation.

Table 1. Net Migration Rate (NMR) by Counties and Cities (Selected Years, ‰)

Counties/Cities	1996	1997	1998	2000	2001	2002	2004	2005	2006	2008	2009	2010
Taipei City	−5.42	−10.16	5.23	−5.90	−8.37	−0.24	−4.90	−5.73	3.32	−4.36	−7.53	3.14
Kaohsiung City	−0.55	−7.44	10.11	4.55	−2.10	6.19	−0.53	−4.15	0.68	1.69	0.18	0.26
Taipei County	5.60	8.43	1.98	8.15	5.44	2.88	3.91	3.07	3.88	5.57	6.66	3.72
Ilan County	−8.77	−7.09	−8.99	−6.89	−3.75	−7.51	−4.99	−3.81	−4.12	0.57	0.84	−2.65
Taoyuan County	17.54	15.24	11.53	12.71	8.79	8.95	10.81	8.49	10.91	7.26	5.75	8.80
Hsinchu County	3.49	3.32	3.89	1.35	5.43	5.37	10.27	15.57	14.46	9.02	9.28	0.95
Miaoli County	−9.33	−8.74	−7.78	−8.28	−4.66	−5.47	−4.23	−4.11	−1.91	−0.87	1.76	−1.20
Taichung County	4.90	2.36	4.39	−1.22	−2.42	−0.72	−0.96	−0.89	2.17	0.73	−0.72	0.69
Changhua County	−5.98	−5.87	−5.51	−5.18	−4.24	−4.67	−4.50	−4.54	−3.92	−3.66	−2.99	−5.22
Nantou County	−9.00	−7.72	−8.55	−11.85	−4.82	−5.42	−6.13	−4.57	−4.89	−3.67	−1.12	−6.65
Yunlin County	−10.45	−9.89	−10.73	−11.73	−5.39	−6.05	−7.08	−6.45	−7.44	−2.61	−0.55	−5.46
Chiayi County	−8.70	−5.73	−10.17	−8.97	−3.89	−6.92	−6.90	−3.68	−7.03	−4.22	−0.93	−5.49
Tainan County	−0.21	−1.08	−2.18	−3.28	−4.56	−3.26	−2.79	−0.95	−0.19	−0.71	0.19	−0.53
Kaohsiung County	3.26	6.06	−7.32	−4.56	−3.26	−7.64	−1.81	0.20	−0.30	−2.46	−1.07	1.22
Pingtung County	−7.27	−7.64	−9.66	−8.33	−2.35	−7.02	−5.36	−3.11	−5.87	−4.64	−1.30	−7.99
Taitung County	−7.99	−10.93	−17.08	−15.55	−6.20	−5.23	−10.49	−6.19	−12.87	−7.19	4.39	−5.51
Hualien County	−6.96	−8.39	−9.38	−10.96	−4.28	−5.15	−6.36	−5.39	−5.77	−4.46	0.05	−4.14
Penghu County	−12.84	5.29	−22.75	−1.02	26.26	−2.20	−6.09	5.60	−8.53	10.26	30.08	9.22
Keelung City	5.95	4.55	−0.40	1.08	2.55	−1.85	−1.44	−2.99	−4.12	−3.92	−1.71	−9.67
Hsinchu City	4.13	5.21	3.86	8.70	5.86	6.97	3.65	2.90	3.18	8.19	7.53	2.87
Taichung City	14.59	16.35	7.62	17.07	11.76	7.35	7.38	6.78	7.02	5.93	3.75	5.89
Chiayi City	−3.47	−9.90	−5.39	−2.50	2.23	−4.10	0.42	3.21	0.19	0.86	−0.80	−5.51
Tainan City	−0.17	0.74	−1.34	2.30	3.84	1.97	3.97	0.12	1.72	2.59	1.27	0.73

Source: Department of Statistics, Ministry of the Interior, R.O.C. Taiwan.

Notes: The gray lattices mean county magistrate or mayoral elections taken place. Kaohsiung Municipality merged with surrounding Kaohsiung County in 2011 and had a municipality mayoral election in 2010. Tainan City merged with Tainan County, Taichung City merged with Taichung County, Taoyuan County and Taipei County (changed name to New Taipei) became municipalities in 2011 and had a municipality mayoral election in 2010.



