A spatial econometric study on effects of fiscal and financial supports for agriculture in China

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Abstract: Since the reform and opening-up, the disparity between Chinese rural economy and the overall national economic development has already become the key constraint for further development of the national economy. In order to increase the farmers' income and to promote rural economic development, the efforts of China's budgetary and financial policies to support agriculture have been strengthened year by year. However, it lacks an accurate and effective assessment to evaluate the effects of China's fiscal and financial policies supports for agriculture. This paper proposes to estimate and measure the effects of China's fiscal and financial supports for agriculture utilizing the Chinese provincial panel data on the basis of the latest spatial panel econometric method. The results show that since China intensified the fiscal and financial support in 2004, the direct effects of fiscal and financial supports for agriculture have improved, but the spatial spillover effects have turned from positive to negative.

Key words: direct effects, effects of policies, spatial panel econometrics, spatial spillover effects

In the 1960s, Lewis, Schultz and Todaro stressed that the government should use fiscal and monetary policies to transform the traditional agriculture so as to promote agriculture and rural economic development. Afterwards, Ghatak and Ingersent (1984), Barro et al. (1992), Munnel (1992), Tatom (1993), Evans and Karras (1994), Gramlich (1994), Holtz-Eakin (1994), Garcia-Mila et al. (1996), Darrat (1999) analyzed the role of the government fiscal and monetary policies in agriculture, rural development and discussed the mechanism of the governments' fiscal and financial means to promote rural development. When embracing the 21st century, it is apparent that the policies of fiscal and financial support for agriculture in developing countries not only have their positive sides, but also negative effects. Rioja and Valev (2004), for example, have an empirical analysis on the basis of data in 74 countries from 1960 to1995, and they reveal that the policy effects of financial implementations are not necessarily positive. Though having promoted economic growth, the degree is also different. Also, in regions with a low-level economy, its impact may be negative. The reasons are the lack of the effective financial market system and the inefficient allocation of rural capital (Koester 2000; Allanson 2006), the government-subsidized agricultural credit system's distortions on the credit market (Jensen 2000), the lack of the necessary risk management in agricultural units (Townsend and Yaron 2001), the differences of economic conditions in different regions (Jim 2005), and so on. Therefore, scholars proposed some countermeasures from different point of views in order that the policies of fiscal and financial supports for agriculture play an active role in agriculture and rural economic development. Getaneh Gobezie (2009) started research of the rural financial market failures and adverse selection problems, emphasizing on targeted interventions to ensure that the services benefit the poor and sustainable development. Also, he raises that rural financial service providers who commit themselves to sustainable development cannot rely solely on contributions, but instead they should get their funds from efficient services, setting the appropriate prices. Jayne and Boughton (2011) note that keeping sustainable development of agriculture will increase investment and it is essential to develop policies to encourage private capital into the rural areas, as well as to improve the level of the financial market services for agriculture. There is no doubt that developing countries should establish a strong government-led investment system in agriculture.

After the reform and opening-up, Chinese economy has made remarkable achievements. The GDP was only 364.5 billion yuan in 1978, yet in 2010 China overtook

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Japan as the world's second largest economy and the GDP was increasing to 47.1564 trillion yuan. China's average annual GDP growth rate is about 9.5% excluding price factors. However, the development of rural economy is lagging behind; the urban-rural income gap is being enlarged. During 1978–2011,the absolute gap of urban and rural resident incomes expanded to 14 833 yuan from 209.8 yuan and the ratio was 2.5 : 1 by the early 1980s, 1.8 : 1 in the mid-1990s, expanding to 3.13 : 1[1] in 2011. Taking into consideration the material object of the farmer income, the real income gap may be 6–7 : 1. In recent years, the Party Central Committee and State Council puts a great emphasis on this phenomenon and 2004–2011, the central files' key points are the problems about agriculture, rural areas and peasantry, thus reinforcing the fiscal and financial policies on rural development. On the one hand, government expenditures for agriculture continue to increase and the government is playing a more positive role to promote the rural reform and development. In 2010, the central expenditures for agriculture reached 857.97 billion yuan, an increase of 18.3%. On the other hand, financial support for agriculture is also increasing. At the end of 2010, agriculture-related loans arrived at 11.76801 trillion yuan accounting for 24.56% of the loan balance for the same period and the balance increased by 28.68%. Xing's (2010) research offers the affirmation to the effects of the Chinese fiscal and financial policies supports for agriculture on increasing the farmers' incomes and narrowing the income gap between urban and rural residents, but it also points out that the fiscal structure of agriculture is irrational and makes some relevant policy commendations, not only to increase the intensity of financial support, but also to put more emphasis on productive expenditures, capital expenditures, reasonable distribution of relief expenditures and funds of science and technology in rural areas. However, the status of the rural economic development makes fiscal and financial support for agriculture alone useless to solve the bottleneck of rural economic funds, therefore, the fiscal and financial support for agriculture policies should be integrated to enhance the leverage effects of policies. Based on this, it will make sense to increase the funding and to enhance the overall support for agriculture significantly (Guanghe 2009).

The objective of this study is to quantitatively estimate the direct effects and the indirect effects of fiscal and financial supports for agriculture in China, to test dynamic changes of the effects in fiscal and financial supports for agriculture in different periods, and further to offer proposals for perfecting the Chinese fiscal and financial policies supports for agriculture. The contribution of this article is threefold. First, we study the overall effects of fiscal and financial supports for agriculture instead of the single effects of the fiscal or financial measures. Moreover, we take into account different effects of the fiscal and financial policies supports for agriculture at different periods; analyze the dynamic change of the effects of the China s fiscal and financial supports for agriculture as the time goes on. Second, it is the method of the spatial panel econometrics that is adopted to perform an empirical research in this paper. The empirical methods in the existing literature are too weak, especially not considering the spatial effects of variables. It would have resulted in the misspecification of the model and the inaccurate estimated results. Third, we measure the indirect effects of fiscal and financial supports for agriculture in China.

CONSTRUCTION OF THE THEORETICAL MODEL

In order to analyze the mechanism of fiscal and financial policies, we introduce the Odedokun's (1992) economic efficiency model and the output growth model that Greenwood and Jovanvic (1990) proposed in the paper. In the model of economic efficiency, economic growth depends on the increase of capital and the improvements of efficiency. As follows:

$$\Delta Y/Y = EFK\ (\Delta K/Y) \tag{1}$$

ΔY is defined as the increased output, Y is the total output and EFF is defined as economic efficiency that is the resource utilization efficiency, represented by the increased output – capital ratio ($\Delta Y/\Delta K$). ΔK is the increased capital; the total capital investment is represented by K. According to the Equation 1, economic growth will be achieved by the changes of the resources' efficiency (EFF) or investment resources ($\Delta K/Y$) or both changes.

In the analysis of economic growth, we have introduced the traditional analytical framework of the production function: the output is a function of capital and labour:

$$Y = F\ (K, L) \tag{2}$$

Learning from Parente and Prescott's (1991) practices in the analysis of financial development and economic growth, we specify the maximum value of our la-

[1]Data in this section are from the National Bureau of Statistics of China 2012 (http://www.stats.gov.cn/).

bour input in restraint of the capacity, represented by $\bar{L}$. θ represents the output elasticity of labour input under the conditions per unit of capital.

$$Y = K \min(L, \bar{L})^{\theta} \quad \theta > 0 \qquad (3)$$

The current capital formation depends on the capital stock in the previous period and the current amount of the funds' conversion and taking into account the main sources of agriculture funding includes fiscal policy, capital inflows of financial policy guidance, and the own funds of the farmers the rural capital becomes:

$$K_t = (1-\delta)K_{t-1} + EFF(X_{t1}, X_{t2}, X_{t3}) \qquad (4)$$

δ and X_{t1} are defined as the depreciation rate and the scale of investment funds which the fiscal policy guides respectively. X_{t2} represents the level of rural credit that financial policy guides and X_{t3} is the farmer's own investments. And *EFF* is defined as the allocation efficiency of funds. Equation (4) is an increasing function when the fiscal and financial support for agriculture and farmers' investment are increased and efficient, there will be a rapid growth of the investment correspondingly, thereby increasing the total capital of agriculture in the rural areas and promoting the rural economic development.

