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Study on the Inverted "U" - Shaped Relationship between Macro - Tax Burden and Economic Growth - An Empirical Test Based on Chinese Provincial Panel Data

Yiming Ding*

Business School, East China University of Political Science and Law, Shanghai, 201620, China
**Corresponding Author*

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Abstract: This study employs panel data of China's 31 provincial administrative units over the period 2001–2022 to examine how macro tax burden interacts with economic growth. Taking fiscal spending as the core transmission mechanism, this research applies a two-way fixed-effects model to evaluate the economic impacts of broad-caliber tax burden. The empirical outcomes confirm an inverted U-shaped correlation between macro tax burden and economic growth, which still holds after addressing endogeneity and conducting multiple robustness checks. The estimated optimal tax burden ratio for the whole country falls between 17% and 24%. Furthermore, macro tax burden influences economic development via fiscal spending and industrial restructuring, whereas the transmission role of technological innovation has not been observed yet. In addition, the linkage between tax burden and economic growth presents distinct characteristics across different areas of China.

1. Introduction

The 2008 global financial crisis severely impacted China's economy.To mitigate the economic downturn, China initially adopted structural tax reductions alongside expansive fiscal spending to stimulate aggregate demand and restore high-speed economic growth. As the economic structure gradually evolved, the marginal effect of growth driven by resource expansion and investment declined, and traditional demand-side tax policies could no longer adapt to the new development situation. Against this backdrop, advancing supply-side structural reform and implementing tax reduction and fee relief policies have become crucial for shifting the economy from high-speed growth to high-quality development. As a core instrument of macroeconomic regulation, taxation serves to raise fiscal revenue and optimize resource allocation. Macroeconomic tax burden, a key component of the tax policy system, reflects the interaction between taxation and economic performance. An unreasonable tax burden will generate adverse effects: an excessively low tax burden weakens the government's macro-control capacity and distorts resource allocation, while an excessively high tax burden dampens the enthusiasm of microeconomic entities and inhibits economic growth. Accordingly, this paper mainly explores the relationship between macroeconomic tax burden and economic growth, its transmission channels and regional heterogeneity. Theoretically, different from existing literature, this paper takes fiscal expenditure as the transmission channel of

macro tax burden and conducts empirical tests based on the revenue-expenditure principle of "living within means", which expands the existing research framework. Practically, as China enters a new normal and growth momentum transforms into innovation-driven development, this study provides theoretical support for fiscal and tax reform and high-quality economic development. Furthermore, given the unbalanced regional development across the country, analyzing regional differences can offer references for industrial restructuring and the formulation of preferential tax policies in different regions.

2. Literature Review

Foreign research on macro tax burden and economic growth has a long history and a well-evolved theoretical framework. Adhering to the idea of a free market, classical economics advocated a low-tax regime, holding that excessive tax burdens would discourage capital accumulation and hinder economic development. After the Great Depression in the 1930s, Keynesian economics became the mainstream paradigm. Scholars recognized the regulatory function of fiscal and tax policies, and proposed to cut taxes to stimulate aggregate demand and mitigate economic downturns, which gradually fostered theories regarding the automatic stabilizer effect of taxation and counter-cyclical fiscal regulation. After World War II, academic focus shifted to long-term economic growth. The neoclassical growth theory argued that long-term economic growth is determined by exogenous factors such as technological progress, and taxation only affects output level rather than the steady-state growth rate. By contrast, the Neo-Cambridge School emphasized using taxation to adjust income distribution and consolidate the social foundation for economic development. Later, the endogenous growth theory revised traditional viewpoints, demonstrating that taxation impedes the accumulation of both physical and human capital, thereby generating persistent distortionary effects on economic growth. Faced with the stagflation in Western economies in the 1970s, supply-side economics emerged. Based on the Laffer Curve, this school clarified the correlation among tax rates, fiscal revenue and economic growth, and advocated tax reduction to vitalize aggregate supply. Subsequent theoretical and empirical studies have verified that macro tax burden exerts both positive and negative effects on economic growth, and the two variables present an inverted U-shaped nonlinear relationship, which has become a mainstream consensus in international academia.

