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LOCATION AND ECONOMIC GROWTH: CASE STUDY IN CHINA

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ABSTRACT: This paper explores how location could affect economic growth and it has always been omitted in economic analysis. Geographic factors can affect economic activities. Three mechanisms of location affecting economic growth have been studied: consumption, production and migration. The initial superior location will take such advantages as lower transport costs and lower price level, so it could have higher consumption utility, higher productivity, and attract more human capital, then lead higher growth. Those regions with the superior location will have higher utility due to more product varities and the comparative lower price, and higher wage due to the production technology, and it would attract more individuals with higher human capital to move to this location. It is a kind of agglomeration, meaning the superior location will hold more advantages and higher growth rate, otherwise those locations with poor geographic factor will be even worse. Based on Chinese provincial economic growth experiences of these years, this paper does some empirical analysis by regressing on some variables including the geographic ones. In this paper, the dummy variables and population density are used to measure the location factor. And we find evidences supporting the view that dominant locations such as coastal areas grow faster, on the contrary, middle and western provinces grow slower. Location does affect economic growth.
KEY WORDS: location; economic growth; advantage

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1 INTRODUCTION

Unlike time, which has been prevailed in economic analysis as a way of dynamic analysis, location and space have not yet been put into the mainstream economic analysis. The economists, like MASHALL, had already realized this shortcoming, and believed that geographic factors significantly influence the economic activities. But till now the clear shortcoming is not well removed, which is mainly due to the inner difficulty of setting the geographic factors into economic analysis. And many economists interested in that have made great efforts. Paul KRUGMAN is the best one who is trying to introduce location and space into economics, he believed that it will be the final frontier of economics (KRUGMAN, 1998), and his aim is to make out the subject of economic geography as part of mainstream economics. Since then this field has attracted many researchers: KONRAD *et al.* (2002) studied the residual choice of siblings and the location of family in the economic framework; DONALD and WEINSTEIN (2002) were interested in the distribution of economic activities, and they explored which theory of increasing returns, random growth and location could mostly explain this distribution and the experience of Japan gave some empirical results; EATON and KORTUM (2002) tried to relax the assumption that the country is the same in location and tried to take geographic factors into the trade theory; BOSCHMA and LAMBOOY (1999) explained how the evolutionary economics has been a part of economic geography, especially keywords such as path dependence, convergence, increasing returns and so on. Many papers are trying to make out the choice of location by different agents. GERSBACH and SCHMUTZLER (1999) explored the location choice of innovation activity by firm; KRUGMAN (1991) studied the increasing returns in the economic geography and TROPEANO (2001) believed that information asymmetry might be a source of location choice.

These efforts are worthy to be made, and they make the economic analysis more realistic. It is certain that location affects the economic activities, and now we are interested in this factor in economic growth. These kinds of interest are mainly concerned the agglomeration in economic growth, for example, MARTIN and

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OTTAVIANO (2001) believed that growth and agglomeration is self-reinforcing process. And this paper tries to make out the mechanism that location affects economic growth by some empirical analysis and data of Chinese provincial growth including consumption, production and human capital.

2 MECHANISM OF LOCATION AFFECTING ECONOMIC GROWTH

Agents of households and firms set up the whole economic system, if we limit our analysis on closed economy omitting the government and foreign country. And surely the household as one side they are consumers and on the other hand they are labor suppliers. And the firm hires the labor from the households and combines other inputs as capital to produce the intermediate and the final goods to earn their profits. And there are two regions, numbered as 1 and 2 in the model to be developed in the study. First, different from most studies, we set the hypothesis that the regions are different in initial situations, and without generality we set region 1 is superior to region 2. And we are mainly concerned with the behavior in region 1, and the similar results of region 2 could be got at the same way.