In Equation (3), if $m = (\bar{L})^{\theta}$, it shows the largest production capacity of agriculture and rural area, so m is inversely proportional to the output ratio. Therefore, agriculture will be faced with constant returns to scale and the output growth is equal to the rate of the capital stock once reaching the maximum workforce capacity. After combined with Equation (4), the results are:

$$Y_{t+1} = m(1-\delta)K_t + m \times EFF(X_{t1}, X_{t2}, X_{t3}) \qquad (5)$$

when X = (0, 0, 0), the first-order Taylor expansion is:

$$EFF(X_{t1}, X_{t2}, X_{t3}) \approx EFF(0,0,0) + EFF'_{X_{t1}}(0,0,0)X_{t1} + EFF'_{X_{t2}}(0,0,0)X_{t2} + EFF'_{X_{t3}}(0,0,0)X_{t3} \qquad (6)$$

Putting Equation (6) into Equation (5), we can get the equation (7).

$$Y_{t+1} = m(1-\delta)K_t + m\left[EFF(0,0,0) + EFF'_{X_{t1}}(0,0,0)X_{t1} + EFF'_{X_{t2}}(0,0,0)X_{t2} + EFF'_{X_{t3}}(0,0,0)X_{t3}\right] \qquad (7)$$

$Y_t = mK_t$ is substituted in Equation (7):

$$\Delta Y_{t+1} = -\delta m K_t + m\left[EFF(0,0,0) + EFF'_{X_{t1}}(0,0,0)X_{t1} + EFF'_{X_{t2}}(0,0,0)X_{t2} + EFF'_{X_{t3}}(0,0,0)X_{t3}\right] \qquad (8)$$

Known from Equations (7) and (8), the funds of fiscal and financial policies for agriculture and farmers' own investments are the relevant variables affecting the agriculture output and growth. Moreover, the rural output and its growth are also dependent on the overall efficiency of fund utilization $[EFF(0,0,0)]$, fiscal policies the conversion rate of investment fund for agriculture $\left[EFF'_{X_{t1}}(0,0,0)\right]$, the conversion rate of financial policies' investment in rural credits funds $\left[EFF'_{X_{t2}}(0,0,0)\right]$ and the conversion rate of the farmer owned-investment $\left[EFF'_{X_{t3}}(0,0,0)\right]$.

Both sides of (7) are divided by m, and then we can get the rural per capita output model. In this model, after the rural per capita output is replaced with the per capita net income of rural residents (*FR*), we would build the equations of fiscal and financial policies on the rural residents' per capita net income.

$$FR = (1-\delta)K_t + EFF(0,0,0) + EFF'_{X_{t1}}(0,0,0)X_{t1} + EFF'_{X_{t2}}(0,0,0)X_{t2} + EFF'_{X_{t3}}(0,0,0)X_{t3} + C \qquad (9)$$

As Equation (4) has shown, it is reasonable to denote the agricultural capital stock in base period (K_0) by the amount of agricultural capital by 1997 and to choose the fixed depreciation rate (δ). Agricultural capital stock is represented by a linear combination of the input of fiscal support for agriculture, agricultural credit funds input and the farmers' owned founds input. So it is unnecessary to introduce agricultural capital into the model, or it will produce a redundant variable and a multicollinearity problem. In addition, considering that there are many factors affecting economic growth, the model (9) will introduce appropriate controlling variables and we also control the effects of non-core variables. A theoretical model of fiscal and financial supports for agriculture is established:

$$FR_{it} = \beta_0 + \beta_1 CZ_{it} + \beta_2 XD_{it} + \beta_3 TZ_{it} + \theta CON + \mu_{it} \qquad (10)$$

FR_{it} is the indicator of rural economic development, CZ_{it} and XD_{it} reflect the fiscal and financial supports for agriculture respectively, TZ_{it} is the indicator of the farmer-owned financial input and CON is the appropriate controlling variables, i and t represents for region and time, μ_{it} stands for the random interference items.

DATA AND VARIABLE SPECIFICATIONS

Based on the theoretical model (10) of fiscal and financial support for agriculture, the specification of variables and data sources will be elaborated in the following sections.

The core variables

FR_{it}: The improvement of the farmers' income is crucial to the "Problems about agriculture, rural areas and peasantry"; consequently the changes of the rural residents' net income can reflect the running effects of fiscal and financial policies supports for agriculture to the full. The rural residents' per capita net income comes mainly from four aspects: wages, income of the household business, property income and transferred income in the Statistical Yearbook, the per capita income of rural household business and the per capita transfer income directly reflects the policy effects of fiscal and financial support for agriculture, and in turn the effects of agricultural policies for rural residents' per capita wages and property income are more indirect and less important. For this reason, the rural residents' per capita net income includes only the per capita income of rural household business and the per capita transfer income which data originates from the "Statistical Yearbook of China (1998–2011)" (Statistical Yearbook 2012).

CZ_{it}: The indicator of fiscal support for agriculture reflects the degree of financial policies supporting rural economic development. In the paper, the per capita fiscal expenditures are adopted to measure fiscal policies supporting agriculture and the ratio of the fiscal expenditure for supporting agriculture and the total rural employment is the index which originates from the data of the "Statistical Information of 60 years on new China" (2010) and the "Statistical Yearbook of China (2009–2011)" (Statistical Yearbook 2012).The previous statistics and studies have suggested that agriculture and rural development are subject to the fiscal policies supports for agriculture. The levels and structures of financial support for agriculture have a significant positive impact on the per capita net income of rural residents (Yuandong and Yongjun 2011).

XD_{it}: The indicator of financial support for agriculture reflects the degree of financial policies supporting rural economic development. Financial policies supporting agriculture have played a role in promoting the development of agricultural economy, especially for the new rural construction and infrastructure, such as water constructions. We have access to the "blood transfusion" for agricultural economy by the means of credit to solve the gap between supply and demand of funds which are supporting the development of modern agriculture and improving the rural residents' per capita income levels. Hence, we make use of the per capita amount of credit to measure the financial support of agriculture, thus setting the total amount of credit divided by the total rural employment[2], which is based on the data from the "Statistical Information of 60 years on new China" and the "Provincial Statistical Yearbooks (1998–2011)".

TZ_{it}: The indicator of the farmers' owned founds input measures the support of farmers' own funds to rural economic development. The farmers' owned founds input can accelerate the accumulation of agricultural capital and promote the increase of the rural residents' income. Not given the corresponding data of the farmers' own funds in the previous statistic, this paper will introduce the data of farmers' investment in fixed assets after the reduction of the residential investment, which is based on the data from the "Statistical Yearbook of China (1998–2011)".

The controlling variables

CON represents the control variable. In order to reflect accurately the main factors affecting the rural residents' income and consider the availability of data, we have identified the following four control variables:

EDU_{it}: The indicator of the rural residents' human capital. The new economic growth theory suggests that human capital has gradually become an important factor affecting economic growth with the economic growth. It is expected to have a positive role. However, it needs human capital to meet the basic requirement of human capital, namely the threshold level; otherwise its effect is not significant. We select the average years of schooling of rural residents' to measure the EDU_{it}[3]. The data are taken from the "Statistical Yearbook of Rural China (1998–2011)".

