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Spatial Pattern of Female Non-agricultural Employment and Its Driving Forces in Guangdong Province, China: A Perspective of Individual and Family-level

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Abstract: Promoting women's employment is not only the need of social and economic development, but also the historical mission of liberating women. This paper uses data from the 1% Population Sample Survey, taken in Guangdong Province in 2015, to explore how women's marital status, education, and family environment affect the female non-agricultural employment rate (FNAER) on a county scale using a spatial-lag model. The results show that: 1) The female non-agricultural employment rate in counties of Guangdong Province is low, with more than three-quarters of counties having female non-agricultural employment rate less than 50%. Moreover, the spatial distribution of FNAER is uneven, with the high-value areas concentrated in the southeast and the low-value areas mainly distributed in the central and western parts of Guangdong Province. 2) From the perspective of industry, there are significant spatial differences among women. In the southeast, women are mainly engaged in the secondary industry, while in the central and western regions, women are mainly engaged in the tertiary industry. 3) Women having better skills and more effective support from the elderly can improve the FNAER. Women having lower skills, smaller-scale families, a higher fertility rate, and households with two or more elderly members have a negative effect on the FNAER. 4) Public policies suggest that improving women's education and their family environment, building social welfare facilities, and repairing the family environment will increase the FNAER.

Keywords: female non-agricultural employment (FNAER); spatial distribution; driving factors; family environment; individual characteristics; Guangdong Province, China

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1 Introduction

Employment in the non-agricultural sector can not only reduce poverty but also promote economic growth and urbanization (Lim-Applegate et al., 2002; Luo et al., 2014; Imai et al., 2015; Mahendra Dev, 2017). Socio-economically empowering women by increasing their share of total household income can improve their future prospects (Buvinić and Furst- Nichols, 2016; Maligalig et al., 2019; Van den Broeck and Kilic, 2019). In China, since the reform and opening-up in 1978, the rapid development of industrialization, urbanization, and modernization has greatly increased women's opportunities to participate in non-agricultural economic sectors. However, as a result of differences in non-agricultural economic development and the traditional concept of 'men are in charge of the outside world, women are in charge of the inside world,' there are still many obsta-

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cles that hinder the development of women's careers. On the one hand, women suffer from unequal treatment, low wages, and low positions in the labor market; on the other hand, they also take care of babies, care for the elderly, and handle household chores. Faced with this sharp contrast between the workplace and the family, women sometimes have to withdraw from the labor market to take care of the family. Therefore, studying geographical differences in women's non-agricultural employment and the driving forces behind these differences is becoming more important than ever.

Numerous studies have shown that improving women's education can strengthen their rights, improve family status, avoid domestic violence, guarantee more access to employment information, and reduce economic dependence (Becker, 1962; Van Ham and Büchel, 2006; Contreras and Plaza, 2010; Matas et al., 2010; Noback et al., 2013; Akram, 2018; Castellano and Rocca, 2018; Singh and Pattanaik, 2019). Maletta (2008) argued that women with a higher level of education are less restricted by cultural and traditional norms, which helps to increase their status in the family, increase the likelihood of them participating in non-agricultural sectors, and reduce their unemployment rate. Dolado et al. (2001) comparatively analyzed the differences in employment and occupational changes between women in the EU and the USA in the 1990s and argued that steadily improving their education level is a major way to reduce regional and gender differences. Therefore, for women aspiring to compete with men in the labor market, having a higher level of education is their most powerful weapon (Sinha Mukherjee, 2015; Lai et al., 2017).

However, it is generally believed that fertility has a negative impact on women's employment (Cramer, 1980; Van Ham and Büchel, 2006; Heath, 2017). Especially after giving birth, women will face more intense competition due to social changes and personal factors. Although some mothers can return to work smoothly, they have to be devoted to taking care of babies, which is bound to damage their career development in non-agricultural sectors (Miller, 2010; Agüero and Marks, 2011; De Jong et al., 2017; Lundborg et al., 2017). De Jong et al. (2017) found a significant negative correlation between a woman's ability to work in non-agricultural sectors and the number of children they have that are under six, and this was found to reduce the employment rate of African mothers by 6.0%. Cao (2019) found that the labor participation rate of women with two children decreased by 4.6% compared with that of women with one child. In addition, fertility also reduces the employment rate of women in the formal sector, and the impact on employment for women aged 21–35 is significantly greater than that for women aged 36–49 (Francavilla and Giannelli, 2011; Nguyen, 2019).

