

# Relationship Between Population Quantity and Economic Growth in Mountainous Areas of Northern Guangdong

Based on the Empirical Analysis of Urban Panel Data from 2010 to 2017

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**Abstract**—Guangdong Province, as a big economic province in the whole country, has an unbalanced regional economic development. The Pearl River Delta has a large population and a high economic volume, while the mountainous area of northern Guangdong has a small population and a low economic volume. This paper focuses on the relationship between population and economic growth in the mountainous area of northern Guangdong. Based on the fixed effect model of population quantity and economic growth, this paper draws the following conclusions: the effect of population number on economic aggregate is significant in the mountainous area of northern Guangdong, and an increase of 10, 000 people can bring about 1.787 billion yuan of economic growth. In addition, raising the level of human capital and investment in fixed assets can also contribute to economic growth.

**Keywords**—fixed effect model; population growth; economic growth; mountain area of northern Guangdong

## I. INTRODUCTION

According to the data released by the China Statistical Yearbook (the National Bureau of Statistics, 2017), the gross domestic product of Guangdong Province reached 8.085491 trillion yuan in 2016, accounting for 10.86 percent of the country's gross domestic product, and the gross domestic product of Guangdong Province reached 9.477 trillion yuan in 2017. This is Guangdong Province in the country's 31 provinces and cities (excluding Hong Kong, Macao and Taiwan) in a row 28 years of GDP data occupy the first in the country. It is worth noting that although Guangdong, as a big economic province, ranks first in the country's total economic output, there is a big gap between the economic scale and the speed of development among the various regions within the provinces. According to the division of Guangdong statistics bureau, Guangdong Province is divided into four regions, namely the Pearl River Delta, the east wing, the west wing and the mountainous area. "Table I" shows the gross domestic product and population of the four regions in Guangdong Province in 2017. It can be seen that the GDP of the Pearl River Delta region accounts for 79.67 percent of the province's gross domestic product, showing that the economic

development of each region is extremely uneven. Guangdong Province, apart from maintaining the first place in the country for 28 years in a row, its total population reached 109.99 million in 2016, accounting for 7.95 percent of the country's total population, and reaching 111.69 million at the end of 2017, it is the only province with a population of more than 100 million of 31 provinces and municipalities directly under the Central Government. Similarly, the population distribution in Guangdong is still uneven, with more than half of the resident population in the Pearl River Delta region, which has been the fastest-growing region, rising from 1026 people per square kilometer in 2010 to 1094 in 2016. In contrast, the population growth in northern Guangdong is slower. Since the data in Table 1 show that the growth rate of regional GDP is consistent with the growth rate of population, it is the goal of this study to confirm the characteristics of the relationship between population and economic growth.

TABLE I. THE GROSS DOMESTIC PRODUCT OF GUANGDONG PROVINCE IN 2017 AND THE RESIDENT POPULATION TT THE END OF THE YEAR

Region	Regional GDP (100 Million Yuan )	Regional GDP Growth	Population (Ten Thousand People)	Growth Rate of Population
The Pearl River Delta	75809.75	7.9	5998.49	2.11%
The east wing	6431.62	7.2	1735. 58	0.48%
The west wing	7156.88	7.0	1592.46	0.58%
The mountainous area	5756.88	5.6	1672.47	0.51%

<sup>a</sup>. Note: Pearl River Delta area refers to Guangzhou, Shenzhen, Zhuhai, Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing nine cities. East wing refers to Shantou, Shanwei, Chaozhou and Jieyang four cities. West wing refers to Yangjiang, Zhanjiang and Maoming three cities. Mountain area refers to Shaoguan, Heyuan, Meizhou, Qingyuan and Yunfu five cities.

<sup>b</sup>. Source: Guangdong Province Statistical Yearbook (2017)

## II. INFLUENCING FACTORS OF REGIONAL ECONOMIC GROWTH

Economic growth has always been the focus of economic research. Experts and scholars at home and abroad have made extensive research on economic growth from various angles

