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IS THE AGE STRUCTURE OF THE POPULATION ONE OF THE DETERMINANTS OF THE HOUSEHOLD SAVING RATE IN CHINA? A SPATIAL PANEL ANALYSIS OF PROVINCIAL DATA

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Is the Age Structure of the Population One of the Determinants of the Household Saving Rate in China? A Spatial Panel Analysis of Provincial Data

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Abstract

In this paper, we use provincial panel data on China for the 2002-19 period to conduct a spatial autocorrelation analysis of household saving rates as well as a dynamic panel analysis of the determinants of household saving rates using a spatial Durbin model. To summarize our main findings, we find that, in China, the household saving rate shows significant positive spatial autocorrelation with an overall "high-high" and "low-low" clustering pattern, that, as predicted by the life-cycle hypothesis, the youth dependency ratio and the old-age dependency ratio have a negative and significant impact on the household saving rate, and that the logarithm of per capita household disposable income, the regional economic growth rate, the share of the urban population, the industrialization rate, and the income disparity between urban and rural areas also have a significant impact on the household saving rate.

Key words: age structure of the population; China; dependency ratio; household saving rate; life-cycle hypothesis or model; old-age dependency ratio; spatial autocorrelation; spatial Durbin model; youth dependency ratio

Journal of Economic Literature classification codes: D14, D15, E21, G51, J11, O16, and R20

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1 Introduction

China's economy has continued to grow at a rapid rate and has received increasing attention since the implementation of reform and open policies over 30 years ago. However, in comparison to other nations in the world, China's final consumption rate remains low. In 2014, China's final consumption rate (the share of final consumption in GDP) was 46%, whereas nations such as the United States, the United Kingdom, India, and Brazil all had rates above 80%.

The lack of consumption in China is reflected in the high household saving rate. The household saving rate in China has been increasing since the implementation of reform and open policies in 1978. China's national saving rate surpassed 50% in 2014, making it the highest in the world, with the household saving rate hovering around 20%. On the one hand, China remains a lower middle-income country in terms of per capita GDP, but on the other hand, household saving rate in China is high. The term "Chinese Saving Puzzle" has been coined to describe this paradox. The phenomenon of high saving in China has attracted the attention of many scholars around the world. Numerous scholars have offered different explanations for this phenomenon. Qi (2000), Shi and Zhu (2004) and Zhou (2010) suggest that China's high saving rate is mainly due to the fact that China is undergoing a transition from a planned economy to a market economy and that the uncertainty of residents' future income and expenditure has led to a sharp increase in precautionary saving. According to Long et al. (2002) and Ai and Wang (2008), the high saving phenomena is due to Chinese people's traditional lifestyles and consumption behavior. Luo and Kinugasa (2020) use generalized moments estimation to investigate the determinants of the household saving rate in China, finding that factors that are typically thought to promote China's economic development, such as state-owned enterprise reform, are the primary cause of the excess saving problem and that negative factors in the traditional sense, such as the real estate bubble, actually mitigate the excess saving problem.

China's household saving rate has been continuously high for more than three decades, during which China experienced the world's longest development cycle and highest growth rate. As a result, there must have been some persistent factors that were responsible for China's high saving rate. One possibility is that the age structure of the population is an important determinant of China's household saving rate. The life-cycle hypothesis or model assumes that individual save during their working years to prepare for life after retirement and that they dissave during their retirement years to finance their living expenses, implying that the old-age dependency ratio (the ratio of the old-age population to the working-age population) will have a negative impact on the aggregate household saving rate. Thus, if this hypothesis applies in the case of China, the low level of the old-age dependency ratio can help explain China's high household saving rate.

To restrict population increase, China began implementing the "one-child policy" in the late 1970s. The one-child policy is an interesting natural experiment for examining the relationship between the age structure of the population and the household saving rate because it makes fertility largely exogenous and enables us to assess the impact of the age structure of the population on the household saving rate without worrying about endogeneity issues. Furthermore, because the one-child policy was applied more leniently to ethnic minorities, differences in ethnic composition resulted in significant differences in population age structures across provinces, allowing us to precisely estimate the impact of the age structure of the population on the household saving rate.

