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Quantitative Analysis of Historical Land Tax Reforms: Assessing Impact on Farmer Revenues in Qing Dynasty China through Mathematical Modeling

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Abstract:

The "Tan Ding Ru Mu" policy, introduced by the Qing Dynasty emperor in 1712, represents a significant administrative reform in tax policy. This policy shifted the tax basis from individual poll taxes to a system based on land or household units. The objective of this paper is to analyze the policy's impact on farmers' annual income and the broader economic shifts that ensued. Traditionally, research on this policy has relied heavily on literary analysis, often lacking empirical evidence. This study seeks to address this gap by constructing a mathematical model to demonstrate the effectiveness of "Tan Ding Ru Mu." Using historical data, the research estimates the revenue changes for farmers post-policy implementation. The data, spanning eight provinces in ancient China from 1724 to 1766, includes variables such as population dynamics, grain prices, and the tax burden on farmers. The findings indicate a decline in the average annual per capita income of farmers across both southern and northern provinces. Rapid population growth led to land saturation, outpacing food production capabilities. Additionally, landlords continued to lease land and used the rent collected from tenant farmers to fulfill tax obligations, ultimately failing to alleviate the farmers' tax burdens.

Keywords:

Tan Ding Ru Mu; Mathematical Model; Tax Policy; Farmers' Revenue.

1. Introduction

The purpose of this paper is to analyze the implication of the policy of "Tan Ding Ru Mu" implemented in Qing Dynasty. Literally, "Tan Ding Ru Mu" means sharing man taxation into fields. Taxation policy always played as a vital part in the ancient governance, keeping strong economic development and stable regime. To specify the improvement of the post-policy, a concise model is proposed focusing on the changes of revenues, from the perspective of the farmers, following by the essential analysis.

As many previous researches and papers indicate, different kind of tax would lead to various kinds of economic growth [1]. This rule is applicable to sharing man taxation into fields as well,which led to a significant and complex change in the society, including the rapid growth of population [2], and consolidating the government's rule by easing class contradiction. At the same time, new problems caused by the policy also arose [3]. It is stated in many papers that sharing man taxation into fields increase the burden of farmers [4]. Nevertheless, these passages solely mentioned the influence of the policy in words and lacked rigorous data. People may find these words confusing or not convincing enough for them to understand the implication of the policy. This paper is written to demonstrate the policy's influence on farmersquantitatively.

Instead of analyzing the policy's impact on farmers revenue by a traditional historical approach,this paper proposes a mathematical model to illustrate the effectiveness of the policy. In the following part, data collected from historical record has been used to estimate the average

revenue of farmers after the policy was implemented. The scope of the data reaches population changes, grain price, and the amount of tax payed by farmers from 8 provinces in China from 1724-1766. And last, some discussions are conducted to demonstrate the changing trends of farmers' revenue in different provinces in China in tables and figures, visualizing the impact of "Ding Tian Ru Mu" and rendering it easier for readers to perceive.

2. Background

2.1. Definition

Land tax in the Qing Dynasty was a combination of two types of taxes: one was man taxation levied on each household's population, and the other was the land tax based on the estimated harvest volume and the land held by each household. Before the 1820s, these two types of taxes were levied separately until Yongzheng, the third emperor of the Qing Dynasty, decided to abolish the man taxation and only levy taxes on each household based on the land [3]. This policy was called "Tan Ding Ru Mu", which means sharing man taxation into fields.

2.2. Origin of the policy

Sharing man taxation into fields was the continuation and development of the "One Lash Method" in the Ming Dynasty and was popularized in all provinces in the early years of Yongzheng.

