

## Economic Center of Gravity based on Western Han Dynasty

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**Abstract:** The economic center of gravity is an important historical concept in the historical research. It reflects on the changes of ancient economic development and is of great significance in exploring the economic, political and cultural development of ancient Chinese society. The Han Dynasty inherited the Qin system. As a far-reaching great unification dynasty in Chinese history, the historical status of the Western Han Dynasty is not limited. Based on objective historical facts, this article explores and establishes the economic center of gravity of the Western Han Dynasty using geospatial analysis and quantitative historical techniques. Through the study of the economic center of gravity of the Western Han Dynasty, understand the importance of the economic center of gravity to the economic development of the Western Han Dynasty and its far-reaching impact on the historical process of China.

### Introduction

The Western Han Dynasty, is a great unification dynasty which is spanning more than 200 years in Chinese history, ended the turbulent and divided situation in the last years of the Qin Dynasty. However, the destruction of the war withered the people's livelihood in the early years of the Western Han Dynasty. For this reason, in the early years of the Han Dynasty, they recuperated on policies in order to restore social economy, this loose policy gradually brought the Western Han Dynasty to its heyday. "Historical Records of Cargo Production" contains: "Han Xing, one at home, opening and closing beams, and the prohibition of Chi Shanze, is a world of wealthy businessmen, the transaction is inexhaustible" [1] Live description. The study of the economic center of gravity of the Western Han Dynasty is helpful to understand the political, economic, cultural, and social formations of the Western Han Dynasty, and it can reflect the great changes of the ancient Chinese economic development.

### 1 Exploring the Related Factors of Western Han Economy

The state is a superstructure based on the economy, and it is also closely related to the political environment and historical natural climate of this historical period. This article intends to explore the economic focus of the Western Han Dynasty from three aspects: economic factors, natural environmental factors and historical and political factors.

#### 1.1. The Economic Factors:

In the strict sense, the Qin Dynasty was China's first unified feudal dynasty, and it established many economic systems, including taxes. However, due to the short history of the Qin Dynasty, a systematic economic system was not completely established. It was not until the Western Han Dynasty that a systematic economic system was truly established.

##### 1.1.1 Population

Population is an active factor in economic development. "Hanshu Geography" is the earliest existing national population statistics in China. It records the number of hukou registered in the second year of the Western Han Dynasty, and it is the earliest and most accurate national population

statistics in the world. It is an important document in the Western Han population research.

### **1.1.2 Land**

Land is an important indicator of the level of economic development in the Western Han Dynasty. The Western Han Dynasty adopted a series of measures to ensure the amount of land in each state. Liang Fangzhong's "Statistics on Household Registration, Fields, and Land Fu in Chinese Dynasties" detailed the land acres and average acres in each state and county in the second year of the Western Han Dynasty [3], which is the direct reference basis for the study.

### **1.1.3 Taxation**

Taxation is the foundation of the national economic base, and it performs fiscal, regulatory, and supervisory functions in the national economy. With reference to the research by Zhao Weizhi [4], the taxes in the Western Han Dynasty were divided into Tian Fu, head tax and miscellaneous taxes:

#### **(1) Tian Fu**

Tianfu is a land tax levied by the Western Han government on landowners. The total land harvest ratio is used as the taxation standard, and it is stable at 30%. In addition, a unified assessment standard is given based on the soil conditions in the area, and the taxable amount is calculated (the taxable amount of each household = the actual number of acres of the household × the assessed output of the township × 1/30), and the organization collects taxes.

#### **(2) Head tax**

The head tax in the Western Han Dynasty mainly includes calculation, dictation and contribution.

Counting is a poll tax on adults. Han Gaozu stipulated that "from the 15th to the 56th year of the Republic of China, the money will be paid from one year to the 22nd year." [5].

The head tax imposed on minors is called dictation. Western Han minors generally refer to people in the age group of seven to fourteen. The tax amount is twenty dollars. According to the article "Anthology of Brief Explanations of the Simple Tombs of the Han Tombs in Yinwan" [6], according to the Han Jane unearthed in the Han Tombs in Yinwan, the number of people aged seven to fourteen and fifteen to fifty-six can be deduced as a quantitative calculation And the basis of dictation.

Contributions are a kind of head tax, collected by local officials for the needs of princes' pilgrimage. "Hanshu" contained, "Let the princely kings, the princes often make donations in October, and the counties give their donations at the age of sixty-three." [7]

#### **(3) Miscellaneous taxes**

## **1.2 Natural Factors**

The natural environment is the basis for human existence and development, and does not change with the development of productive forces. Therefore, the natural environment will affect economic development. The influence of the natural environment on human survival in the Western Han Dynasty during the period when the productivity was generally low was decisive.