STR_{it}: The industrial structure indicator. Along with the rationalization and the upgrade of industrial structure, there is a significant growth in the regional economy, which should be in harmony with the industrial structure. A unreasonable industrial structure is bound to restrict economic development. The proportion of the primary industry output value to GDP is used to measure the degree of the industrial structure optimization. The greater the value of the indicator

[2]Agricultural loans in rural credit consist of agricultural loans of financial institutions and township enterprises loans (Chongzheng and Xiwu 2005).

[3]The average years of education = the proportion of illiteracy * 1 + the proportion of elementary schools * 6 + the proportion of middle schools * 9 + the proportion of high school * 12 + the proportion of secondary schools* 12 + college and above the proportion of * 15.5.

is, the lower is the optimization of industrial structure. Even so, the large proportion of first industrial output value reflects the industry output increasing which is closely related to farmers' income and the rural residents' income should be increased, too. Both kinds of effects jointly determine the direction and size of the industrial structure's index. The data stem from the "Statistical Yearbook of China (1998–2011)".

$POWER_{it}$: The total power of agricultural machinery shows the degree of mechanization of agricultural production. Science and technology are the primary productive forces and the mechanization of agriculture is the representative of the advanced productive forces. The development of agricultural mechanization is of a great significance for modern agriculture and the farmers' income. Based on the per capita total power of agricultural machinery in this model, each of the provinces' mechanical power is divided by the total number of employees in rural areas with a positive expected value. The data derive from the "Statistical Yearbook of China (1998–2011)".

FEI_{it}: The per capita usage of agricultural fertilizer that reflects the investments in agricultural production. In this paper, it is obtained by dividing the total usage of agricultural fertilizer by sown areas and it is expected to have a positive effect. In addition to the data in 2006 taken from the "Statistical Yearbook of China's Agriculture" (2007), the data of the remaining years are derived from the "Statistical Yearbook of China".

The variables in the text are expressed as a per capita number rather than the overall level in order to exclude the impact of the total population and its structure. Meanwhile, taking into account the inherent characteristics of the panel data, there are some problems such as heteroscedasticity and multicollinearity, so we finish the logarithm of the data processing. Depending on the selected control variables, the Equation (10) is expressed as:

$$FR_{it} = \alpha_0 + \alpha CZ_{it} + \alpha_2 XD_{it} + \alpha_3 TZ_{it} + \alpha_4 EDU_{it} + \alpha_5 STR_{it} + \alpha_6 POWER_{it} + \alpha_7 FEI_{it} + \mu_{it} \quad (11)$$

The Equation (11) is the non-spatial econometric model of the fiscal and financial supports for agriculture.

THE SPATIAL ECONOMETRIC ANALYSIS OF OVERALL EFFECTS OF FISCAL AND FINANCIAL SUPPORTS FOR AGRICULTURE

As proposed in spatial econometrics by Anselin, the phenomenon of economic geography in a spatial unit shares the relevant value with the neighbouring regions and almost all of the spatial data are equipped with the spatial dependence. Based on the provincial panel data in China, each province is a spatial unit, but is there any spatial dependence between the neighbouring spatial units? Due to the similarities of culture, economy and geographical structures, the income of rural residents in the neighbouring provinces has shown interdependence and mutual influence. The spatial aggregations will emerge in the long term (Yuandong and Yongjun 2011). What has been proved in the studies of Li et al. (2006) and Yuandong and Yongjun (2011), is that some policies such as the promotion of agricultural technology, the demonstration of seed, vegetation protection and land management for the rural economic development have taken on a strong demonstration effects and the inter-provincial positive spatial spillover effects in a long term. Along with professional skills and knowledge, the rational flowing of human resources between provinces would bring in the spatial spillover effects on the neighbouring provincial economic growth (Yuandong and Yongjun 2012). In addition, the spatial dependences of physical capital inputs, scientific researches' investment and other variables between regions have been confirmed by a large number of studies, such as Fischer (2006) and Pede et al. (2006). As far as we are concerned, many variables involved in the paper often have spatial dependence in the provinces.

As a regular non-spatial econometric model, the econometric model of fiscal and financial supports for agriculture (11) assumes that the spatial units are independent of each other, ignoring the objective existence of spatial effects, so that the omissions of some important explanatory variables in the model, the misspecification of the model and inaccurate empirical results cannot be avoided. Thus, we will take into account the variables' spatial effects that may exist and propose spatial econometric models of fiscal and financial supports for agriculture after the transformation.

The construction of a spatial econometric model

Based on the Elhorst's (2010) methods of the spatial panel data model's confirmation, the following steps will construct the spatial econometric model of fiscal and financial support for agriculture from 1997 to 2010. In the first step, we take advantage of 30 Chinese provinces' panel data from 1997 to 2010 and have the Likelihood Ratio (LR) test on the basis

of the estimation results of Equation (11), in order to determine the type of the fixed effects' model. As shown in Table A1, both the spatial fixed effects and time-period fixed effects are significant, so the model should use the spatial and time-period fixed effects. In the second step, we will have the Lagrange multiplier (LM) test to identify the appropriate model form. If the non-spatial model on the basis of these LM tests is rejected in favour of the spatial lag model (SLM), the spatial error model (SEM) or in favour of both models, then the spatial Durbin model (SDM) should be estimated (Elhorst 2010), which extends the spatial lag model with spatially lagged independent variables[4]. The Lagrange multiplier test results are shown in Table 2. The null hypothesis of the non-spatial model are rejected at the 5% significance level in the state of the spatial and time-period fixed effects, that is the spatial Durbin model should be used. In the third step, after the Hausman test, we could have a better knowledge about whether the spatial fixed effects of the Durbin model would be regarded as a random effect. As shown in Table A3, it is more appropriate to adopt the Durbin model with the fixed effects estimation. In the fourth step, we have the Wald test of corresponding model in order to make sure if the spatial Durbin model can be simplified for the spatial lag model or the spatial error model (Burridge 1981). The results of the Wald test (Table A3) show that the model cannot be simplified for the spatial error model or the spatial lag model, so the final model is the spatial Durbin Model with the spatial and time-period specific effects:

$$\begin{aligned} FR_{it} = {} & \alpha_0 + \alpha_1 CZ_{it} + \alpha_2 XD_{it} + \alpha_3 TZ_{it} + \alpha_4 EDU_{it} \\ & + \alpha_5 STR_{it} + \alpha_6 POWER_{it} + \alpha_7 FEI_{it} + \alpha_8 W{\times}C_{it} \\ & + \alpha_9 W{\times}XD_{it} + \alpha_{10} W{\times}TZ_{it} + \alpha_{11} W{\times}EDU_{it} \\ & + \alpha_{12} W{\times}STR_{it} + \alpha_{13} W{\times}POWER_{it} + \alpha_{14} W{\times}FEI_{it} \\ & + \rho W{\times}FR_{it} + s_i + \nu_t + \mu_{it} \end{aligned} \quad (12)$$

s_i refers to the spatial fixed effects; ν_t represents the time-period fixed effects; μ_{it} stands for the random interference items. Let w represent the exogenous spatial weight matrix with its elements w_{ij} equal to 1 for $i \neq j$ if the Province i and the Province j share some border and otherwise is 0. The spatial weight matrix is row standardized, that is $\sum_{i \neq j}^{N} w_{ij} = 1$ for i = 1, 2,..., N. Equation (12) is the spatial econometric model of fiscal and financial supports for agriculture in China from 1997 to 2010.

