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ORIGINAL PAPER

Fertility and Crime: Evidence from Spatial Analysis of Taiwan

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Abstract Current literature indicates the possible effects of crime on family-related demographic events, including fertility. However, there is no empirical study that confirms this effect. The research purpose of this study is to fill this gap. Using county-level panel data during 2000–2010 from Taiwan, the estimated results of the fixed-effect spatial error models discovered that crime did have a significantly negative effect on fertility, although the magnitude was modest. Furthermore, fertility has spatial dependence: that is, some unobservable factors that promote fertility in a county will likely have positive impacts on the fertility of neighboring counties. From a general viewpoint, the estimated results of other control variables showed that economic factors were still the primary determinants of fertility.

Keywords Crime rate · General fertility rate · Fixed-effect spatial error model · Taiwan

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Introduction

Among many subjects in the fields of population and household economics, fertility has been a primary focus in developed countries in recent years. Fertility is related not only to the development of the next generation through the supply of human capital, but also to the benefits of this generation by its interaction with pension plans. For example, Fenge and Meier (2005) and van Groezen et al. (2003) determined that the relationship between fertility and pensions was causal: that is, fertility affected future pension funds, and pensions affected today's fertility rate. For Taiwan, the unusually low fertility rate has drawn public attention, and more studies are needed to interpret this scenario and to infer policy implications.

Figure 1 shows the annual general fertility rate (GFR, hereafter) and total fertility rate (TFR, hereafter) in Taiwan from 1971 to 2011.[1] The downward movement of both fertility rates is very obvious. Except for some small peaks in the year of the dragon,[2] i.e., 1976, 1988 and 2000, which were considered by some Taiwanese couples to be good years to intentionally give birth, the GFR and TFR declined each year. The lowest point was in 2010, when the TFR was below 900.

[1] The general fertility rate is defined as the number of births per 1000 women of childbearing age (15–49). The total fertility rate is defined as the sum of the age-specific birth rates for 1000 women per cohort from age 15 to age 49 multiplied by 5.

[2] The Chinese animal zodiac, literally translated as "born resembling," is a rotating cycle of 12 years, with each year being represented by an animal and its reputed attributes. The 12 animals are, in order, rat, ox, tiger, rabbit, dragon, snake, horse, goat, monkey, rooster, dog and pig. Generally speaking, the dragon is the most popular animal from the Chinese viewpoint.

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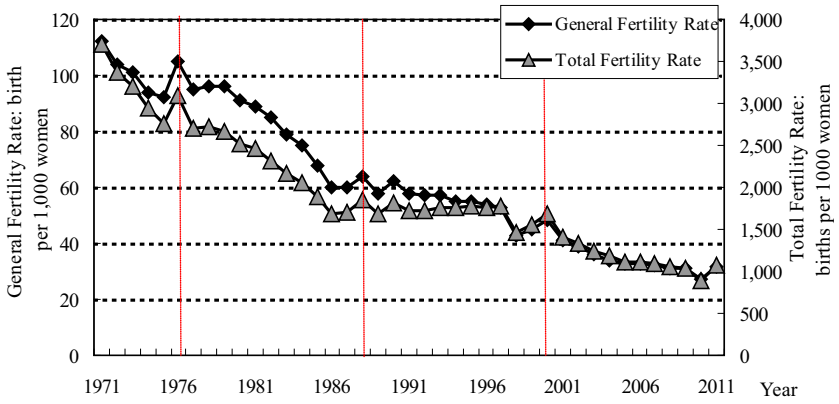

Fig. 1 TFR and GFR of childbearing age women, 1971–2011. Data Source: Ministry of the Interior, Taiwan

Currently, Taiwan has the lowest fertility rate in the world. Taiwan's government has acknowledged possible negative consequences of the low fertility rate in terms of population replacement, aging, and fiscal policies and has applied many incentive policies to promote the fertility rate. Chen (2012) summarized these incentive policies, including cash bonuses, childcare subsidies, education subsidies, etc. Moreover, tax reduction policies were employed at the national as well as local level, such as by Taipei City.