(a) 1995 (b) 2010

Source: Department of Statistics, Ministry of the Interior, R.O.C. Taiwan.

Figure 2. Spatial Distribution of NMR, MNMR and FNMR in Taiwan (1995, 2010)

4. Methodology

As mentioned earlier, the assumption of the independence of bilateral migration flows in discussions on migration can be misleading and may lead to illusory results. However, until now, relatively few relevant studies have concentrated on the potential presence of the spatial dependency of migratory flows. If the cross-sectional observations represent spatial dependence, this study should adopt spatial econometric models for the county-/city-level panel data in order to explore the possible influence of one region on adjacent regions after controlling other variables and to avoid inefficient or even biased estimates (LeSage and Pace, 2009).

In the literature, the commonly used spatial econometric models for continuous dependent variables are the SDM, spatial autoregressive model (SAR) and spatial error model (SEM). The SDM, extended from the SAR, was created by LeSage and Pace (2009) and includes spatial-lag terms for both the independent and dependent variables. The advantage of the SDM is that it overcomes the problems of omitted variables and spatial heterogeneity that the SAR and SEM might ignore.

When involving a simple model with a single explanatory variable, the SDM can be described as follows:

$$y_{i,t} = \mu_i + \rho \sum_{j=1}^{N} w_{i,j} y_{j,t} + \alpha + \beta x_{i,t} + \theta \sum_{j=1}^{N} w_{i,j} x_{j,t} + \varepsilon_{i,t}, \quad i \neq j, \tag{1}$$

where $y_{i,t}$ is the dependent variable, NMR, MNMR or FNMR, $w_{i,j}$ is an element in the ith row and jth column of a spatial weight matrix W, the $w_{i,j}y_{j,t}$ stands for the effect of adjacent dependent variables $y_{j,t}$ on $y_{i,t}$, ρ is a coefficient of spatial autocorrelation, θ and β are coefficients of explanatory variables and μ_i represents the spatial-specific effect in a panel data model. LeSage and Pace (2009) further considered an average total effect as a composition of the average direct effect and the average indirect effect.[16] However, for simplicity, this study analyzes the estimation results only for the average total effect.

The SAR is the most common spatial econometric model in the literature because it can investigate the direct impact of y_j on its neighboring y_i and vice versa, and it only concerns the spatial lag effect of an independent variable (Lee and Chen, 2010). According to Elhorst (2010), the SAR eliminates $\Sigma w_{i,j} x_{i,j,t} \theta$ from Equation (1). In addition, the SEM aims to fix any spatial autocorrelation among the error terms. The SEM eliminates $\rho \Sigma w_{i,j} y_{j,t}$ and $\theta \Sigma w_{i,j} x_{j,t}$ from Equation (1) and defines the error term as $\phi_{i,t} = \rho \Sigma w_{i,j} \phi_{j,t} + \varepsilon_{i,t}$. Here, ρ represents the coefficient of spatial error. When ρ is significant and not equal to 0, it shows the existence of spatial correlation among the error terms in the model, and the error term is no longer a white noise but is auto-correlated.

This study uses the Wald test for testing two null hypotheses H_0^1: $\theta = 0$ and $H_0^2 = \rho\beta + \theta = 0$ proposed by Elhorst (2010) to determine the proper spatial econometric model among the SDM, SAR and SEM. If both H_0^1: $\theta = 0$ and $H_0^2 = \rho\beta + \theta = 0$ are rejected, the

[16] The average direct effect stands for the average effect of changes in $x_{i,t}$ on $y_{i,t}$, and the average indirect effect refers to the average effect of changes in $x_{j,t}$ on $y_{i,t}$.

SDM is chosen. However, if H_0^1: $\theta = 0$ cannot be rejected, then the SAR best describes the data and the (robust) LM tests point to the SAR, but if $H_0^2 = \rho\beta + \theta = 0$ cannot be rejected, then the SEM best describes the data and the (robust) LM tests point to the SEM. Then, the Hausman test proposed by Hausman (1978) is adopted to determine which of the fixed-effects or the random-effects model is better.