2.1 Consumer's Behavior

Following the location framework by KRUGMAN (1991) and monopolistic competition model by DIXIT and STIGLITZ (1977), we set up the consumer behavior model. The object of the household behavior is to maximize his inter-temporal utility (U) with the formula as follows:

$$U(t)=\mu\times\ln D(t)+(1-\mu)\times\ln Q(t) \quad (1)$$

where $Q(t)$ is the consumption of the common good which could be produced in each region and does not need to be traded, μ is the share of expenditures devoted to $D(t)$, and $D(t)$ is the consumption of composite goods which consist of a number of different varieties, as the model of monopoly competition of DIXIT and STIGLITZ (1977):

$$D(t)=\left[\sum_{i=1}^{n+m} D_i(t)^{1-1/\sigma}\right]^{\sigma/(\sigma-1)} \quad (2)$$

where $n+m$ is the total number of different varieties available in the whole economy (one kind of common good is produced in the two region, and $n+m+1$ kinds of goods are in the whole economic system), n is the number of goods only produced in region 1 and m is that only in region 2, and σ is the elasticity of substitution between varieties. $D_i(t)$ is the consumption of the ith goods.

The total expenditure $C(t)$ equals:

$$C(t)=\sum_{i=1}^{n} P_i(t)\times D_i(t)+\sum_{j=1}^{m} P_j^*(t)\times(1+d)\times D_j(t)+P_Q(t)\times Q(t) \quad (3)$$

where P_i, P_j^* are the production prices of different goods in regions 1 and 2, and P_Q is the price of the common goods; d is the transfer cost between regions, and no transaction costs exist within the same region, and the time variable t will be omitted if not confused in the following text. For simplicity, P_j expresses the consumption price of the goods produced in region 2 but also traded and sold in region 1: $P_j=P_j^*+d$ (where j from 1 to m); and then we could denote $P_0=P_Q$ as the price of the common goods.

Then the total expenditure could be expressed:

$$C=\sum_{i=0}^{n+m} P_i D_i \quad (4)$$

The problem for the representative household is to maximize his total life utility subject to the budget constraint:

$$\underset{C(t)}{\text{Max}}\left\{\int_{t=0}^{\infty} U(C(t))\exp(-\rho\times t)dt\right\}$$

where ρ is the time preference. We could set his budget constraint as simple as:

$$\dot{a}=r\times a+w-C \quad (5)$$

where a is the capital the household owns, w is the wage, and r is the interest rate. $\dot{a}$ is the time pattern of the variable a. From the dynamic optimization by HAMILTON, the consumption is governed by the following equation:

$$g_C=\dot{C}/C=(r-\rho)/\delta \quad (6)$$

where g_C denotes the growth rate of consumption, and δ is the coefficient of the relative risk aversion. And from the static optimization:

$$(\partial U/\partial Q)/(\partial U/\partial D_i)=(P_0\times Q)/(P_i\times D_i)=\mu$$

$$(\partial U/\partial D_i)/(\partial U/\partial D_j)=(P_i\times D_i)/(P_j\times(1+d)\times D_j)=1-1/\sigma$$

And set $P=P_0^{1-\mu}\times\{\sum_{i=1}^{n} P_i^{-\beta}+\sum_{j=1}^{m} P_j^{-\beta}\}^{-\mu/\beta}$, that is the price index. And we are interested in that with the same real wage (w/P), which region will make out higher utility. From the above we know that due to the different transaction costs between regions the price is different except the same kind of goods, and the initial better region, region 1, which produces more varieties of goods ($n>m$) and therefore the consumers in this region will take less transaction costs, which means the price index for them is lower and therefore their budget constraint is softer and they could obtain higher u-

tility. This is the first mechanism that location affects economic activities. It will affect the behavior of consumers. And it could be made clear from intuition, since more goods should be transported from the other places and the price of such goods will be higher and the consumers have to pay more and gain less utilities.

2.2 Firm's Behavior

Different from the usual economic model where there are different sectors with different production functions, we just set the production function (F) as simple as:

$$Y=F(A, K, L)=AK^{\alpha}L^{1-\alpha} \quad (7)$$

where Y is the total output, and A is technology, K is capital, L is labor, α is the share of capital. We take a special form of A:

$$A(t)=\exp(M_0+g(H)\times t) \quad (8)$$

where M_0 expresses the initial situation including the factors of technological progress, geography and others. $g(H)$ is the growth rate of technological process, where H is the human capital as the endogenous growth model shows.