The media often blames Taiwan's low fertility on stagnant economic performance, the high cost of childbearing, and the change in viewpoint regarding a woman's role in the family.[3] Several economic factors and structural changes in society have been confirmed as contributing to the decreasing fertility rate in Taiwan (Chen 2013; Poston 2000). Previous studies have implied that similar to other developed countries, when Taiwan achieves a certain level of social and economic development, a low fertility rate becomes inevitable. However, in addition to the socioeconomic variables that would intuitively affect fertility, this study explores whether there are any other potential determinants overlooked by the empirical literature but crucial to low fertility in Taiwan.

Crime was treated as the most important factor in this study. Some studies have mentioned that crime could affect women's childbirth either by changing a household's life course (Wilson and Daly 1997) or by damaging men's economic value in families and marriage markets (South and Messner 2000). However, to our knowledge, no empirical study has been conducted to support this hypothesis. Therefore, the purpose of this study is to fill this gap by quantifying the effect of crime on fertility under the consideration of the spatial dependence of fertility. This study adopted panel data from 20 counties and cities in Taiwan over the period from 2000 to 2010 and used spatial panel econometric models to consider the spatial dependence of fertility.

This study was organized as follows. The related literature was reviewed in the next section. Then the data sources and spatial panel econometric models for analyzing the impact of the crime rate on the GFR were introduced. After that, the estimation results of the empirical model were analyzed, and some specification tests were applied to examine the accuracy of the empirical model, followed by conclusions in the last section.

Literature Review

Several studies have explored the determinants of the fertility rate in Taiwan. Freedman et al. (1994) concluded that the decline in Taiwan's fertility rate in the 1980s was primarily due to late marriages. In addition, Poston (2000) found that changes in social and economic status contributed to a substantial reduction in the fertility rate in Taiwan. Huang (2002) indicated that the personal tax exemption had a statistically significant and positive impact on the fertility rate in Taiwan. Huang (2003) further concluded that the conception rate was negatively affected by the unemployment rate. Huang et al. (2006) determined that college tuition and fees had a significantly negative influence on regional GFR in Taiwan. Chen (2013) and Lo (2012) observed that housing costs and female opportunity costs determined childbearing decisions. Chen (2012) also discussed the trends in marriage and fertility and further explored the evolution of population policies using a methodology similar to Poston (2000), taking possible determinants of the fertility rate into the estimations. However, there is no study discussing the relationship between crime and fertility in Taiwan.

In fact, studies in economics have often focused on the economic determinants of fertility (Ekert-Jaffe and Stier

[3] For example, Sui (2011), a BBC News report, mentioned that some Taiwanese women were reluctant to have children. In addition, Tso (2009), a report of *Time*, indicated that most women were afraid of losing their jobs if they took time out to have a child.

2009; Hakim 2003; Sobotka et al. 2011) and the causality between fertility and other economic variables, such as the relationship between fertility intention and women's working hours (Shreffler and Johnson 2013). Meanwhile, studies in sociology have tended to discuss fertility in the context of life course and demographic background. Crime plays an important role by changing life course and thus also demographic characteristics. The issue regarding the influence of crime on life course and the population process has been extensively studied (Hagan and Wheaton 1993; Sampson and Laub 2003; Yamaguchi and Kandel 1987). In addition, some studies focused on marriage issues have confirmed that crime can change marriage patterns (Lichter et al. 1991; Tucker and Mitchell-Kiernan 1995). In fact, some studies have noted that fertility would also be affected by crime. South and Messner (2000) indicated that crime would lessen the desirability of men in the marriage market through the possibility that their economic status was diminishing. As a result, women's marriage and fertility patterns would change because of crime. Wilson and Daly (1997) also found that crime shortened life expectancy, which led to a compressed life horizon. The timing of parenthood would be earlier for neighborhoods with lower life expectancies. Because life-course theory does not predict the effect of crime on fertility, this study adopts the viewpoints by South and Messner (2000) and proposes the hypothesis that the crime rate could negatively affect the fertility rate.

To our knowledge, there have been few works, particularly empirical studies, analyzing the impact of crime rates on fertility rates in the past decade. Furthermore, most studies discussed the relationship between crime and demographic characteristics without controlling other determinants; therefore, the influence of crime on demographic characteristics cannot be estimated accurately. This study attempts to fill this gap by estimating econometric models to quantify the effect of the crime rate on the fertility rate, keeping other factors constant and under the consideration of the spatial dependence of fertility rates.

