Lottery Sales and Geographical Income Level Differences: Empirical Tests Based on Provincial Panel Data

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Abstract. With the continuous development of China's economy, residents' income has improved significantly, consumption has gradually upgraded, and residents' income and lottery sales show a correlation, and then analyze whether the relationship between residents' income and lottery sales is affected by geographical differences. This paper analyzes that the per capita disposable income of all residents has a significant negative impact on lottery sales, and the impact of per capita disposable income of all residents on lottery sales has significant geographical differences. Based on this, this paper analyzes the fixed effects model and two stage least square of lottery sales and per capita disposable income of all residents in 31 provinces of China from 2012 to 2020, exploring the impact of income heterogeneity on lottery sales.

Keywords: Fixed effect model; Two stage least square; Panel data; Per capita income; Lottery sales

1 Introduction

With the continuous development of China's economy and society, the per capita income of China's residents has also increased, people's standard of living is improving, the entertainment market is gradually expanding, and along with the growing maturity of the Internet, the development of China's lottery market provides good conditions. Based on the current research on the relationship between income level and lottery sales, Rubin & Paul (1979) analyzed that when people are in different growth cycles, they have different risk preferences, which affects their purchase of lottery tickets [1]. Mikesell (1994) found that the relationship between income and sales is significantly positive, and the effect of the unemployment rate on sales is not significant [2]. Han Jingjing (2015) found that disposable income per capita and gross product of the tertiary sector are positively related to lottery sales [3]. Xu Yanfang (2021) found that GDP per capita, education level and urbanization have significant positive impact on lottery sales, and unemployment rate is negatively correlated with lottery sales [4]. Guo Ziyu, Chen Gang (2022) found that the level of regional economic development significantly and positively affects the attention of the lottery, and that there is a stable and divergent trend of lottery sales among provinces [5]. Zhang Zengfan (2022) found that lottery sales are positively related to the proportion of high school (junior college) education [6]. Liu Wenjing, Bai Zifei, Song Hemin (2023) found that education level has a significant positive effect on the propensity to consume sports lottery [7]. Lv Songtao (2022)

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found that the growth rate of domestic GDP per capita has a significant positive effect on the level of lottery sales per capita [8]. While some scholars hold the opposite view, Chen Huijuan (2020) found that GDP per capita and disposable income of urban residents have a negative effect on lottery sales, and the unemployment rate has a positive effect on lottery sales [9]. By combing through the past literature, we found that the relationship between residents' income and lottery sales has not reached a unanimous conclusion, and put forward hypothesis 1: the impact of the per capita disposable income of all residents on lottery sales is heterogeneous depending on these education level and regions, and the impact is negatively correlated. Zhong Yaping, Li Qiangyi (2019) found that the disparity in economic levels between region is the main reason for the spatial differences in lottery sales, and that income has a more significant positive correlation with lottery sales in less economically developed regions [10]. Guo Ziyu, Chen Gang (2024) found that the sales of various types of sports lotteries have a stepwise increasing distribution from west to east in China [11]. Further research on the impact of different geographic income levels on lottery sales, proposed hypothesis 2: the relationship between residents' income and lottery sales is also affected by geography, in the region with high residents' income, its low-income group of lottery ticket purchasing power is strong. Therefore, this paper will use the provincial panel data of China from 2012 to 2020 to explore the relationship between lottery sales and per capita income of each province, and analyze the lottery sales by combining the geographical differences.

2 Model setting and data

2.1 Model Setting

In order to study the impact of per capita disposable income on lottery sales under different provinces, this paper adopts the Hausman (Hausman) test, and the result rejects the original hypothesis, so it adopts the fixed effect model. The benchmark regression model is setting as the equation(1):

$$y_{it} = \alpha + \beta income_{it} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

where y_{it} represents lottery sales, $income_{it}$ represents disposable income per capita for all residents, and X_{it} represents each control variable, ε_{it} as a random disturbance term.