Family structure also has a greater impact on the female non-agricultural employment rate. Lee et al. (2016) found that women in joint families have smaller decision-making powers and often require permission from other members of the family to perform some family activities; women in nuclear families have higher labor participation rates. Dhanaraj and Mahambare (2019) examined the relationship between family structure and the non-agricultural employment rate of married women and found that the proportion of married women participating in non-agricultural work was 12% lower when living in a joint family, mainly because married women in joint families are more restricted by cultural and traditional norms, thus reducing the possibility of labor participation. Chen and Hamori (2010) argued that a greater number of family members and more household chores hinder women's employment. Liu et al. (2003) noted that being married reduces women's non-agricultural employment opportunities, but also found that family size was positively correlated with women's non-agricultural employment.

The existing research largely focuses on how education, fertility, and family structure affect women's non-agricultural employment. However, there are still some research gaps that have yet to be filled. 1) There is natural spatial heterogeneity in women's non-agricultural employment, and the same factors have different effects on this employment in different regions. However, many studies have ignored this spatial heterogeneity and use linear regression methods to analyze the factors that influence female non-agricultural employment. 2) Few studies separate household-level and individual-level factors when examining their influence. 3) There have been many studies on women's non-agricultural employment in Europe and Africa, but research in China is still scarce. Therefore, this paper considers 122 counties in Guangdong Province, examining the spatial differences in women's non-agricultural employment and using the spatial autocorrelation model to explain the influencing

factors from two dimensions: individual characteristics (education, marriage, and fertility) and family environment. The main reasons for our study of Guangdong Province are as follows. 1) Guangdong Province was one of the first regions to experience China's reform and opening up. Under the influence of industrialization and urbanization, the socioeconomic structure and ideological and cultural concepts have undergone profound changes. Thus, traditional family ethics have been impacted, patriarchy has weakened, women's status in the family has continued to increase, and participation in non-agricultural economic activities has become a common phenomenon. The rapid social changes that Guangdong has undergone are now also happening in other parts of China. Therefore, Guangdong Province can be considered as a model for the rest of the country. 2) In the context of social transformation, examining the relationship between women's non-agricultural employment and education, marriage, fertility, and the family environment is not only important to the interests of women, but also to the sustainable development of Guangdong's population, society, and economy. We will reveal the spatial patterns of and driving forces behind the female non-agricultural employment rate in Guangdong Province. Moreover, we have expanded the scope of the research to include both urban and rural regions to supplement the existing research bias toward rural women's non-agricultural employment.

2 Theoretical Framework

Human capital theory holds that education has a significant impact on women's performance in the labor market (Becker, 1962). Firstly, women with a higher education level tend to have a stronger awareness of individual rights and a greater desire to shake off the bonds of traditional gender roles. Secondly, a woman with a higher education level has better skills and is more competitive in the labor market and is therefore more likely to be employed (Fig. 1). Thirdly, women with a higher education level often consider individual career planning as the top concern in their life planning, which has a significant impact on the trade-off between work and family.

Marital status significantly affects women's living conditions (Xing and Jin, 2003), and the spouse plays a key role in this. On the one hand, women with spouses can benefit from their financial support, which reduces financial pressure and is in contrast to women without spouses. On the other hand, being with a spouse also means more family involvement, especially in child rearing and housework, which further deprives women of time and space to pursue other activities. Therefore, not having a spouse is beneficial to women's non-agricultural employment.

The theory of family division of labor contends that work such as raising and caring for children and cleaning has a significant impact on women's employment (Nock, 1985). People aged 65 and over may be retired, but they can potentially work within the family and provide strong support with parenting, cooking, and cleaning (Arpino et al., 2014). However, this support gradually declines with age, and an older person may become a burden on the family. Family size refers to the number of people in a family; with more people in the family, there are more household chores, and more family support is required. In the majority of Chinese families, housework is still considered to be the duty of women. Therefore, the larger the family size, the greater the negative impact on women's non-agricultural employment and vice versa.

Based on the existing research mentioned above, we build a theoretical framework of female non-agricultural employment and its drivers. The first component is individual characteristics, which include women's education, marital status, and total fertility. The second component is the family environment, which includes the family scale and the number of elderly people in the family. We will examine the mechanisms that influence female non-agricultural employment at the levels of the individual and the household.