The “one-child policy” has aided the rapid transformation of the age structure of China’s population, with low birth rates and rapid aging becoming unavoidable tendencies. According to the Seventh National Population Census in 2020, China’s population between the ages of 0 and 14 is 253.38 million or 17.95%; the population between the ages of 15 and 59 is 894.38 million or 63.35%; and the population between the ages of 60 and above is 264.02 million or 18.70% (of which the population aged 65 and above is 190.64 million, accounting for 13.50%). Compared with 2010, the proportion of the population aged 0-14, 15-59, and 60 and above increased by 1.35 percentage points, decreased by 6.79 percentage points, and increased by 5.44 percentage points, respectively. China has already become an aging society, with the speed of population aging accelerating, and it will continue to confront the challenge of how to achieve long-term balanced population growth. Thus, it is critical to investigate the influence of the age structure of the population on the household saving rate.

Agglomeration effects may cause the economic activities of a specific industry to cluster in certain regions as the industrial division of labor, urbanization, and regional economic integration deepen, and this clustering effect may cause developed regions to attract more economic activities and intensify the economic development imbalance between regions. Liu and Zhao (2018) use a spatial Durbin model with panel data on 31 Chinese provinces from 1998 to 2015 to look at the geographical spillover effects of population aging on regional economic development in China. According to the findings of their empirical study, economic activity in China’s provinces is spatially clustered, and population aging has a large negative spatial spillover effect on neighboring provinces’ economic growth.

It is quite possible that saving behavior is also spatially correlated due to the flow of residents between neighboring prefectures for work, study, shopping, leisure, and other activities. As a result, it is crucial to take account not only of the age structure of the population in the province in question but also the impact of factors such as the household saving rate and the age structure of the population in neighboring provinces when researching the determinants of the household saving rate.

Accordingly, the purpose of this paper is to use provincial panel data on China for the 2002-19 period to conduct a spatial autocorrelation analysis of household saving rates as well as a dynamic panel analysis of the determinants of household saving rates using a spatial Durbin model. In so doing, we hope to provide an answer to the question: Is the age structure of the population one of the primary determinants of China’s household saving rate?

The remainder of this paper is organized as follows: In section 2, we conduct a survey of the relevant literature; in section 3, we describe each variable in detail and perform a descriptive statistical analysis; in section 4, we conduct a spatial autocorrelation analysis; in section 5, we discuss the estimation method; and in section 6, we present the estimation results. Section 7 is a brief concluding section.

2 Literature Review

As discussed above, the life-cycle hypothesis of Modigliani (2005) predicts that the age structure of the population will be an important determinant of the household saving rate and, in particular, that the old-age dependency ratio will have a negative impact on the household saving rate. Moreover, the hypothesis also predicts that the youth dependency ratio (the ratio of children to the working-age population) will also have a negative impact on the household saving rate because children consume but do not earn income.

Scholars from all over the globe have researched the impact of the age structure of the population, particularly the youth dependency ratio and the old-age dependency ratio, on the household saving rate and have obtained varied results using data from various nations and regions. This research may be classified into two groups—studies that find that the youth dependency ratio and the old-age dependency ratio have a negative and significant impact on the saving rate, as predicted by the life-cycle hypothesis, and studies that find that they do not.

2.1 Studies that support the life-cycle hypothesis

The findings of the first set of researchers support the implication of Modigliani's life-cycle hypothesis that the youth dependency ratio and the old-age dependency ratio will have a negative impact on the household saving rate.