Data and Methodology

The data adopted in this study were the official county-level panel data from 20 counties and cities over the period from 2000 to 2010 in Taiwan.[4] The primary variables of interest were the fertility rate and the crime rate. The fertility rate was represented by the GFR, defined as births per thousand women between the ages of 15 and 49.[5] Figure 2 presents the average GFR for each county and city over the research period of 2000–2010. The darker the shade, the higher the GFR. Counties and cities with a high average GFR are agricultural regions; counties and cities with a low GFR are more industrialized and urbanized. The range of the GFR is between 50 (Hsinchu County) and 30 (Keelung City).

Data in Fig. 2 indicate counties and cities clustered together based on the level of the GFR. To investigate the spatial dependence of the GFR, this study employed Moran's I, proposed by Moran (1950). The formula for Moran's I can be described as follows:

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

In Eq. (1), $i \neq j$, and w_{ij} was the inversed geographical distance between region i and j or an element in the ith row and jth column of a spatial weight matrix that defined the geographical distance between any two regions. The null hypothesis of this test was H_0: there is no spatial correlation. If the test result rejected the null hypothesis, it implied that observations feature spatial correlation. Generally speaking, Moran's I has an asymptotically standard normal distribution with values ranging from -1 to 1; the higher the absolute value of Moran's I was, the stronger the spatial correlation would be. The z-value of Moran's I was 1.61 and the p value was 0.054, showing that the null hypothesis of no spatial correlation was rejected at a 10 % significance level, and that there was positive spatial correlation of the GFR. Because both the figure and Moran's I supported the spatial dependence of the GFR, this study used a spatial econometric model to examine the influence of the crime rate on the regional GFR in Taiwan.

Because the cross-sectional observations represented regions contingent or close to each other and the GFR had spatial dependence, this study adopted spatial econometric models for the county-level panel data. Doing so included the possibility that observations in one region could affect other regions, after controlling other variables. Ignoring the spatial dependence of the GFR could cause inefficient or even biased estimates (LeSage and Pace 2009). This study adopted two spatial panel econometric models: the spatial error model (SEM) and the spatial autoregression model (SAR). The advantage of the SEM was that it did not

[4] Because some regional-level variables were not available after 2010, this study limited the research period from 2000 to 2010.

[5] According to Whittington et al. (1990), the theoretical advantage of the GFR is that it is not as sensitive to changes in the age and sex structure of the population as the birthrate. However, when compared with the TFR, the GFR is more volatile because the former is age-adjusted, and the number of women in each age group is assumed to be the same (Huang et al. 2006). In empirical studies, the GFR is also a common dependent variable for testing the determinants of fertility (Huang et al. 2006; Poston 2000; Whittington et al. 1990).

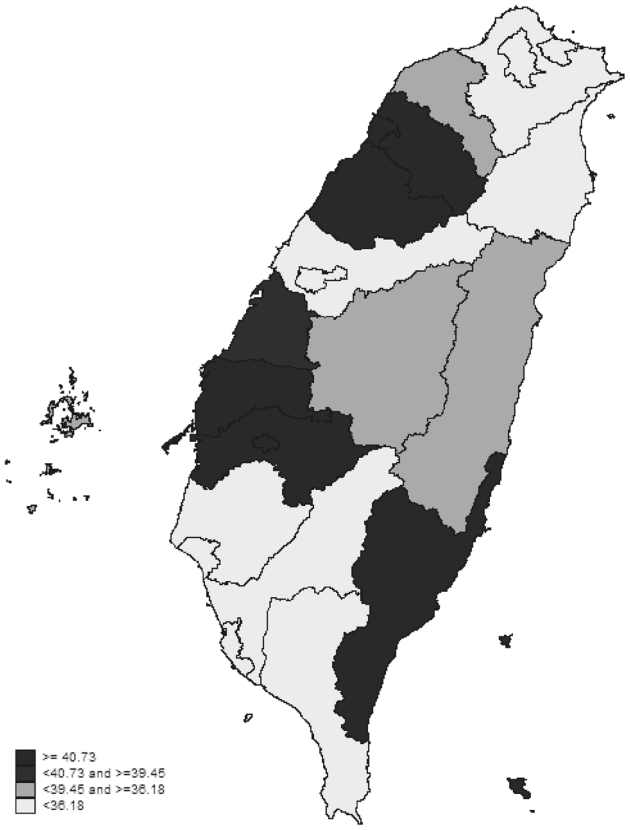

Fig. 2 Average GFR of County and City from 2000 to 2010. Data Source: Ministry of the Interior, Taiwan