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and using various methods. Through literature collection, it is found that there are five factors including the growth of labor force, the improvement of labor quality, the quantity of investment in fixed assets, the quality of capital and the development of finance, which is the focus of scholars' research. Their impact on economic growth has been discussed by many scholars, although the conclusions are different, their role in the field of economic development can not be underestimated. Schultz believes that the improvement of human capital, such as knowledge, ability and health, contributes more to economic growth than the increase of material and labor force. However, if the role of raising the level of labor force alone in driving economic growth is limited, without the expansion of the number of labor forces, it will be difficult for social production to expand in terms of total amount, so it will be difficult to achieve substantial economic growth. For economic growth areas, the increase in the number of labor force is its inevitable demand. In the theory of urban economics, urban scale is an important variable affecting economic growth. Urban size is a quantitative concept that measures the size of a city, including urban population size, land use scale, economic scale, and infrastructure scale. These four aspects are interrelated and different from each other, and population is the decisive index to measure the size of the city. This view indirectly confirms the influence of the population quantity change on the economic growth. Through his statistical research on the real estate market, Xu Xianchun and others believe that the rational growth of the real estate economy is of great significance to the healthy development of the national economy, and that too high or too low a growth rate will affect the steady growth of the national economy. Therefore, the real estate economy should maintain a reasonable growth rate. At different levels of financial development, the effect of financial development on economic growth in China is different, showing the nonlinear characteristics of threshold effect and marginal efficiency decline (Yang Youcai, 2014). In addition, Kuznets and other researchers put forward the impact of income inequality on economic growth from the perspective of income distribution. Studies by Lewis (1958), Kaldor (1957) and Pasinetti (1962) suggest that income inequality contributes to the accumulation of wealth among the rich, while the high savings rate of the rich provides sufficient funds for investment, which in turn contributes to economic growth. After 1970, as income inequality appears at the same time as economic growth stagnates, more scholars realize that income inequality will hinder economic growth. The fertility effect, the educational effect (Alesina, 1996) and the social conflict effect (Perotti, 1996) of income inequality all point out that income inequality can restrain economic growth.

### III. MODEL CONSTRUCTION AND INDEX DESIGN

In this paper, the city annual economic aggregate is taken as the explained variable, the annual population quantity, the human capital level, the price level and the fixed asset investment are taken as the explanatory variables, and the effect of the population quantity on the regional economic growth is investigated emphatically. Because the number of samples and time variables in this study is small, and the generalized moment estimation model (GMM) has large

sample characteristics and is suitable for short panel data, this study does not have the data conditions to use GMM model. In addition, the deviation correction least squares virtual variable method (LSDV) is suitable for long panel data, but it requires all explanatory variables to be strictly exogenous. According to the relevant literature on economic growth, we can find that this condition is difficult to meet. Therefore, the fixed effect model is used for parameter estimation in this study. After many statistical analysis tests, the final estimation results of the model are of reference value.

As the geographical location of northern Guangdong is the main factor affecting its population inflow and economic growth, and the geographical location will not change over time, the results of the research and data collection in the reference literature are combined, this study considers the feasibility and rationality of model parameter estimation and hypothesis test, the individual fixed effect model is established in this study.

$$G_{i,t} = \beta_1 P_{i,t} + \beta_2 Edu_{i,t} + \beta_3 Cpi_{i,t} + \beta_4 Inv_{i,t} + u_i + \varepsilon_{it}$$

$$i=1, 2, 3, 4, 5$$

$$t=1, 2, \dots, 8$$

Among them,  $i$  represents different cities,  $t$  represents the year,  $G_{i,t}$  is the gross economic output of the  $i$  city in the  $t$  year,  $P_{i,t}$  is the total population of the  $i$  city in the  $t$  year,  $Edu_{i,t}$  is the level of human capital of the  $i$  city in the  $t$  year,  $Cpi_{i,t}$  is the price level of the  $i$  city in the  $t$  year,  $Inv_{i,t}$  is fixed asset investment of the  $i$  city in the  $t$  year,  $u_i$  represents the regional fixed effect of the  $i$  first city, which does not change with time, and which represents individual heterogeneity.  $\beta_1, \beta_2, \beta_3$  and  $\beta_4$  denote the parameters to be estimated,  $\varepsilon_{it}$  is the perturbation term which varies with individual and time.

According to research on existing relevant Literature in regional economic growth, the literature uses the (GDP) of the region's gross domestic product to denote the gross economic output  $G$ , The regional annual added value of the education industry indicates the level of human capital  $Edu$ , which can reflect the quality of the labor force in the same year in the region; Consumer price index (CPI) indicates price level  $Cpi$ ; The region annual fixed asset investment quantity represents fixed investment  $Inv$ , is used to control the effect of fixed assets investment on economic growth.

### IV. DATA SPECIFICATION

This paper collects economic and social statistics for five cities (Shaoguan, Heyuan, Meizhou, Qingyuan and Yunfu) in northern Guangdong from 2010 to 2017. The data are derived from official public data such as the Statistical Yearbook of Guangdong Province and other cities and the Bulletin of Statistics on National Economic and Social Development issued annually by the Bureau of Statistics of the prefectures and cities. Among them, the GDP is 100 million yuan, the population is 10,000 people, the added value of the education

industry is 100 million yuan, and the fixed assets investment is 100 million yuan.