Leff (1969) constructs the “Leff model” using cross-country cross-section data and discovers that a rise in the old-age dependency ratio lowers the household saving rate and that there is a substantial negative association between the two. According to Yu (1996), an increase in the elderly population will reduce the level of saving and the growth rate of saving in China. Wang (2010) uses provincial panel data from the 1989-2006 period to examine the effects of economic growth, changes in the age structure of the population, and their interactions on China’s saving rate and finds that high economic growth and declining dependency ratios caused by population aging are important factors contributing to the increase in China’s saving rate. The regression results of Yang and Zhang (2013), based on provincial data for China for the 1994-2010 period, show that the youth dependency ratio has a significantly positive impact on the household saving rate, whereas the old-age dependency ratio has a significantly negative impact on the household saving rate. Fan and Zhu (2012) use differential generalized moment estimation and systematic generalized moment estimation methods to empirically examine the influence of the change in the age structure of the population on China’s household saving rate using provincial panel data for the 1990-2009 period. Their findings show that, when the time dimension is taken into account, an increase in the youth dependency ratio raises the national saving rate, whereas an increase in the old-age dependency ratio reduces it. Liu and Liu (2015) use provincial panel data on China for the 1989-2012 period to conduct a systematic generalized moments estimation and threshold regression, and their results show that the youth dependency ratio has a significantly negative impact on the household saving rate, with the negative effect decreasing as income levels rise; however, they find that the old-age dependency ratio has a positive and significant impact on the household saving rate, with the positive effect increasing as income levels rise.

2.2 Studies that do not support the life-cycle hypothesis

The findings of the second set of researchers refute the link between changes in the age structure of the population and the household saving rate, claiming that the youth dependency ratio and the old-age dependency ratio do not have a negative impact on the household saving rate, as predicted by the life-cycle hypothesis.

Contrary to Leff (1969), Gupta (1971) argues that the dependency ratio is not a significant determinant of the household saving rate in most underdeveloped countries. Ram (1982) also disagrees with Leff's conclusion. Wilson (2000) finds that both Australia and Canada experienced long-term growth in their saving rates in the twentieth century using a cointegration regression and a comparison study of time series data on household saving rate in the two nations. The regression findings do not show a link between the age structure of the population and the household saving rate. The main cause for the rise in Australia's and Canada's saving rates is found to be income growth. As a result, productivity gains, rather than declining fertility rates, provide a more comprehensive and satisfactory explanation for these countries' household saving rate shifts. Deaton and Paxson (1997) also suggest that changes in the age structure of the population do not explain the relationship between economic growth and the household saving rate. Kraay (2000) examines the determinants of rural and urban families' saving rates over the 1978-83 and 1984-89 periods using panel data from China's household survey and finds that the dependency ratio has no meaningful influence on the household saving rate. Similarly, Horioka and Wan (2007) use a life-cycle model and panel data on China's provinces for the 1995-2004 period from a household survey to conduct a dynamic panel analysis of the determinants of the household saving rate in China and find that variables relating to the age structure of the population have little impact on the household saving rate.

However, none of the studies mentioned above takes into account the household saving rate's geographical influence. The domestic saving rate in China has a substantial positive spatial autocorrelation (i.e., an overall "high-high" and "low-low" agglomeration pattern), with the household saving rate in the eastern area being much higher than in the central and western regions. As a result, spatial methods should be employed to investigate the geographical implications of China's household saving rate. Wang et al. (2016) analyze the determinants of the household saving rate using a spatial lagged model (SLM) and a spatial error model (SEM) and discover that both the youth dependency ratio and the old-age dependency ratio have a negative and significant influence. However, Wang et al. (2016) do not consider using the more general spatial Durbin model in their empirical research, which includes both the spatial error and spatial lag models as particular examples. LeSage (2008) indicate that the appropriate spatial econometric model should be chosen using the LM test or the LR and Wald tests.

The LM test and the LR and Wald test will be employed in this research to assess if the spatial Durbin model should be chosen.

2.3 Summary

As this survey has shown, although there is a large literature on the impact of demographic factors on the household saving rate, they have reached differing conclusions. Some studies have found that demographic factors have a significant impact on the saving rate while others have not. The results differ drastically depending on data sources, variable selection, and estimating methodologies. A unified consensus on the influence of the age structure of the population on China's household saving rate has yet to be reached, necessitating further research and analysis.