2.2 Data Description

Fixed effects modeling of lottery sales and disposable income per capita of all residents in 31 provinces in China from 2012 to 2020, the data sample in this paper consists of panel data from 31 provinces from 2012 to 2020. The core explanatory variable is disposable income per capita of all residents (inc), and the explanatory variable is lottery sales (loty). The control variables are GDP per capita (pgdp), elderly population dependency ratio (ageo), urban registered unemployment rate (unem), urban disposable income per capita (uinc), per capita disposable income of rural residents (rinc), value added of the tertiary industry (gdp3), gross domestic product (gdp), urban population (upop), male population (mpop), percentage of employed persons with undergraduate education (edu), and proportion of unmarried males aged 15 years and over in the total population (sg). As shown in Table 1, the main variables in this paper are deflate at the 1% quartile.

Table 1. Descriptive statistics of the data.

Variable Indicator	unit	Observations	Average	Standard Deviation	Minimum	Maximum
inc	ten thousand dollars	279	2.415	1.113	0.977	6.943
loty	billions	279	1.219	0.903	0.095	4.228
pgdp	ten thousand million	279	5.533	2.757	2.283	15.66
ageo	%	248	14.12	3.363	7.500	22.70
unem	%	279	3.218	0.631	1.300	4.500
uinc	ten thousand million	279	3.262	1.060	1.836	7.385
rinc	ten thousand dollars	279	1.309	0.530	0.559	3.193
gdp3	%	279	1.084	0.027	0.990	1.132
gdp	trillion	279	2.494	2.095	0.094	10.28
upop	billions of people	279	0.262	0.179	0.008	0.887
mpop	ten thousand dollars	248	2.066	1.434	0.132	7.525
edu	%	248	8.270	5.461	2.761	30.39
sg	%	248	0.096	0.017	0.066	0.148

Table 1 reports the descriptive statistics of the regression sample used in this paper, the results are show that the disposable income per capita of all residents (inc) and lottery sales (loty) used in the sample of this paper have a certain degree of volatility, which can be analyzed by regression; it also reflects the basic characteristics of disposable income per capita of all residents and lottery sales in China. The darker color of Figure 1 indicates a higher correlation coefficient.

Fig. 1. Heatplot.

From the two-dimensional scatter plot and the trend of the fitted line, the lottery sales in Figure 2 are positively correlated with the disposable income per capita of all the residents, the changes in the lottery sales of the provinces in the middle-income and low-income regions do not fluctuate much with the increase of income, the changes in the lottery sales of the provinces in the high-income regions are greatly with the increase of income. The comparison of Figures 3, 4, and 5, shows that in the regions with high-income levels, the disposable income per capita of all residents is negatively correlated with lottery sales, in the middle-income and low-income regions, the disposable income per capita of all residents is positively correlated with lottery sales.