Domestic scholars have conducted extensive empirical studies based on China’s economic data. Although minor discrepancies exist due to differences in statistical criteria, datasets and research methodologies, most studies also confirm the above-mentioned nonlinear relationship. Using provincial panel datasets, Liu Changsheng [1] confirmed the existence of an inverted U-shaped correlation between tax rates and economic growth. Jin Ge [2] supported this relationship through theoretical modeling and pointed out that China’s actual macro tax burden has exceeded the optimal level. Fan Qingquan et al. [3] found that productive indirect taxes can promote economic growth and social welfare, and their effects vary alongside market-oriented reforms. Furthermore, Li Yanlong and Qiao Qian [4] revealed that the impact of macro tax burden on economic growth exhibits prominent regional heterogeneity.

Building on existing literature, this paper takes fiscal expenditure as the transmission channel through which macro tax burden affects economic growth, and conducts empirical tests on other potential channels, so as to enrich the existing research framework. Nevertheless, constrained by research capacity, this paper fails to construct a mathematical model and systematically elaborate the internal mechanism linking macro tax burden, fiscal expenditure and economic growth from a theoretical perspective.

3. Theory and Hypotheses

3.1 Macro - tax Burden and Economic Growth: Laffer Curve

According to Laffer's theory, tax revenue changes along an inverted U-shaped curve as tax rates adjust. Revenue will keep growing until tax rates reach the optimal point for revenue maximization. Any tax rate above this threshold falls into the "taxation forbidden zone". Such excessive taxation will curb the expansion of tax sources and create obstacles to economic development. Accordingly, this paper sets forth the first testable hypothesis as follows:

Hypothesis 1: An inverted U-shaped nexus exists between macro tax burden and economic growth.

3.2 Fiscal Expenditure Channel

Regarding the relationship between government fiscal revenue and expenditure, economists have proposed four theories: the "income determines expenditure" hypothesis, that is, changes in fiscal revenue will cause changes in fiscal expenditure; the "expenditure determines income" hypothesis, that is, fiscal expenditure determines fiscal revenue; the "fiscal synchronization" hypothesis, that is, fiscal revenue and expenditure are interdependent and influence each other; the "institutional separation" hypothesis, that is, there is no causal relationship between fiscal revenue and expenditure.

All the above viewpoints have been verified by existing empirical studies. When exploring which theory can explain the revenue-expenditure linkage of China's public finance, academic research has yielded inconsistent or even contradictory results due to differences in sample periods. Drawing on the findings of Feng Qiaobin [5] as well as Lou Yingjun and Yang Yiqun [6], this study holds that China's fiscal operation follows the revenue-driven expenditure hypothesis. In line with mainstream public finance theories, the expansion of government spending is conducive to faster economic growth. Accordingly, we put forward the second research hypothesis:

Hypothesis 2: The macro - tax burden affects economic growth through fiscal expenditure.

3.3 Innovation Channel

Tax policy is widely regarded as a key factor influencing regional innovation capacity and exerts notable effects on corporate research and development. A firm's innovative activities are closely linked to applicable tax rates and tax categories. Using empirical data of 14 European Union member states between 1992 and 1994, Faber et al. [7] confirmed a strong negative correlation between corporate tax burden and innovation output, which is measured by granted patents. Similarly, domestic researchers Lin Zhifan and Liu Shiyuan [8] demonstrated that tax pressure restrains diverse types of corporate R&D and innovative practices.

Nevertheless, Zhang Xi et al. [9] observed that areas with higher macro tax burden tend to generate more innovative achievements. This finding implies that the influence of macro tax burden on innovation may follow an inverted U-shaped curve. Numerous prior studies have also proven that innovation serves as a core engine for sound economic growth. On this basis, we propose the third testable hypothesis:

Hypothesis 3: The macro - tax burden affects economic growth through innovation.

3.4 Industrial Structure Channel

To optimize overall economic structure and shift the economic development pattern, China takes industrial upgrading as a primary task. Tax policy, as an essential macro-regulation instrument, has long been recognized as a vital factor shaping industrial distribution. Luo and Luo [10] indicated that

a sound tax burden framework is beneficial to industrial optimization. Empirical evidence from Yang Zhi'an and Qiu Guoqing [11] reveals a non-linear inverted U-shaped relationship between macro tax burden and industrial structure improvement.