In terms of research methodologies, most studies have used traditional econometric approaches, such as cross-sectional, time series, and panel data models, to analyze the determinants of the household saving rate. However, these traditional approaches regard units of observation as self-contained and homogenous areas that do not have any spatial associations with one another even though the household saving rate in one area is likely to be affected by that in other areas, especially areas that are more closely located. Thus, geographical considerations must be taken into account when analyzing the determinants of the household saving rate.

The current study improves upon earlier studies in a number of respects: (1) It uses the most recently available data. China's economy and the age structure of its population have shifted in recent years, particularly after 2010, but the majority of previous studies use data before 2010, making them less relevant to present-day China. This analysis uses the most recent data for 2002-2019 from the China Statistical Yearbook, and thus the conclusions are more persuasive. (2) It surveys previous studies and chooses a comprehensive set of explanatory variables as possible determinants of the household saving rate. (3) It employs a novel econometric approach to explore the influence of the age structure of the population on the household saving rate. In particular, it conducts a spatial autocorrelation analysis and chooses to use a spatial Durbin model based on the results of the LM test and the LR and Wald tests.

3 Variable Selection and Data Description

In this paper, we use provincial panel data for the 2002-19 period from the *China Statistical Yearbook*, which is compiled by the National Bureau of Statistics of China (annual). The data were taken from http://www.stats.gov.cn/tjsj/ndsj/ (the English-language equivalent is http://www.stats.gov.cn/english/Statisticaldata/Annual Data/).

3.1 Variable selection

This subsection discusses what variables we used and how they were defined. The choice of explanatory variables differs greatly across studies. Horioka and Wan (2007) use the income growth rate, the one-year lag of the saving rate, the real interest rate, etc., as explanatory variables, while Luo and Kinugasa (2020) include the sex ratio, the transfer income ratio, the urbanization ratio, the growth and level of income, etc. Wang et al. (2016) focus on the impact of demographic factors (the dependency ratio, the sex ratio, household size, the proportion of the urban population, etc.) on the household saving rate. Liu and Liu (2015) use the logarithm of per capita disposable income, the regional economic growth rate, the urban-rural income gap, the proportion of the urban population in total population, the industrialization rate, the ratio of government expenditures to GDP, etc., and Fan and Zhu (2012) use the death rate as a proxy for life expectancy.

Learning from previous studies, we use the household saving rate as the dependent variable and the youth dependency ratio and the old-age dependency ratio as the core explanatory variables and the logarithm of per capita disposable income, the death rate, the regional economic growth rate, the proportion of the urban population, the industrialization rate, the ratio between the per capita incomes of urban and rural residents, and the real interest rate as additional explanatory variables.

3.2 Variable definitions

The specific definitions of the variables we used in our analysis are as follows:

The household saving rate (SR) is defined as the ratio of household saving to household disposable income, and the formula for calculating it is as follows:

$$SR = \left(\frac{per\ capita\ disposable\ income - per\ capita\ expenditure}{per\ capita\ disposable\ income}\right) \times 100\% \quad (1)$$

The dependency ratio is the proportion of persons who are not of working age to those who are of working age in the population as a whole, given as a percentage. The dependency ratio can be divided into the youth dependency ratio (YD) and the old-age dependency ratio (OD), which are the core explanatory variables in this paper. The formulas for calculating them are as follows:

$$YD = \left(\frac{Population\ of\ children\ aged\ 0\text{–}14}{Working\text{–}age\ population\ aged\ 15\text{–}64}\right) \times 100\% \quad (2)$$

$$OD = \left(\frac{Population\ 65\ years\ old\ or\ over}{Working\text{–}age\ population\ aged\ 15\text{–}6}\right) \times 100\% \quad (3)$$

lnPI is calculated by taking the logarithm of per capita household disposable income.

Data on the death rate (DR) were taken directly from the Chinese Statistical Yearbook.

The regional economic growth rate (GR) is defined as the growth rate of the gross regional product of each province. The formula for calculating it is as follows:

$$GR = \left(\frac{this\ year's\ gross\ regional\ product - last\ year's\ gross\ regional\ product}{last\ year'\ \ gross\ regional\ product}\right) \times$$

100% (4)

The proportion of the urban population in the total population (UP) was taken directly from the Chinese Statistical Yearbook.