Taking into account the length of the sample periods, we adopted the recommendations of Lee and Yu (2010) and Elhorst (2010) to estimate the model (12) by using the bias-corrected ML method of based on the panel data of 30 provinces from 1997 to 2010 (including municipalities or autonomous regions)[5]. In order to analyse the deviations of the coefficient's estimation in the non-spatial econometric model, the model (11) has been estimated with the same data, as the results shown in Table 1.

The deviation analysis of non-spatial econometric model

As shown in the second column of Table 1, the estimation results of the model (11) without considering spatial effects show that: from 1997 to 2010, China's fiscal and financial policies supports for agriculture, the farmers' owned funds, human capital in rural areas and the consumption volume of agricultural fertilizers place a promoting influence on the improvement of the rural residents' net income. The estimated value of fiscal support, financial support, farmers' owned funds, rural human capital and the consumption of agricultural fertilizers are 0.092, 0.144, 0.085, 0.114 and 0.106 respectively. And the estimated signs are in line with the expectations. The total power of agricultural machinery and industrial structures are statistically insignificant, and it is also known that the estimated sign of the agricultural machinery's total power is negative, contrary to the theoretical expectations. Moreover, the goodness of fit is lower (Adj R^2 = 0.4737). Compared with the non-spatial model, the estimation results of the spatial Durbin model with the spatial and time-period specific effects show that the total power of agricultural machinery has played a significant role in increasing the net income of rural residents. And the estimated value of direct effect remains 0.050, which is consistent with the theoretical expectation. At the same time,

[4]Spatial dependence can be incorporated in two distinct ways: as an additional regressor in the form of a spatially lagged dependent variable, or in the error structure. The former is referred to as a spatial lag model, the latter, a spatial error model.

[5]Due to the incomplete statistics of Tibet, this study did not include it; because the agricultural loans and township enterprises loans of most provinces prior to 1997 are given in the data of the National Bank and after 1997, the data are agricultural loans of financial institutions and township enterprises loans, the time span of this study ise from 1997 to 2010 in order to make the periods comparable.

Table 1. The estimations of overall effect in fiscal and financial policies supporting for agriculture

Dependent variable: *FR*		
	Non-spatial panel model with fixed effects	Spatial Durbin Model with spatial and time-period fixed effects
CZ: Fiscal support for agriculture	0.0922152 (0.0000)	0.100000 (0.0000)
XD:Financial support for agriculture	0.14401 (0.0000)	0.103136 (0.0000)
TZ: Farmers' owned funds	0.084519 (0.0000)	0.107838 (0.0000)
EDU: Rural residents' human capital	0.1140456 (0.0000)	0.068253 (0.0037)
STR: Industrial structure	−0.0025803 (0.8780)	−0.010475 (0.6021)
POWER: Total power of agricultural machinery	−0.0300224 (0.1450)	0.049576 (0.0455)
FEI: Usage of agricultural fertilizer	0.1059511 (0.0000)	0.075688 (0.0000)
W×*CZ*		0.081150 (0.0181)
W×*XD*		0.050339 (0.1985)
W×*TZ*		0.033839 (0.1311)
W×*EDU*		−0.007961 (0.8317)
W×*STR*		−0.122801 (0.0002)
W×*POWER*		−0.204854 (0.0000)
W×*FEI*		0.026792 (0.1270)
W×*FR*		0.233965 (0.0000)
$\bar{R}^2$	0.4737	0.6089
Log-likelihood		214.43741
F	51.31(0.0000)	
Hausman test	35.21(0.0000)	

The decompositions of variable effects				
	Direct effects	*t*-stat	Indirect effects	*t*-stat
CZ	0.1071	5.4096	0.1303	3.0235
XD	0.1081	6.0079	0.0939	2.0124
TZ	0.1118	10.1044	0.0736	2.6236
EDU	0.0684	2.9308	0.0113	0.2377
STR	−0.0179	−0.9179	−0.1572	−3.7618
POWER	0.0369	1.5691	−0.2418	−4.9707
FEI	0.0784	9.2191	0.0559	2.6147

The *Z* (or *P*) statistic in parentheses indicates the probability of the corresponding statistics

the goodness of fit on the model has been improved remarkably (Adj R^2 = 0.6089). In addition, the policies of fiscal support for agriculture, industrial structures, the total power of agricultural machinery and the net income of rural residents have significant spatial dependences. It is necessary to consider the spatial effects of variables. As a whole, applying the spatial Durbin model is more appropriate and robust compared with the non-spatial economic model.

To quantify the bias of coefficient estimates in the non-spatial model (11), it cannot be done by the comparison with the corresponding estimation results of the spatial model (12) as that both of the coefficient estimates meanings are entirely different. In the non-spatial model, the coefficients estimates of independent variables have shown the direct effects of the independent variables on the dependent variables, reflecting the output elasticity, while in the spatial mode, the coefficient estimates include not only the direct effects of the independent variables on the dependent variables but also the feedback effects that arise as a result of the impacts passing through neighbouring provinces and back to the provinces themselves. These feedback effects are partly due to the coefficient of the spatially lagged dependent variable, and partly due to the coefficient of the spatially lagged value of the explanatory variable itself. The estimate of the spatial lag dependent variables $W \times FR$ in the spatial Durbin model (12) is significantly positive at 1% significance level. The spatially lagged value of fiscal support for agriculture ($W \times CZ$) is positive and significant statistically; the spatially lagged value of financial support for agriculture ($W \times XD$), the spatially lagged value of farmers' owned funds ($W \times TZ$) and the spatially lagged value of the fertilizers' consumption ($W \times FEI$) are positive, but insignificant statistically; the spatially lagged value of human capital ($W \times EDU$), industrial structure ($W \times STR$) and agricultural machinery ($W \times POWER$) are negative and they are significant statistically except for ($W \times EDU$). Therefore, it is apparent that only the feedback effects are excluded from the coefficient estimated value of the spatial model in order to compare with the coefficient estimates in the non-spatial model.

As we can see from Table 1, the decomposition results of the effects in the spatial Durbin Model (12) have shown that direct effects of fiscal support, financial support, farmers' owned funds, rural human capital, the total power of agricultural machinery and the consumption of agricultural fertilizers are 0.1071, 0.1081, 0.1118, 0.0684, 0.0369 and 0.0784, respectively. And we should ignore the direct effects of the industrial structure because the results are not significant. This means that in the non-spatial model, the estimated coefficient of fiscal support for agriculture 0.0922 is undervalued by 13.9%, the estimated coefficient of financial support for agriculture 0.1440 is overestimated by 33.2%, the estimated value of farmers' owned funds 0.0845 is underestimated by 24.4%, the coefficient estimation of rural human capital 0.1140 is overestimated by 66.6%, the coefficient of the total power of agricultural machinery –0.0300 is estimated to the wrong symbol and the coefficient of agricultural fertilizers and 0.1060 is overestimated by 35.2%. It is obvious that the estimated results are biased too much due to having ignored the spatial effects in the non-spatial model (11).

The analysis of the variables' direct effects

Generally speaking, the direct effects of fiscal support for agriculture, financial support for agriculture and farmers' owned funds on the rural resident income are significant in the 1% level. Three core variables' elasticities on the net income of rural residents are 0.1071, 0.1081 and 0.1118. The direct effects of farmers' owned funds on the rural resident income are both the strongest and the most significant.

Except for the industrial structure, the direct effects of the remaining controlling variables are significant, such as the rural human capital, the total power of agricultural machinery and the consumption of fertilizers, whose coefficient elasticities are 0.0684, 0.0369 and 0.0784. It reflects that the effects of the industrial structures optimization on the rural residents' income do not come into use and the adjustment of the industrial structure should be carried on. Meanwhile, we need to focus on the optimization of the internal structure of the primary industry, to increase the support for agriculture and to promote the income of rural residents.