### V. EMPIRICAL ANALYSIS

In this study, stata15 is used as a statistical analysis tool for parameter estimation and hypothesis testing. First, descriptive statistics of variables are carried out to show the balance of the

data panel and the overall statistical indicators of the data. Secondly, the relationship between regional economic aggregate and population is preliminarily observed by scattered plot. Finally, the fixed effect model is used to estimate the parameters, and the Hausman test is used to verify the validity and consistency of the fixed effect model, and then the weight and significance of each explanatory variable to the explained variable is determined.

TABLE II. VARIABLE DESCRIPTIVE STATISTICAL RESULTS

Variable		Mean	Std. Dev.	Min	Max	Observations	
g	overall	886.4145	271.0133	401.09	1500.9	N =	40
	between		232.534	626.8388	1199.505	n =	5
	within		170.5327	540.2133	1195.113	T =	8
p	overall	329.7568	68.02808	236.29	437.43	N =	40
	between		74.92326	243.4787	431.4125	n =	5
	within		4.67705	320.6555	336.9717	T =	8
edu	overall	39.16675	14.29097	12.12	71.02	N =	40
	between		9.770226	23.56875	49.16375	n =	5
	within		11.22087	14.973	61.023	T =	8
cpi	overall	102.4825	1.181674	101.1	105.6	N =	40
	between		.040117	102.425	102.5375	n =	5
	within		1.181115	101.045	105.6075	T =	8
inv	overall	531.4125	195.1348	195.52	996.9	N =	40
	between		95.19314	417.1787	619.0475	n =	5
	within		175.0494	280.9038	921.0038	T =	8

a. Note: variable refers to variable name; mean refers to mean value; Std.Dev refers to the standard error; min refers to the minimum; Max refers to the maximum; Observations refers to the object of observation.

### VI. MEASUREMENT RESULTS AND ANALYSIS

Run the stata15 command to display the panel data structure, and the results show that the panel data is a balanced panel, in which the number of individuals  $n=5$ , and the time period is  $T=8$ , each individual has the same variable statistics, with a total of 40 observations. The values in "Table II" describe the data statistical characteristics of gross economic volume (g), population size (p), human capital level (edu), inflation rate (cpi) and fixed asset investment (inv). "Fig. 1" shows the time trend map of gross economic volume g, which shows that annual Gdp trends in different cities are similar, with the exception of a small number of annual fluctuations (for example, Qingyuan 2010 and 2011 Gdp), observation of cities are in a steady upward trend for most of the time, to some extent, this time series diagram is helpful to estimate the factors that determine the regional economic growth. "Fig. 2" depicts the trends of the observed cities annual economic aggregates with the population from 2010 to 2017. It can be intuitively seen from the figure that the linear regression method is reasonable in the analysis of the relationship

between the two variables. Moreover, the regression coefficient of population quantity should be positive, that is, the total economic volume increases with the increase of population, and there is a positive correlation between the two.

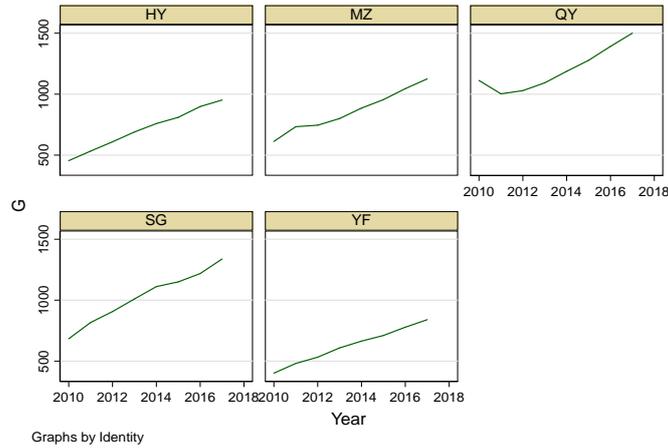


Fig. 1. Temporal trend chart of economic Gross change in five cities in north Guangdong from 2010 to 2017.

a. Note: HY represents Heyuan ; MZ represents Meizhou; QY represents Qingyuan; SG represents Shaoguan; YF represents Yunfu