In the mid-Ming Dynasty, due to the government's excessive collection of levies and natural disasters, the phenomenon of peasants fleeing became more obvious. The situation of "good people escaping, and fields deserted" happened during the Jiajing period, "there were many people from other provinces, few local residents, and escaping people everywhere" in various parts of the country. This circumstance causes the lack of labors and made the industry in the country difficult to be developed. Under the pressure of this situation, the reform of taxation has been put on the agenda. Many bureaucrats believed that the collection of tax determined by population would be a difficult task since population would fluctuate frequently whereas collecting tax determined by the area of land would be easy because the land is stable and would never change. They argue to share man taxation into fields in order to eliminate the flaw of previous policy. In the tenth year of Jiajing, under the auspices of Tao Xie, the land was completely measured and the corvee was spread into the fields. As a content of the "One Lash Method," sharing man taxation into fields first appeared in Ming Dynasty.

In the Yongzheng period in Qing Dynasty, the imperial court enacted the system of sharing man taxation into fields throughout the country.

2.3. Development and implication

The implication of the policy of sharing man taxation into fields was profound and affected various social groups in Qing Dynasty. Some of the most significant impacts on society are listedbelow.

The policy brought lots of improvements to the society. As a reform that conforms to the historical trend, sharing man taxation into fields has certain positive influence. It legally abolished the feudal head tax, which greatly weakened famers' dependency to landlords. In addition, the policy objectively reduces the burden of those who have no land or less land, helping ease class contradictions and consolidate the foundation of governance [4].

However, since the policy of sharing man taxation into fields was branded with feudalism fromthe beginning, it could not fundamentally solve the social problems caused by the defects of feudal society itself.

1) Farmers in some region in China such as Shanxi Province need to pay a larger amount of tax. Because the tax used to pay by population who engage in trading instead of farming was now shared into lands owned by farmers. As a result, farmers need to pay more tax.

2) Many farmers moved to other Province due to natural disaster. However, the official record did not recognize that and the actual population was much lower than that recorded officially. Consequently, farmers are obliged to pay for those who escaped from their original Province [5].

3) Officials in many parts of China impose or increase additional amount of tax without sanction from higher institution, providing farmers with excess burden.

Government in some provinces in China did modifications as they realized the problem brought by this new tax policy. Some adopted the system with least amount of man taxation and then shared it into fields. In some counties where farmers were in severe poverty, head tax that would be shared into lands was abolished completely to decrease the burden for residents.

3. Modeling process

Through the collection of a large amount of data and the construction of a mathematical model, this paper specifically analyzes the impact of the policy of sharing man taxation into fields on farmers. This paper created a mathematical model to calculate the per capita income of farmers. Variables used in the model are shown below in the Table 1.

Table 1 Variables Used in the Model

Symbol	Meaning
P	Population (capita)
A	Agricultural acreage (mu)
T	Tax per year (currency) (tael)
C	Tax per year (cereals) (dan)
B	Total cereals consumed by farmers (dan)
O	Amount of cereals before paying for the tax (dan)
F	Cereal surplus per year (dan)
R	Revenue Surplus per year (tael)
M	Average Revenue per capita per year (tael/capita)

4. Data analysis

4.1. Dataset

The data is from ancient Chinese historical records [6-13], focusing on basic information of eight provinces in China in the year of 1724, 1753, and 1766. This information includes population, agricultural acreage, and other data required in the model stated above.

4.2. Results

1. Therefore, this paper will calculate average revenue per capita per year for Southern and Northern provinces separately.

After plugging the data into the model (2.6), graphs that demonstrate the changing trend of average revenue per capita in eight provinces are shown below.

Table 2 and Table 3 shows the data of southern provinces and northern provinces respectively. And Figure 1 and Figure displays the trend of the average revenue per capita per year (tael/ capita) of southern provinces and northern provinces respectively from 1724 to 1766.

Table 2. Data of Northern Provinces

Region	Year	Population (capita)	Average Revenue per capita per year (tael/capita)
Zhili Province	1724	3,406,843	13.73
	1753	9,374,217	7.45
	1766	16,690,573	0.09
Shanxi Province	1724	1,768,657	16.23
	1753	5,162,351	2.81

	1766	10,468,349	1.81
	1724	2,278,305	32.34
Shandong Province	1753	12,628,987	3.60
	1766	25,634,566	-0.38

Note that average revenue per capita per year in Southern provinces declined. The tables and figures of 3 Northern Provinces are shown below.