The correlation between industrial changes and economic growth has sparked two mainstream academic arguments. Followers of Kuznets maintain that aggregate economic growth brings about adjustments across various industrial sectors. On the contrary, Rostow and his supporters propose that industrial restructuring is the fundamental engine propelling overall economic growth. Most Chinese scholars share the view that industrial transformation can effectively fuel national economic growth. Using the Granger causality method, Zhu Huiming and Han Yuqi [12] proved the positive role of industrial adjustment in economic expansion. Jiang Zhensheng and Zhou Yingzhang [13] drew the same conclusion via cointegration analysis and variance decomposition, proving that industrial variation exerts a strong influence on economic growth. Accordingly, we establish the fourth research hypothesis:

Hypothesis 4: The macro - tax burden affects economic growth through the industrial structure channel.

4. Research Design

4.1 Model Setting

On the basis of the research of Yang Guangli and Sun Huiqing [14], this paper sets up the following econometric model:

$$EGL_{it}=\alpha+\theta_1 TAX_{it}+\theta_2 TAX^2_{it}+\sum_{j=1}^{n}\beta_j X_{jit}+\mu_i+\lambda_t+\varepsilon_{it} \quad (1)$$

Among them, EGL_{it} is the economic growth level of province (autonomous region or municipality directly under the Central Government) i in year t. TAX_{it} is the macro - tax burden level of province i in year t. In order to test the possible inverted "U" - shaped relationship between the macro - tax burden and economic growth, the quadratic term of the macro - tax burden level of province i in year t, that is, TAX^2_{it}, is added to the model. $\sum_{j=1}^{n}\beta_j X_{jit}$ is a series of control variables concerned in this paper. Since there are many factors affecting a country's economic growth, in addition to the macro - tax burden we are most concerned about and other control variables that have been included, there are also other possible influencing factors that cannot be fully observed. Therefore, this paper uses a two - way fixed - effects panel model for estimation. μ_i and λ_t represent the province fixed effect and the year fixed effect respectively. ε_{it} represents the random disturbance term.

4.2 Variable Selection and Data Source

4.2.1 Explained Variable

This paper selects the growth rate of per capita real regional GDP of each province (autonomous region and municipality directly under the Central Government) in China to measure the economic growth level (EGL). The data on per capita regional GDP comes from the National Bureau of Statistics, and the per capita real regional GDP with 2000 as the base period is calculated through the regional GDP index.

4.2.2 Core Explanatory Variables

The core explanatory variables in this paper are the macro - tax burden level (TAX) of each province (autonomous region and municipality directly under the Central Government) and its

quadratic term TAX^2). Referring to the research of An Tifu and Yue Shumin [15], it is measured by the large - caliber macro - tax burden and the small - caliber macro - tax burden. The macro - tax burden data comes from the National Bureau of Statistics. The small - caliber macro - tax burden is the ratio of the total tax revenue of local governments to the regional GDP of the current year, and the large - caliber macro - tax burden is the ratio of the sum of local government tax revenue, fiscal revenue, and other revenue to the regional GDP of the current year.

4.2.3 Control Variables

Referring to prior studies conducted by Li Tao et al. [16], Zhao Jianchao et al. [17] and Yao Qiuge et al. [18], this paper selects a set of control variables as follows. Foreign direct investment (FDI) is calculated as the share of local FDI in regional GDP. Human capital level (HCL) refers to the percentage of enrolled university students in the total regional population. Infrastructure level (IFL) is represented by highway density, with the unit of km/km ². Trade openness (OPEN) is defined as the ratio of total regional imports and exports to local GDP. Urbanization level (URBAN) equals the proportion of urban residents in the total population. Financial development level (FDL) is measured by the contribution of the financial sector to regional GDP. All datasets for these control variables are sourced from the National Bureau of Statistics of China. Table 1 presents the descriptive statistics of all variables involved in this research.