The analysis of the variables' spatial spillover effects

The variables' spatial spillover effects mean the indirect effects of variables. Spatial spillover effects are assumed to be zero in the non-spatial model, which is inconsistent with the essential fact of independent variables owing to the spatial spillover effects. It can be seen from Table 1 that the spatial spillover effects of all core variables are significant, and the spatial spillover effects of control variables except human capital are significant statistically. The spatial spillover effect of the fiscal support for agriculture is 0.1303, accounting for 121.6% of the direct effects; the spatial spillover effect of the financial support for agriculture is 0.0939, accounting for

86.7% of the direct effects; the spillovers of farmers' owned funds effect is 0.0736, being the direct effect of 65.8%; the spatial spillover of fertilizers is 0.0559, 71.3% of its direct effects 0.0559, which have shown strong spatial spillovers[6]. Therefore, if a provincial fiscal and financial support for agriculture, farmers' owned investment and the consumption of fertilizers are increasing, not only in the province rural residents' net income will be increased significantly, so it would also in the adjoining province. In addition, the dependent variable of the rural residents' net income owns a positive spatial interdependence significantly between provinces ($W \times FR$ = 0.24), the increase of the rural residents income in a province has a promotive effect on increasing the rural residents income in the adjacent areas, while the rural residents income of a province is promoted significantly by the residents income increase of the rural adjacent provinces.

To sum up, from 1997 to 2010, not only in the province the fiscal and financial policies supports for agriculture and farmers' owned funds play a significant part in promoting the farmers' income, but also in the adjacent provinces the rural resident income is boosted by the spatial spillover effects caused by the flows of rural labour, the farmers' interprovincial loans and a good demonstration effect. On the other hand, the spatial spillover effect of the fiscal support for agriculture remains the largest and that of the farmers owned funds is the smallest. Finally, it is advised to increase the financial and fiscal supports for agriculture, to improve the optimization of structures, to lead the farmers to increase capital investment, to open up financial channels, and to take full advantage of the positive spatial spillover of input elements in order to promote the common growth of the adjacent provincial farmer income steadily.

THE SPATIAL ECONOMETRIC ANALYSIS OF SUB-PERIODS EFFECTS OF THE FISCAL AND FINANCIAL SUPPORTS FOR AGRICULTURE

Since 2004, the "First file" of the central authorities is focused on the "Problems about agriculture, rural areas and peasantry", which has increased investments in the agriculture and is gradually reducing the agricultural tax year by year. Insisting on the policy of industry – nurturing – agriculture, cities support the rural and give more, take less and loosen control. As a result, the year of 2004 may become a turning point in the fiscal and financial policy. In order to discuss whether there is a significant difference in the effects of the fiscal and financial supports for agriculture before and after 2004, we will make a thorough inquiry about the policy effects of first period (1997–2003) and the second period (2004–2010) as follows.

The effects of the fiscal and financial policies supports for agriculture in the first period (1997–2003)

Based on 30 provinces' panel data from 1997 to 2003, we get the test results (Table A4), and ascertain that the final model is the spatial Durbin Model with the spatial and time-period fixed effects in accordance with the above mentioned steps of the spatial econometric model confirmation. That is,

$$\begin{aligned} FR_{it} = {} & \alpha_0 + \alpha_1 CZ_{it} + \alpha_2 XD_{it} + \alpha_3 TZ_{it} + \alpha_4 EDU_{it} \\ & + \alpha_5 STR_{it} + \alpha_6 POWER_{it} + \alpha_7 FEI_{it} + \alpha_8 W{\times}CZ_{it} \\ & + \alpha_9 W{\times}XD_{it} + \alpha_{10} W{\times}TZ_{it} + \alpha_{11} W{\times}EDU_{it} \\ & + \alpha_{12} W{\times}STR_{it} + \alpha_{13} W{\times}POWER_{it} \\ & + \alpha_{14} W{\times}FEI_{it} + \rho W{\times}FR_{it} + s_i + \nu_t + \mu_{it} \end{aligned} \quad (13)$$

s_i represents the spatial fixed effects, ν_t refers to the period fixed effects and μ_{it} stands for the random interference items. We also make use of the deviation correction ML method to estimate, as shown in the second column of Table 2.

What can be seen from the decomposition of effects in Table 3 is that the direct effects of the fiscal support for agriculture, the financial support for agriculture and farmers' owned funds between 1997–2003 are 0.0720, 0.1246 and 0.1195 respectively. They are significant at the level of 1% and are in line with the expected signs that means for every 1-unit increase in fiscal support for agriculture financial support for agriculture and farmers owned funds; the rural residents' net income rises by 0.072%, 0.1246% and 0.1195%, respectively. Financial support for agriculture has a stronger effect on the net income of rural residents, while the fiscal policies effects are relatively small. Except for the industrial structure, the direct effects of the remaining controlling variables are significant, such as the rural human capital, the total power of agricultural machinery and the consumption of fertilizers, whose elasticity

[6]The direct effects of the industrial structure and the total power of agricultural machinery are not significant and the ratio of their spillover effects and direct effects is meaningless, so this article does not compile statistics of this part.

coefficients are 0.0507, 0.0882 and 0.0670, respectively. Compared to the direct effects of the fiscal and financial supports for agriculture in the entire sample (1997–2010), the estimations results in the first period are similar except for the fine distinction of estimates.

In addition, the spatial spillover effect of the fiscal support for agriculture, the financial support for agriculture and the total power of agricultural machinery are statistically significant, but the spatial spillover effects of the total power of agricultural machinery are negative and others are not significant. The spatial spillover effect of the financial support for agriculture is 0.1725, accounting for 239.5% of the direct effects; the spatial spillover effect of the financial support for agriculture is 0.2454, accounting for 197.0% of the direct effects. Compared with the entire sample (1997–2010) the spatial spillover effects of variables in the first period have increased significantly. As regards the spatial spillover estimates of the dependent variable ($W \times FR$ = 0.3189), they have shown that there exists a significant positive spatial dependence across the provinces during the first period.

Table 2. The estimated results of sub-period spatial effects of fiscal and financial supports for agriculture in China

Dependent variable: *FR*			
Sample periods	The first period (1997–2003)	The second period (2004–2010)	The overall period (1997–2010)
Model types	Spatial Durbin Model with		
	spatial and time-period fixed effects	spatial fixed effects	spatial and time-period fixed effects
CZ: Fiscal support for agriculture	0.060318 (0.0138)	0.102597 (0.0004)	0.100000 (0.0000)
XD: Financial support for agriculture	0.108846 (0.0000)	0.131273 (0.0000)	0.103136 (0.0000)
TZ: Farmers' owned funds	0.117881 (0.0000)	0.049117 (0.0002)	0.107838 (0.0000)
EDU: Rural residents' human capital	0.048228 (0.0262)	1.019747 (0.0000)	0.068253 (0.0037)
STR: Industrial structure	–0.030621 (0.2676)	0.055234 (0.0281)	–0.010475 (0.6021)
POWER: Total power of agricultural machinery	0.116043 (0.0006)	0.067319 (0.0499)	0.049576 (0.0455)
FEI: Usage of agricultural fertilizer	0.064795 (0.0000)	0.082550 (0.0000)	0.075688 (0.0000)
W×*CZ*	0.104428 (0.0102)	0.073437 (0.0612)	0.081150 (0.0181)
W×*XD*	0.140148 (0.0025)	–0.115240 (0.0006)	0.050339 (0.1985)
W×*TZ*	–0.024636 (0.3792)	–0.015280 (0.5658)	0.033839 (0.1311)
W×*EDU*	0.017276 (0.6209)	0.606000 (0.0083)	–0.007961 (0.8317)
W×*STR*	–0.021209 (0.6648)	0.011712 (0.7437)	–0.122801 (0.0002)
W×*POWER*	–0.344631 (0.000000)	–0.125938 (0.0079)	–0.204854 (0.0000)
W×*FEI*	0.006316 (0.7852)	0.015506 (0.5670)	0.026792 (0.1270)
W×*FR*	0.318999 (0.0000)	0.341957 (0.0000)	0.233965 (0.0000)
$\bar{R}^2$	0.6546	0.7785	0.6089
Log-likelihood	128.44505	108.24521	214.43741