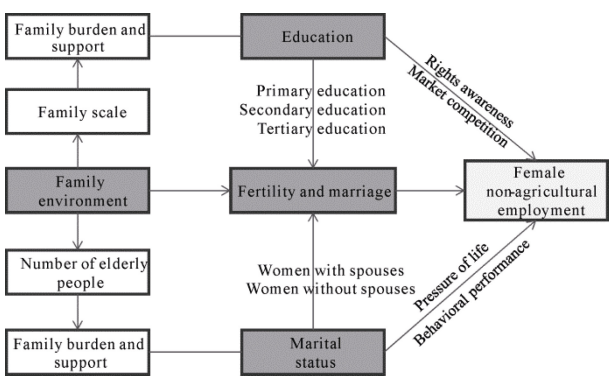

Fig. 1 Theoretical framework for women's non-agricultural employment

3 Materials and Methodology

3.1 Study area

Guangdong Province is located in the southeast of China, bordering the South China Sea and adjacent to Hong Kong and Macao (Fig. 2). With geographical advantages and policy support, it has attracted a large amount of domestic and overseas capital since 1978 and has gradually become one of China's richest provinces. In 2018, the GDP reached 9727.78 billion yuan (RMB), and the added value of the primary, secondary, and tertiary industries achieved 383.144 billion yuan, 4069.52 billion yuan, and 5275.12 billion yuan, respectively. The ratio of these three industrial sectors is 4.0:41.8:54.2. By the end of 2018, the resident population of Guangdong Province was 113.46 million, and women accounted for 47.82% of the total. The proportion of those aged 0–14 yr was 17.18%, the proportion of the population aged 65 and over was 8.62%, and the level of urbanization was 70.70% (National Bureau of Statistics, 2019).

During the past 40 years, the province has been experiencing a high-level of social and economic development, along with vigorous industrialization, urbanization, and modernization. Correspondingly, the changes in women's values and the family environment have been relatively significant, and the impact on women's non-agricultural employment is salient. For a region with such rapid socioeconomic development as Guangdong Province, the relationship between non-agricultural employment and women's individual characteristics and family environment not only concerns women's immediate interests, but also regional socioeconomic development and sustainable population development.

3.2 Data

Non-agricultural employment mainly refers to employment in industries excluding agriculture, forestry, animal husbandry, and sideline fisheries. The female non- agricultural employment rate refers to the proportion of women aged 15–64 in non-agricultural industries. Agricultural

