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Empirical Analysis and Factors Influencing the Structural Adjustment of Tea Industry in Enshi

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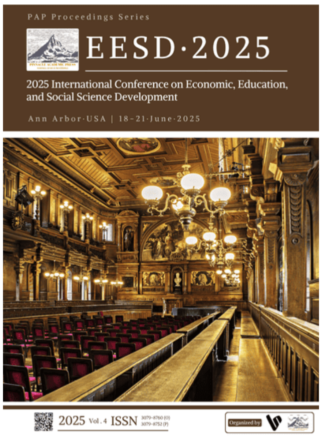

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Abstract: Since the reform and opening up, the tea industry in Enshi region has developed rapidly. The role and status of the Enshi Prefecture tea industry have been significantly enhanced both within the national tea industry and in Hubei Province's rural economy. With the new round of comprehensive adjustment of China's entire agricultural industrial structure and the change of the macroeconomic environment caused by China's entry into a new historical development stage, the development of Enshizhou tea industry is facing new opportunities and challenges. In order to maintain the strong growth momentum, Enshi tea industry needs to further optimize the structure, through strengthening institutional innovation and technological innovation, as well as the development of local tea production to adapt to a people-centered management system, in order to cultivate new growth drivers and promote further sustainable development. This paper is based on relevant data from the tea industry in Enshi Prefecture from 2000 to 2021 to establish a time series model, explore the impact of Enshizhou tea industry on agricultural output value, and finally put forward policy proposals to optimize the tea industry structure in Enshi region from different angles, such as optimized resource allocation and sustainable development.

Keywords: Tea industry; industrial restructuring; Enshi

1. Introduction

China's agricultural industrialization is undergoing a strategic transformation that reflects broader national economic shifts. This transformation is not merely an incremental or adaptive adjustment but a comprehensive, systemic restructuring. It aims to resolve critical issues such as underdeveloped distribution channels and stagnant income growth among farmers, while simultaneously adhering to the principles of sustainable development. Agricultural development must be pursued in alignment with both sector-specific goals and the overarching trajectory of national economic growth. This positions the restructuring of rural economies as a long-term and complex endeavor. Rural restructuring was defined by Woods (2009a) as "the reshaping of social and economic structures in rural areas during the late twentieth century and early twenty-first century produced by various, interconnected processes of change including the declining economic significance of agriculture, the rise of the service sector, urban to rural migration, and so on" [1].

Following nearly five decades of reform, China's agriculture and rural sectors have entered a new phase. The shift from a seller's to a buyer's market for agricultural products signifies that the long-standing scarcity of supply has been fundamentally addressed. As a result, the traditional route of raising farmers' incomes through increased production or higher prices has become increasingly constrained. Simultaneously, the primary bottlenecks for sustainable agricultural development have shifted from natural resource constraints to a broader set of structural and market-based limitations. Recent years have seen worsening issues such as declining product prices, distribution inefficiencies, and slow income growth among rural populations. While these trends reflect increased output, they also underscore persistent imbalances in the structure and quality of agricultural products. Consequently, optimizing the agricultural structure has become essential—not only to meet the increasingly diverse and quality-driven market demand but also to achieve coordinated development in both scale and efficiency.

In January 2001, national policy directives emphasized that the strategic adjustment of the agricultural and rural economic structure should serve as a central focus for the new stage of development. As a traditional economic crop, tea is subject to the same pressures for structural reform in response to these evolving demands. Tea trees originated in southwest China 60 million or 70 million years ago. Written records show that Chinese ancestors had begun drinking tea over 3000 years ago [2].