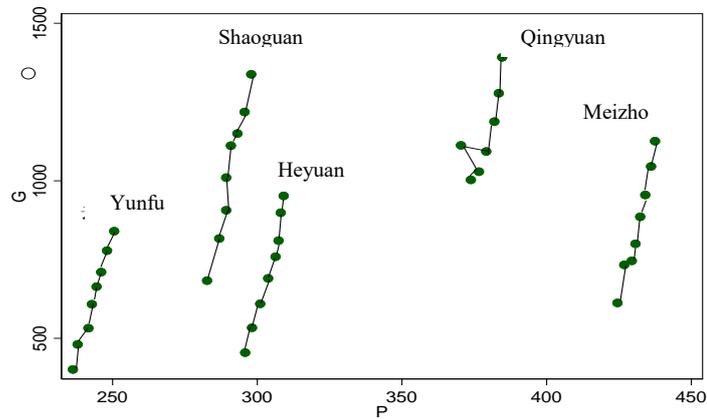


Fig. 2. The scattered point linkage chart of population and economic aggregate of five cities in north Guangdong from 2010 to 2017.

a. Note: P represents the variable "population" and g represents the variable "economic aggregate"

“Table III” shows the results of the fixed effect analysis of the data set,  $R^2=0.95$ , which shows that the model fits well, the test results of F distribution show that  $p=0.0000$ , which indicates that the original hypothesis of  $u_i=0$  can be rejected, thus confirming the existence of individual effect. The number of population, the level of human capital, the investment in fixed assets and the constant term in the variables are significant ( $p = 0.001, 0.009, 0.000$  and  $0.003$  respectively, the results show that it is significant at the

“Table III” also shows the regression results running using the random effect GLS method. The results show that the chi-square test results are significant ( $p < 0.0000$ ), thus rejecting the hypothesis that explanatory variables are not related to individual effects, which indicates that the explanatory variables are related to individual effects, so the individual

significant level of 0.05.)-cons denotes the constant term, which is the average value of all individual effects  $u_i$ . The last row of the table shows " $\rho=0.99$ ", so the variance of the complex perturbation term comes mainly from the variation of individual effects. The results of fixed effect statistical analysis confirm the existence of individual effect, but whether the individual effect is a random effect needs to be tested again.

effects are not random effects. Finally, the Housman test is carried out, which can help to determine whether the fixed effect model or the random effect model is more suitable for this estimation and test. The Housman test in “Table IV” shows that the p value is 0.0000; strongly reject the hypothesis

that the variable and the disturbance are not related, so it is more appropriate to use the fixed effect model.

TABLE III. FIXED EFFECT AND RANDOM EFFECT ANALYSIS RESULTS

Variable	Fixed Effect Model	Random Effect Model
p	<b>0.001***</b> (17.8738)	0.499 (0.2466)
edu	<b>0.009***</b> (5.2973)	<b>0.000***</b> (14.7144)
cpi	0.189 (11.9400)	<b>0.021**</b> (46.0127)
inv	<b>0.000***</b> (0.2932)	<b>0.000***</b> (0.5634)
Sample number	40	40
<b>R<sup>2</sup></b>	within	0.9505
	betwee n	0.2769
	overall	0.2369
rho	0.9989	0

<sup>a</sup>. Note: The numbers in parentheses are coefficients  $\beta_1, \beta_2, \beta_3$  and  $\beta_4$ ; \*, \*\*, \*\*\* represents a significant level of 10% or 5% and 1% respectively.

TABLE IV. HOUSMAN TEST RESULTS

	Coefficients			
	(b) FE	(B) RE	(b-B) Difference	sqrt (diag (V <sub>b</sub> -V <sub>B</sub> )) S.E.
p	17.87379	.2466211	17.62717	12.70106
edu	5.297255	14.71435	-9.417098	4.499552
cpi	11.93999	46.01271	-34.07272	11.6024
inv	.2931734	.5633994	-.270226	.0570624
_cons	-6594.501	-4786.119	-1808.382	4794.241

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{chi2}(3) &= (b-B)' [(V_b - V_B)^{-1}] (b-B) \\ &= 30.18 \\ \text{Prob} > \text{chi2} &= 0.0000 \\ & (V_b - V_B \text{ is not positive definite}) \end{aligned}$$

## VII. CONCLUSION

According to the data analysis results of the fixed effect model, we can observe the effect of each explanatory variable on the economic growth. Obviously, the population size, the level of human capital, the price level, and the fixed assets investment have positive effects on the economic growth. Among them, the effect of population size, human capital level and fixed asset investment on economic growth is significant, but the price level is not significant.

