Socio-Economic Model of Jiangsu Province Based on Panel Data

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Abstract Based on the meaning of Panel Data, regression model and its specific estimation method of Panel Data are introduced. Combined with the actual situation of farmland in Jiangsu Province, socio-economic factors affecting the farmland change is taken as the explanatory variables, such as total population, regional GDP, agricultural output value, total investment of fixed asset, total retail sales of social consumer goods, per capita disposable income of urban residents, and per capita income of farmer. And farmland is taken as the explained variable. According to the Panel Data of 13 cities in Jiangsu Province, Fixed Effect Model of fixed coefficient and variable intercept is selected based on the result of Hausman Test. This model is also used to construct the farmland socio-economic model of 13 cities in Jiangsu Province. Result shows that population is the most important driving force factor of farmland change in Jiangsu Province; socio-economic factors have relatively weaker fixed effects on farmland; regression coefficient of agricultural output is not significant; and model coefficient of GDP reflects a different economic meaning from the reality. Thus, this model is generally significant from an economic sense.

Key words Farmland; Panel Data; Eviews; Socio-Economic Model; China

Land-Use and Land-Cover Change (LUCC) takes a vital part both in International Geosphere-Biosphere Programme (IGBP) and International Human Dimensions Programme on Global Environmental Change (IHDP)[1-4]. It has been discovered that socio-economic factors (economy, population, urbanization, etc.) are leading driving forces resulted in the variability of land use, especially in short period. However, the quantitative study on relationships between socio-economic factors and change of land use lacks of sounding result due to various limitations[5]. Existing studies mainly rely on time series data and separate lands with different locations for the assessment of the relationships between lands and socio-economic factors. In order to optimize the result, the author utilized 13 Panel Data in Jiangsu Province from 2000 to 2008 to observe relationships between changes of farmland use and socio-economic factors with the purpose of finding socio-economic features when farmland use changes in Jiangsu Province and providing reference for sustainable use of Jiangsu farmland.

1 Panel data and regression model

1.1 Panel data Panel data, which is also called time series and cross section data or pool data, is two-dimensional data obtained via time and space in synchronization. Seen from transversal surface, it consists of observed values of some entities at some particular time points; while from cut plane, it is a time serial.

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Variables with double subscripts are used to represent Panel Data, it forms as y_{it} ($i=1,2,\cdots,N$; $t=1,2,\cdots,T$), where N is the number of entities in Panel Data, T is the maximum length of time serial.

1.2 Panel data regression model The equation of panel data model is:

$$y_{it}=\alpha_{it}+\beta'_{it}x_{it}+\varepsilon_{it}, \quad (1)$$

where y_{it} represents the observed value of entity i when a defined variable is used at the time point of t; $x'_{it}=(x_{1it}, x_{2it}, \cdots, x_{kit})$, representing observed value of entity i when a nonrandom variable k is used at the time point of t; β'_{it} is pending parameter vector and ε_{it} is random error term.

1.3 Estimation of panel data model According to different types of α_{it} and β'_{it} in equation (1), the panel data models can be divided into Variable Coefficient model [equation (2)] and Variable Intercept model [equation (3)]:

$$y_{it}=\alpha_i+\beta'_i x_{it}+\varepsilon_{it}, \quad (2)$$

$$y_{it}=\alpha_i+\beta' x_{it}+\varepsilon_{it}. \quad (3)$$

Both of the equations (2) and (3) consist of Fixed Effect model and Random Effect model. The estimation method varies for each type of models. Generally, Fixed Effect model adopts OLS estimation (least-square estimation), while Random Effect model adopts GLS estimation (generalized least squares estimation)[6].

2 Data sources and selection of variables

The data introduced in our study are originated from documents of Department of Land and Resources of Jiangsu Province, as well as *Statistical Yearbook of Jiangsu Province*. As is listed, cases of 13 cities in Jiangsu Province are chosen for this study: Nanjing (NJ), Wuxi (WX), Xuzhou (XZ), Changzhou (CZ), Suzhou (SZ), Nantong (NT), Lianyungang (LYG), Huai'an(HA), Yancheng(YC), Yangzhou(YZ), Zhenjiang(ZJ), Taizhou(TZ), Suqian(SQ). Moreover, combined with the actual situation of farmland in Jiangsu Province, socio-economic factors affecting the farmland change is taken as the explanatory variables, such as total population, regional GDP, agricultural output value, total investment of fixed asset, total retail sales of social consumer goods, per capita disposable income of urban residents, and per capita income of farmer. And farmland is taken as the explained variable.