Over the past two decades, tea production and output value in Enshi Prefecture have increased steadily. The tea industry is the pillar industry of Enshi Prefecture [3]. Structural optimization efforts within the tea industry have made significant progress, leading to noteworthy achievements. China is the world's largest tea producer, with annual output accounting for ~45% of the global total in 2018 [4]. By 2000, tea plantations in Enshi covered approximately 1.29 million hectares, accounting for around 11% of China's total tea cultivation area. The region's tea production reached 101,700 tons, with a total output value of 1.515 billion RMB, placing it at the forefront nationally. The Enshi tea industry serves as a model in several domains, including high-yield mountain tea cultivation, individual household business management, and institutional and cultural innovations in specialty tea production. As a distinctive agricultural sector, China's tea industry involves more than 80 million tea farmers, more than 70,000 tea enterprises and more than 20 tea-producing provinces and autonomous regions. Tea industry is the pillar industry of economic development in many counties in southern China [5].

As China's agricultural industrial structure continues to evolve, the changing patterns of domestic and international market demand necessitate corresponding adjustments in investment and production structures within Enshi's tea sector. To enhance its national and international competitiveness, the region must implement forward-looking structural and policy reforms aligned with long-term development trends.

International scholarship on industrial development and structural transformation predates that of China, offering a rich body of theoretical and empirical studies. This literature has contributed key concepts such as industrial structure optimization, which refers to the reallocation of economic resources to promote coordinated, sustainable development across sectors. Broadly, industrial structure encompasses the composition, proportions, and interrelations among economic sectors, while optimization focuses on improving these configurations to better meet evolving market and development needs.

The prevailing academic discourse tends to approach industrial restructuring from both supply- and demand-side perspectives. Some frameworks have expanded from closed domestic models to more open systems, incorporating international trade and other exogenous factors as key drivers of structural change.

Despite improvements in China's agricultural structure since the onset of reform and opening-up, numerous inefficiencies persist. Current structural contradictions include tensions between short- and long-term interests, misalignments between governmental objectives and farmers' practices, and gaps between market demand and expectations. Furthermore, inconsistencies persist between traditional agricultural methods and modern economic principles [6]. Additionally, energy costs are a critical factor in tea processing, and the level of urbanization is closely tied to the degree of structural optimization in agriculture [7]. Studies also suggest that rational adjustments in agricultural structure can contribute positively to rural incomes and energy efficiency, particularly in underdeveloped western regions.

The agricultural development experiences of other countries, tailored to their respective national contexts, offer valuable reference models that have stood the test of time. Similarly, China must localize general theories of structural optimization in accordance with its own economic conditions and development path. Region-specific and adaptable policy frameworks are necessary to advance key sectors within primary industries, including tea [8].

As China's agriculture transitions into a new historical period, several trends have emerged. The movement from scarcity to surplus and from factor-driven growth to technology- and management-driven productivity has introduced new imperatives for structural realignment [9]. As such, optimizing the agricultural structure has become a prerequisite for satisfying the market's increasing demand for diversified, high-quality products and for ensuring long-term sustainability. Adjusting and optimizing the agricultural structure is an important approach to enhance agricultural sustainability [10].

In this context, tea, as a traditional economic crop in China, is central to this structural transformation. In the past few decades, tea planting areas and production expanded greatly worldwide [11]. In Enshi Prefecture, both the volume and value of tea production have increased steadily in recent years. However, in response to macroeconomic shifts driven by globalization, the structure of demand, along with patterns of investment, product design, and enterprise organization within the tea sector, have all undergone substantial changes. Addressing these transformations is critical to achieving further structural optimization in the regional tea industry.

Enshi enjoys unique advantages in terms of natural resources, cultural heritage, and accumulated experience in tea production. These foundational strengths must be leveraged to facilitate industrial upgrading. Like other major tea-producing regions in China, Enshi benefits from favorable geographic and ecological conditions. The integration of digital technologies, the emergence of the digital economy, and the potential for combining tea production with tourism offer new development opportunities [12].

As one of the world's leading tea-producing nations, China possesses a rich cultural and historical foundation in tea. The tea industry plays an increasingly important role in promoting income growth in mountainous rural areas, supporting regional development, and contributing to the growth of the service sector. Against this backdrop, this study aims to analyze the theoretical foundations of tea industry structure and structural adjustment. Based on panel data from 2000 to 2019, a time-series econometric model is constructed to evaluate the contribution of Enshi's tea industry to agricultural output. Finally, policy recommendations are proposed to guide future industrial optimization in the region.