The object of firm is to maximize its profits under the constraint. They will hire labor with different human capital and rent the capital. In the factor of capital there is a common capital market where the interest rate between the two regions are the same, but as far as the labor is concerned they are much more complicated and unrealistic to assume that they are the same. For each location we could solve the interest rate (r) and wage (w) on average:

$$w=\partial F/\partial L=(1-\alpha)AK^{\alpha}L^{1-\alpha}$$
$$r=\partial F/\partial K=\alpha AK^{\alpha-1}L^{1-\alpha}$$

But it is clear that since the factor of initial situation exists, M_0, which means that region 1 is better and may produce more efficiently, and therefore the unit output is higher and it could give higher wage level. If nothing has been changed, such trend will be persisted. But the question is whether it could sustain? Therefore we should make out the behavior of labor markets between the regions.

2.3 Migrant's Behavior

Surely households could make their choice between regions but migration is not free lunch but with costs and it is not easy and equal for all.

The general motivation for migration is that people will be better off while in the better region, but the other motivation is much stronger: the wage differences between regions. Seldom could we see that the wages in different regions are the same whatever the nominal or real one. This could be explained in the production function as the factor of M_0.

For a higher wage and higher utility, under the assumed surroundings as usual economic settings of free entry, all the household will move to the better region. It is not a easy job to simulate the behavior of migrant which is something similar as the search and match process in the labor markets, and these behavior could be just extended by the search and match between different locations. But the locations are not the same and the individuals who search job are also different in characters. Here just assume that the job seeker is the migrant, and as we could know that the individuals who are in the initial poor location will intend to migrate. What we are interested in is which level of location the individual could migrate to.

Suppose the individual with the human capital h_i in the initial poor location firstly has the job in the primary location with the wage w_2. The probability for him to get the new job in the better location is $Pr(h_i)$, where h_i is his own human capital, and $Pr(h_i)$ is increasing with h_i. In the new location if he could get the job then his wage will be w_1, which is higher than w_2. But such a migration will take the cost of z. This agent's choice value (V) could be that:

$$V(w_2(t))=\max(w_2(t), Pr(h_i(t))\times w_1(t)-z) \quad (9)$$

then the Bellman Equation is:

$$V(t)=\max\{w_2(t)/(1-\rho), -C(t)+\rho\times Pr(h_i(t))\times w_1(t)/(1-\rho)+(1-Pr(h_i(t)))\rho^2V(t+1)\} \quad (10)$$

We could see that one with high human capital have the higher probability of getting the job opportunity and then the probability of migrant will be higher too.

Then the initial better location will attract more individuals with higher human capital and this in turn will improve the technological progress and accelerate economic growth rate.

2.4 Some Equilibrium Results

To determine the equilibrium, we have to compare the locations in different markets. One is certain that the interest rate must be equal in the capital market. If the interest rate is different, the capital will move to the location with higher return. The capital market as we observe is almost completely mobile in most of the system (within a nation or around the world), therefore the interest rate should be equal: $r=r^*$

$$r=\partial F/\partial L=A\alpha K^{\alpha-1}L^{1-\alpha}$$
$$r^*=\partial F^*/\partial K^*=A^*\alpha K^{*\alpha-1}L^{*1-\alpha}$$

where * denotes the variable of the poor location in equilibrium.

For the labor market it is usually assumed that the

real wages between locations might be equal, therefore we have:

$$w/P=\partial F/\partial L=(1-\alpha)AK^{\alpha}L^{-\alpha}$$

$$w^{*}/P^{*}=\partial F^{*}/\partial L^{*}=(1-\alpha)A^{*}K^{*\alpha}L^{*-\alpha}$$

But we should be careful of such equilibrium conditions for the labor markets between locations, for the labor markets are further from completeness than that of capital market.

Then we could see that the location with advantage will have higher growth rate due to the higher human capital.

Therefore, three mechanisms are possible for the superior location to take a persistent higher growth rate: consumption optimization between regions, production profits and migration selection of individuals with high human capital. And it is due to the initial conditions, which are from the transfer costs, and they are because of the location and geography.

3 DATA AND EMPIRICAL RESULTS

Now we will verify whether location does influence the economic growth as hypothesized. The samples we choose are Chinese provinces and regions, whose growth rates have been rather different. To measure the location we just use the dummy variable. The coastal regions in China are commonly believed to be the better location, partly due to the natural character such as the costless water and more rain, and partly due to the nearer to the foreign markets, so we set them to be 1 in the location variable, including Beijing, Tianjin, Liaoning, Heilongjiang, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong and Hainan. The inner provinces, usually thought to be in a disadvantage location, are set to be 0.