Table 1: Descriptive Statistics of Variables

Variable	Observations	Mean	Standard Deviation	Minimum	Median	Maximum
EGL	651	0.10	0.03	-0.05	0.10	0.20
TAX	651	0.12	0.05	0.04	0.12	0.35
TAX^2	651	0.02	0.01	0.00	0.01	0.12
FDI	651	0.58	2.24	0.05	0.25	44.91
HCL	651	0.02	0.01	0.00	0.02	0.04
IFL	651	0.76	0.50	0.03	0.69	2.25
OPEN	651	0.29	0.33	0.01	0.15	1.66
URBAN	651	0.52	0.16	0.21	0.52	0.90
FDL	651	0.06	0.03	0.01	0.05	0.20

Data source: National Bureau of Statistics, Statistics Bureaus of autonomous regions and municipalities directly under the Central Government

5. Empirical Analysis

This study adopts panel data covering China's 31 provincial-level administrative regions over the period 2001–2022 and applies a two-way fixed-effects model to examine how macro tax burden influences economic growth. To guarantee credible regression outcomes, we carry out multiple robustness checks and adopt the instrumental variable approach to address endogeneity. In addition, this paper further explores the transmission mechanism of macro tax burden and its heterogeneous impacts across different areas.

5.1 Baseline Regression Results

The baseline regression results of the model are shown in Table 2. Column (1) only introduces the first - order term of the macro - tax burden for regression, and the coefficient is positive but not significant. Column (2) introduces the quadratic term of the macro - tax burden on the basis of column (1). The results show that the coefficient of the first - order term is significantly positive, and the

coefficient of the quadratic term is significantly negative, indicating that the inverted "U" - shaped relationship between the macro - tax burden and economic growth is established. After introducing control variables in column (3), the signs and significance of the first - order and quadratic terms of the macro - tax burden have not changed, indicating that the inverted "U" - shaped relationship between the macro - tax burden and economic growth is robust, and Hypothesis 1 is preliminarily verified. According to the regression results in column (3), the optimal macro - tax burden level is about 24%.

Table 2: Baseline Regression Results

Variable	(1)	(2)	(3)
TAX	0.131	0.605	0.550
	(1.592)	(3.834)	(3.380)
TAX^2		-1.326	-1.129
		(-4.438)	(-3.051)
Control Variables	NO	NO	YES
Province Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
N	651	651	651
Within R2	0.784	0.795	0.799

Note: Values in parentheses are t - values and indicate significance at the 1%, 5%, and 10% levels respectively. The same below.

5.2 Robustness Tests

5.2.1 Subsample Regression

Since the National Bureau of Statistics did not report the year - end urban population data of various places from 2000 to 2004, this paper obtained the corresponding data from the local statistics bureaus for improvement. However, to prevent the impact of statistical errors and missing value imputation on the estimation results, this paper uses the data from 2005 to 2021 as a sample to estimate the model. The corresponding regression outcomes are displayed in Column (1) of Table 3. The linear coefficient is significantly positive, while the quadratic coefficient presents a significantly negative value. In this case, the optimal macro tax burden rises to 27%, which proves the robustness of the inverted U-shaped linkage between macro tax burden and economic growth.

5.2.2 Replacement of Control Variables

In order to prevent the impact of errors caused by the inconsistency between the location of the operating unit and the domestic destination and source of goods when calculating the total import and export volume on the estimation results, the trade openness (OPEN2) calculated by using the total import and export volume defined by the location of the operating unit as the standard is used to replace the trade openness (OPEN) calculated by using the total import and export volume defined by the domestic destination and source of goods as the standard to estimate the model. The regression results are shown in column (2) of Table 3. The signs and significance of the first - order and quadratic terms have not changed, and the optimal macro - tax burden level is still 24%, indicating that the baseline regression results are robust.

5.2.3 Replacement of Core Explanatory Variables

Broad-caliber macro tax burden merely reflects the overall tax pressure of the national economy and cannot fully reflect the government's fiscal status and revenue capacity. By contrast, narrow-caliber macro tax burden serves as a more appropriate indicator to measure governmental fiscal strength . In this study, we adopt the linear term (STAX) and quadratic term ($STAX^2$) of narrow-caliber tax burden to substitute the original broad-caliber indicators (TAX and TAX^2) for model re-estimation. The relevant outcomes are presented in Column (3) of Table 3.On the basis of this variable replacement, we also carry out the subsample regression and control variable replacement mentioned earlier, with results displayed in Columns (4) and (5) of Table 3. The estimation outcomes reveal that the linear coefficients remain significantly positive while the quadratic coefficients are significantly negative under the narrow-caliber standard. The inverted U-shaped correlation between tax burden and economic growth still exists, and the optimal tax burden fluctuates between 11% and 15%. This outcome confirms the reliability of the baseline regression results.