The sample used in this study consists of panel data for 23 counties and cities from 1995 to 2010, resulting in 368 observations. This study excludes two island counties, namely, Kinmen and Lienchiang (also called Matsu) due to their special features.[17] The period is limited to the year 2010 because the jurisdiction adjustment reduced the 23 counties and cities at that time to 20 in 2011. The period from 2011 to 2014, which consists of the most recent data available, has a different spatial weight matrix (20×20) and reduces the number of degrees of freedom.[18] Data on all variables are officially released by publications and the website of the central government of Taiwan, R.O.C.[19]

As mentioned before, Ravenstein's laws clarified the importance of the economic characteristics of regions to migration flows, implying that people seek better life standards by moving to places with superior economic and environmental status. Therefore, the economic and environmental variables adopted in this study are based on the literature. The SDM adopted in this study can be expressed as follows:

$$\begin{aligned} y_{i,t} = {} & \mu_i + \rho \sum_{j=1}^{N} w_{i,j} y_{j,t} + \alpha + \beta_1 \log(\mathrm{SWS}_{i,t-1}) + \beta_2 \mathrm{HI}_{i,t-1} + \beta_3 \mathrm{CRI}_{i,t-1} + \beta_4 \mathrm{EDU}_{i,t-1} \\ & + \beta_5 \mathrm{THIRD}_{i,t-1} + \beta_6 \mathrm{UNEM}_{i,t-1} + \beta_7 \mathrm{ELE}_{i,t} + \beta_8 T + \theta_1 \sum_{j=1}^{N} w_{i,j} \log(\mathrm{SWS}_{j,t-1}) \\ & + \theta_2 \sum_{j=1}^{N} w_{i,j} \mathrm{HI}_{j,t-1} + \theta_3 \sum_{j=1}^{N} w_{i,j} \mathrm{CRI}_{j,t-1} + \theta_4 \sum_{j=1}^{N} w_{i,j} \mathrm{EDU}_{j,t-1} \\ & + \theta_5 \sum_{j=1}^{N} w_{i,j} \mathrm{THIRD}_{j,t-1} + \theta_6 \sum_{j=1}^{N} w_{i,j} \mathrm{UNEM}_{j,t-1} + \theta_7 \sum_{j=1}^{N} w_{i,j} \mathrm{ELE}_{j,t} + \varepsilon_{i,t}, \quad i \neq j. \end{aligned} \tag{2}$$

The primary explanatory variable in Equation (2) is the real social welfare per capita denoted as SWS. As discussed earlier, according to the theory of the welfare magnet, it is expected that SWS should have a positive impact on internal migration. In addition, its positive impact on migration is expected to be more significant for females than for males.

[17] These two island counties are very close to China and people cannot move and become registered there without permission. Under the restrictive-migration regime, the magnet hypothesis cannot be examined.

[18] Some independent variables are one year behind the dependent variable. Therefore, the sample for this period consists of only 60 observations.

[19] Data sources are the *Monthly Bulletin of Interior Statistics, The Survey of Family Income and Expenditure*, *Annual Report on Audited Financial Statements*, *Cities and Counties' Important Statistical Indicators from National Statistics*, *Education Statistics*, *Annual Statistics of the Police Administration*, *Annual Report on Audited Financial Statements*, *The Survey of Family Income and Expenditure*, *Weekly Bulletin of Interior Statistics*, and the website of National Statistics, Taiwan, R.O.C.

Moreover, the real average household disposable income denoted as HI has shown solid evidence of there being a relationship between income and migration in the literature.[20] Fidrmuc (2004) concluded that higher income can enhance the flow of an area. In addition, Kennan and Walker (2011) found that the expected income differential has a significant effect on the interstate migration decisions of white males with a high school diploma. Hence, HI is expected to have a positive influence on the population inflow of an area.[21] The rate of serious crime (CRI), defined as the number of serious crimes per 100,000 people, might also play a role in migration. Andrienko and Guriev (2004) indicated that crime rates significantly raise the population outflow of a district.[22] As a result, it is expected that CRI will have a negative effect on migration inflows. The quality of middle and elementary education (EDU), defined as the number of teachers per student at the middle school level, might also affect migration decisions. A higher level of EDU will attract more population and further increase population inflow. It is thus expected that EDU should have a positive influence on population inflows.