The industrialization rate (INR) is defined as the proportion of industrial value added to regional GDP is known as. The formula for calculating it is as follows:

$$INR = \left(\frac{additional\ industrial\ value}{gross\ regional\ product}\right) \times 100\% \quad (5)$$

Income disparity between urban and rural areas (IND) is measured as the ratio of per capita disposable income in cities to per capita disposable income in rural areas. The formula for calculating it is as follows:

$$IND = \left(\frac{Urban\ per\ capita\ disposable\ income}{Rural\ per\ capita\ disposable\ income}\right) \times 100\% \quad (6)$$

The real interest rate (RI) was taken directly from the following World Bank Open Data website: https://data.worldbank.org.cn/indicator/FR.INR.RINR?locations=CN

3.3 Descriptive statistics

Table 1 shows the descriptive statistics for each variable. It can be seen from this table that most variables show a considerable range of variation. This implies that China's population age structure and economic indicators have changed dramatically over time and/or that there are substantial regional variations in these variables, suggesting that empirical analyses need to take account of links across regions.

[Table 1 goes here.]

Table 2 shows the correlation coefficient matrix, and as can be seen from this table, SR has negative correlations with YD, GR, IND, and RI and positive correlations with the other variables.

[Table 2 goes here.]

4 Spatial Autocorrelation Analysis

It is necessary to test for spatial autocorrelation before using a spatial econometric model to examine the impact of changes in population age structure on provincial household saving rates. We use the global Moran's I index to test for the global spatial correlation of the household saving rate (Moran, 1950). As can be seen from Figure 1, there is a positive spatial correlation of the household saving rate across provinces, indicating that a province's household saving rate is positively influenced by the household saving rate of neighboring provinces and that there is some geographic similarity with the household saving rate in neighboring provinces as well as an overall pattern of "high-high" and "low-low" clustering (the value of the global Moran's I index is 0.4315).

[Figure 1 goes here]

Given the substantial spatial correlation of the household saving rate across provinces, it is necessary to estimate a spatial econometric model of the determinants of the household saving rate in China, which is what we do in the next two sections of the paper.

5 Model Construction

5.1 Model selection

There are three standard models for analyzing spatial autocorrelation: the spatial lag model (SLM), the spatial error model (SEM), and the spatial Durbin model (SDM). The SLM focuses on the geographical connectivity between residents' saving behavior and assumes that the household saving rate in the province is influenced not only by the values of the explanatory variables in the province in question but also by spillover effects from the household saving rate in neighboring provinces. However, it ignores the impact of the values of the explanatory variables in neighboring provinces on the household saving rate.

The SEM takes account of the fact that the values of the explanatory variables in neighboring provinces may influence the value of the explanatory variables in the province in question by adding a spatial error term to the estimation equation.

The SDM model, on the other hand, takes into account not only the impact of the values of the explanatory variables in the province in question and the household saving rate in neighboring provinces on the household saving rate in the province in question but also the impact of the values of the explanatory variables in neighboring provinces thereon.

Both the spatial lag and spatial error models are variants of the spatial Durbin model. LeSage (2008) argued that an appropriate model may be selected based on the LM test or the LR and Wald tests, and in this paper, the LM test and the LR and Wald tests rejected the initial hypothesis of the spatial lag and spatial error models, suggesting that the spatial Durbin model is the correct model.

5.2 Estimation model

In this section, we briefly describe our estimation model.

$$y_{it} = \rho w y_{jt} + x_{it} + \delta w x_{jt} + u_{it} + \varepsilon_{it} \quad (7)$$

where i denotes one's own province, j denotes a neighboring province, t denotes year, y denotes the household saving rate, x denotes the vector of all explanatory variables used in the analysis, ρ and δ denote the spatial correlation coefficients of the dependent and explanatory variables, respectively, w denotes the spatial weight matrix, wy denotes the spatial lagged term of the household saving rate of neighboring provinces, wx denotes the spatial lagged term of the explanatory variables of neighboring provinces, u is a fixed effect, and ε is a random disturbance term.