The *Z* value in parentheses indicates the probability of the corresponding statistics

The effects of fiscal and financial policies supports for agriculture in the second period (2004–2010)

We do further the spatial econometric studies measuring the policies effects of Chinese fiscal and financial supports for agriculture during the second period (2004–2010). On the base of the relevant test results in the second period (Table A5), we finally choose the spatial Durbin Model with the spatial fixed effects. Namely:

$$\begin{aligned} FR_{it} = {} & \alpha_0 + \alpha_1 CZ_{it} + \alpha_2 XD_{it} + \alpha_3 TZ_{it} + \alpha_4 EDU_{it} \\ & + \alpha_5 STR_{it} + \alpha_6 POWER_{it} + \alpha_7 FEI_{it} + \alpha_8 W{\times}CZ_{it} \\ & + \alpha_9 W{\times}XD_{it} + \alpha_{10} W{\times}TZ_{it} + \alpha_{11} W{\times}EDU_{it} \\ & + \alpha_{12} W{\times}STR_{it} + \alpha_{13} W{\times}POWER_{it} \\ & + \alpha_{14} W{\times}FEI_{it} + \rho W{\times}FR_{it} + s_i + \mu_{it} \end{aligned} \quad (14)$$

s_i represents the spatial fixed effects and μ_{it} stands for the random interference items. We estimate the above model using the Chinese provincial panel data from 2004 to 2010, as shown in the third column of Table 2.

What can be seen from the decomposition results of effects in Table 3 is that all the direct effects of variables are significant and positive in the second period. The estimate values of direct effects of the fiscal support for agriculture, the financial support for agriculture and farmers' owned funds are 0.1136, 0.1253 and 0.0497. It is apparent that the elasticity coefficient of the financial support for agriculture on the rural residents' net income is the largest, which is consistent with the first period. However, the effects of the farmers' owned funds are becoming smaller. The direct effects of the rural human capital, the industrial structure, the total power of agricultural machinery and the fertilizers application on the net income of rural residents are 1.1049, 0.0581, 0.0562 and 0.0867. The rural human capital showed the most remarkable effect among all control variables. It reflects that the rural human capital level and structure are improved, and the influence of human capital on the rural resident income is becoming more and more important in the recent years.

The estimation results of the spatial spillover effects show that the spatial spillovers of the fiscal support for agriculture, the financial support for agriculture, the rural human capital, the total power of agricultural machinery are statistically significant , the estimate values of which are corresponding to 0.1528, –0.1004, 1.3712 and –0.1467. However, the spatial spillover of the total power of agricultural machinery is negative and others are insignificant.

The spatial spillover effects in the second period (2004–2010) differ from the first period (1997–2003) in the following apparent respects: One is that the spillover effect of the financial support for agriculture is negative, i.e. an increase of the financial support for agriculture in a province has an inhibitory action on the raise of the farmers' income in the adjacent provinces. To some extent, it reflects the scarcity of capital in the development of rural economy, and the differentiation in economic performance between

Table 3. The decomposition results of variable effects in sub-period

Period	The first period effects		The second period effects		The overall effects (1997–2010)	
	direct effects	indirect effects	direct effects	indirect effects	direct effects	indirect effects
CZ	0.0720 (2.9424)	0.1725 ((2.9554)	0.1136 (4.1189)	0.1528 (3.7665)	0.1071 (5.4096)	0.1303 (3.0235)
XD	0.1246 (5.3561)	0.2454 (3.6459)	0.1253 (5.5001)	–0.1004 (–2.5332)	0.1081 (6.0079)	0.0939 (2.0124)
TZ	0.1195 (8.2990)	0.0178 (0.4502)	0.0497 (3.5352)	0.0011 (0.0295)	0.1118 (10.1044)	0.0736 (2.6236)
EDU	0.0507 (2.2952)	0.0467 (0.9249)	1.1049 (7.4381)	1.3712 (6.3338)	0.0684 (2.9308)	0.0113 (0.2377)
STR	–0.0332 (–1.2289)	–0.0450 (–0.6785)	0.0581 (2.4269)	0.0421 (0.9961)	–0.0179 (–0.9179)	–0.1572 (–3.7618)
POWER	0.0882 (2.8032)	–0.4293 (–5.7316)	0.0562 (1.7554)	–0.1467 (–2.5969)	0.0369 (1.5691)	–0.2418 (–4.9707)
FEI	0.0670 (5.7698)	0.0376 (1.1606)	0.0867 (6.7306)	0.0637 (1.7040)	0.0784 (9.2191)	0.0559 (2.6147)

T-statistic is in parentheses

the adjacent regions may lead to a negative effect of the financial support for agriculture in the region (Rioja and Valev 2004). The other is that the spatial spillover effects of the rural human capital become significant ether than insignificant, reflecting the improvements of human capital in rural areas and the optimization of the human capital structure. The rural human capital can effectively promote the enhancements of the rural economic development and the rural residents' income level in the province, and it plays a positive role in the adjacent provincial rural economy. The spatial interdependence of the rural residents income across provinces has increased slightly from the first period to the second period ($W \times FR = 0.3419$), revealing strengthening relationships of the rural economic development between the adjacent provinces.

Dynamic changes of the effects of the China's fiscal and financial policies supports for agriculture

By comparing the direct effects and the spatial spillover effects of each variable between the first period and the second period, we could have a better understanding about the dynamic change of the effects of the fiscal and financial supports for agriculture with time. The results are as follows:

(1) From the first period to the second period, the direct effects of the fiscal support for agriculture on the net income of rural residents were increasing gradually and there remain significant positive spatial spillover effects. The direct effects of the fiscal support for agriculture remain to be 0.1071 throughout the entire sample period, and they have a significant role in promoting the increase of the rural resident income. Specifically, the direct effects of the financial support for agriculture have changed from the first period of 0.0720 to the second period of 0.1136, an increase of 57.8 %. Taken as a whole, the spatial spillover effects of the financial support for agriculture are positive and significant. Also, the increase of the fiscal support for agriculture in the province can effectively promote a rise of the rural resident income in the adjacent provinces by positive spatial spillover effect.

(2) The direct effects of financial supports for agriculture on the rural resident income are robust steadily, but their spatial spillovers are opposite in the two periods. The financial support for agriculture helped to promote the increase of the rural income, the direct effects of which are 0.1246 and 0.1253 in the two periods. However, the spatial spillover effect of the financial support for agriculture is 0.2454 in the first period, while it is –0.1004 in the second one. It means that the role of financial inputs for agriculture in a province on the rural resident income of the adjacent provinces has replaced promotion with inhibition. Considering selecting the index of the rural per capita credit amount to measure the financial support for agriculture in the paper, it partly reflects the competition in extracting more funds between the provinces with the increases of demands for funds in the rural economic development. As a result, the direction of the spatial spillover effects of the financial support for agriculture is reversed. On the other hand, the current development and business scopes of the new-type rural financial institutions have led to a segmentation of the rural financial market to a certain extent. Meanwhile, the great differences of economic development between the adjacent provinces also cause the spillover effects to be negative.