To sum up, the inverted U-shaped linkage between macro tax burden and economic growth is statistically significant across subsample tests and variable replacement tests, which further validates Hypothesis 1.

Table 3: Robustness Tests

Variable	(1)	(2)	(3)	(4)	(5)
TAX	0.627	0.565			
	(4.489)	(3.469)			
TAX^2	-1.158	-1.177			
	(-3.222)	(-3.164)			
STAX			0.713	0.820	0.736
			(2.635)	(3.026)	(2.661)
$STAX^2$			-3.167	-2.851	-3.289
			(-2.995)	(-2.095)	(-3.044)
OPEN	0.009		0.007	0.005	
	(1.256)		(0.714)	(0.591)	
OPEN2		0.004			0.004
		(0.302)			(0.353)
Other Control Variables	YES	YES	YES	YES	YES
Province Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
N	527	651	651	527	651
Within R2	0.836	0.799	0.792	0.826	0.791

5.3 Endogeneity Issues

Economic conditions shape tax revenues, while tax policies also exert influences on economic operations. To be specific, the scale, pace, quality and structural features of economic growth will determine the overall tax volume, growth trend and tax composition. As a core macroeconomic regulation tool, taxation also generates extensive impacts across economic sectors. The mutual causal interaction between macro tax burden and economic growth gives rise to endogeneity in the empirical model.

Though the two-way fixed-effects model and multiple robustness checks have alleviated part of the endogeneity bias, we further adopt the instrumental variable method to acquire more precise

regression coefficients. This study takes the geographic distance from each provincial capital to Beijing as the instrumental variable. This indicator is closely linked to local fiscal conditions and affects regional economy mainly via fiscal channels, which satisfies the correlation and exclusion restrictions for valid instruments. The distance data is sourced from the shared dataset of Feng Dongfa et al. [19].Given that geographic distance is a time-invariant indicator, we create two types of time-varying instrumental variables. First, following Liu Xiuyan et al. [20], we construct an interaction term between distance and the reciprocal of the exchange rate. The regression results in Column (1) of Table 4 show a significantly positive linear coefficient and a significantly negative quadratic coefficient, with the optimal macro tax burden calculated at 19%. The inverted U-shaped relationship remains solid. Second, referring to Acemoglu et al. [21], we combine distance with a time dummy variable to build another interaction term. The outcomes in Column (2) of Table 4 prove the persistence of the inverted U-shaped pattern, and the corresponding optimal tax burden stands at 20%.We also employ the first-order and second-order lagged terms of macro tax burden as additional instrumental variables, with results presented in Columns (3) and (4) of Table 4. The inverted U-shaped nexus is still observable, and the optimal tax burden reaches 20% and 17% respectively. All instrumental variables pass the underidentification test and weak instrument test, which verifies the reliability of baseline regression results.

Overall, this paper applies four instrumental variables to address model endogeneity. The inverted U-shaped correlation between macro tax burden and economic growth is statistically significant in all tests, which fully validates Hypothesis 1.

Table 4: Instrumental Variable Regression Results

Variable	(1)	(2)	(3)	(4)
TAX	3.328	1.266	0.621	0.887
	(3.408)	(4.354)	(4.383)	(2.677)
TAX^2	-8.560	-3.143	-1.545	-2.597
	(-3.585)	(-3.954)	(-3.724)	(-2.381)
Control Variables	YES	YES	YES	YES
Province Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
N	651	651	651	620
Within R2	0.557	0.799	0.816	0.807
KP-LM Statistic	10.285	54.682	12.121	10.365
15% Critical Value	4.58	42.23	4.58	4.58
Endogeneity Test Statistic	35.391	5.591	5.033	8.267