6 Empirical Analysis

6.1 Estimation results

The estimation results are shown in Table 3. Columns (1) and (2) show the results for the explanatory variables in the province in question, with column (1) showing the results for the fixed effects model and column (2) showing the results for the random effects model. Columns (3) and (4) show the results for the explanatory variables in neighboring provinces, with column (3) showing the results for the fixed effects model and column (4) showing the results for the random effects model. A Hausman test showed that the preferred model is the0 random effects model, so we focus on the estimation results in columns (2) and (4) in the subsequent discussion.

[Table 3 goes here.]

As shown in Table 3, the value of spatial rho is 0.187, and it is statistically significant. This indicates that the household saving rate of neighboring provinces has a positive and significant effect on the household saving rate in the province in question and that the household saving rate is spatially autocorrelated. This result is consistent with the results of the analysis in Section 4.

The youth dependency ratio (YD) and the old-age dependency ratio (OD) of the province in question do not have a significant effect on SR, but the YD and OD of neighboring provinces has a negative and significant effect thereon, with values of -0.277 and -0.257, respectively. Both the logarithm of per capital household disposable income (lnPI) of the province in question and that of neighboring provinces have a positive and significant effect on SR. Neither the death rate (DR) of the province in question nor that of neighboring provinces has a significant effect on SR. Both the regional growth rate (GR) of the province in question and that of neighboring provinces have a positive and significant effect on SR, but the coefficients are small. Both the share of the urban population (UP) of the province in question and that of neighboring provinces have a negative and significant effect on SR. The industrialization rate (INR) of the province in question has a positive and significant effect on SR, but that of neighboring provinces does not have a significant effect thereon. The income disparity between urban and rural areas (IND) of the province in question has a negative and significant effect on SR, but that of neighboring provinces has a positive and significant effect thereon, with values of -4.239 and 2.502, respectively. Neither the real interest rate (RI) of the province in question nor that of neighboring provinces has a significant effect on SR.

6.2 Estimation results of direct, indirect, and total effects

LeSage (2008) suggests that direct effects, indirect effects, and total effects should be used in spatial econometric models to analyze the influence of explanatory variables on the dependent variable. The direct effect represents the influence of an explanatory variable in the province in question on the dependent variable in the same province, including feedback effects. Feedback effects refer to the fact that the explanatory variables in one province may have an effect on the dependent variable in neighboring provinces, which in turn may affect the dependent variable in that province. Indirect effects, also known as spatial spillover effects, measure the effect of an explanatory variable in a neighboring province on the dependent variable in the province in question. The total effect is the sum of the direct and indirect effects.

Table 4 shows the estimation results for the random effects model, and as can be seen from this table, the youth dependency ratio and the old-age dependency ratio do not have a significant direct effect on the household saving rate in the province in question but that they have a negative and significant effect on the household saving rate through an indirect effect, and ultimately that the total effect on the household saving rate is negative and significant. This result is consistent with the life-cycle hypothesis.

[Table 4 goes here.]

Looking next at the coefficient of the logarithm of per capita disposable income (lnPI), its direct effect, indirect effect, and total effect are all positive and significant. This suggests that the sustained increase in per capita disposable income over the last three decades is an important reason for the phenomenon of a high household saving rate in China.

Looking next at the coefficient of the death rate (DR), which is used as a proxy for life expectancy, none of its three effects was statistically significant. This suggests that changes in life expectancy do not have a significant effect on the household saving rate.

Similar to the case of lnPI, the direct effect, indirect effect, and total effect of the regional economic growth rate (GR) and of the proportion of the urban population to the total population (UP) are all positive and significant.

The industrialization rate (INR) has a positive direct effect on the household saving rate, but its significance is not high, the indirect effect is not significant, and the total effect is positive and significant.

Looking next at the coefficient of the income disparity between urban and rural areas (IND), its direct effect, indirect effect, and total effect are all positive and significant. It may be that the differing consumption habits of urban and rural residents have contributed to this result.