Another variable about the geographic character, always omitted in economic analysis, is the area of the region. And in this paper we try to do some researches about this variable. The area of one region contains some of the information about the total scale. In economic analysis, economic scale is not the same as the area, and all provinces are not the same size in area. Therefore, the economic scale, which is always denoted by GDP, is not proper to measure the scale. We could see that area of different provinces is different. The largest one, Xinjiang, has the area of 1660.4km^2 and the smallest one, Shanghai, just has that of 6.3405km^2.

To measure the scale of regions we select these variables: gross domestic product (*GDP*), total population (*POP*). And trade (*Trade*) (import and export) is chosen as the control variables to measure its openness. To enlarge the observation we extend the observation years from 1998 to 2001 and then get 124 samples. As we have showed in the variable of area (*AR*), the scale of economy is rather largely different: Guangdong Province has the largest scale of economy and Tibet has the smallest one. The same phenomenon could be found in population variable. If the GDP and population variables are known we could have the variable of GDP per capita, which is to measure the economic efficiency per capita. And the similar variables are able to get: GDP/area (*GA*), which is dividing GDP by the *AR*, to measure the output as GDP from per unit of area; population /area (*PA*), which comes from dividing the total population by the area to measure the population density. And GDP per capita (*PG*) could also be obtained by dividing GDP by population, and the growth rate (g) of *PG* could also be directly got in the data sets. As we have proposed that the differences in most variables among locations are quite large which could be seen not only from the difference from maximum and minimum value but also from the standard deviation, skewness and kurtosis coefficient (Table 1).

Table 1 Summary and descriptive statistics of data

	GDP	*PG*	g	*POP*	*AR*	*GA*	*PA*
Mean	3016.33	0.7903903	9.1000	4037	310.1	47.97	35.898
S.D.	2393.64	0.5190270	1.2028	2587	382.9	121.63	44.378
Max	10647.71	0.5190270	12.8000	9555	1660.4	780.83	364.017
Min	91.18	0.2301476	5.1000	252	6.3	0.07	0.205
Skewness	1.154799	2.1574400	−0.0070	0.45025	2.203117	4.7684	3.46975
Kurtosis	3.865987	8.2034190	4.0940	2.26271	7.147935	25.9033	16.92323

Sources: China Statistical Yearbook, 1998, 1999, 2000, 2001

To measure the growth rate we denoted the variable g as the economic growth rate, calculated at comparable prices, unlike the scale variable *GDP*. At the same time, different locations have different growth rates.

What we intend to make out is whether the location variable affects the economic growth and as a result of long-term growth, the development of locations is related to the location or not. In the simple correlation

analysis most of the variables mentioned above are significantly positively correlated with the dummy variable location. Among them, *PG* is mostly significant and the *Trade* follows, but two variables are negatively correlated, one is total population but not significantly, and the other is the scale of geography, *AR* with significant correlation. But the variable generated from these two variables, *PA*, is positive significantly correlated with location.

While running panel data analysis we could firstly simply regress the development level and the location, the dependent variable is the natural log of *GDP* and the independent variable is just *Location*, but different methods are employed: random effect, fix effect, robust and maximum likelihood estimation. Most of the empirical analysis show that the results from random effect are similar as that of robust and maximum likelihood estimation, while fix effect always shows that variable *Location* is dropped, whose reason may be that *Location* is related to some variables, which are some kinds of the provincial indexes. As in the ln*GDP* regression (Table 2), location could be significantly explained by the variable of *Location*, while adding the variable of population density, both of these geographic variables are significant in explaining the economic scale.

Table 2 Regression results (dependent variable: ln*GDP*)

Variable	Coefficient	*P* value	Standard error
Constant	7.2891160	32.67	0.2231390
	7.0898190	31.36	0.2260578
Location	0.8442888	2.35	0.3586460
	0.4555782	1.24	0.3685730
PA	–	–	–
	0.0097433	3.56	0.0027391

Then we try to explain the GDP per capita. First, just the variable of location is entered, and we could see that location is significant in explaining. Second, we add another variable of population density, and it shows that both of these variables of geography are significant and the power of explaining is improving. Finally, we add the variable of economic system, and the variable we choose is *Trade*, which is always thought to be the important factor in China's economic growth. The result shows that the significance of the geographic variables is decreasing to 15% level. And the variable of *Trade* is significant in the equation (Table 3). The reason is partly due to that the trade is correlated with the location.