2. Theoretical Foundation

2.1. Structure of the Tea Industry

The term "structure" refers to the arrangement and interplay of components within a system. Broadly defined, industrial structure encompasses the composition of a national economy, including the proportional distribution of industries and their interrelationships. A more specific interpretation posits that industrial structure denotes the linkages between production factors across or within industries. The tea industry comprises an integrated system of production, processing, and sales. The tea industry has become a significant contributor to the economies of major producing countries such as China, India, Kenya, and Sri Lanka [13]. Market mechanisms serve as the primary driver, connecting producers, processors, and distributors into a shared-interest network. This study adopts the narrow definition of industrial structure, focusing on the relationships among production factors within or between industries, to analyze the tea industry's internal framework, including its product composition and regional distribution.

2.2. Industrial Restructuring

Broad industrial restructuring primarily involves coordinating and optimizing the input of various industrial sectors or intra-sectoral production factors through industrial adjustments. The optimization of structure is fundamentally guided by the input-output ratios and performance metrics across industries or within specific sectors, aiming to foster balanced and sustainable development among different segments of the national economy. This ensures that industrial growth aligns with the overarching trajectory of national economic progress. Accelerating industrial structure optimization has become a necessary strategy for China's sustainable economic development [14]. The industrial structure optimization discussed in this paper specifically refers to adjustments in the input allocation of distinct production factors within relevant industries. Taking this study as an example, when an industry's primary inputs consist of capital, labor, and technology, further development and expansion of scientific and technological inputs can significantly enhance the industry's production efficiency and input-output ratio, thereby achieving sustainable development for the sector.

3. Model Specification and Variable Selection

3.1. Model Specification

In the mid-1950s, the renowned American economist Solow proposed the following model: $Y = F(K, L, t)$

Assume a production function of the form:

$$Q_t = A_t f(L_t, K_t) \quad (1)$$

Where Q_t denotes the total output in period t; L_t represents the labor input in period t; K_t stands for the capital input in period t; and A_t captures the level of technological progress in period t.

The growth rate of total output in period t, G_Q, can be decomposed into contributions from technological progress (G_A), labor growth (G_L), and capital growth (G_K):

$$G_Q = G_A + \alpha G_L + \beta G_K \quad (2)$$

Where α and β denote the output elasticities of labor and capital, respectively.

The economic implication of this equation is that the portion of economic growth not explained by capital and labor contributions referred to as the "residual" is attributed to technological progress:

$$\varepsilon G_A = G_Q - \alpha G_L - \beta G_K \quad (3)$$

This residual can also be expressed as the rate of technological progress:

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \alpha \cdot \frac{\Delta K}{K} - \beta \frac{\Delta L}{L} \quad (4)$$

In this study, we measure agricultural technological progress using the total power of agricultural machinery in Enshi Prefecture, while human capital is proxied by the number of rural employed individuals. To examine the impact of tea production on agricultural output value, we construct the following time-series model:

$$lnY_t = \alpha_0 + \alpha_1 lnX_{1t} + \alpha_2 lnX_{2t} + \alpha_3 lnX_{3it} + \mu_t \quad (5)$$

Here, Y denotes agricultural output value, X_1 denotes tea production, X_2 denotes the total power of agricultural machinery, X_3 denotes the rural labor force, t denotes the time period (2000–2019), and u denotes the random error term. Given the large absolute values and inconsistent units of the data, we apply a logarithmic transformation to all variables to mitigate the effects of time trends and heteroskedasticity on the regression results.