Looking next at the coefficient of the real interest rate (RI), it has a positive and significant direct effect on the household saving rate, but its indirect and total effects are not statistically significant.

Our findings imply that the one-child policy was successful in controlling China's population growth although the problem of declining fertility that it caused has contributed to China's high saving rate phenomenon.

7 Conclusion

In this paper, we used provincial panel data for China for the 2002-19 period to conduct a spatial autocorrelation analysis of household saving rates as well as a dynamic panel analysis of the determinants of household saving rates using a spatial Durbin model.

To summarize our main findings, we find that, in China, the household saving rate shows significant positive spatial autocorrelation with an overall "high-high" and "low-low" clustering pattern, that, as predicted by the life-cycle hypothesis, the youth dependency ratio and the old-age dependency ratio have a negative and significant impact on the household saving rate, and that the logarithm of per capita household disposable income, the regional economic growth rate, the share of the urban population, the industrialization rate, and the income disparity between urban and rural areas also have a significant impact on the household saving rate.

Our findings answer the question posed at the beginning of this paper—namely, whether or not the age structure of the population is one of the determinants of the household saving rate in China—in the affirmative. Thus, our findings imply that, as China's population ages (and as the rate of economic growth slows), the saving rate of Chinese households will decline in the future.

Finally, turning to directions for further research, there are a number of factors that we were not able to consider in this analysis due to data limitations, such as borrowing constraints, precautionary saving, bequest motives, and old-age pensions. We hope to be able to incorporate these factors in our future research.

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Table 1: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
SR	26.72	5.345	10.59	49.25
YD	24.49	7.183	9.640	44.65
OD	12.96	3.075	6.710	23.82
lnPI	1.514	1.081	0.257	6.944
DR	6.085	0.952	4.210	13.87
GR	13.55	7.653	-25.02	60.77
UP	51.31	15.08	22.61	89.60
INR	37.93	9.917	6.808	56.49
IND	2.891	0.590	1.845	5.525
RI	1.855	2.349	-2.310	5.530

Note: The number of observations is 558, the number of provinces is 31, and the number of years is 31.

Table 2: Correlation coefficient matrix

	SR	YD	OD	lnPI	DR	GR	UP	INR	IND	RI
SR	1									
YD	-0.206	1								
OD	0.137	-0.318	1							
lnPI	0.365	-0.538	0.455	1						
DR	0.0203	0.0788	0.415	-0.114	1					
GR	-0.0667	0.169	-0.253	-0.415	-0.0717	1				
UP	0.219	-0.780	0.388	0.773	-0.187	-0.231	1			
INR	0.0381	-0.221	0.0907	-0.153	0.130	0.174	0.0863	1		
IND	-0.445	0.625	-0.378	-0.554	0.0806	0.313	-0.667	-0.183	1	
RI	-0.0520	0.00630	0.0553	0.119	0.151	-0.484	0.0488	-0.132	-0.104	1

Note: The number of observations is 558, the number of provinces is 31, and the number of years is 18.