With respect to the industrial structure, this study adopts the ratio of employees in the tertiary sector to all employees (THIRD) in the empirical model. Hsueh *et al.* (2007) asserted that THIRD has a significant effect on residents' moving decisions in Taiwan because THIRD in Taiwan has exceeded the ratios of other sectors. To some extent, a higher proportion for the tertiary sector means a higher degree of economic development and is likely to attract a larger population inflow. As a result, THIRD is expected to have a positive effect on migration inflows. The opportunities for employment might thus affect the population inflows of a region. This study uses the regional unemployment rate (UNEM) to capture this impact. A region with a higher unemployment rate, implying more difficulty in finding a job, is expected to discourage immigrants and encourage emigrants. It is thus expected that UNEM will have a negative impact on population inflows. As mentioned earlier, the literature has demonstrated that the phenomenon of phantom voters exists in each election year in Taiwan, implying that there are higher population inflows in a region as elections take place. Therefore, the election dummy variable (ELE) is expected to have a positive coefficient. A time trend variable (T) that captures the effect of time is also included.

It is noted that both the SWS and HI are deflated by the 2001 CPI in order to eliminate the effect of price changes over time and that all explanatory variables are one year behind the dependent variable, except for ELE and T, to partly solve for possible endogeneity between the independent and dependent variables, such as between SWS and NMR. The definitions and descriptive statistics of all variables and the expected signs of their impact are presented in Table 2.

[20] This study includes real average household disposable income as an explanatory variable in the regression model and as a proxy for per capita GDP due to a lack of information regarding per capita GDP in county- and city-level jurisdictions in Taiwan.

[21] This paper has considered the average effective income tax rate as an explanatory variable. However, it is highly correlated with HI. The correlation coefficient between them is almost 0.9. Therefore, the average effective income tax rate is excluded from the regression.

[22] Andrienko and Guriev (2004) used panel data from Russia for 1992–1999 and conducted fixed-effects OLS estimation.

Table 2. Definitions and Descriptive Statistics of Variables

Variables	Descriptions	Mean	S.D.	Min.	Max.	Exp. Sign
A. Dependent variables						
$NMR_{i,t}$	Net migration rate defined as the proportion of net inflow population to population (‰)	−0.995	6.886	−24.340	30.080	
$MNMR_{i,t}$	Male net migration rate defined as the proportion of net inflow male population to male population (‰)	−1.136	6.392	−28.310	29.757	
$FNMR_{i,t}$	Female net migration rate defined as the proportion of net inflow female population to female population (‰)	−0.906	7.544	−24.900	31.373	
B. Independent variables						
$SWS_{i,t-1}$	Real social welfare spending per person in the previous year ($NT, deflated by CPI in 2001 = 100)	3703.830	2634.890	853.650	34,230.400	+
$HI_{i,t-1}$	Real average household disposal income in the previous year ($NT, deflated by CPI in 2001 = 100)	803,090	149,924	509,072	1,244,310	+
$CRI_{i,t-1}$	The rate of serious crime in the previous year; the number of serious crimes per 100,000 people (case)	224.575	149.153	11.789	1129.530	−
$EDU_{i,t-1}$	Teacher/student ratio in the previous year; the number of teachers per student at the middle school level (person)	5.594	1.156	3.589	10.713	+
$THIRD_{i,t-1}$	The ratio of employees in the tertiary sector to all employees in the previous year (%)	54.541	12.003	33.520	80.980	+
$UNEM_{i,t-1}$	Unemployment rate in the previous year (%)	3.648	1.274	0.870	6.000	−
$ELE_{i,t}$	A dummy variable; ELE = 1 if local governor election held in this year; = 0 otherwise	0.250	0.434	0	1	+
T	Time trend; setting year of 1995 equal to 1 and adding one as year increases by one	2002.500	4.616	1995	2010	?