(3) As the second period began, the direct effects of the farmers owned money have markedly declined while its spatial spillover effects have become significant. The direct effects of the farmer owned capital have changed from the first period of 0.1195 to the second period of 0.0497, a decrease of 58.4%. The reason lies in the quantity and capital efficiency of the farmers owned investment. From the statistical data, the famer owned investment of the second period is double than that of the first period. Apparently, the decline of the direct effects of the farmers owned funds is due to the decrease of capital efficiency. The spatial spillovers of the farmer owned funds are not significant in the first period. Instead, it is in the second period that it is significant, though its value is still small (0.0011).

(4) The direct effects of the rural human capital on promoting the rural resident income is increasing and the spatial spillover effects are significant after 2004. The direct effects of the rural human capital vary from the first period of 0.0507 to 1.1049 in the second period, which means a tremendous increase. In addition, the spatial spillover effects become significant in the second period, in other words, its spatial spillovers play gradually a still more important role in the rural economic development. With the improvement of the rural human capital level and structures, the effects of the rural human capital come out gradually, driving the advancements of the rural economic development.

(5) During the second period, the direct effects of the industrial structure have a positive part in the increase of the rural resident income while the spatial spillover effects of the industrial structure in both the periods are not significant. On the one hand, the increase in the index of industrial structure reflects the low-level of the industrial structure, leaving the

negative impact on the rural resident income; on the other hand, it reflects that the industry is in a rapid growth, having a positive effect on the rural resident income. In the first period, the direct effects of the industrial structure are negative and are not statistically significant, while in the second period, the direct effects of the industrial structure are positive significantly, indicating that the rapid development of the agricultural modernization in the second period has played a dominant role in the rural resident income.

(6) After 2004, the direct effects of the total power of agricultural machinery have declined slightly and had negative spatial spillover effects. During the first period and the second period, the direct effects of the total power of agricultural machinery are 0.0882 and 0.0562, respectively, reduced by 36.3%. In the initial stage of the China's agricultural developments, the level of agricultural mechanization is low. Production has advanced significantly due to the applications of agricultural machinery widely. Owing to the land fragmentation and other problems, the large agricultural machinery cannot be used, so that it is difficult to further promote the widespread use of agricultural machinery. As a result, the direct effects of agricultural machinery decrease slightly. As suggested above, the estimated result in the paper are more identical to the facts. In addition, the spatial spillover of the total power of agricultural machinery is negative significantly.

(7) From the beginning of 2004, the direct effects of the fertilizers applications have improved steadily while their spatial spillover effects are not significant. In both periods, the direct effects of the fertilizers applications are 0.067 and 0.0867, respectively, which means an increase of 29.4 percent.

CONCLUSIONS AND POLICY RECOMMENDATIONS

Based on the economic efficiency model proposed by Odedokun (1992) and the output growth rate model developed by Greenwood and Jovanvic (1990), the general theoretical model of the fiscal and financial supports for agriculture has been proposed. Taking into account the spatial effects of variables, we develop spatial econometric models of the overall period (1997–2010) and the sub-period (1997–2003; 2004–2010) respectively on the basis of the econometric test techniques including the Likelihood Ratio test, the Lagrange multiplier test and other methods. The direct effects and the spatial spillover effects of the fiscal and financial supports for agriculture on the rural resident income have been estimated using the Chinese 30 provincial panel data. Furthermore, we have examined dynamic changes of the effects of the fiscal and financial supports for agriculture in time. The main conclusions are made as follows:

In the entire period from 1997 to 2010, the policy of fiscal support for agriculture, the policy of financial support for agriculture and the farmers owned investment play promotional effects on the farmer income. In the light of our results, it is suggested to be consistent with the conclusions which are proposed by Rioja and Valev in 2004. Thus there are strong positive effects of the countries' financial development policies on economic growth, especially in some European countries' with a high-level economy, such as Spain, Ireland, Italy and the Netherlands, Sweden and the United Kingdom. We could also find that Allanson (2006) has made the studies showing that the inputs supporting agriculture in Scotland have a positive influence on the farmers' income, that are similar with the paper, while the role of fiscal and financial policies in the economic growth in the less developed countries is uncertain, for example in Malawi, Niger, Rwanda and Zaire. After more than 30 years of economic reforms, China's fiscal and financial system has gradually got rid of the low-level state of less developed countries, reaching the level of European countries, so as to realize the objectives of the government's policies[7].

Except for the industrial structure, the direct effects of the remaining controlling variables are significant, such as the rural human capital, the total power of agricultural machinery and the consumption of fertilizers. In addition, the spatial spillover effects of other variables except human capital are significant statistically. Above all, the spatial spillover effects of the three core variables are positive significantly, the spatial spillover effect of the fiscal support for agriculture is the strongest, even more than its direct effects. As we can see in the entire sample period, the implementations of fiscal and financial policies for agriculture in a province can promote the farmers' income not only in the province itself but also in other adjoining provinces. On the average level, both the direct effect and the spatial spillover effect of fiscal and financial policies for agriculture are able play a significant role. With the help of the fiscal and financial supports for agriculture, the farmers' income has increased, the rural reform is in the process and the rural economy has developed. As a whole, the

[7]And we cannot ignore the fact that Felix Rioja and Neven Valev have not taken into account the spatial spillovers effects.

policies of fiscal and financial support for agriculture are effective and robust in China.

From the first period (1997–2003) to the second period (2004–2010), the direct effects of the fiscal support for agriculture on the rural residents' income were up to 57.8% and its spatial spillover effects are significant and positive in both periods. The direct effects of the financial support for agriculture are the largest and they increased slightly after 2004. From the first period to the second period, its spatial spillover effects actually were very different because of the segmentation of the rural financial market, varying from positive to negative. At the beginning of 2004, the direct effects of the farmers owned money declined remarkably while its spatial spillover effects gradually become significant. Besides, the direct effects of the rural human capital, the industrial structure and the agricultural fertilizers applications receive improvements to a certain extent in the second period. The study results show that since China increased the fiscal and financial supports for agriculture in 2004, the direct effects of the fiscal and financial supports for agriculture got a bigger rise, especially the fiscal ones for agriculture. At the same time, the spatial spillover effects of the fiscal and financial supports for agriculture changed obviously. In particular, the rural human capital was a great boost to the farmers' income in the aspects of the direct effects and the spatial effects. However, the spatial spillover effects of the financial support for agriculture became negative rather than positive. Instead, an increase of the financial support for agriculture in a province will inhibit the farmers' income of the adjacent provinces. It reflects a large demand gap of the capital and the vicious competition in acquiring funds in the rural economic development between provinces, due to the segmentation of the rural financial market.

Regardless of the sub-period or the overall period, the rural residents' net income shows a significant positive spatial interdependence between provinces, the increase of the rural residents income in a province has a promotive effect on increasing the rural residents income in the adjacent areas, while the rural residents income of a province is promoted significantly by the residents income increase of the adjacent rural provinces.

Based on the above conclusions, in order to promote the effects of the fiscal and financial supports for agriculture (including direct effects and spatial spillover effects), we put forward the following suggestions in terms of the quantity and structure of the fiscal and financial supports for agriculture and the formulation of the relevant national policy:

(1) In order to cope with the difficult problem of the farmer additionally receiving, stress should be put on increasing the rural fiscal and financial investment for agriculture unceasingly, in particular, increasing the rural credit. And we should make the best of the direct effects of the fiscal and financial supports for agriculture to promote the rural residents' income improvement significantly. More importantly, the fiscal and financial expenditure for supporting agriculture should not only be maintained with regard to the total growth, but also more attention should be paid to the optimization of the investment structure, ensuring the important spending needs on the "Problems about agriculture， rural areas and peasantry". In addition, the effects of the single fiscal policy or financial policy are limited and both polices should be integrated to enhance the overall effects.