require a theoretical foundation for a spatial interaction process as indicated by Anselin et al. (1996) and Ku et al. (2014). However, the SAR is the most common spatial econometric model in the literature because it can investigate the direct impact of one county's fertility on the fertility of its neighboring counties and vice versa. This study also provides results estimated from non-spatial panel data models as a comparison.

The SEM specified that unobservable factors in a region had a spatial reaction with factors in other regions. More explicitly, let y_{it} be the dependent variable for region i at time t; using the notations of Elhorst (2010), the SEM was described as follows:

$$y_{it} = a_i + x'_{it}\beta + \varphi_{it}$$

$$\phi_{it} = \rho \sum_{j=1}^{N} w_{ij}\phi_{jt} + \varepsilon_{it}, \quad i,j = 1,2\ldots,N \tag{2}$$

where a_i was a scalar representing the individual intercepts capturing region i's specific characteristics; x_{it} was the $k \times 1$ matrix of explanatory variables; and β was a $k \times 1$ vector of estimates. φ_{jt} was the spatially autocorrelated error term, whose magnitude of the effect was adjusted by w_{ij}. The larger the distance, the smaller w_{ij}, and the smaller the effect conveyed by φ_{jt} to φ_{it}. The term ρ was a scale parameter representing the average strength of the spatial dependence of $\varphi_{jt}.\varepsilon_{it}$ was an error term that independently and identically followed a normal distribution with 0 mean and variance σ^2. The parameters β, ρ, σ^2 were needed to be estimated using the maximum likelihood method.

The specification of the SAR was that the GFR in a region had a spatial relation with that in other regions. Using the notations of Elhorst (2010), the SAR was described as follows:

$$y_{it} = a_i + \rho W y_{it} + x'_{it}\beta + \varepsilon_{it} \tag{3}$$

where ρ was a scale parameter representing the average strength for the spatial dependence of the GFR.

To determine which was more suitable for describing the data and for use as the baseline model, Akaike's information criterion (AIC) and the Bayesian information criterion (BIC) were calculated. The baseline model would have the lower AIC and/or BIC. Then, the test proposed by Hausman (1978) was adopted to determine whether the fixed-effect or the random-effect model was better. If the fixed-effect model was better than the random-effect model, a_i could also be estimated as an intercept for the ith region, but it did not affect the values of other parameters and is rarely the interest of research.

Regarding the primary explanatory variable, crime rate, there were two measures. One was the total crime rate defined as the number of crimes committed per 100,000 people, including some civil violations. The other was the rate of offense defined as the number of offenses committed per 100,000 people. The rate of offense is more relevant because many studies emphasize major offenses, such as homicide in Lichter et al. (1991), Tucker and Mitchell-Kiernan (1995) and Wilson and Daly (1997), in which major offenses led to shorter expected life, thereby compressing the life course and implying higher fertility rates. Therefore, the impacts of the rate of offense on fertility are expected to be more significant than other types of minor crime.

Other independent variables were selected based on the literature (Chen 2013; Poston 2000; Yang and Liu 2014) and included the junior-high-or-below ratio[6] to measure educational level, two variables for household finances (household disposable income and the home ownership ratio), the female labor force participation rate, unemployment rate, the infant mortality rate, and the female ratio. It is worth noting that in addition to controlling these independent variables, this study also considers the impacts caused by the spatial dependence of the GFR while the influence of the crime rate on the GFR was examined.

[6] Junior high school education has been compulsory in Taiwan since 1968.