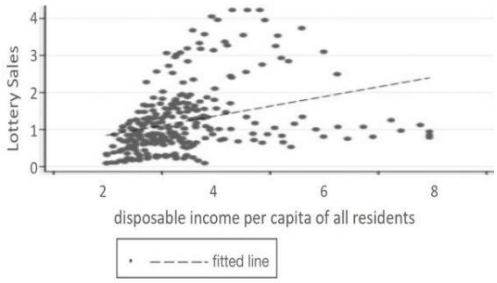

Fig. 2. Lottery sales and revenue

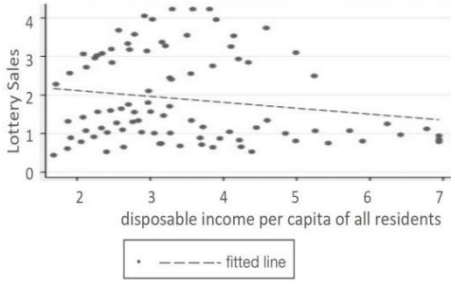

Fig. 3. Lottery sales and high revenue

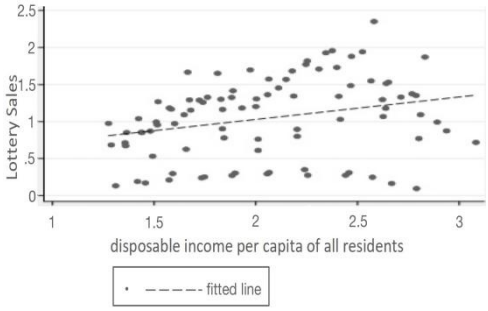

Fig. 4. Lottery sales and middle-income sales

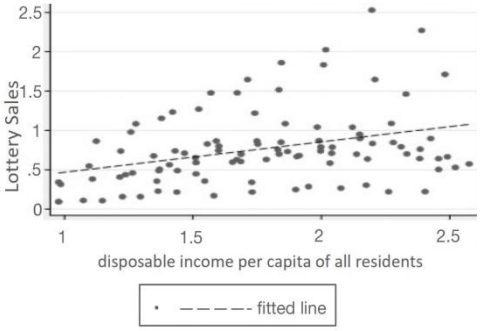

Fig. 5. Lottery sales and low income

3 Empirical analysis

Table 2. Benchmark regression results.

Variable	(1)	(2)	(3)	(4)
	OLS	FE	Two-way FE	2SLS
inc	-0.100	-0.808***	-0.446**	-0.426***
	(-0.84)	(-3.27)*	(-2.70)	(-3.25)
pgdp	-0.011***	0.128*	0.119**	0.063
	(-0.28)**	(1.74)	(2.57)	(1.52)
unem	-0.003	-0.046	-0.006	0.010

	(-0.12)	(-0.82)	(-0.12)	(0.38)
uinc	0.129	0.626***	0.241	0.328***
	(1.47)	(2.86)	(1.60)	(3.28)
gdp3_	2.757***	4.671***	-0.054	2.653***
	(2.89)	(5.51)	(-0.40)	(2.77)
gdp	0.269***	-0.056		0.186**
	(3.59)	(-0.67)		(2.54)
upop	1.660**	6.464***	6.521***	2.436***
	(2.41)	(3.05)	(3.35)	(3.56)
Constant	-2.982***	-6.046***	-0.903	-3.185***
	(-2.63)	(-4.73)	(-1.55)	(-2.80)
Observations	279	279	279	279
Region FE	NO	YES	YES	NO
Time FE			YES	0.868
Adj-R^2	0.871	0.490	0.724	
F	252.4	26.22	18.26	

Note:1.The standard error based on heteroscedastic robustness standard error method is estimated in brackets.

2.*, **, ***represent the regression coefficients are significant at the level of 10%,5%and 1%respectively.

This paper adopts a fixed effect model at the national level, setting residents' income from 2002-2010 as an instrumental variable, to conduct a two stage least square regression on lottery sales, which is used to address its endogeneity. It can be seen that under the national-level fixed-effects model, disposable income per capita of residents negatively affects lottery sales after controlling for regional effects, and is significant at the 1% level. The results are shown in Table 2. And the effect of urban population on lottery sales is significantly positive, and the increase in value added of the tertiary industry promotes lottery sales. On this basis, the time fixed effects model is also add to further verify hypothesis 2 that there is significant geographical variability in the impact of per capita disposable income of all residents on lottery sales.

Table 3. Results of return of education provinces.