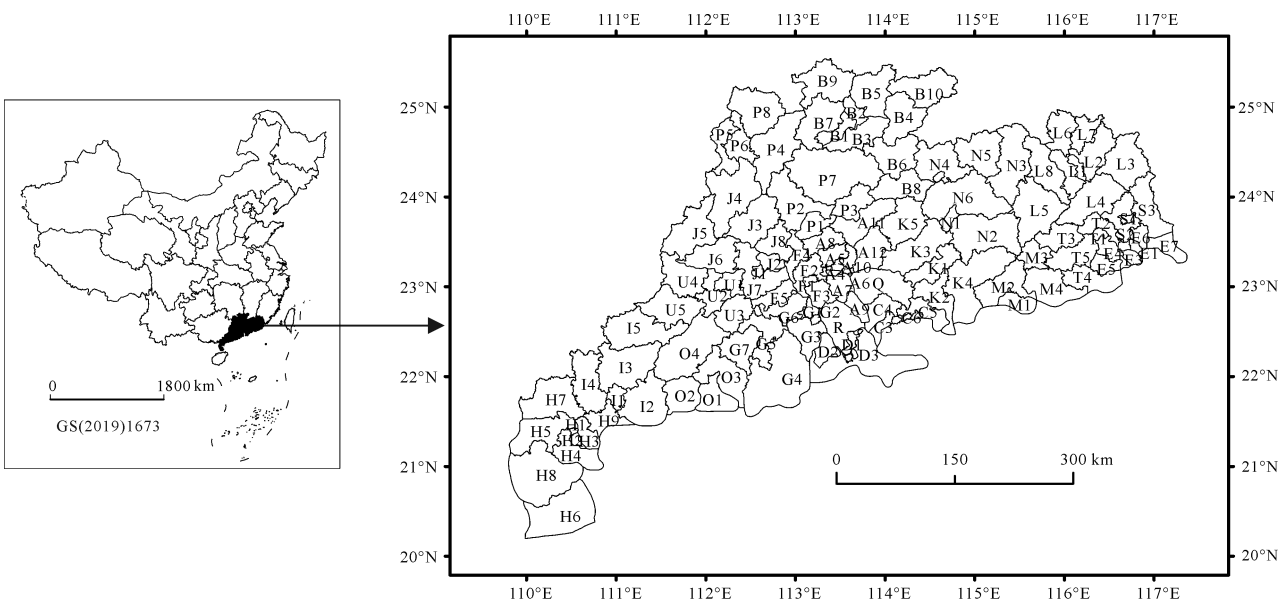

Fig. 2 Location of the studied area. A1, A2, ..., A12 respectively represent Liwan, Yuexiu, Haizhu, Tianhe, Baiyun, Huangpu, Fanyu, Huadu, Nansha, Luogang, Conghua, Zengcheng; B1, B2, ..., B10: Wujiang, Zhenjiang, Qujiang, Shixing, Renhua, Wengyuan, Ruyuan, Xinfeng, Lechang, Nanxiong; C1, C2, ..., C6: Luohu, Futian, Nanshan, Bao'an, Longgang, Yantian; D1, D2, D3: Xiangzhou, Doumen, Jianwan; E1, E2, ..., E7: Longhu, Jinping, Haojiang, Chaoyang, Chaonan, Chenghai, Nan'ao; F1, F2, ..., F5: Chancheng, Nanhai, Shunde, Sanshui, Gaoming; G1, G2, ..., G7: Pengjiang, Jianghai, Xinhui, Taishan, Kaiping, Heshan, Enping; H1, H2, ..., H9: Chikan, Xiashan, Potou, Mazhang, Suixi, Xuwen, Lianjiang, Leizhou, Wuchuan; I1, I2, ..., I5; Maonan, Dianbai, Gaozhou, Huazhou, Xinyi; J1, J2, ..., J8: Duanzhou, Dinghu, Guangning, Huaiji, Fengkai, Deqing, Gaoyao, Sihui; K1, K2, ..., K5: Huicheng, Huiyang, Boluo, Huidong, Longmen; L1, L2, ..., L8: Meijiang, Meixian, Dapu, Fengshun, Wuhua, Pingyuan, Jiangling, Xingning; M1, M2, ..., M4: Chengqu, Haifeng, Luhe, Lufeng; N1, N2, ..., N6: Yuancheng, Zijin, Longchuan, Lianping, Heping, Dongyuan; O1, O2, ..., O4: Jiangcheng, Yangxi, Yangdong, Yangchun; P1, P2, ..., P8: Qingcheng, Qingxin, Fogang, Yangshan, Lianshan, Liannan, Yingde, Lianzhou; Q: Dongguan; R: Zhongshan; S1, S2, S3; Xiangqiao, Chao'an, Raoping; T1, T2,..., T5: Rongcheng, Jiedong, Jiexi, Huilai, Puning; U1, U2, ..., U5: Yuncheng, Yun'an, Xinxing, Yunan, Luoding

employment has the characteristics of large flexibility in working hours, short commuting distances, and low skill requirements. Non-agricultural employment is characterized by low flexibility, long commuting distances, high skill requirements, and unbalanced employment opportunities. Therefore, the non-agricultural employment of women is affected by their level of education, maternity and marital status, and the family environment.

The data used in this study were obtained from the Population Sample Survey of 1% of Guangdong Province in 2015 (Guangdong Provincial Bureau of Statistics, 2017), including 120 counties and two prefecture-level cities (Dongguan City and Zhongshan City, with no subordinate county-level units considered the county-level sample). According to the theoretical analysis framework constructed in the second part, women's individual characteristics and family environment have an important impact on women's off-farm employment. In accordance with this framework, this paper constructs an indicator system of factors affecting female off-farm employment, including: female marital status, education level, family size, family structure and total fertility rate. The detailed indicators are shown in Table 1.

3.3 Methodology

According to the characteristics of interaction among geographically adjacent regions (Tobler, 2004), we assume that the spatial variation in the non-agricultural employment rate of women in Guangdong Province is relevant. The occurrence of spatial correlation can be tested by calculating Moran's *I* value. When *I* value is greater than 0, this indicates that there is a positive spatial correlation; if *I* value is less than 0, this indicates that there is a negative spatial correlation; when *I* value is equal to 0, there is no spatial correlation (Anselin et al., 2006; Wei et al., 2018).

