Study on Causes of Differences in Tax Burden of Value-Added Tax from the Perspective of Industrial Linkage

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It is of great practical significance to analyze the differences of actual tax burden value-added tax (VAT) from the perspective of industrial linkage for accelerating the construction of a modern industrial system and promoting the formation of a new development pattern. This paper explains the differences and causes of the actual VAT tax burden in the manufacturing industry from the perspective of industrial linkage. According to the research results, the closer the intermediate input connection between an industry and other industries, the lower the actual VAT tax burden it bears. The characteristics of production network have a moderating effect on the relationship between the linkage of the manufacturing industries and the actual VAT tax burden. For the industries in the center of the production network, a stable backward linkage weakens the influence of industrial linkage on their actual tax burden. It is difficult for industries located in the spillover block to reduce their tax burden by adjusting the linkage of intermediate goods. In addition, highly linked manufacturing enterprises can also reduce their actual VAT tax burden by tax avoidance, tax shifting, adjusting the types of intermediate inputs and so on. Smoothing the domestic production network of the manufacturing industry and optimizing the VAT burden bearing mechanism of each manufacturing sub-industry will help promote the stable growth of the manufacturing industry and healthy development of the macro economy in China.

Keywords: actual tax burden of VAT, manufacturing industry, industrial linkage, production network Introduction

1. Introduction

As a key component of the real economy, the manufacturing industry is the "ballast

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stone" and "stabilizer" of the national economy (Zheng and Zhang, 2022). The high-quality development of the manufacturing industry largely depends on the rational use of economic regulation and control policies, especially fiscal and tax policies. How to use proactive fiscal and tax policies to better serve the transformation and upgrading of the manufacturing industry and stable economic growth is not only the top priority to improve the resilience and integrity of the industrial chain, but also a key link to accelerate the improvement of the modern fiscal and tax system and improve the national governance capacity. During the accelerated construction of a new development pattern, the linkage among various industries in the domestic circulation will become increasingly close. In order to avoid industry hollowing and over-service, and improve the balance and coordination of industrial development, it is necessary to incorporate fiscal and tax policies of the manufacturing industry into the overall optimization of the industrial system and the economic system, and grasp the laws and characteristics of the input-output flow among industries. For example, in the fiscal and tax policy system, the reform of the VAT system is the focus of policy adjustment, which reflects the typical characteristics of the combination of micro-policies to stimulate the market vitality and structural policies to smooth the economic circulation.

Since the official imposition of VAT in China in 1994, the difference in the actual tax burden of VAT in industries has remained controversial (Wang *et al*., 2022). In fact, the core of the VAT system reform is to keep VAT revenue neutral. For example, the "VAT transformation" expands the scope of input tax deduction and further promotes enterprises to increase fixed asset investment (Ma *et al*., 2019); the "replacement of business tax with VAT" optimizes the VAT deduction chain (Li and Yan, 2018) and helps improve the specialized division of labor among industries (Fan and Peng, 2017). However, the "VAT transformation" and "replacement of business tax with VAT" focus on reducing the actual tax burden of VAT in the industry on the whole, and do not make a full explanation of the tax burden difference, causes and structural characteristics of the industry. In order to create a fairer tax environment, scholars proposed to simplify and consolidate the VAT tax rates tiers (Fang *et al*., 2022), so as to reduce the differences in tax deduction among enterprises in the industry. In addition, implementing structural tax reduction policies can reduce the distortion of social welfare levels (Ni, 2021).

As for the difference in the VAT tax burden in China's manufacturing industry, most domestic scholars explained the causes from the perspective of the VAT system (Chen, 2013; Ni *et al*., 2020). The specific reasons can be classified into three categories as follows. 1. A non-single tax rate system is used, such as multiple tax rates; 2. The VAT deduction scope is limited. For example, under the production-oriented VAT system, enterprises that are highly dependent on fixed assets for production activities can obtain small amount of input tax deduction; 3. The VAT deduction is incomplete. Before the "replacement of business tax with VAT", the VAT deduction chain between the

manufacturing and service industries was discontinuous, which led to high VAT paid by manufacturing enterprises relying heavily on intermediate inputs from the service industry. In addition, the intervention of local governments is also an important factor affecting the actual tax burden of enterprise VAT. For example, the fluctuation in the VAT share ratio leads to changes in the tax collection intensity of local governments (Chen, 2017).

Some literatures study the difference of the actual tax burden from the perspective of enterprise heterogeneity. For example, Saez (2002) conducted a study on early commodity tax and believed that the consumer preference heterogeneity or corporate product heterogeneity led to different commodity tax rates among enterprises. Yin *et al*. (2021) discussed the scale of excess VAT burdens for Chinese manufacturing enterprises from the perspective of enterprise productivity heterogeneity and product heterogeneity, and regarded the distribution of comprehensive heterogeneity as an important factor leading to different excess VAT burdens of various industries. Compared with the above studies, this paper highlights the influence of the input-output correlation among manufacturing industries on the actual VAT tax burden of different industries from the perspective of industrial linkage, and further considers the moderating effect brought by the production network characteristics of various industries, so as to further explain the causes of the difference in the actual VAT tax burden of manufacturing enterprises in China.