3 Setup of models

3.1 Selection of models Policies related to population, economy and land should be compliant with those of Jiangsu provincial government. Therefore, model coefficient β is supposed to remain constant, but individual differences of each city are necessary to be considered during setting up the model. Hence, we define the socio-economic model of farmland change in Jiangsu Province as equation(3), which is featured with fixed coefficient and variable intercept. And Hausman Test could decide whether to use Fixed Effect model or Random Effect model. It is assumed that " H_0: random effect is irrelevant to explanatory variables", and " H_1: random effect is relevant to explanatory variables". The statistic $W = (\hat{\beta} - \hat{\beta}_{GLS})' \sum_{i=1}^{n} {}_{\beta}^{-1} (\hat{\beta}_W - \hat{\beta}_{GLS})$, where $\hat{\beta}_W$ is internal estimator, $\hat{\beta}_{GLS}$ is the least squares estimator. When H_0 is true, W gradually submits to x^2 distribution whose degree of freedom is K. When $W > x^2_{0.05}(K)$, H_0 is refused. Thus, random effect is thought to be relevant to explanatory variable and Random Effect model must be selected[7]. By deploying Hausman Test with Eviews statistical software, it is concluded that $W = 100.601\,9 < x^2_{0.05}(80)$, so we should choose H_0. In other words, Fixed Effect model is a better choice.

3.2 Parameter estimation and inspection With Eviews software, fixed effect panel model can be adopted to make parameter estimation(see results in Table 1). The fixed effect parameters of 13 cities in Jiangsu Province are −79.745, −215.778, 396.328, −270.168, −5.600, 215.601, −99.087, 56.282, 528.447, −126.451, −355.514, −96.680, and 52.366.

Table 1 Model parameter estimation

Variable	Coefficient	Standard error	*t* statistics	*P* value
Constant	730.050 800	165.957 900	4.399 011	0.000 0
TP	−0.568 545	0.302 345	−1.880 453	0.063 5
GDP	0.007 403	0.007 414	0.998 499	0.320 9
AOV	0.064 428	0.122 287	0.526 859	0.599 7
IFA	−0.052 468	0.027 524	−1.906 275	0.060 0
SCG	−0.018 425	0.032 211	−0.572 027	0.568 8
FPI	−0.048 639	0.011 727	−4.147 741	0.000 1
UPI	0.020 037	0.004 500	4.452 163	0.000 0

According to results outputed by Eviews, the sample goodness of fit $R^2 = 0.994\,267$, the holistic significance statistic of model F is 766. 678 4, and concomitant probability is 0.000 000, which proves this model possesses high degree of fitting and regression model is remarkable. But, within the parameter significance test t, the t values of AOV and SCG are 0.526 859 and −0. 572 527 respectively; while concomitant probability are 0. 599 7 and 0. 568 8, which shows the coefficient of these two explanatory variables are indistinctive so that some necessary adjustments are needed. In this case, we adjust the model by removing those unremarkable coefficients, then, reassess and reexamine the new model.

3.3 The final model Through repeated retesting and adjusting, the final socio-economic model of farmland of Jiangsu Province comes out eventually:

$$FL_i = C_i - 0.506\,TP + 0.005\,GDP - 0.063\,IFA - 0.049\,FPI + 0.020\,UPI, \quad (4)$$

where i = *NJ*, *WX*, *XZ*, *CZ*, *SZ*, *NT*, *LYG*, *HA*, *YC*, *YZ*, *ZJ*, *TZ*, *SQ*, and C is constant term. Its statistical results are displayed in Table 2.