(1)The regression analysis between the two variables of population and economic output in five cities in northern Guangdong shows that the population growth is positively correlated with economic growth, and the population growth

rate is 10,000 for every increase in population, the GDP could be increased by 1.787 billion yuan that year, which indicates that cities in the mountainous areas of northern Guangdong can effectively achieve economic growth by increasing the number of people. The municipal government should attract the young and middle-aged working population to settle and obtain employment through the policy of urban construction and talent incentive. It is beneficial to the regional economy to continue the phenomenon of population dividend. Wang Guixin and Huang Zuyu of the Institute of population Research at Fudan University found: "in the early 1990s, in the urban population growth, the largest scale of regional change growth was found, the migration growth was the smallest, and the natural growth was in the middle, but on the whole the

scale was small, the difference was small. With the deepening of economic reform and the rapid development of cities, the scale of population growth of the three major sources of cities has shown an increasing trend, especially the scale of migration growth has increased rapidly. By 2010, the cumulative contribution of urban migration and growth to the development of urbanization has rapidly increased to 15.24 percentage points, which is close to 56% of the cumulative contribution of urban growth. "This is 4.27 times and 1.80 times as much as the natural growth in the population and the change in administrative divisions in the same period,"

According to the data set of population quantity collected in this study, it can be seen intuitively that the resident population at the end of the year in five cities is increasing steadily, the average growth rate is about 0.5%, and the population growth rate is relatively low. Natural population growth needs to be achieved through government policies to encourage fertility and to improve social and fiscal policies such as maternity insurance and subsidies. At the same time, we still have to improve early childhood education, infrastructure improvement and social security and other aspects to improve public satisfaction. Raising the natural rate of population growth is a big problem, and it has received widespread attention from society and experts. So far, many suggestions have been made, but the actual effect has been very little. The main reason is that the existing policy recommendations cannot reduce people's worries about the security of life after childbirth. Moreover, some urban economic and cultural reasons have led to young people's resistance to fertility, and raising the natural fertility rate requires the government to do more social research. The government should make the encouragement policy from the people's greatest concern, and ensure the policy's landing and implementation. Migration growth refers to the migration of population from other regions to reside and live in this region. The three major economic zones in China (Beijing, Tianjin and Hebei, the Yangtze River Delta and the Pearl River Delta) have a relatively high growth rate of migration, and they are mainly based on factors such as superior geographical location, developed economy, well-equipped infrastructure and abundant job opportunities to attract people from abroad to settle down. The mountainous areas of northern Guangdong have natural geographical and economic development disadvantages, and do not have the innate conditions to attract positive population inflow. Therefore, the government needs to start with all aspects, such as settling down, getting employment and then living, the first is to leave existing talent, the second is to attract more talents, let the foreign population discover the charm and development potential of the city, so as to be willing to settle here and support the local economic development.

(2) The relationship between the level of human capital and economic growth is also a positive correlation, raising the level of human capital can significantly improve the level of economic development. The results of the analysis in "Table III" show that every 100 million yuan increase in the output value of the education industry in the five cities in northern Guangdong can lead to a GDP of 529 million yuan, which indicates that the municipal government should advocate the

investment of youth education funds and private education industry investment so as to improve the level of education for all and the quality of labor force, it has been agreed by experts and scholars that human capital investment can significantly promote economic growth. In some studies, the contribution of the level of human capital to economic growth is even greater than the contribution of the increase in the number of workers to economic growth. It can be seen that efforts to improve the existing level of labor force, attract high-quality foreign labor force, appropriately improve the treatment of middle and senior workers, and enhance the quality of low levels of labor are the focus of government work.

(3) Fixed assets investment is the sum of the completed construction, acquisition of fixed assets and related expenses in the form of money within a certain period of time. According to the results of the model analysis in "Table III", the increase of fixed assets investment can also significantly increase the local economic aggregate, for every 100 million yuan fixed investment increase in five cities in northern Guangdong, the GDP can be increased by 29 million yuan. The main bodies of fixed assets investment are: state-controlled economy investment, foreign investment, Hong Kong, Macao and Taiwan economy and private economy. Fixed asset investment can be invested in three major industries, especially in the real estate industry. However, with the prosperity of the real estate market, more and more regions are beginning to impose restrictions on purchases. Therefore, it is difficult for cities at all levels to promote the development of economic aggregate through real estate investment, so we need to find a new economic growth point. At present, the state encourages innovation and entrepreneurship, and encourages fund holders to invest in real areas where wealth can be created, not only to increase economic growth, but also to increase the competitiveness of cities and countries, as well as the well-being of people's lives. For the five cities in the mountainous areas of northern Guangdong, to optimize the investment structure of fixed assets, it is even more necessary to do their own work to upgrade the level of urban infrastructure, to improve the transportation network facilities, to accelerate urbanization, and to build beautiful villages and so on, which not only can directly realize economic growth, but also can be used to attract migrants to live and work for economic growth.

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