Figure 1: Global Moran's I

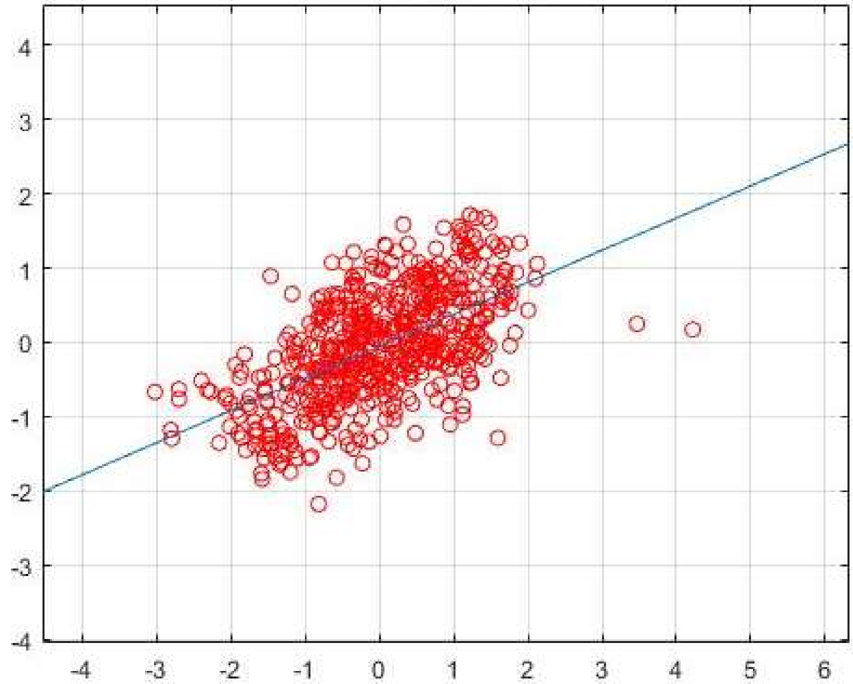

Table 3: Estimation results

	(1) SR	(2) SR		(3) SR	(4) SR
Main			Wx		
YD	-0.137**	-0.0753	YD	-0.268***	-0.277***
	(-2.38)	(-1.42)		(-2.90)	(-3.13)
OD	-0.0270	-0.0885	OD	-0.230	-0.257*
	(-0.29)	(-1.00)		(-1.53)	(-1.75)
lnPI	3.217***	2.797***	lnPI	0.387	1.165*
	(6.24)	(7.27)		(0.53)	(1.82)
DR	-0.110	-0.0438	DR	0.158	0.178
	(-0.60)	(-0.23)		(0.47)	(0.52)
GR	0.0405*	0.0502**	GR	0.104***	0.0959**
	(1.72)	(2.12)		(2.59)	(2.38)
UP	-0.112***	-0.140***	UP	-0.160**	-0.126**
	(-3.13)	(-4.42)		(-2.56)	(-2.07)
INR	0.0733**	0.0520*	INR	0.0294	0.0462
	(2.33)	(1.78)		(0.59)	(0.97)
IND	-4.691***	-4.239***	IND	2.489**	2.502***
	(-6.54)	(-7.15)		(2.38)	(2.72)
RI	-0.00102	0.0104	RI	0.0407	0.0211
	(.)	(.)		(0.50)	(0.25)
Constant		40.91***			
		(6.52)			
Spatial					
Rho	0.193***	0.187***			
	(3.75)	(3.58)			

Notes: Columns (1) and (2) show the results for the explanatory variables in the province in question, while columns (3) and (4) show the results for the explanatory variables in neighboring provinces. Columns (1) and (3) show the results for the fixed effects model, while columns (2) and (4) show the results for the random effects model. Standard errors are in parentheses; *, **, and *** denote significant at the 10%, 5%, and 1% levels, respectively.

Table 4: Estimation results of direct, indirect, and total effects

	Direct Effect	Indirect Effect	Total Effect
YD	-0.0865	-0.348***	-0.434***
	(-1.59)	(-3.48)	(-3.67)
OD	-0.105	-0.317*	-0.422**
	(-1.22)	(-1.73)	(-2.00)
lnPI	2.909***	1.939***	4.848***
	(7.99)	(2.90)	(6.81)
DR	-0.0333	0.209	0.176
	(-0.18)	(0.50)	(0.35)
GR	0.0551**	0.123***	0.178***
	(2.39)	(2.61)	(3.33)
UP	-0.146***	-0.182***	-0.328***
	(-4.47)	(-2.66)	(-3.98)
INR	0.0551*	0.0698	0.125**
	(1.83)	(1.21)	(1.99)
IND	-4.197***	1.966*	-2.231**
	(-7.20)	(1.91)	(-2.03)
RI	0.0114***	0.0243	0.0357
	(2.76)	(0.24)	(0.34)
N	558		
R-squared	0.348		

Notes: Standard errors are in parentheses; *, **, and *** denote significant at the 10%, 5%, and 1% levels, respectively.