Table 2 The constant term in socio-economic model of each city administered by provincial government

Serial No.	City	Constant term
1	*NJ*	617.937
2	*WX*	490.229
3	*XZ*	1 081.902
4	*CZ*	441.571
5	*SZ*	696.876
6	*NT*	903.705
7	*LYG*	607.613
8	*HA*	761.666
9	*YC*	1 221.789
11	*YZ*	579.514
12	*ZJ*	361.083
13	*TZ*	607.13
14	*SQ*	756.931

4 Conclusions and discussion

4.1 Conclusions

(1) Compared to coefficients of regional GDP, total investment of fixed asset, the absolute value of total population is the biggest among them, which shows that population is the most important driving force factor of farmland change in Jiangsu Province. With the rapid growth of population and the mass migration from rural area to cities during urbanization, the transformation of farmland into urban lands for construction would be unavoidable, with very rapid speed of transformation.

(2) For developed cities, such as Nanjing, Suzhou, Yangzhou, Zhenjiang and Lianyungang, the constants of their models are smaller than those of other cities, which shows that socio-economic factors have relatively weaker fixed effect on farmland. This could attribute to a higher development of socio-economic level in these five cities, Besides, socio-economic change at the same degree has imposed relatively weak impact on transformation rate of lands. As a result, the relevant effect would be relatively weak as well.

(3) The absolute value of regional GDP' coefficient is the smallest one among all variables, showing that the regional GDP has a little impact on farmland. However, in fact, the fast growth of our national economy has undoubtedly tremendous influence on farmlands due to the data error and incomplete processing methods.

(4) The coefficient of agricultural output value is not re-

markable. Although agricultural output value raises with the development of agricultural technology, the increment is balanced out with output value reduction caused by farmland losses. Hence, this result cannot objectively describe its influence on farmland change, because it is difficult to distinguish these two reasons leading to changes of agricultural output values mentioned above (In this case, we remove the variable to maintain fineness of our model).

4.2 Discussion Since there are various types of panel data models and model estimation involves huge amount of data informations, Eviews soft is adopted to yield twice the result with half the effort in selecting and estimating models. Although the test on this model and economic significance has obtained good effect, the farmland use and its change are a complicated system under combined actions of society and economy. Therefore, the model in this study has its own limitation with merely main socio-economic factors being chosen. Furthermore, socio-economic factors and natural causes, such as climate and environment, also have great impact on farmland change which requires our further research as well.

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基于面板数据的江苏耕地社会经济模型

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摘要 在界定了面板数据含义的基础上,介绍了面板数据回归模型及其具体估计方法。结合江苏省耕地利用现实情况,选取了总人口、地区生产总值、农业产值、固定资产总投资、社会消费品零售总额、城镇居民人均可支配收入、农民人均村收入 7 个对耕地变化有影响的社会经济因子作为解释变量,耕地作为被解释变量。利用江苏省 13 个市 2000 ~ 2008 年的面板数据,根据 Hausman 检验结果选用了固定系数、变截距的固定效应模型,并运用该模型构建了江苏省 13 个市的耕地社会经济模型。结果表明,人口因素是江苏省耕地变化最重要的驱动力因子,社会经济因素对耕地的固定效应较弱,农业产值的回归系数不显著,地区生产总值的模型系数所反映的经济含义与现实不符,模型从经济意义上来说总体是显著的。
关键词 耕地;面板数据;Eviews;社会经济模型

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基于影响因素角度和时间序列模型的耕地资源目标预测研究
——以山东省安丘市为例

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摘要 以山东省安丘市为例,在介绍研究区概况的基础上,从耕地资源数量变化、耕地资源结构变化、耕地变化动态的区域差异 3 个方面分析了安丘市耕地资源动态变化状况,从基于粮食需求的耕地需求预测(人口规模预测、人口粮食占有量、粮食单产预测、复种指数预测)、经济作物生产对耕地需求预测、耕地需求目标 3 个方面探讨了探讨了影响耕地资源需求目标的因素,采用多项式预测模型和线性预测模型探讨了基于时间序列的耕地资源目标预测,为安丘市规划期内土地利用提供决策依据。结果表明,耕地总量呈逐年增多趋势,人均耕地数量相对稳定;水浇地占耕地比重逐年减少,旱地占耕地比重逐年增多;各乡镇街道耕地动态变化区域差异不大;安由于人口数量的不断增加,人均耕地的数量将会面临很大的压力,耕地形势仍然不容乐观。
关键词 耕地资源;影响因子;时间序列;安丘市