Table 1 Definitions and descriptive statistics of variables

Variables	Definitions	Max (Min)	Mean	Standard deviation
General fertility rate (GFR)	The number of births per 1000 women of childbearing age (15–49)	50.18 (30.00)	38	5.59
Measure of crime				
Total crime Rate (TCR)	The number of crimes, including some civil violations, committed per 100,000 people	2922.22 (951.14)	1885	519.62
Rate of offense (RO)	The number of offenses committed per 100,000 people	2926.40 (954.48)	1868	536.36
Education				
Junior high or below ratio	The percentage of the population older than 14 years with a junior high school diploma or lower education level (%)	57.42 (18.15)	41	10.25
Literacy rate	The percentage of the literate population older than 14 years (%)	98.62 (93.61)	97	1.41
Household finance				
Household disposable income	Yearly disposable household income (NTD)	1,249,802 (630,580)	823,142	160,612
Household savings	Yearly household savings (NTD)	297,975 (126,060)	189,943	40,427
Home ownership ratio	The percentage of households who own their own houses	94.10 (80.42)	88	3.89
Female labor force participation rate	The percentage of female population in the labor force (%)	62.65 (49.11)	58	3.22
Unemployment rate	The percentage of the labor force who are unemployed (%)	4.80 (4.00)	4	0.23
Infant mortality rate	The number of infants who die at less than 1 year old per 1,000 births	8.67 (4.16)	5	1.11
Female ratio	The ratio of female to total population	0.51 (0.46)	0.49	0.01

Sources: Ministry of Interior, Taiwan

Because the response of the fertility rate to changes in any explanatory variables cannot be instantaneous, all independent variables were taken with a 1-year lag, i.e., x_{it-1} instead of x_{it} in Eq. (2). In addition, the spatial weight matrix was created based on the inversed Euclidean distance between each county's centroid. Finally, the literacy rate replaced the junior-high-or-below ratio, and household savings replaced household disposable income in the fixed-effect SEM for the robustness check. The definitions and descriptive statistics for all variables are presented in Table 1.

Empirical Results

After calculating the AIC and BIC, AIC and BIC were lower in the SEM than in the SAR in both the fixed-effect and the random-effect models. Therefore, it is concluded that the SEM is better than the SAR for this study.[7] In addition, the Hausman test failed to reject the null hypothesis that the fixed-effect SEM was more efficient than the random-effect model.[8] Thus, this study selected the fixed-effect SEM as the baseline model.

Models 1 and 2 are the baseline models of the fixed-effect SEM with the total crime rate and the rate of offense as the crime variables, respectively. Their counterparts in the traditional fixed-effect panel model are Models 3 and 4. According to Table 2, the results of Model 1 are quite similar to those of Model 2. Therefore, the result of Model 1 is the case discussed in this study. It is shown in Table 2 that the total crime rate has a statistically significant and negative effect on the GFR. As mentioned by South and Messner (2000), in a population with a high likelihood of committing a crime, the value of men diminishes in the marriage market and family, resulting in women's unwillingness or inability to give birth. The estimated parameter in the SEM is the marginal effect of the total crime rate on the GFR, meaning that when the total crime rate increases by 1000 crimes committed per 100,000 people,

[7] The AIC and BIC of the fixed-effect SEM were 900.1759 and 930.7186, respectively. The AIC and BIC of the fixed-effect SAR were 1034.578 and 1136.386, respectively.

[8] The Chi square statistic and the p value from the Hausman test were 77.20 and smaller than 0.0001, respectively.

Table 2 Empirical results of the fixed effect SEM and panel model

Independent variables	Fixed-effect SEM		Fixed-effect panel model	
	Model 1	Model 2	Model 3	Model 4
Total crime rate	−0.0029**		−0.0014*	
	(0.0006)		(0.0006)	
Rate of offense		−0.0027**		−0.0013*
		(0.0006)		(0.0006)
Female labor force participation rate	−0.0653	−0.0700	−0.1344*	−0.1362*
	(0.0546)	(0.0547)	(0.0603)	(0.0602)
Unemployment rate	−1.8860**	−1.8611**	−1.1583**	−1.1539**
	(0.4515)	(0.4518)	(0.2179)	(0.2179)
Junior high or below ratio	1.3857***	1.3934**	1.5217***	1.5252***
	(0.1605)	(0.1600)	(0.1272)	(0.1269)
Household disposable income	8.07×10^{-6}*	8.10×10^{-6}*	8.55×10^{-6}*	8.58×10^{-6}*
	(3.45×10^{-6})	(3.46×10^{-6})	(4.13×10^{-6})	(4.13×10^{-6})
Home ownership ratio	0.0038	0.0026	0.0666	0.0652
	(0.0553)	(0.0556)	(0.0661)	(0.0661)
Infant mortality rate	0.2286*	0.2330*	0.3247**	0.3261**
	(0.1087)	(0.1090)	(0.1229)	(0.1229)
Female ratio	5.0730**	5.1556**	5.1722**	5.2211**
	(1.3602)	(1.3580)	(1.5766)	(1.5687)
ρ	0.6658**	0.6595**		
	(0.1277)	(0.1309)		
σ^2	3.2602***	3.2757***		
	(0.3466)	(0.3483)		
Log-likelihood	−408.8701	−409.1674		
R^2	0.2585	0.2581	0.2618	0.2614

† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

the GFR will decline by approximately 3 births per 1000 women of childbearing age (15–49) for a county or city. This result indicates that the increase in the total crime rate is not the primary cause of the low fertility rate in Taiwan.

Other factors that have a significant impact on the GFR are the unemployment rate, the junior-high-or-below educational status ratio, household disposable income, the infant mortality rate, and the female ratio. The estimated coefficients of these variables have a negative or positive sign, which is consistent with our expectations. The impact of the unemployment rate on the GFR was statistically significant and negative at a 1 % significance level. This result implies that a higher unemployment rate will cause a lower GFR. This finding is consistent with Huang (2003), which found that household disposable income had a statistically and significantly positive impact on the GFR, suggesting that children were normal goods in the eyes of the Taiwanese people. In addition, the estimated coefficient of the junior-high-or-below ratio is statistically and significantly positive, meaning that having more people with a junior high school diploma or a lower educational level would cause a lower GFR. There are several ways to interpret the mechanism behind the inverse effect of education on the GFR: for example, schooling could change the traditional perspective of a woman's role in a family, or it could change marriage patterns (Basu 2002).

Moreover, both the infant mortality and the female ratio have a statistically and significantly positive impact on the GFR. When the infant mortality rate is higher, people are more likely to have more births to compensate for the lost infants, further increasing the GFR. In regards to the positive impact of the female ratio, this study asserts that people have more opportunity to marry when the female ratio is larger, given that the gender structure is imbalanced toward females. Finally, the positive and significant estimated ρ indicates that some unobservable positive factors in a county will likely have a positive effect on the GFR of its neighboring counties.

In addition to the fixed-effect SEM, Table 2 also presents the estimated results of the traditional fixed-effect model without considering spatial effects for comparison. It is very obvious that without taking spatial effects into account, the negative impacts of the total crime rate, the rate of offense, and the unemployment rate were underestimated. However, the positive impacts of the junior-high-or-below ratio, household disposable income, the infant

Table 3 Robustness check for the fixed-effect SEM

Independent variables	Fixed-effect SEM			
	Model 5	Model 6	Model 7	Model 8
Total crime rate	−0.0026**		−0.0033**	
	(0.0006)		(0.0006)	
Rate of offense		−0.0025**		−0.0031**
		(0.0006)		(0.0006)
Female labor force participation	−0.0723	−0.0765	−0.0687	−0.0740
	(0.0542)	(0.0541)	(0.0506)	(0.0508)
Unemployment rate	−1.7760**	−1.7507**	−1.3838**	−1.3685**
	(0.4297)	(0.4279)	(0.3680)	(0.3674)
Junior high or below ratio[#]	1.3390***	1.3439***		
	(0.1500)	(0.1496)		
Literacy rate[#]			−4.2806**	−4.2859**
			(0.3800)	(0.3807)
Household disposable income[#]			5.72×10^{-6}†	5.72×10^{-6}†
			(3.33×10^{-6})	(3.34×10^{-6})
Household savings[#]	9.41×10^{-6}*	9.69×10^{-6}*		
	(4.72×10^{-6})	(4.72×10^{-6})		
Home ownership ratio	0.0289	0.0277	0.0341	0.0332
	(0.0544)	(0.546)	(0.0563)	(0.0540)
Infant mortality rate	0.2095†	0.2135*	0.1838†	0.1877†
	(0.1078)	(0.1077)	(0.1018)	(0.1021)
Female ratio	4.7786**	4.8422**	−1.1978	−1.1181
	(1.3650)	(1.3627)	(1.2011)	(1.2095)
ρ	0.6442**	0.6389**	0.6800**	0.6759**
	(0.1242)	(0.1263)	(0.0938)	(0.0969)
σ^2	3.3029***	3.3140***	3.0424***	3.0640***
	(0.3472)	(0.3482)	(0.3159)	(0.3185)
Log-likelihood	−409.5865	−409.7691	−402.3702	−402.9526
R^2	0.2455	0.2456	0.3332	0.3310