	High	Medium	Low	High	Medium	Low
Variable	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	FE	FE	FE	FE
inc	-1.341***	-3.359**	-1.049*	-1.358*	-2.182**	-0.925*
	(-3.50)	(-2.46)	(-1.87)	(-1.92)	(-2.45)	(-1.80)
gdp3	0.442***	0.584**	0.744***	0.427***	0.691***	0.756***
	(6.81)	(2.34)	(4.76)	(5.46)	(4.89)	(6.17)
mpop	0.015	0.037	0.028**	0.028	0.007	0.045

	(0.58)	(1.57)	(2.77)	(0.34)	(0.14)	(1.17)
uinc	1.142**	2.885**	0.850**	1.164	1.863**	0.607*
	(3.02)	(2.76)	(2.35)	(1.54)	(2.31)	(1.77)
gdp3_	-1.128	-0.079	-2.781	0.078	-0.933	-2.018
	(-0.63)	(-0.06)	(-1.34)	(0.03)	(-0.62)	(-1.38)
edu	0.004	-0.022	-0.070**	-0.003	0.004	-0.010
	(0.33)	(-0.76)	(-2.40)	(-0.13)	(0.16)	(-0.30)
Constant	1.959	-0.212	3.178	0.438	0.639	2.233
	(0.89)	(-0.15)	(1.34)	(0.18)	(0.37)	(1.42)
Observations	72	88	88	72	88	88
Region FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	YES	YES	YES
Adj-R^2	0.574	0.627	0.758	0.658	0.780	0.799
F	23.11	12.22	85.66	11.33	23.81	26.37

Note:1.The standard error based on heteroscedastic robustness standard error method is estimated in brackets.

2.*, **, ***represent the regression coefficients are significant at the level of 10%,5%and 1%respectively.

This paper argues that this is the result of the decreasing marginal impact of per capita income on lottery sales in areas with different levels of education, in areas with a high level of education per capita, the gap between the per capita income of residents and the level of thinking is larger, the extent of the impact of changes in income on lottery sales. The results are shown in Table 3. And with the decline in the level of education, the gap between the level of income and the level of thinking of the residents themselves is gradually becoming smaller, and changes in disposable income per capita have a diminishing marginal impact on the behavior of the residents and the thinking of the residents, resulting in a decrease in the significance of the impact of income on the sales of lottery tickets.

Table 4. Income level province return results.

	High	Medium	Low	High	Medium	Low
Variable	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	FE	FE	FE	FE
inc	-0.652	-5.399**	-0.619***	-3.371***	2.127	0.295
	(-0.72)	(-2.82)	(-4.20)	(-3.05)	(0.81)	(0.86)
gdp3	-0.440*	-0.120	1.002***	-0.055	0.955**	1.271***
	(-2.02)	(-0.47)	(3.59)	(-0.28)	(2.28)	(6.59)
rinc	0.170	0.970	-0.903*	0.839	-4.113**	-0.936***
	(0.34)	(0.59)	(-2.01)	(1.62)	(-2.27)	(-2.72)
uinc	0.611	2.938***	0.854***	3.426***	-1.265	0.799***
	(0.74)	(3.49)	(3.72)	(3.18)	(-0.66)	(4.16)

upop	14.568***	9.079*	0.044	7.307**	-0.849	-3.615*
	(3.63)	(2.04)	(0.02)	(2.08)	(-0.18)	(-1.81)
mpop	-0.014	0.016	0.023**	-0.001	0.038	0.047*
	(-0.87)	(0.87)	(3.03)	(-0.02)	(0.70)	(1.82)
pgdp	0.065	0.563***	-0.058	-0.117	0.073	-0.027
	(0.84)	(3.43)	(-1.16)	(-1.63)	(0.41)	(-0.49)
Constant	-3.454**	-2.451**	-0.002	-3.147***	2.746	-0.706*
	(-3.09)	(-2.39)	(-0.01)	(-3.24)	(1.05)	(-1.69)
Observations	80	80	88	80	80	88
Region FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	YES	YES	YES
Adj-R^2	0.696	0.670	0.782	0.826	0.763	0.899
F	174.2	47.42	122.1	28.38	19.84	57.19

Note:1.The standard error based on heteroscedastic robustness standard error method is estimated in brackets.

2.*, **, ***represent the regression coefficients are significant at the level of 10%,5%and 1%respectively.