5. Empirical Results

There are three regressions with different dependent variables, namely, NMR, MNMR, and FNMR, respectively, employed in this study. For the purpose of comparison, panel data models that both consider and do not consider the spatial dependence of internal migration for these three regressions are estimated. This study analyzes the estimation results using the ordinary panel data model first and then later discusses the spatial panel data model.

5.1. *Fixed-effects model*

The empirical results of the three panel data models without taking the spatial dependence of migration into account are presented in Table 3. According to Table 3, the LM test results suggest that both the fixed-effects and random-effects models are more appropriate than the classical model in all three cases. Furthermore, the Hausman test concludes that the fixed-effects model is better than the random-effects model, regardless of which

Table 3. Estimation Results of Fixed-Effects Model w/o Spatial Dependence

	Dependent Variable		
	NMR_t	$MNMR_t$	$FNMR_t$
Variables	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)
$LOG(SWS_{t-1})$	1.930**	1.434*	2.458***
	(0.815)	(0.788)	(0.871)
HI_{t-1}	1.68×10^{-5}***	1.61×10^{-5}***	1.78×10^{-5}***
	(4.38×10^{-6})	(4.23×10^{-6})	(4.68×10^{-6})
CRI_{t-1}	0.001	0.002	0.001
	(0.003)	(0.003)	(0.003)
EDU_{t-1}	1.857***	1.779***	1.966***
	(0.379)	(0.367)	(0.405)
$THIRD_{t-1}$	0.388***	0.365***	0.411***
	(0.116)	(0.112)	(0.124)
$UNEM_{t-1}$	−0.938***	−0.673**	−1.214***
	(0.313)	(0.303)	(0.335)
ELE	2.509***	2.321***	2.705***
	(0.477)	(0.461)	(0.510)
T	−0.074	−0.189*	0.056
	(0.102)	(0.098)	(0.109)
Number of Obs.	368	368	368
Adj. R^2	0.675	0.647	0.690
F-Stat.	26.35***	23.41***	28.28***
LM test	391.430***	401.840***	358.980***
Hausman test	29.300***	31.222***	29.989***

Note: *, ** and *** indicate that the null hypothesis is rejected at 10%, 5% and 1% significance level, respectively.

dependent variable is used. Therefore, the three fixed-effects regressions with NMR, MNMR and FNMR as the dependent variable, respectively, are estimated to control the regional-specific effect and, to some extent, are also able to control regional heterogeneity.

It is shown in Table 3 that the same determinants of NMR, MNMR and FNMR are statistically significant, namely, SWS, HI, EDU, THIRD, UNEM and ELE. The SWS has a statistically positive impact on the three dependent variables at the 1% or 5% significance levels, indicating that regions with a higher level of social welfare expenditure per capita can increase their net population inflows. The magnitude of this influence is even larger in the case of females than males. This finding is consistent with the conclusion of Nannestad (2006) that females are more likely to move to regions with more generous welfare provisions. The coefficients of ELE in the three regression models are statistically positive at the 1% significance level, implying the statistically significant existence of phantom voters.

Each of HI, EDU and THIRD has a positive impact on NMR, MNMR and FNMR at the 1% significance level. This finding is consistent with our expectations and implies that people prefer to locate their residences in a region with higher household income, better educational quality and a higher level of industrial structure. However, UNEM has a negative influence on all three dependent variables.

5.2. *Fixed-effects SDM*

As noted before, Moran's I is adopted in this study to test the null hypothesis that a variable has a pattern of spatial dependence. The statistics and standard deviations (S.D.) of Moran's I for NMR, MNMR and FNMR in each year from 1995 to 2010 are presented in Table 4. It is shown that the statistics for Moran's I reject the null hypothesis in 10 out of 16 years in the cases of NMR and FNMR. However, they reject the null hypothesis in 9 out of 16 years in the case of MNMR. Since the spatial dependence of internal migration appears in most years, this study estimates the spatial econometric model for each of NMR, MNMR and FNMR.