Symbol # indicates the independent variables used to conduct the robustness checks

† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

mortality rate, and the female ratio were overestimated when spatial effects were neglected. It is thus concluded that the existence of spatial dependence is crucial to the estimated results. If spatial dependence is ignored, the estimations will be biased.

A robustness check was conducted to examine whether the influence of the crime rate and other explanatory variables were stable and robust. Models 5 and 6 used household savings to replace household disposable income in Models 1 and 2, respectively. The estimated results of Models 5 and 6 in Table 3 were consistent with their counterparts in Models 1 and 2. In addition, Models 7 and 8 used the literacy rate to replace the junior-high-or-below ratio in Models 1 and 2.[9] The impact of both types of crime rate on the GFR is still statistically and significantly negative. Therefore, the conclusion of a negative influence from the crime rate on the GFR is very robust, regardless of which educational and household finance variables are adopted in the empirical model.

Concluding Remarks

The purpose of this study was to explore a rarely discussed but important issue regarding the impact of the crime rate on the fertility rate in Taiwan. This study used official county-level panel data from 20 counties and cities over the 2000–2010 period in Taiwan and estimated a fixed-effect SEM. The primary finding of this study was that that after controlling other factors and considering spatial dependence, the crime rate had a statistically and significantly negative impact on the GFR in Taiwan, regardless of whether total crime rate or the rate of offense was used as the crime variable in the empirical model. This conclusion

[9] The literacy rate had a negative effect on the GFR, as Caldwell (1980) noted, by shifting the economy away from labor-intensive family-based production; mass education led to a lower level of fertility.

is reasonable and consistent with our expectations. In addition, this study also supports the public's opinion that economic factors, such as household disposable income and household savings, are essential to families' decision to have children. The unemployment rate had a negative impact on the GFR, but the junior-high-or-below ratio, infant mortality, and the female ratio have a positive impact on the GFR. Finally, the positive and significant estimated ρ indicates that some unobservable positive factors in a county will likely have a positive effect on the GFR of its neighboring counties. The conclusions drawn from the empirical results are robust, and once the spatial dependence is ignored, estimations will be biased. The first limitation of this study is that the county-data are not available before 2000 and after 2010. Therefore, it is not certain that the effect of crime on fertility is circumstance only of recent years or if the effect has existed for a longer period of time. The second limitation is the inability to identify the channel between crime and fertility. Since the theory predicts that by affecting marriage, crime could have an effect on fertility, household profiles might help to confirm this prediction. However, to our knowledge, a thorough household survey regarding marriage has still not been conducted in Taiwan.

Because the issue regarding low fertility rates is crucial to the economic development of many developed and developing countries, especially Taiwan, the conclusions provided by this study can make some contributions in this regard. According to the results from the empirical models, this study suggests a pro-natal policy in which the government increases efforts to reduce the total crime rate. Doing so will not only secure people's lives but will also encourage people to have more children. Although the total crime rate is not the most important factor affecting the GFR, it is a statistically significant factor.

Other feasible pro-natal policies are also proposed by this study. An increase in household disposable income can raise the GFR, according to empirical results. Therefore, if the government can adopt policies that increase household disposal income, such as mitigating the family tax burden, providing subsidies to families, or stimulating economic growth, people will be encouraged to have more children, further increasing the GFR. In addition, the government must promote employment opportunities by implementing labor policies. When the unemployment rate decreases, it will cause an increase in the GFR. Finally, it is found that the female ratio has a positive effect on the GFR. To increase the female ratio, the government can consider releasing restrictions on the immigration of females from foreign countries, given that cross-country marriage is becoming common and popular in Taiwan.

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