5.4 Mechanism Test

In order to study the possible mechanisms through which the macro - tax burden affects economic growth, this paper tests three possible channels: fiscal expenditure, innovation, and industrial structure. The regional fiscal expenditure (GOV) is measured by the proportion of local general budget expenditure to regional GDP. The regression results with fiscal expenditure as the channel variable for the macro - tax burden affecting economic growth are shown in column (1) of Table 5. The inverted "U" - shaped effect of the macro - tax burden on fiscal expenditure is very significant, indicating that the macro - tax burden indeed acts on economic growth through fiscal expenditure, and Hypothesis 2 is verified. Referring to the practice of Chen Jin et al. [22], the regional innovation level (INNOVATION) is measured by the logarithm of the number of domestic patent applications accepted in each region. Column (2) of Table 5 shows the regression results with innovation as the channel variable. Although the macro - tax burden shows an inverted "U" - shaped relationship with

innovation, it is not significant, indicating that the macro - tax burden has not yet acted on economic growth through innovation, and Hypothesis 3 cannot be verified. Referring to the method of Yuan Yijun and Xie Ronghui [23], the regional industrial structure (STRUCTURE) is measured by the proportion of the sum of the output values of the secondary and tertiary industries in each region to the regional GDP. The regression results with the industrial structure as the channel variable are shown in column (3) of Table 5. Although the inverted "U" - shaped effect of the macro - tax burden on the industrial structure is very significant, the effect of the macro - tax burden acting on economic growth through the industrial structure is confirmed, and Hypothesis 4 is verified. The data of the channel variables all come from the National Bureau of Statistics.

Table 5: Mechanism Test Results

Variable	(1)	(2)	(3)
	GOV	INNOVATION	STRUCTURE
TAX	2.777	7.547	0.900
	(3.553)	(1.552)	(2.703)
TAX^2	-4.814	-18.073	-2.082
	(-2.611)	(-1.317)	(-2.415)
Control Variables	YES	YES	YES
Province Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
N	651	651	651
Within R2	0.771	0.944	0.671

5.5 Heterogeneity Analysis

To further examine the regional heterogeneity of macro tax burden's impact on economic growth, we split the full sample into Eastern, Central and Western China in line with the classification criteria issued by the National Bureau of Statistics and conduct grouped regressions. The corresponding outcomes are presented in Columns (1) to (3) of Table 6. The inverted U-shaped influence of tax burden is statistically insignificant in Central and Western areas, while this nonlinear correlation is only valid for the Eastern region. Given that ethnic minority autonomous regions enjoy higher fiscal autonomy, this study further divides the sample into autonomous and non-autonomous regions based on the Statistical Table of Administrative Divisions of the People's Republic of China, so as to compare the regional disparities in tax burden effects. The regression results are reported in Columns (4) and (5) of Table 6. The inverted U-shaped relationship is highly significant in non-autonomous regions. Although a similar nonlinear trend can be observed in ethnic autonomous regions, it fails to reach the conventional significance level.

Table 6: Heterogeneity Analysis

Variable	(1)	(2)	(3)	(4)	(5)
	Western	Central	Eastern	Non-autonomous Regions	AutonomousRegions
TAX	-0.104	0.721	0.807	0.632	0.969
	(-0.179)	(1.143)	(4.820)	(3.209)	(0.883)
TAX^2	0.464	-3.111	-1.504	-1.196	-3.097
	(0.241)	(-2.006)	(-4.372)	(-3.011)	(-0.900)
Control Variables	YES	YES	YES	YES	YES
Province Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
N	252	168	231	546	105
Within R2	0.794	0.824	0.883	0.823	0.795

6. Conclusions

The empirical results confirm the existence of an inverted U-shaped link between macro tax burden and economic growth, and this finding stays reliable after addressing endogeneity and conducting various robustness checks. Generally speaking, the optimal interval of macro tax burden is calculated at 17% to 24%. Fiscal spending and industrial restructuring act as two major transmission paths for tax burden to influence economic development, whereas innovation has not yet become an effective intermediary.In terms of regional differences, the inverted U-shaped correlation is statistically significant in Eastern China, while such a relationship cannot be validated in Central and Western areas. Besides, this nonlinear pattern holds true for non-ethnic autonomous regions, but it shows no statistical significance in ethnic minority autonomous regions.

References

[1] Liu, C. S. (2009). The internal influence mechanism of taxation and fiscal expenditure policies on macroeconomic operation: An analysis based on provincial panel data of China[J]. Journal of Public Management, 6(3), 47-54.

[2] Jin, G. (2010). Optimal taxation and public expenditure structure in economic growth[J]. Economic Research Journal, 11, 35-47.