To determine the model's specifications, both the null hypotheses of H_0^1: $\theta = 0$ and $H_0^2 = \rho\beta + \theta = 0$ are rejected at the 1% significance level in all three cases, and thus the SDM is chosen. Furthermore, the results of the Hausman test indicate that the fixed-effects model is better than the random-effects model, in all three cases. Therefore, the three fixed-effects SDM models with NMR, MNMR and FNMR as the dependent variables, respectively, are estimated and their results are presented in Table 5.

From a comparison of Tables 3 and 5, it appears that, consistent with Maza and Villaverde (2008), factors significantly affecting the dependent variables in Table 3 become insignificant after considering the spatial dependence of migration in Table 5, except for the primary factors of SWS and ELE. According to Table 5, the welfare magnet effect exists in the cases of NMR and FNMR, but not in the case of MNMR. This finding is different from its counterpart that does not consider spatial dependence. The coefficient of SWS is statistically positive at the 10% significance level in the NMR regression and at the 5% significance level in the FNMR regression. This study concludes that a region with a

Table 4. Moran's *I* Test of Three Independent Variables

	NMR	MNMR	FNMR
Year	Moran's *I* (S.D.)	Moran's *I* (S.D.)	Moran's *I* (S.D.)
1995	0.113 (0.161)	0.075 (0.154)	0.152 (0.163)
1996	0.176 (0.165)*	0.159 (0.164)*	0.180 (0.165)*
1997	0.091 (0.167)	0.037 (0.167)	0.139 (0.167)
1998	0.238 (0.166)**	0.234 (0.165)**	0.239 (0.166)**
1999	0.171 (0.166)*	0.146 (0.166)	0.190 (0.167)*
2000	0.244 (0.165)**	0.230 (0.165)**	0.251 (0.166)**
2001	0.072 (0.149)	0.043 (0.152)	0.097 (0.147)
2002	0.177 (0.168)*	0.195 (0.168)*	0.151 (0.168)
2003	0.107 (0.168)	0.089 (0.167)	0.114 (0.168)
2004	0.251 (0.165)**	0.238 (0.163)**	0.247 (0.167)**
2005	0.129 (0.159)	0.095 (0.159)	0.148 (0.160)
2006	0.337 (0.163)***	0.338 (0.161)***	0.323 (0.165)**
2007	0.320 (0.167)**	0.286 (0.165)**	0.337 (0.168)**
2008	0.274 (0.168)**	0.274 (0.167)**	0.268 (0.168)**
2009	0.032 (0.124)	0.034 (0.118)	0.028 (0.129)
2010	0.201 (0.167)*	0.169 (0.165)*	0.225 (0.168)**

Note: *, ** and *** indicate that the null hypothesis of no spatial dependence is rejected at 10%, 5% and 1% significance level, respectively.

Table 5. Estimation Results of Fixed-Effects Spatial Durbin Model (Average Total Effect)

	Dependent Variable		
	NMR_t	$MNMR_t$	$FNMR_t$
Variables	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)
$LOG(SWS_{t-1})$	3.551*	2.402	4.791**
	(2.032)	(1.835)	(2.325)
HI_{t-1}	1.14×10^{-5}	1.12×10^{-5}	1.14×10^{-5}
	(8.01×10^{-6})	(7.23×10^{-6})	(9.16×10^{-6})
CRI_{t-1}	−0.004	−0.003	−0.005
	(0.004)	(0.004)	(0.005)
EDU_{t-1}	0.756	0.382	1.173
	(0.714)	(0.646)	(0.817)
$THIRD_{t-1}$	0.010	−0.029	0.052
	(0.242)	(0.220)	(0.277)
$UNEM_{t-1}$	0.414	−0.111	−0.738*
	(0.351)	(0.317)	(0.401)

Table 5. (*Continued*)