This paper uses the global Moran index to assess whether there was spatial correlation between the non-agricultural employment rates of women in the county units in Guangdong in 2015. The formula for this is

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

Table 1 Descriptive statistics

Variables	Measured	Mean	SD	Minimum	Maximum
Dependent variables					
Female non-agricultural employment rate *Y*	Women's non-agricultural employment/total population of women aged 15–64	0.383	0.145	0.116	0.732
Explanatory variables					
Women with spouses x_1	Women with spouses/marital status of women aged 15 and over	0.702	0.044	0.557	0.770
Women without spouses x_2	Women without spouses/marital status of women aged 15 and over	0.298	0.044	0.230	0.443
Primary education x_3	Number of women with junior-high-school education or below/total population of women aged 15–64	0.725	0.139	0.302	0.907
Secondary education x_4	Number of women with high school and secondary specialized school education/total population of women aged 15–64	0.179	0.061	0.074	0.321
Tertiary education x_5	Number of women with tertiary education/total population of women aged 15–64	0.096	0.086	0.016	0.429
Households with one elderly person x_6	Households with one elderly member/total households	0.134	0.044	0.025	0.221
Household with two or more elderly people x_7	Household with two or more elderly members/total households	0.060	0.017	0.009	0.100
Small-scale families x_8	Families with four or fewer people/total families	0.722	0.138	0.326	0.935
Medium-scale families x_9	Families with five to seven people/total families	0.242	0.109	0.062	0.530
Large-scale families x_{10}	Families with eight or more people/total families	0.036	0.034	0.001	0.194
Fertility rate x_{11}	Number of children born in 2015/number of women aged 15–49	1.673	0.492	0.853	3.550

where m represents the number of samples, x_i and x_j are the female non-agricultural employment rates of county i and county j, respectively, x is the average value of the non-agricultural employment rate of women in the counties of Guangdong Province, and w_{ij} represents the weighting between spatial units. This paper adopts adjacency for the spatial weighting, which is applied as follows.

$$W_{ij}=\begin{pmatrix}1 & \text{Area } i \text{ is adjacent to area } j\\ 0 & \text{Area } i \text{ is not adjacent to area } j\end{pmatrix} \quad (2)$$

The spatial measurement method assumes that the space is heterogeneous and there is a correlation between the regions, which makes up for the homogeneity hypothesis of the traditional regression method and improves the objectivity of the regression results to some extent. The method is divided into the spatial-lag model (SLM) and the spatial-error model (SEM, Long et al., 2014). The spatial-lag model is used to analyze whether the dependent variable has a diffusion or spillover effect in a certain area. The expression is

$$\ln Y_i=\rho\sum_{i=1}^{m}W_{ij}\ln Y_i+\beta\ln x_i+\varepsilon_i\ , \quad (3)$$

where Y_i is the dependent variable, i.e., the observed value for region i, ρ is the female non-agricultural employment rate coefficient, indicating the degree of influence of the observation value of the adjacent region on the observed value of the region, w_{ij} is a 122 × 122 spatial weighting matrix, β is the regression coefficient of an independent variable, x_i is the explanatory variable, and ε_i is a residual disturbance term.

The spatial-error model is mainly used to analyze the interaction between the error terms of the dependent variables between similar regions and can be expressed

$$\ln Y_i=\beta\ln x_i+\varepsilon_i,\ \varepsilon_i=\lambda\sum_{i=1}^{m}W_{ij}\varepsilon_i+\mu_i\ , \quad (4)$$

where μ_i is the residual-disturbance term, λ is the spatial-error coefficient, which reflects the extent of the impact of an adjacent region due to the error impact of the interpreted variable on the observation value of the region, and $w_{ij}\varepsilon_i$ is the spatial-lag disturbance term. Other parameters are the same as in Eq.(3).

4 Results

4.1 Women's non-agricultural employment in Guangdong

Fig. 3 shows the spatial pattern of female non-agricultural employment rates in Guangdong in 2015. The average rate in Guangdong was 38.3%, and 54 counties were lower than this average, accounting for 44.0% of the total. Some 71 counties had a rate below 40.0%, accounting for 58.0% of the total. This indicates that the overall non-agricultural employment rate of females in Guangdong Province was not high, and the scale of female participation in the non-agricultural economy needs to be improved. The female non-agricultural employment rate had large spatial variations. The county with the highest non-agricultural employment rate was Bao'an District, Shenzhen, at 73.2%. However, in Fengkai County, the northwestern Guangdong Province, it was only 11.6%. On the whole, the regions where the female non-agricultural employment rate was higher than 50% were mainly concentrated in the southeastern coastal areas, while the areas with a rate lower than 40% were mainly distributed in the north, east, and southwest. This indicates that there is clear spatial clustering in women's non-agricultural employment, which manifests as a spatial structure that gradually decreases outward from the southeastern coast.