[3] Fan, Q. Q., & Zhou, X. H. (2016). Changes of tax structure in the process of marketization[J]. The Journal of Quantitative & Technical Economics, 4, 21-39.

[4] Li, Y. L., & Qiao, Q. (2019). Macroeconomic tax burden, industrial structure and economic growth[J]. China Soft Science, (6).

[5] Feng, Q. B. (2003). Living within revenue or living within expenditure: On government financial management philosophy[J]. Fiscal Research, (7), 6-9.

[6] Lou, Y. J., & Yang, Y. Q. (2004). An empirical study on China's fiscal revenue and expenditure principles from 1978 to 2002: Living within revenue or living within expenditure[J]. Henan Social Sciences, (6), 57-59, 70.

[7] Faber, J., & Hesen, A. B. (2004). Innovation capabilities of European nations: Cross-national analyses of patents and sales of product innovations[J]. Research Policy, 33(2), 193-207.

[8] Lin, Z. F., & Liu, S. Y. (2017). Tax burden and corporate R&D innovation: Empirical evidence from World Bank Chinese enterprise survey data[J]. Fiscal Research, (2), 98-112.

[9] Zhang, X., Luo, N. S., & Peng, Y. (2014). Tax arrangement and regional innovation: An empirical study based on provincial panel data of China[J]. Economic Geography, 34(9), 33-39.

[10] Luo, F. Z., & Luo, N. S. (2016). How does tax burden affect industrial structure adjustment? Discussion based on tax burden hierarchy and scale[J]. Industrial Economics Research, (1), 20-29.

[11] Yang, Z. A., & Qiu, G. Q. (2019). Research on the impact of structural tax reduction on industrial structure optimization: An empirical test based on provincial panel data of China[J]. Soft Science, 33(4), 21-24, 39.

[12] Zhu, H. M., & Han, Y. Q. (2003). Empirical analysis on the relationship between industrial structure and economic growth[J]. Operations Research and Management Science, (4), 68-72.

[13] Jiang, Z. S., & Zhou, Y. Z. (2002). The effect of industrial structure change on economic growth: Empirical analysis and policy implications for China[J]. Collected Essays on Finance and Economics, (5), 1-6.

[14] Yang, G. L., & Sun, H. Q. (2020). Research on the relationship between macro tax burden and economic growth: Also on the effect of tax reduction and fee reduction policies under the COVID-19 pandemic[J]. Price: Theory & Practice, (8), 84-87.

[15] An, T. F., & Yue, S. M. (1999). Analysis, judgment and adjustment of China's macro tax burden level[J]. Economic Research Journal, (3), 43-49.

[16] Li, T., Huang, C. C., & Zhou, Y. A. (2011). Taxation, tax competition and China's economic growth[J]. The World Economy, 34(4), 22-41.

[17] Zhao, J. C., Zhao, C. P., & Peng, Z. J. (2014). Measurement of the financial industry's contribution to economic growth and a comparison between China and the United States[J]. Financial Regulation Research, (4), 72-86.

[18] Yao, Q. G., Sun, J. S., & Huang, K. (2020). Tax structure, government expenditure and economic growth[J]. Shanghai Journal of Economics, (3), 49-61.

[19] Feng, D. F., Zhang, T., Li, A., & Gong, R. N. (2023). Parameter estimation and application of heterogeneous spatial stochastic frontier model[J]. Statistical Research, 40(1), 144-156.

[20] Liu, X. Y., Li, S. L., & Chen, Z. Y. (2017). Polycentric spatial development model and regional income gap[J]. China Industrial Economics, (10), 25-43.

[21] Acemoglu, D., Johnson, S., & Robinson, J. A. (2005). The rise of Europe: Atlantic trade, institutional change and

economic growth[J]. American Economic Review, 95(3), 546-579.
[22] Chen, J., Chen, Y. F., & Yu, F. Z. (2007). The impact of FDI on regional innovation capacity in China[J]. Science Research Management, (1), 7-13. https://doi.org/10.19571/j.cnki.1000-2995.2007.01.002
[23] Yuan, Y. J., & Xie, R. H. (2014). Research on the industrial restructuring effect of environmental regulation: An empirical test based on China's provincial panel data[J]. China Industrial Economics, (8), 57-69.