(2) To improve the efficiency of capital, it is necessary to increase the rural credit funds, and to broaden the financing channels by guiding farmers to increase the private investment, project financing, and so on. In addition to promoting the development of new rural financial institutions for meeting the needs of the local financial services, the unified level of rural financial markets should be gradually established. By the means of enhancing the rural credit funds and improving the efficiency of funds, it is possible to alleviate the shortfall in funding needed in the process of rural economic development and to promote the positive spillover effects of the financial support for agriculture. The corresponding favourable policies will be implemented to guide the farmers to increasing own capital investment, especially the slack fund from the cross-regions and cross-provinces in order to open up a financing channel. It is a fundamental solution to solve the insufficient funds of rural development and to avoid vicious competitions of capital investment between the provinces.

(3) To speed up the construction of the rural human capital, particularly to enhance the training and introduction of talents in Western region, it is important to establish a reasonable mechanisms such as the talent training and the mobility of talents and to maximize the direct effects and the spatial spillover effects of the rural human capital on the income of rural residents in order to promote the Western farmers' income.

(4) To accelerate the adjustment of the regional industrial structure, to improve the efficiency of the primary industry in order to bring into play the effect of the optimization of industrial structure on promoting rural economy and increasing the residents' income.

(5) In provinces of the fast-growing rural resident income, we should make the full use of the significant positive spatial spillover effects of the peasant income to between provinces, and to strengthen the cross-province exchanges of economy, the culture human resource construction and so on, in order to realize the common growth of the rural residents' income in the regions including many provinces.

Appendix

Table A1. Likelihood ratio (LR) test

	LR	*P*
Null hypothesis (H0): Spatial fixed effects are not significant Alternative hypothesis (H1): Spatial fixed effects are significant	322.9053	0
Null hypothesis (H0): Time-period fixed effects are not significant Alternative hypothesis (H1): Time-period fixed effects are significant	240.5523	0

Table A2. Lagrange multiplier (LM) test

		LM	*P*
Pooled OLS	LM Spatial lag	81.8525	0.000
	LM Spatial error	43.5108	0.000
	Robust LM Spatial lag	38.3863	0.000
	Robust LM Spatial error	0.0447	0.833
Spatial fixed effects	LM Spatial lag	164.8550	0.000
	LM Spatial error	105.3689	0.000
	Robust LM Spatial lag	60.4017	0.000
	Robust LM Spatial error	0.9156	0.339
Time-period fixed effects	LM Spatial lag	58.9550	0.000
	LM Spatial error	15.2085	0.000
	Robust LM Spatial lag	59.0432	0.000
	Robust LM Spatial error	15.2967	0.000
Spatial and Time-period fixed effects	LM Spatial lag	20.4678	0.000
	LM Spatial error	14.0370	0.000
	Robust LM Spatial lag	15.5568	0.000
	Robust LM Spatial error	9.1260	0.003

Table A3. Hausman test and Wald test

Test type		*P*
Hausman test		
Null hypothesis (H0): The random effects estimation should be adopted Alternative hypothesis (H1): The fixed effects estimation should be adopted	170.5421	0
Wald test		
Null hypothesis (H0): The model could be simplified for the SLM Alternative hypothesis (H1): The model could not be simplified for the SLM	88.7735	0
Null hypothesis (H0): The model could be simplified for the SEM Alternative hypothesis (H1): The model could not be simplified for the SEM	121.031	0

Table A4. Test results for spatial econometric model of Chinese fiscal and financial supports for agriculture in the first period (1997–2003)

Lagrange multiplier (LM) Test		LM	*P*
Pooled OLS	LM Spatial lag	39.6362	0.000
	LM Spatial error	28.2464	0.000
	Robust LM Spatial lag	11.6914	0.001
	Robust LM Spatial error	0.3016	0.583
Spatial fixed effects	LM Spatial lag	35.3006	0.000
	LM Spatial error	26.3964	0.000
	Robust LM Spatial lag	13.2614	0.000
	Robust LM Spatial error	4.3572	0.037
Time-period fixed effects	LM Spatial lag	39.6774	0.000
	LM Spatial error	11.9007	0.001
	Robust LM Spatial lag	32.8179	0.000
	Robust LM Spatial error	5.0413	0.025
Spatial and Time-period fixed effects	LM Spatial lag	16.6035	0.000
	LM Spatial error	10.3204	0.001
	Robust LM Spatial lag	18.0762	0.000
	Robust LM Spatial error	11.7930	0.001
Likelihood ratio (LR) Test		LR	*P*
Null hypothesis (H0): Spatial fixed effects are not significant Alternative hypothesis (H1): Spatial fixed effects are significant		286.6562	0.0000
Null hypothesis (H0): Time-period fixed effects are not significant Alternative hypothesis (H1): Time-period fixed effects are significant		30.3054	0.0001
Hausman Test			*P*
Null hypothesis (H0): The random effects estimation should be adopted Alternative hypothesis (H1): The fixed effects estimation should be adopted		367.4366	0.0000
Wald Test			P
Null hypothesis (H0): The model could be simplified for the SLM Alternative hypothesis (H1): The model could not be simplified for the SLM		51.1393	8.6256e-009
Null hypothesis (H0): The model could be simplified for the SEM Alternative hypothesis (H1): The model could not be simplified for the SEM		67.1874	5.4582e-012

Table A5. Test results for spatial econometric model of Chinese fiscal and financial supports for agriculture in the second period (2004–2010)

Lagrange multiplier (LM) Test		LM	*P*
Pooled OLS	LM Spatial lag	10.8895	0.001
	LM Spatial error	3.6118	0.057
	Robust LM Spatial lag	7.6159	0.006
	Robust LM Spatial error	0.3381	0.561
Spatial fixed effects	LM Spatial lag	56.7457	0.000
	LM Spatial error	3.1221	0.077
	Robust LM Spatial lag	65.7043	0.000
	Robust LM Spatial error	12.0807	0.001
Time-period fixed effects	LM Spatial lag	10.1548	0.001
	LM Spatial error	4.1527	0.042

Continuation Table A5

Time-period fixed effects	Robust LM Spatial lag	6.9660	0.008
	Robust LM Spatial error	0.9639	0.326
Spatial and Time-period fixed effects	LM Spatial lag	0.8412	0.359
	LM Spatial error	0.4140	0.520
	Robust LM Spatial lag	1.1419	0.285
	Robust LM Spatial error	0.7147	0.398
Likelihood ratio (LR) Test		LR	*P*
Null hypothesis (H0): Spatial fixed effects are not significant Alternative hypothesis (H1): Spatial fixed effects are significant		406.7577	0.0000
Null hypothesis (H0): Time-period fixed effects are not significant Alternative hypothesis (H1): Time-period fixed effects are significant		4.4500	0.5100
Hausman Test			*P*
Null hypothesis (H0): The random effects estimation should be adopted Alternative hypothesis (H1): The fixed effects estimation should be adopted		1971.4464	0.0000
Wald Test			P
Null hypothesis (H0): The model could be simplified for the SLM Alternative hypothesis (H1): The model could not be simplified for the SLM		46.7151	6.3436e-008
Null hypothesis (H0): The model could be simplified for SEM Alternative hypothesis (H1): The model could not be simplified for the SEM		53.0607	3.6062e-009

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