### **1.2.1 Climate**

The population of the Western Han Dynasty is mainly concentrated in the mid-latitude warm temperate zone. At that time, the densely populated North China Plain, Guanzhong Plain, Nanyang Basin, and Jianghuai Plain were all in the mid-latitude regions of 30-40 degrees north latitude, and belonged to the semi-dry early and semi-humid climate zone in the warm temperate zone.

To the north of 40 degrees north latitude, the climate is cold and dry, which is not conducive to the growth of crops and human life during the Western Han Dynasty, which relied heavily on weather conditions. In the vast area south of the Yangtze River at 30 degrees north latitude, the rivers and lakes are vertical and horizontal, with high temperatures and rain in summer, and it is easy to breed pathogens. Based on the medical conditions at the time, humans struggled to survive.

### **1.2.2 Terrain**

The population of the Western Han Dynasty is mainly concentrated in basins and plains below 400 meters above sea level, and hills and mountains, rivers and lakes in lower elevations, and the population is sparse. The desert area in the west is inaccessible. Terrain restricts human travel and the circulation of means of production.

### 1.2.3 The Soil

From the perspective of soil conditions, good soil conditions have brought about a large population and promoted the circulation and exchange of production materials. The Guanzhong Plain formed by the Weihe River and its tributaries in the seat of the Western Han Dynasty's capital, Changan, the North China Plain and the Huaihe Plain formed by the Yellow River and the Huai River, the Yiluo Plain formed by the Yihe River and the Luohe River, and the Chengdu Plain formed by the Oujiang River and the Oujiang River. The fertile soil in the area was the main farming area and taxation area in the Western Han Dynasty, and gathered a large number of people. Conversely, in areas with poor soil, lack of labor and poor soil restrict economic development.

### 1.2.4 Water Source

Water resources are a necessary condition for human survival. Most of the population is gathered in areas near rivers or lakes for easy access to water and drinking. Most of the above plain areas have rivers passing by, and the abundant water sources greatly facilitate transportation and agricultural production. It fully shows that population distribution has a strong dependence and tendency on rivers [8]. In those places far away from water sources and where water resources are scarce, agricultural production is vulnerable to the threat of early disasters and severely restricts economic development [9].

### 1.3. Political Factors

Socio-political factors in the Western Han Dynasty also affected the economy. For example, the mandatory population migration of rulers, the inward migration of ethnic minorities caused by the war, and the attraction of population to political and cultural centers such as Guanzhong and Heluo. In the early years of the Western Han Dynasty, the population in Guanzhong area was relatively small. Han Gaozu adopted Liu Jing's suggestion. The large number of immigrants has greatly promoted the speed and scale of economic development in the Guanzhong region. At the time of Emperor Wudi, the master uncle wrote: "The world's magnanimous annexation home and the people of the chaos can all migrate to Maoling." [10] was adopted by Wudi. Many migrants in Maoling. In addition, Emperor Wu emigrated to the southeast and northwest regions, which changed the local economic development to a certain extent.

## 2 Center of Gravity Determination

According to the existing literature [11-13], determine the population, average acres, land tax, and head tax of each county, and calculate the tax based on land and head tax. Three types of data, such as population, field, and tax, were selected as factors to determine the center of gravity of the economy, and each factor was normalized for principal component analysis.

The principle of principal component analysis is as follows: the original random vector whose components are correlated by means of an orthogonal transform

$$X = (x_1, x_2, \dots, x_p)^T \quad (1)$$

Into a new random variable whose components are uncorrelated

$$U = (u_1, u_2, \dots, u_p)^T \quad (2)$$

Make it point to the P orthogonal directions where the sample points are scattered most, and then reduce the dimension of the multi-dimensional variable so that it can be converted into a low-dimensional variable with a higher accuracy.

First construct the sample matrix,

$$X = \begin{bmatrix} X_1^T \\ X_2^T \\ \dots \\ X_n^T \end{bmatrix} = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1p} \\ X_{21} & X_{22} & \dots & X_{2p} \\ X_{31} & X_{32} & \dots & X_{3p} \\ X_{n1} & X_{n2} & \dots & X_{np} \end{bmatrix} \quad (3)$$

among them  $x_{ij}$  Represents the value of the j-th variable in the i-th sample data. Next, transform the sample matrix X

$$Y = [y_{ij}]_{n \times p} \quad (4)$$

$$\text{among them } y_{ij} = \begin{cases} x_{ij} & \text{Positive index} \\ -x_{ij} & \text{Contrapositive index} \end{cases} \quad (5)$$

Then normalize the Y to obtain a normalized matrix.

$$Z = \begin{bmatrix} Z_1^T \\ Z_2^T \\ \dots \\ Z_n^T \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} & \dots & Z_{1p} \\ Z_{21} & Z_{22} & \dots & Z_{2p} \\ Z_{31} & Z_{32} & \dots & Z_{3p} \\ Z_{n1} & Z_{n2} & \dots & Z_{np} \end{bmatrix} \quad (6)$$

$$\text{among them } z_{ij} = \frac{y_{ij} - \bar{y}_j}{s_j}, \bar{y}_j, s_j$$

The mean and standard deviation of the j-th column in the Y

respectively

matrix, . Calculate the sample correlation coefficient matrix of the normalized matrix Z

$$R = [r_{ij}]_{p \times p} = \frac{Z^T Z}{n-1} \quad (7)$$

Finding Eigenvalues

$$|R - \lambda I_p| = 0 \quad (8)$$

Solve for p eigenvalues. Determine the decision matrix and establish a weight model.