The residents of disposable income for lottery sales are negative, the results are shown in Table 4. This paper argues that this is the result of the increasing marginal impact of per capita income on lottery ticket sales in different income levels, and that in areas with high per capita income levels, the gap between the income levels of low-income groups and high-income groups is too large, which leads to a stronger willingness to buy lottery tickets among low-income groups.

Table 5. Results of the regional regression analysis.

	East	Central	West	East	Central	West
Variable	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	FE	FE	FE	FE
inc	1.019**	3.737**	-0.093	-1.013	6.722***	0.004
	(2.22)	(2.62)	(-0.42)	(-0.99)	(3.17)	(0.01)
sg	-6.616***	3.478	0.718	-2.346	5.033*	-0.646
	(-3.31)	(0.63)	(0.26)	(-1.04)	(1.87)	(-0.34)
rinc	1.195**	-2.353	-1.497**	1.159**	-4.193***	-1.645***
	(2.25)	(-1.64)	(-3.07)	(2.36)	(-3.25)	(-2.67)
gdp	0.045	0.270*	0.604***	0.040	0.508***	0.820***
	(0.76)	(2.18)	(9.93)	(0.60)	(3.37)	(4.46)
uinc	-1.522**	-1.809**	0.731***	0.674	-3.972***	0.669**
	(-2.75)	(-2.42)	(5.21)	(0.66)	(-2.77)	(2.12)
upop	9.995***	5.663**	-2.808	8.081***	3.257	-7.388**

	(5.21)	(2.88)	(-1.22)	(3.75)	(1.12)	(-2.11)
mpop	0.007	0.002	0.035**	0.010	-0.010	0.067*
	(0.35)	(0.19)	(2.93)	(0.21)	(-0.19)	(1.74)
Constant	-0.509	-1.008	-0.135	-2.035**	0.618	0.417
	(-0.90)	(-1.78)	(-0.31)	(-2.43)	(0.70)	(0.56)
Observations	96	72	80	96	72	80
Region FE	YES	YES	YES	YES	YES	YES
Time FE	NO	NO	NO	YES	YES	YES
Adj-R^2	0.676	0.684	0.774	0.787	0.855	0.829
F	97.67	49.46	347.4	26.80	31.39	29.01

Note:1.The standard error based on heteroscedastic robustness standard error method is estimated in brackets.

2.*, **, ***represent the regression coefficients are significant at the level of 10%,5%and 1%respectively.

This paper argues that, as China's eastern and central regions the growth of disposable income of residents to promote the increase in lottery sales, and the western region of the level the change in income does not have a significant impact on lottery sales. The results are shown in Table 5. The results of the effect of residents' income on lottery sales in the eastern and western regions are not in line with the results of the national impact, which is explained by the theory of inverted U-shape of Portuguese scholar Kaiseler, indicating that China's lottery market is not saturated, and there exists a significant space for development.

4 Conclusion

This paper measures the lottery preference of residents in each province by establishing a fixed effects model and two stage least square with lottery sales, and studies the impact of disposable income of all residents on the lottery preference of residents in each province of China by utilizing the panel data of 31 provinces in China from 2012 to 2020. The results show that the disposable income of all residents has a significant negative impact on the lottery sales in China, and the impact of the disposable income of all residents on the lottery sales in each province has a contributing role in the increase of lottery sales. The impact of disposable income on lottery sales is heterogeneous due to the differences in income levels, education levels and geographical differences between regions, and the development of the tertiary industry has a facilitating effect on the increase of lottery sales. The overall development of the lottery is in line with the trend of regional economic development, and the purchasing power of low-income groups in regions with high income is strong.

Based on the status quo of China's economic transformation, combined with the advantages of Internet development, optimize the lottery sales channels, reasonably broaden the sales scale, at present China's lottery market has not yet reached saturation, and increase the consumers' recreational channels to promote the expansion of the lottery market, and safeguard the healthy development of the lottery market.

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