Considering the industrial sectors in which women were employed, the proportion in secondary industry was not high. Most regions had a level of employment in secondary industry of 30%–50%, and the number of regions with a rate greater than 50% was relatively small. The regions with a value greater than 50% were concentrated in the southeastern and eastern coastal areas, while the areas below 50% were concentrated in the north and the southwest. The proportion of female employment in tertiary industries was relatively high and in most counties was greater than 50%; the areas with values greater than 50% were distributed in the north, east, and southwest, and those with rates less than 50% were concentrated in the southeastern coastal areas. To sum up, women in Guangdong were found mainly to work in tertiary industries, and there were few working in secondary industries; the spatial pattern of the proportion of employment in secondary industries largely matches the

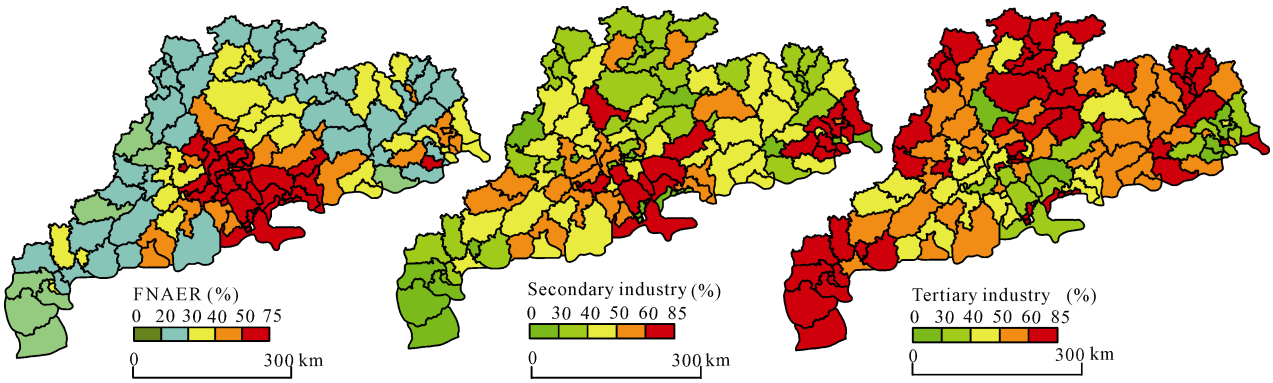

Fig. 3 Spatial patterns of female non-agricultural employment rate (FNAER) in Guangdong Province

spatial pattern of the overall non-agricultural employment rate. This indicates that the tertiary-industry sector in Guangdong is the main choice for most women in employment, while relatively few women choose secondary industries.

4.2 Examining the female non-agricultural employment rate

4.2.1 Model test

According to Formula (1), the value of the residual Moran's *I* is 0.7709, the *z* value is 12.503, and the significance test is passed at the 1% level, indicating that there is significant spatial dependence of the residual of the traditional ordinary-least-squares (OLS) regression model. The *P* values of the Breusch-Pagan test and the Koenker-Bassett test are both less than 0.05, indicating that the model does not have heteroscedasticity, and the model fitting effect is better, which further confirms the existence of spatial autocorrelation (Table 2). Therefore, taking into account the spatial factors, we used the GeoDa software developed by professor Anselin of the University of Chicago to analyze the factors influencing the female non-agricultural employment rate. In terms of model selection, we selected Lagrange Multiplier (LM) and Robust Lagrange Multiplier (R-LM) according to Anselin et al.'s (2006) model fitness evaluation criteria.

It can be seen that the statistics of the LM lag and the LM error pass the significance test; the robust LM (lag) passed the significance test at the 1% level, and the robust LM (error) passed the significance test at the 10% level. However, the values of LM lag and robust LM (lag) are significantly larger than those of LM error and robust LM (error), indicating that the spatial-lag model is more suitable for analysis of the factors affecting the non-agricultural employment rate of women in Guangdong Province.

4.2.2 Driving forces behind the female non-agricultural employment rate

Table 3 presents the drivers of the female non- agricultural employment rate in Guangdong Province. It can be seen that marital status does not pass the significance test, indicating that marital status does not have a major influence on the female non-agricultural employment rate.

Primary education was negatively correlated with the female non-agricultural employment rate, suggesting that women with lower levels of education have lower participation in non-agricultural work. However, secondary education was positively associated with the female non-agricultural employment rate. Guangdong Province has witnessed a transformation from primary processing and imitation of products to independent innovation. Accordingly, the need for skilled workers has gradually increased, and low-skilled labor is gradually decreasing because it fails to meet the requirements of

Table 2 Diagnostic tests of model estimation results

Test	Breusch-Pagan	Koenker-Bassett	LM (lag)	Robust LM (lag)	LM (error)	Robust LM (error)
Value	34.088	25.893	25.893	8.822	21.729	3.664
Prob	0.000	0.007	0.000	0.003	0.000	0.056

industrial development. Middle-skilled laborers with a certain level of knowledge and operational skills, however, do meet the skill requirements for industrial development and are more capable than those with only a primary-education background. Therefore, secondary education has a positive effect on the non-agricultural employment rate of women in Guangdong Province.