	Dependent Variable		
	NMR_t	$MNMR_t$	$FNMR_t$
Variables	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)
ELE	1.496***	1.386***	1.603***
	(0.494)	(0.449)	(0.560)
T	0.193	0.102	0.295*
	(0.154)	(0.138)	(0.178)
P	0.109*	0.064*	0.153**
	(0.066)	(0.038)	(0.067)
σ_e^2	10.325***	9.387***	12.128***
	(0.762)	(0.692)	(0.897)
Number of Obs.	368	368	368
H_0^1: $\theta = 0$	$\chi_7^2 = 133.93$***	90.54***	89.46***
$H_0^2 = \rho\beta + \theta = 0$	$\chi_8^2 = 76.13$***	87.16***	86.29***
Hausman test	$\chi_7^2 = 26.01$***	48.32***	12.08*

Note: *, ** and *** indicate that the null hypothesis is rejected at 10%, 5% and 1% significance level, respectively.

higher level of SWS can attract more people, particularly females, to move in. However, it does not affect the males' decision with regard to residential location. This conclusion is consistent with that in Nannestad (2006).

It is worth noting that the other factor affecting people's decisions regarding residential area concerns the years in which elections take place. As an election for a local mayor is taking place, more males and females will move into this region compared with those places without such elections. This conclusion is found to hold for both specifications, i.e., whether or not consideration is given to the spatial dependence of migration. This conclusion further confirms the existence of phantom voters in relation to internal migration in Taiwan, after controlling for other factors. The number of phantom voters in an election year can significantly increase the net population inflows into regions in which there are local mayoral elections. However, the question regarding whether the number of phantom voters can change the election results or not is beyond the scope of this study, but from a political point of view it should be seriously considered.

Finally, regarding the spatial dependence of the three dependent variables, it is found that the coefficient of spatial autocorrelation ρ in Equation (2) is statistically positive at the 5% or 10% significance level in all three models. This result confirms the positive spatial correlation of NMR, MNMR and FNMR among counties and cities in Taiwan and is consistent with the results of Moran's I test. Accordingly, once NMR increases (decreases) in a specific county or city, NMR in the neighboring counties and cities will increase (decrease) as well. This finding provides evidence to clarify the existence of NMR

competition among counties and cities in Taiwan, particularly among adjacent counties and cities for the purpose of pursuing better economic prospects. This is also true in the cases of MNMR and FNMR.

6. Concluding Remarks

The purpose of this study is to investigate the influence of social welfare spending as well as election years on internal migration in Taiwan while taking the spatial dependence of migration into consideration. This study adopts panel data for 23 counties and cities in Taiwan from 1995 to 2010 and estimates one-way fixed-effects models both with and without spatial consideration.

The estimated results show that the statistically significant determinants of NMR, MNMR and FNMR are reasonable when the spatial dependence is ignored, but only social welfare and an election year can affect internal migration in Taiwan after taking spatial dependence into consideration. Since the results of Moran's I test and the coefficient of spatial autocorrelation ρ indicate that the one-way fixed-effects SDM is better than the one-way fixed-effects model, the primary findings of this study are that welfare migration exists, particularly for females, and the election year can significantly affect internal migration in Taiwan, due to phantom voters, keeping other things constant. Moreover, this study provides evidence to clarify the existence of competition to attract migrants among adjunct regions and to point out the misleading results obtained using traditional econometric methods.

This study suggests that generous social welfare programs are effective ways to increase net population inflow. In order to promote the economy, local governments can use welfare policies to increase the sizes of their populations. However, one should consider the possibility that migrants may move to regions with generous welfare provisions in order to receive social benefits without sufficiently contributing to the system. Consequently, this places a heavy fiscal burden on the host regions. In addition, this study suggests that the net population inflow, regardless of gender, significantly increases in election years very possibly due to phantom voters, keeping other things constant and considering the spatial dependence of migration. These phantom voters might be able to affect the results of elections and add an element of unfairness to the election campaigns. The electoral authority in the central government needs to pay more attention to this phenomenon.

Finally, this study finds that females are more easily affected by the welfare system than males. That is to say, females are more likely to move to regions with more generous welfare provisions. What are the reasons for this? It could be that females are more mobile than males due to the higher elasticity of their labor supply. However, it might be because females are in a worse economic situation than males and this makes females more likely to move to a region with better social welfare programs. If this is the case, governments should pay more attention to the economic hardships faced by females.

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