3.2. Variable Selection and Data Sources

As shown in Table 1, this study employs tea production (10,000 tons) in Enshi Prefecture as the explanatory variable, with total agricultural machinery power (kilowatts) and rural employment (10,000 persons) as control variables, and agricultural output value (100 million yuan) in Enshi Prefecture as the explained variable. All data are sourced from the Enshi Statistical Yearbook. Tea production refers to the annual weight of tea produced, encompassing various types including green tea, oolong tea, black tea, dark tea, and white tea in Enshi Prefecture. Total agricultural machinery power represents the aggregate power of machinery primarily used in farming, forestry, animal husbandry, and fishery, serving as an indicator of agricultural production technology. Higher values suggest greater mechanization in agricultural production and processing, leading to improved efficiency in agricultural activities. Rural employment denotes individuals aged 16 and above in rural areas who participate in production and operation activities and earn income, excluding the unemployed and unpaid family workers. Greater rural employment indicates more abundant human resources in rural areas. Table 2 presents descriptive statistics for these four variables, including six indicators: mean, median, maximum, minimum, standard deviation, and sample size.

Table 1. Variable Symbols, Names, Units, and Data Sources.

Symbol	Name	Unit	Data Source
Y	Agricultural Output	100 million yuan	*Enshi Statistical Yearbook*
X_1	Tea Production	10,000 tons	*Enshi Statistical Yearbook*
X_2	Agricultural Machinery Power	kilowatts	*Enshi Statistical Yearbook*
X_3	Rural Employment	10,000 persons	*Enshi Statistical Yearbook*

Table 2. Descriptive Statistics of Variables.

	Y	$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$
Mean	115.626	5.237	1917542	185.6133
Median	118.46	4.285	2196757	183.44
Maximum	172	12.05	2642613	195.23
Minimum	65.64	1.49	814930	179.51
Std. Dev.	36.77327	3.499541	614173.1	5.052966
Observations	15	20	15	15

3.3. Stationarity Tests

Non-stationary variables may lead to spurious regression. Therefore, we conducted stationarity tests on these variables. Using EViews software, we performed Augmented Dickey-Fuller (ADF) tests on the four variables: LnY, LnX_1, LnX_2, and LnX_3. A number of tests for a unit root have been proposed, with the most popular being the Sargan and Bhargava (1983) CRDW test, the Dickey-Fuller (DF) test, the augmented Dickey-Fuller (ADF) test, and the test developed by Phillips and Perron based on the Phillips (1987) Z test [15]. The test results are presented in Table 3.

Table 3. Unit Root Test Results for All Variables.

	ADF test statistics	**Critical Value**			**Stationarity**
		1%	5%	10%	
Ln*Y*	**-1.079110**	-4.004425	-3.098896	-2.694039	non-stationary
LnX_1	0.354561	-3.831511	-3.029970	-2.655194	non-stationary
LnX_2	-4.115566	-4.004425	-3.098896	-2.690439	non-stationary
LnX_3	-1.779712	-4.004425	-3.098896	-2.690439	non-stationary

The test results indicate that the ADF test statistics for all four variables ($\mathrm{Ln}Y$, $\mathrm{Ln}X_1$, $\mathrm{Ln}X_2$, and $\mathrm{Ln}X_3$) exceeded the critical values at the 5% significance level. Therefore, we fail to reject the null hypothesis, concluding that these variables contain unit roots and are non-stationary. After first differencing, some variables remained non-stationary. However, second-order differencing significantly improved stationarity, with all four variables becoming stationary series. The results of the unit root tests after second differencing are shown in Table 4.

Table 4. Unit Root Test Results After Second Differencing.

	ADF test statistics	**Critical Value**			**Stationarity**
		1%	5%	10%	
Ln*Y*	**-5.018052**	-3.920350	-3.065585	-2.673459	stationary
$\mathrm{Ln}X_1$	-6.157536	-3.886751	-3.052169	-2.666593	stationary
$\mathrm{Ln}X_2$	-5.892600	-4.121990	-3.144920	-2.713751	stationary
$\mathrm{Ln}X_3$	-5.022906	-4.121990	-3.144920	-2.713751	stationary

3.4. Cointegration Test

Given that all four variables ($\mathrm{Ln}Y$, $\mathrm{Ln}X_1$, $\mathrm{Ln}X_2$, and $\mathrm{Ln}X_3$) became stationary after second differencing, we examined the potential existence of long-term cointegration relationships among them. We first regressed the explanatory variables on the explained variable, with all regression coefficients showing statistical significance. We then generated the residual series and performed a unit root test on it. The test results are as follows in Table 5:

Table 5. ADF Test Results for Regression Residuals.