In contrast to previous research, tertiary education in our model did not pass the significance test. That is, tertiary education is not related to the female non-agricultural employment rate. This may be because Guangdong has a high level of marketization, fierce competition among enterprises, and high salary levels: in 2015, the average annual salary of private enterprises was 44 838 yuan, ranking first in China, and the average annual salary of non-private enterprises was 65 788 yuan, ranking second in China. Correspondingly, the costs and risks of business operations are high. Therefore, for the sake of limiting operating costs, employers are more inclined to hire men, who tend to invest less in family affairs. However, highly educated women tend to be older when they start work, and the ensuing marriage, childbirth, and care needs of the family can force women to interrupt work, which is not conducive to the stable development of the enterprise. In addition, the salaries and working environments of low-level manufacturing and service industries are far from the expectations of highly educated women, and they therefore seldom choose these jobs. The impact of tertiary education on female non-agricultural employment is thus relatively low and it does not pass the model test.

The total fertility rate passed the 5% level of significance test and was negatively correlated with the female non-agricultural employment rate, suggesting that a high fertility rate hinders women's non-agricultural employment. In the areas with high fertility rates in Guangdong, the non-agricultural economy is underdeveloped, and non-agricultural job opportunities are scarce. Women will therefore need to leave their hometowns for developed cities to find suitable jobs. Those who leave their children for a long time may struggle to reunify their families, which can be difficult for mothers. Therefore, the total fertility rate has a significant inhibitory effect on the non-agricultural employment rate of women in Guangdong Province.

Households having one elderly member were positively associated with the female non-agricultural employment rate. However, households having two or more elderly members had a negative effect on the female non-agricultural employment rate. The number of elderly people in the family represents a potential financial burden. Households with a single elderly member will have a lighter financial burden but less parental support (Cao, 2019). Thus, the pressure on family life is usually large. To maintain their standard of living, women have to engage in non-agricultural work. To some extent, having one elderly member in a household may mean they can help with childcare and housework and alleviate the 'work-family' contradiction. However, households with two or more elderly members will have a greater pension burden and require more financial support for those elderly members. With income substitution, women usually pay more attention to entertainment and leisure and are less willing to engage in non-agricultural work (Lai et al., 2017). Moreover, a household with more elderly members may have a heavy family pension burden and may result in women having more responsibility for care. Therefore, households having a single elderly member has a positive effect on the non-agricultural employment rate of women, while households having two or more elderly people has an inhibitory effect.

The factor of small-scale families passed the significance test, but the medium- and large-scale family factors did not have a major influence on the female non-agricultural employment rate. As stated in our theoretical model, a smaller family size and less family labor contribute to a lower overall capital level for the family and a narrower source of family income in a society where labor is capital. With high living costs and less support from fewer family members, small-scale families can face greater pressures, being unable to purchase more social services, and have low risk tolerance. Women are often assumed to take responsibility for caring for the family. Therefore, small-scale families are not conducive to female non-agricultural work.

5 Discussion

The improvement of women's economic status is a necessary condition for women to throw off social oppression, participate equally in labor market competition, and achieve economic independence (Marx and Engels, 1972). However, it must be recognized that women's

Table 3 The estimation results of the spatial lag model (SLM) and spatial error model (SEM)

Model specification variable	SLM			SEM		
	Coefficient	*z* value	Probability	Coefficient	*z* value	Probability
CONSTANT	−0.656	−0.297	0.766	−0.986	−0.489	0.623
Women with spouses	2.458	0.955	0.340	2.62.	1.120	0.263
Women without spouses	−0.098	−0.089	0.929	0.005	0.114	0.909
Primary education	−0.640	−2.392	0.017**	-0.853	−3.090	0.002***
Secondary education	0.303	2.858	0.004***	0.169	1.641	0.100*
Tertiary education	−0.012	−0.146	0.884	−0.039	−0.509	0.611
One elderly people	0.415	3.486	0.000***	0.240	1.802	0.072*
Two or more elderly	−0.573	−5.649	0.000***	−0.540	−4.730	0.000***
Small-scale families	−0.698	−2.303	0.021**	−0.114	−0.382	0.702
Medium-scale families	−0.136	−0.967	0.334	−0.013	−0.093	0.926
Large-scale families	0.024	0.480	0.631	0.039	0.765	0.111
Total fertility	−0.248	−2.260	0.023**	−0.157	−1.398	0.162
R^2	0.792			0.823		
Log-L	32.518			35.635		
AIC	−39.035			−47.271		
SC	−2.583			−13.623		