As we turn to the growth rate, the dummy variable location shows its power in explaining the growth rate significantly (Table 4). And adding another variable,

Table 3 Regression results (dependent variable: ln*PG*)

Variable	Coefficient	*P* value	Standard error
Constant	-0.7156606	-9.91	0.0722281
	-0.8247047	-14.44	0.0571146
	-3.8447120	-12.49	0.3078442
Location	0.8465434	7.29	0.1160904
	0.6338628	6.70	0.0945453
	0.1609704	1.49	0.1080362
PA	–	–	–
	0.0053310	5.33	0.0010010
	0.0016290	1.55	0.0010510
ln*Trade*	–	–	–
	–	–	–
	0.2603957	9.99	0.0260639

Table 4 Regression results (dependent variable: *g*)

Variable	Coefficient	*P* value	Standard error
Constant	8.6828940	46.10	0.1883549
	8.7387110	25.63	0.3409670
	7.9090630	4.79	1.6519940
Location	1.0775220	3.56	0.3027381
	1.1090410	3.16	0.3513293
	0.7166432	1.66	0.4304925
PA	–	–	–
	-0.0234318	-0.20	0.1173362
	0.0057481	1.42	0.0040586
ln*Trade*	–	–	–
	–	–	–
	0.0552005	0.39	0.1408100

population density, the significance is decreasing but still significant at 2% and the whole equation explained power is increasing. And then adding the variable of trade, it is surprising that this variable lost its significance, just significant at 70%, but the significance of the location is still at 10%.

It is clear that there is a strong relationship between the economic activity and the population activity. The reason is that in the coastal regions the development is far beyond the other regions, at the same time, more people intend to take their job in these regions but these provinces just account for small part of the areas in China. The economic activity almost concentrated on these regions by the advantage of reform and openness and good location near to the foreign markets. The most evident case is Guangdong Province, which is now one of the richest provinces. Guangdong has the natural advantage in location nearest to Hong Kong, and when China firstly decided to take the policy of reform and openness step by step, the central government took the experiments by setting the economic special zones, and four of five zones have been set in Guangdong Province (Hainan Province as a province has been separated dependently). And at that time these zones had taken the

advantage of these policy compared with the strict policies in other regions in China. Among these five economic special zones, Shenzhen is a special case, which is just next to Hong Kong. It is quite fit for our analysis: it has taken the soft policy granted by the government and then it took the most advantage of the policy as a window open to outside, as a result it grows rapidly from a town to a modern city which is among the few most competitive cities as well as Beijing, capital of China, and Shanghai, another municipality under central government. Shenzhen intends to set up their own innovation by attracting much of the intelligent graduates and postgraduates. Besides these special zones Guangdong has taken the advantage of trade and almost turns the production center for Hong Kong and other East Asian market. During these years Guangdong has taken the lead in Chinese economy. And such analysis and conclusion could be extended to the coastal provinces for the reform has taken from Guangdong and Fujian to the coastal regions, and then include most and then all the regions in China.

4 CONCLUSIONS

If a region could take the lead in the technological progress as shown in the production function, it would conquer the disadvantage of its own character of location. But it seems like a troublesome task, after all most of the richest and fastest growing regions are in the advantageous locations. The location seems to be a necessary condition for fast growth. If it has such kind of natural character, the good luck will follow: lower real cost, higher technological level and utility will result in higher production efficiency and higher wage to attract more intelligent individuals to strengthen its ability of innovation, and technological progress and growth. The increasing return and growth bring the process of agglomeration. The empirical analysis based on Chinese provincial economic growth supports the proposition that the coastal regions are advantageous locations and attract more individuals to work in these crowed regions, and the income in these regions keeps a much higher level than that in the central and western regions, at the same time they are growing much faster. No evidence appears that this growth will be revert, on the contrary, they have the more intelligent researchers who are really building the stronger economic growth engine. It is not good news for the regions to conclude that location affects growth, but the current fact shows that location does affect growth and for the economics the geography does affect the economic activities.

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