Based on this, the principal component analysis is performed using SPSS, and the weights of each factor are obtained.

**Table 1** Correlation matrix

		Total population	Average acres	Tax
Correlation	Total population	1.000	1.000	.995
	Average acres	1.000	1.000	.995
	Tax	.995	.995	1.000

From the correlation matrix, the correlation is greater than 0.9, and the principal component analysis method should be used.

**Table 2** Explanation of total variance

Component	Initial eigenvalue			Extract load sum of squares		
	Total	Variance percentage	accumulation %	Total	Variance percentage	accumulation %
1	2.994	99.787	99.787	2.994	99.787	99.787
2	.006	.213	100.000			
3	4.441E-16	1.480E-14	100.000			

From Table 2, the characteristic root corresponding to the first principal component is 2.994, and the cumulative variance contribution rate of the first principal component is 99.787%. Therefore, the first principal component can reflect all the index information.

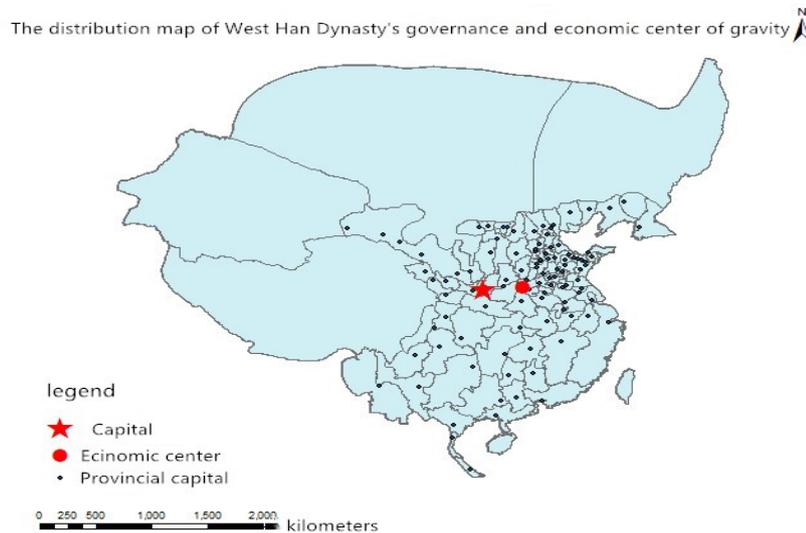
**Table 3** Component score coefficient matrix

	Component
	1
Total population	.334
Average acres	.334
tax	.333

Extraction Method: Principal Component Analysis

From Table 3, it can be seen that the number of the first principal component versus the original load.

Based on the above analysis, the weight of each factor and related index information are obtained, and the data of each factor is added to the attributes of each county. The spatial center of ArcGIS is used to obtain the economic center of gravity of the Western Han Dynasty.



**Figure 1** Distribution of West Han County Governance and Economic Center of Gravity

### 3 result analysis

From Figure 1, under the influence of economic factors, natural factors, and political factors, through quantitative analysis, it is concluded that the economic center of gravity of the Western Han Dynasty is located at the junction of Henan County, Hedong County, Hanoi County, and Hongnong County of the Division: the latitude of the region is moderate, It belongs to the temperate monsoon climate zone. Good hydrothermal conditions are conducive to the growth of crops and human life. The area is located at the intersection of the Guanzhong Plain and the North China Plain. The land is flat and densely populated. Irrigation was a major taxation place in the Western Han Dynasty; the area was adjacent to Chang'an in the west, the Great Plains in the east to the east, the Yellow River

in the north, and the Nanyang Basin in the south, and the Mingmen Wang ethnic group emerged. It was an important talent export place and an active business district in the Western Han Dynasty.

### **Conclusion:**

Based on objective historical facts, this article explores and establishes the economic focus of the Western Han Dynasty through three aspects: natural factors, economic factors, and political factors. The conclusion is that the economic center of gravity of the Western Han Dynasty is located at the junction of Henan County, Hedong County, Hanoi County, and Hongnong County of the Division. In the Western Han Dynasty, the country was unified and its economy developed, which laid a good foundation for its national puppet for more than 200 years. The establishment of the economic center of gravity can reflect the economic situation of the Western Han Dynasty, the pros and cons of the natural climate, and the degree of political enlightenment. At the same time, it can provide a reliable reference for the change of the economic center of gravity throughout the history of China. It has strong historical and practical significance.

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