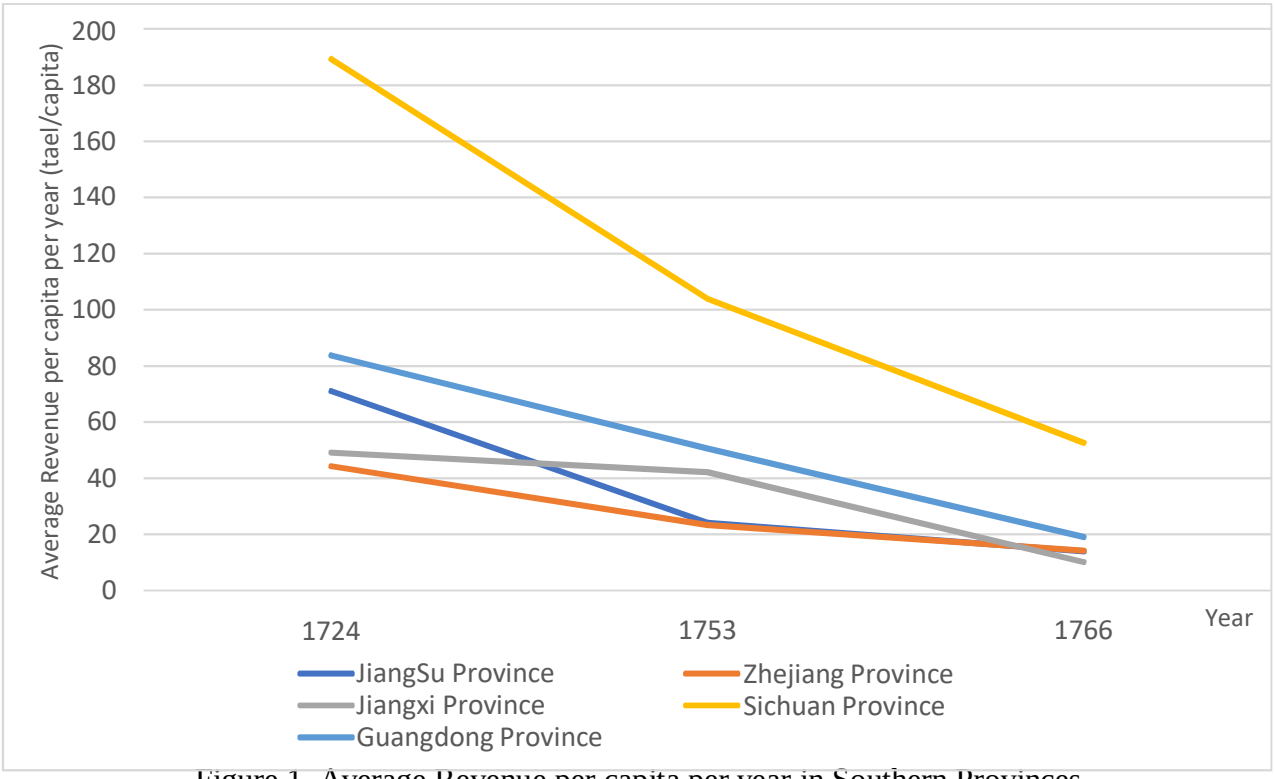

Figure 1. Average Revenue per capita per year in Southern Provinces

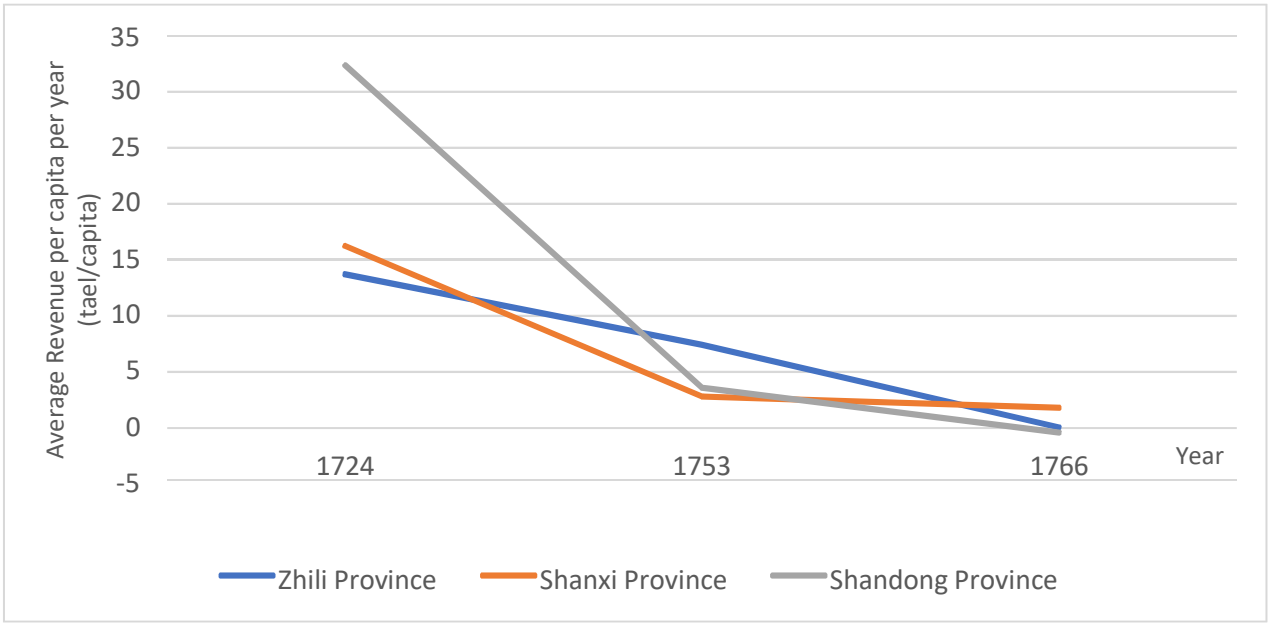

Figure 2. Average Revenue per capita per year in Northern Provinces

Through the figures, it can be clearly seen that the change trend of average revenue per capita per year in both southern and northern provinces decreased, and the decreasing rate of per capita income of some underdeveloped northern provinces was even greater. For the overall population, the policy of "Tan Ding Ru Mu" increased peasants' economic burden in the long run.

5. Conclusion

Regarding the phenomenon that the annual per capita income for farmers declined after the implementation of “Tan Ding Ru Mu", we propose the following explanation.

At the beginning of the policy, the burden on farmers reduced and the freedom of labor increased, this prompted farmers to reclaim a large amount of wasteland and expand their fertility. The population that was concealed by local officials and landlords could also bereported truthfully after the tax was abolished, which led to a substantial increase in the population during the Qianlong period. However, the rapid population growth has made land resources saturated, and the growth of food cannot supply a rapidly rising population. At this time, a large number of farmers will be displaced. Landlords have to rent land again, and they use rent from farmers to pay taxes, and the burden on peasants was again increased. Therefore,the original intention of "Tan Ding Ru Mu" was to solve the conflicts between growing population and limited amount of land in the early Qing Dynasty, to increase national fiscal revenue to a certain extent, prevent local officials from corruption, alleviate social conflicts, and loosen personal dependency, but did not consider the skyrocketing population and the misdeed of local officials. As the results, the policy has led to a decline in the per capita income for farmers.

The main shortcomings of this paper are as follow. First, this article classifies both landlords and tenant farmers, who have significant differences in reality, as agricultural population and treats them in the same way in terms of per capita income. The actual income of landlords should be much higher than the average level. Second, Currency is regarded as a measure of percapita income in the mathematical model, but the value of currency is often affected by the market. Therefore, its value would fluctuate in a small range, and the results proposed by the model may contain errors.

More data from different years and provinces can be adopted, and a mathematical model with more suitable variables and formula calculating the average revenue for farmers can be constructed in future researches to make the results more convincing and accurate.

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