Note: *$P < 0.1$, **$P < 0.05$, ***$P < 0.01$

happiness is not only based on personal income: it also includes emotional care from the family. As the Chinese saying goes, 'If home is prosperous, then everything is prosperous'. Paying attention to the family has been a traditional value in China for thousands of years, one that encompasses a prosperous population, family harmony, and respect for the elderly and the young. However, against the background of industrialization, urbanization, and modernization, a decline in the willingness to have children, an increasing divorce rate, the miniaturization of family size, and the separation of young couples from their parents have become social trends that pose new challenges to the development of social harmony. Consequently, the amount of help grandparents provide with childcare and housework has decreased, and young mothers have to face employment-household conflicts. Therefore, emphasizing the importance of the family and the repair of damaged family environments is required not only to increase the fertility rate but also to promote high-quality employment for women.

First, carry on the traditional Chinese 'family' culture: the spirit of 'respecting the old, caring for the young and helping each other', emphasize the positive role of the function of the family in personal growth and development, enhance people's attachment to the family, and raise residents' understanding of the family. Second, we must promote large-scale family life, appropriately encourage the elderly to return to their families after retirement, reduce the burden of child rearing and housework for young women, maintain good family relationships, and reduce the family's fission to the smallest scale. Third, we must develop the social-service industry, improve related services such as education, care for children and the elderly, guide social capital to invest in the domestic-service industry, and strive to create a convenient, efficient, and diversified domestic-service industry, which in turn will reduce the burden of family life on women and reduce their worries about fertility.

It is worth noting that although tertiary education did not pass the significance test, we can not ignore the need to improve women's education. At present, Guangdong Province is in a critical period of social transformation. With socioeconomic development and the upgrading of industry, the need for skilled workers has increased. Therefore, women must improve their skills and use their human capital reserves to meet the needs of industrial transformation and avoid being laid off.

There are, however, some limitations to our analysis. First of all, our study only discussed the female non-agricultural employment rate in Guangdong Province in 2015, which is a static study and lacks a long-term dynamic study, so it can not fully reveal the characteristics

of the historical evolution of female non-agricultural employment rate. Secondly, the indicator system of influencing factors of female non-agricultural employment rate constructed is not complete, and some indicators that have a great impact on female employment, such as family income, family education difference and personal physical condition, are omitted, which reduces the accuracy of spatial autoregressive model. Thirdly, the regional industrial structure determines the structure of the labor market, and there are differences in the performance of different industries. However, this paper does not analyze the industrial differences of female employment, nor the influencing factors. Finally, our analysis is based on the differences between individuals and families. However, whether women can find suitable jobs in the labor market is not only determined by individual characteristics and family environment, but also depends more on the employment opportunities in the local labor market, the status of women in the society, and the social welfare of work. In the future, we will improve our research in the following aspects: extend the research period to 1953, and analyze the evolution process, industry differences and formation mechanism of female non-agricultural employment since the founding of the People's Republic of China.

6 Conclusions

We develop a theoretical framework for the relationship between the female non-agricultural employment rate and individual characteristics and the family environment. This model considers geospatial dependence and heterogeneity and empirically examines how the family environment and women's individual characteristics affect the female non-agricultural employment rate.

In 2015, the non-agricultural employment rate of women in Guangdong Province was generally low. About 60% of the counties had a non-agricultural employment rate of less than 40%, and only about 25% of the counties had a non-agricultural employment rate of greater than 50%. The spatial distribution was uneven, forming a high-value cluster of female non-agricultural employment rates centered on cities such as Guangzhou, Shenzhen, and Foshan, and a low-value cluster around the central and western parts of Guangdong Province. In addition, most women were found to work in tertiary industries, while their employment in secondary industries was relatively small. Women in southeastern coastal areas were found to have a higher proportion of employment in secondary industries than in tertiary industries.

There was a general proximity effect between the geographical variables. We found that the non-agricultural employment rate of women in Guangdong Province has significant spatial autocorrelation. Using GeoDa, we applied the spatial autoregressive method to explore the factors influencing the female non-agricultural employment rate and found that having a medium skill level and a household with a single elderly member can significantly promote women's non-agricultural employment. Conversely, having a low skill level, a lack of support from family members, a household with two or more elderly members and a high fertility rate are not conducive to women's non-agricultural employment in Guangdong Province.

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