Formation and Revolution of Social Network

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Abstract

This paper solves ...

Acknowledgements

I am grateful to XXX.

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2 Introduction

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3 Analysis

Since the People's Republic of China came into being, the population in this country has been experiencing a huge increase. During the same period, the agricultural acreage expanded a little bit. This can be surprising because of the magnificent industrial programs launched by government. Since then, China witnessed gradual change from an agricultural society to an industrial society. Industrial facilities occupied places where there were originally farmland. Therefore, the agricultural acreage should have decreased rather than increased. Another event to notice is that the population of this country has experienced a sharp increase during the period. Food production should go up which means the total food acreage should also increase. What's more, population growth leads to the environmental degradation which finally puts pressure on acreage expansion.

3.1 Data and variables

The data used in this research are derived from the county annuls of 20 counties in Guangxi province from 1949 to 1990. The data set covers the information of economy, culture, population and etc. Annuls of these counties do not have a uniform standard for data collection and variable measure, the phenomena of missing values are very common. Relatively, the agricultural acreage and population data are a bit more integrated for some counties while we still need do more to solve some this problem with data set before our analysis.

As indicated in the title, the purpose of this paper is to analyze the relationships among agricultural acreage, population growth and environment change. So the variables in this paper include total food acreage (TFA), population and some measures of environment. In the 20 county annuls, six of them have better coverage of the above three parts of variables. These six counties, including Donglan, Nandan, Xincheng, Fusui and Tianlin, locate randomly in Guangxi province which are proper for data analysis below.

Year and *Population* are two important variables while they are highly correlative, whose correlation coefficient is 0.7866 shown in table 1. In order to avoid the problems caused by collinearity, we choose *Population* in our models and use this relationship to impute some missing values for *Population*. In the data set of Guangxi province, ten counties are randomly chosen. The population growth curve shown in figure 1 indicates that the population increases steadily from 1949 to 1990. Generally, the *Population* is in a linear relationship within these years for every county. However, the statistics of some counties do not cover all years between 1949 and 1990. Consequently, it is reasonable to impute the *Population* data for missing values using linear regression method.

Precipitation, using millimeter to measure the amount of rainfall, is included in our models in order to test the channel how *Population* affects agricultural acreage. Only six out of ten are available because of the missing values of *Precipitation*. Observe, the scatter shown in figure 2 are almost on the same level during the years for a specific county. It is supposed to use the mean value method to impute the missing *Precipitation* values within years.

Total food acreages (TFA) of the six counties, as dependent variable, increase slightly from 1949 to 1990.

In figure 3, there are observable fluctuations during the years. The fluctuations are extremely observable in Donglan and Xincheng, which indicates that there are some factors playing an important part in TFA.

In figure 4, food acreages per capita (TFA_{pc}) of the six counties, as another dependent variable, decrease slightly from 1949 to 1990. They remain in a low level except Tianyang County. According to the data from Donglan, Nandan, Fusui and Tianlin, we can see that TFA_{pc} in these four counties remain a relatively low level from year 1949 to 1990. As for Xincheng and Tianyang, TFA_{pc} fluctuates over time.

Lots of researches have studied the relationship between $Population$ growth and Precipitation as well as between $Precipitation$ and agricultural product. $Population$ growth has a negative impact on $Precipitation$. With human activities and infused capital increasing, people fell more timbers for exploitation and settlement and then accelerate tropical deforestation, leading to a negative impact on $Precipitation$. On the other way, more water conservancy facilities are brought into operation, thus increase the evaporation and penetration and change the water balance. Runoff reacts slowly to the $Precipitation$ leading to a decrease in the total amount of water in this area.

What's more, it is shown that temperatures and declining $Precipitation$ over semiarid regions reduce the yields of corn, wheat, rice, and other primary crops in the next two decades. As we mentioned above, the growth of population has a negative impact on the $Precipitation$. The declining $Precipitation$ in turn reduces the production per unit. Therefore, the population growth has a negative impact on the production per unit.

3.2 Models and Data Analysis

From the figures above, it is preliminary to say that population growth has a positive relationship with total agricultural acreage for the reason that $Population$ increases when acreage increases at the same time while population growth has a negative relationship with agricultural acreage per capita for that $Population$ increases when agricultural acreage per capita decrease. And precipitation has a negative relationship with total agricultural acreage for the reason that $Precipitation$ decreases when acreage increases at the same time while $Precipitation$ has a negative relationship with agricultural acreage per capita. Moreover, this paper needs to analyze the effect of population growth on agricultural acreage and it should be more convincing to get the true impact. Then, $Precipitation$ as a channel variable is put into regression in order to test the channel where $Population$ affects acreage.