	ADF test statistics	Critical Value			Stationarity
		1%	5%	10%	
Ln*Y*	-4.530027	-4.004425	-3.098896	-2.690439	stationary

Since the test statistic (-4.530027) is lower than the critical value at the 5% significance level (-3.5529), we conclude that the residual series is stationary. This indicates the existence of a long-term cointegration relationship among tea production, total agricultural machinery power, rural employment, and agricultural output value in Enshi Prefecture.

4. Analysis of Empirical Results

The regression analysis of the model $LnY_t = \alpha_0 + \alpha_1 LnX_{1t} + \alpha_2 LnX_{2t} + \alpha_3 LnX_{3t} + \mu_t$ yields the following results:

$$lnY = 0.682756999702 * LnX_1 - 0.16890272123 * LnX_2 + 1.3457665835 * LnX_3 - 1.07401965544 \quad (6)$$

$$T = (13.14566) \quad (-1.924089) \quad (2.914398) \quad (-0.645999) \quad (7)$$

$$R^2 = 0.994794 \quad DW = 2.210089 \quad (8)$$

From the regression results above, the R^2 value of 0.994794 indicates a high goodness-of-fit for the model. The p-values of the coefficients for $\mathrm{Ln}X_1$, $\mathrm{Ln}X_2$, and $\mathrm{Ln}X_3$ are statistically significant at the 1%, 10%, and 5% levels, respectively, demonstrating the significance of all three variables in the regression. The impact coefficient of tea production in Enshi Prefecture on agricultural output is 0.682756999702, implying that a 1% increase in tea production leads to a 0.6828% rise in agricultural output. This suggests that tea production significantly influences Enshi's total agricultural output. To further boost agricultural output, Enshi Prefecture should prioritize the development of its tea industry by increasing both tea yield and the value-added of tea products, thereby driving economic growth in the region. The total power of agricultural machinery exhibits a weak negative correlation with agricultural output, with a coefficient of -0.1689, though the relationship is not strong. As a proxy for technological factors, this unexpected result may reflect limitations such as low machinery utilization rates, data constraints, or omitted variables, indicating that agricultural production technology in Enshi may currently have limited effectiveness in boosting output. A possible explanation is the inadequate availability and low utilization rate of agricultural machinery in Enshi, which limits improvements in production and processing efficiency, thereby resulting in an insignificant impact on agricultural output. The coefficient for the rural labor force is 1.3457665835, meaning that a 1% increase in the number of rural workers corresponds to a 1.3458% increase in agricultural output. This highlights the rural labor force as a critical factor influencing agricultural output in Enshi. To stimulate economic growth, the Enshi government could enhance rural infrastructure and implement preferential policies to attract more laborers to return and contribute to rural development.

5. Conclusions and Policy Recommendations

This study examines the impact of tea production on agricultural output in Enshi Prefecture and finds a long-term cointegration relationship between the two. The tea industry has significantly driven local agricultural economic growth. Therefore, the regional authorities should vigorously support the development of the tea sector, strengthen its competitive advantages, optimize its industrial structure, and fully leverage its economic potential to sustain regional economic vitality.