Below are the regression models:

$$TFA = \beta_0 + \beta_1 \cdot Population + \mu \tag{3.1}$$

$$TFA = \beta_0 + \beta_1 \cdot Population + \beta_2 \cdot Precipitation + \mu \tag{3.2}$$

$$TFA_{pc} = \beta_0 + \beta_1 \cdot Population + \mu \tag{3.3}$$

$$TFA_{pc} = \beta_0 + \beta_1 \cdot Population + \beta_2 \cdot Precipitation + \mu \tag{3.4}$$

In model 3.1, we only regress TFA on $Population$ to clarify the impact of $Population$ on total food acreage. In model 3.2, adding $Precipitation$ as another independent variable, we regress TFA on $Population$ and $Precipitation$ to clarify the channel of $Precipitation$ on total food acreage. Also in model 3.3, we only regress TFA_{pc} on $Population$ to clarify the impact of $Population$ on food acreage per capita. In model 3.4, we regress

Table 3.1: Correlations between Each Variable

	(1)	(2)	(3)	(4)
VARIABLES	TFA	TFA	TFA_pc	TFA_pc
Population	0.670***	0.574*	$-1.43e-5$***	$-3.52e-5$***
	(0.117)	(0.320)	$(2.14e-6)$	$(6.90e-6)$
Precipitation		-217.5***		-0.00209*
		(52.57)		(0.00113)
Constant	381,235***	643,724***	6.970***	11.99***
	(31,546)	(91,191)	(0.576)	(1.964)
Observations	164	87	164	87
R-squared	0.168	0.192	0.216	0.263

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1

TFA_{pc} on *Population* and *Precipitation* to clarify the channel of *Precipitation* on food acreage per capita. Because the variables have relatively small number of values, in regressions 3.1 and 3.3, we do not drop the observations when *Precipitation* value is missing while in regression 3.2 and 3.4, we drop another 77 observations when *Precipitation* value is missing.

Regression results are shown in table 2. Column (1) to (4) show the estimation of model (1) to (4). Thinking about (1) and (3), only *Population* is taken as independent variable while dependent variables are different. The coefficients are all significant but the first one shows *Population* has a positive effect on TFA while the third one shows *Population* has a negative effect on TFA_{pc}. The results are easy to explain. Taking total agricultural acreage into account, *Population* growth means the pressure on the increase of whole land use which will drive land use rise up. As for agricultural acreage per capita, land use cannot increase as fast as *Population* growth because land resources are limited as well as *Population* growth press people to promote the technology used on farming so that acreage do not need to increase too fast to alleviate the pressure caused by population growth. The highly significant coefficient in estimation (1), 0.670, indicates that total agricultural acreage will increase 0.67 mu (1 mu =667square meter) with one peoples increase. Similarly, the highly significant coefficient in estimation (3), -0.0000143, indicates that agricultural acreage per capita will decrease 0.0000143 mu with one peoples increase. The decrease of TFA_{pc} can be used to explain the decrease of land use in reality. When adding *Precipitation*, we intend to reconsider the effect of *Population* on acreage. Even as we incrementally add *Precipitation* into models, the importance of *Population* remains. After the adding, the magnitude of the coefficient changes, one falling from 0.670 in column (1) to 0.574 in column (2) and the other one falling from -0.0000143 in column (3) to -0.0000352 in column (4) while they remain highly significant statistically. Also, the highly significant coefficients for *Precipitation*, -217.5 and -0.00209, indicate that total agricultural acreage will decrease 217.5 mu with one millimeter rainfalls increase and that agricultural acreage per capita will decrease 0.00209 mu with one millimeter rainfalls increase. Unfortunately, the seemingly low R-squares in columns (1) to (4) illustrate that *Population*, by itself, and in concert with *Precipitation*, can explain limited amount of the variability of agricultural acreage. And there may exist other variables influencing agricultural acreage expansion.

In the first two models (1) and (2), Precipitation is added into model (2) as a channel variable. When adding *Precipitation*, the coefficient of *Population* decreases a bit which means population growth increases total agricultural acreage partly by affecting Precipitation. As we mentioned above, population growth changes the environment, such as lowering down the *Precipitation*, so as to put pressure on TFA expansion. Similarly, in the models (3) and (4), when adding Precipitation, the coefficient of *Population* decreases a bit which means population growth decreases agricultural acreage per capita partly by lowering down *Precipitation*. Then we test the relationship between *Population* and *Precipitation* and regression model is below.

$$Precipitation = \beta_0 + \beta_1 \cdot Population + \mu$$

The estimated β_1 is 0.000159 and the coefficient is not significant which means the relationship induced by the data is not trustable. And we suspect there may be some problems in our data set because the studies by other researchers show that β_1 should be negative. One possible explanation for this accident is the data set scarcity or missing.

Actually, *Precipitation* can be used as a good instrument variable here because Precipitation obviously relates to *Population* growth as we mentioned before while *Precipitation* is not directly related to agricultural acreage expansion. People making their decisions whether they should expand acreage is highly correlated to their current conditions including current *Population* except the unpredictable precipitation. So we can estimate β_1 in model (1) by:

$$cov(Precipitation, TFA) = \beta_1 \cdot cov(Precipitation, Population) + cov(Precipitation, \mu)$$

when $cov(Precipitation, Population) \neq 0, cov(Precipitation, \mu) = 0, then$

$$\beta_1 = \frac{cov(Precipitation, TFA)}{cov(Precipitation, Population)} > 0$$

3.2.1 Conclusion

Using OLS estimation, we have shown that population growth has a significant explanation of agricultural acreage expansion. When we add *Precipitation*, as a channel variable, into models, we extract the impact of *Population* on acreage by the channel of environment, specifically *Precipitation*. Population growth causes the environmental degradation, such as lowering down the *Precipitation*, which finally puts pressure on agricultural acreage expansion. But the seemingly low R-squares illustrate that *Population*, by itself, and in concert with *Precipitation*, can explain limited amount of the variability of agricultural acreage expansion and there may exist other variables influencing agricultural acreage expansion. Finally, we try to use *Precipitation* as an instrument variable to estimate β_1 while the data set here is not suitable. Here is from Boserup et al. (1983) (DeMarzo et al., 2003).

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A Main Proofs

Proofs here...

References

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