5.1. Strengthening Government Regulation

The market economy principle does not advocate excessive government intervention in the economy, as the market mechanism generally promotes resource allocation efficiency. However, market decisions are characterized by blindness and lag, inevitably leading to overproduction and resource waste. In cases of market failure involving essential goods and public products, reliance solely on the market mechanism cannot prevent monopolies, unfair competition, environmental pollution, or resource waste. In the tea industry, product characteristics determine that economies of scale are not prominent, meaning highly monopolistic situations lacking competition are rare. However, excessive or unfair competition caused by externalities is widespread. Examples include exploitation of brand reputation, such as selling ordinary-quality tea under the Yulu brand or pricing ordinary raw tea higher by leveraging the Lichuan Hong brand effect, as well as irrational land use practices like over-fertilization or overexploitation in pursuit of high yields, all of which are typical cases of negative externalities. Ignoring these harms may lead to "bad money driving out good money," rendering market efficiency mechanisms ineffective. Conversely, correctly understanding and leveraging externalities can create external advantages to serve the development of the tea economy. However, such activities are difficult for businesses or individual operators to undertake independently and require government leadership. The government has a responsibility to exercise macroeconomic regulation and policy formulation. Historical experience shows that relying entirely on the market economy system for comprehensive economic regulation cannot achieve sustainable development or risk mitigation. The global financial crisis and its impacts are key manifestations of the market economy's flaws, while subsequent remedial measures often involve government macroeconomic regulation and policy intervention, further underscoring the importance of policy and development direction formulation as well as government guidance under policy frameworks. Thus, the policy focus for the tea industry should not be restricting large-scale development but rather addressing various externality-related issues by formulating practical solutions to standardize business and individual behavior, enhance market efficiency, and curb unfair competition. On the other hand, for external benefits and public resources, the government should adopt proactive measures to protect and sustainably utilize them, even leading relevant initiatives when necessary to create a favorable external environment for industrial development.

5.2. Institutional and Technological Innovation

In the 21st century, the knowledge economy and knowledge competition have become the norm, and without innovation, there is no future. The further optimization of the tea product structure in Enshi Prefecture relies on the development of new products and brands. The tea research institutions in Enshi Prefecture, benefiting from the concentration of talent, the support of local higher education institutions, and a long history of tea cultivation with rich experience, have conducted numerous technological innovations in tea, demonstrating significant advantages. To promote the transformation of scientific and technological achievements, it is necessary to further coordinate the relationship between research institutions and production enterprises, integrate scientific and technological resources, and ensure that tea enterprises become the main beneficiaries of technological innovation. Specific measures include: first, emphasizing the introduction of scientific and technological talent to enhance enterprises' development and innovation capabilities; second, producers acquiring shares or investing in the purchase of scientific and technological achievements developed by research institutions; third, research institutions undergoing corporate restructuring to improve collaboration and commercialization capabilities.

5.3. Development of New Leading Products

Presently, within the tea product structure of Enshi Prefecture, premium and specialty teas dominate the domestic market, while steamed green tea, black tea, and "new-style teas" produced using diverse processing methods from various regions—distinct from local traditional teas—show potential as emerging export products. Against the backdrop of globalization, targeted measures should be implemented to leverage the prefecture’s geographical advantages, enhance the quality of raw tea materials and processing technologies, and elevate the status of innovative tea products within the product hierarchy. Capitalizing on existing brand reputation and strengths can facilitate the promotion and export of these products, thereby fostering new tea brands. Diversifying the prefecture’s tea offerings is critical to enhancing domestic and international market competitiveness amid rising consumer demand and increasingly segmented markets. China’s tea culture boasts a long history, with each producing region renowned for its distinctive premium teas. Ordinary raw teas (e.g., industrial-grade teas for food flavoring or mass production) no longer hold competitive advantages, and indiscriminate expansion of tea plantations would only lead to extensive, inefficient resource utilization and environmental waste. Thus, developing regionally tailored products that amplify local strengths can create viable growth opportunities, fundamentally improving competitiveness and comparative advantages to attract external investments and achieve structural reforms that drive aggregate growth. Concrete measures include: developing organic teas and tea-based beverages. For instance, since their successful commercialization in the late 1970s, Tea beverages have grown rapidly due to multiple advantages: (1) alignment with industrialized production standards, enabling standardized scaling; (2) fostering cross-sector integration between tea and modern food industries to attract investment; (3) high value-added processing with significant economic returns; and (4) consumption patterns suited to modern lifestyles, offering substantial market potential. Consequently, deep-processed products not only extend the industrial chain and increase value addition but also enhance sectoral linkages and expand developmental prospects for the tea industry.

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