In general, there have been abundant studies on the causes of the distortion of VAT tax burden in the manufacturing industry, but most of them were carried out around the manufacturing industry as a whole. With the gradual formation of the domestic circulation and the deepening of specialized division of labor, it is increasingly important to analyze the tax burden issue from the perspective of industrial linkage. This paper holds that the VAT deduction mechanism will be of greater significance if the difference in the VAT tax burden of the manufacturing industry is discussed from the perspective of industrial linkage. According to the principle of VAT deduction, the VAT payable is the difference between the output tax and the input tax, in which the output tax and input tax are respectively the product of sales and purchases and the corresponding VAT rate, which contains the supply-demand relationship or input-output correlation among industries. Therefore, explaining the difference of the actual VAT tax burden in the manufacturing industry from the perspective of industrial linkage reflects the linkage between the input-output correlation and the actual VAT tax burden among industries, and provides a new way of thinking to solve the distortion of the VAT tax burden in the manufacturing industry.

Based on the existing studies, this paper first discusses the practical characteristics of the actual VAT tax burden in the manufacturing industry in China and the input-output correlation among industries, and on that basis, empirically tests the effect of

industrial linkage on the actual tax burden of VAT, and considers the moderating effect of production network characteristics in the industry. It also conducts mechanism tests from the aspects of enterprise tax avoidance, tax shifting ability and substitution elasticity of intermediate inputs, and puts forward policy suggestions at the end to provide a realistic basis for optimizing VAT tax policies supporting the development of the real economy, and offer policy implications for building a modern VAT tax system and promoting the transformation and upgrading of the manufacturing industry.

2. Institutional Background and Cause Analysis

2.1. Characteristics and Causes of the Actual VAT Tax Burden in Manufacturing Industry

Based on the national tax survey data from 2007 to 2014, this paper calculates the actual VAT tax burden of manufacturing enterprises in China, and plots a diagram of the actual VAT tax burden of 15 manufacturing sub-industries. Based on Figure 1, this paper will analyze the characteristics of actual VAT tax burden in the manufacturing industry in China from two aspects: tax burden in the industry and tax burden differences among the sub-industries.

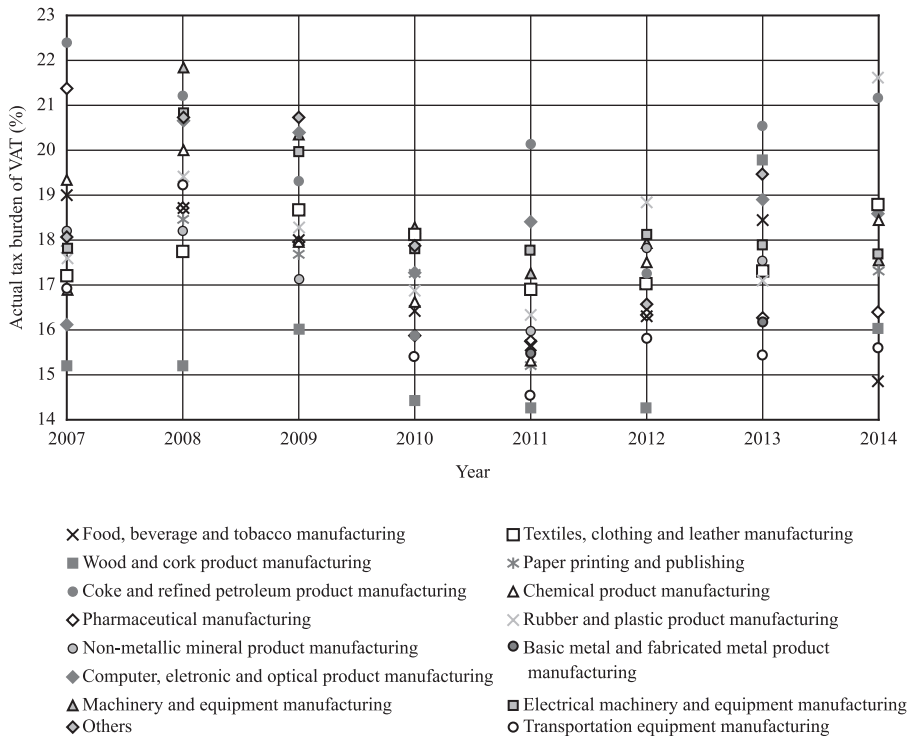

Figure 1. Actual Tax Burden of VAT in Manufacturing Industries in China from 2007 to 2014

On the one hand, the overall VAT tax burden of the manufacturing industry was relatively high before 2010 for the following reasons: First, the reform of tax sharing system in 1994 led to insufficient local financial resources, and the reform of income tax sharing in 2002 further aggravated the local fiscal shortage (Liu, 2018), so local governments were motivated to strengthen the VAT tax supervision (Chen, 2017); Second, the production-based VAT implemented before 2009 resulted in the limited scope of enterprise input tax deduction; Third, tax collection and administration projects such as Golden Tax Project I and Golden Tax Project II strengthened the standardization of VAT invoice management, and the level of VAT tax burden was enhanced (Fan *et al*., 2018). Since 2009, with the introduction of policy measures such as "VAT transformation" and "replacement of business tax with VAT", the tax burden on manufacturing enterprises has eased. Meanwhile, the increase in the share proportion of VAT divided to local governmets is conducive to promoting local governments to implement tax incentives for manufacturing enterprises to drive the development of regional industries (Liu and Mao, 2019).

On the other hand, the distribution of actual VAT tax burden in manufacturing sub-industries is relatively discrete, indicating that there are obvious differences in the actual tax burden borne by sub-industries. The causes of the difference in VAT tax burden among manufacturing sub-industries are complicated. For example, China's VAT collection and management system faces the problem of differential VAT rates represented by multi-level tax rates and preferential tax rates, and the VAT deduction chain is short and incomplete in some sub-industries. Since 2011, the problem of tax differences among manufacturing sub-industries has eased. One reason is that a series of VAT reforms implemented in China since 2008 have achieved remarkable results. For example, the "VAT transformation" has transformed production-based VAT to consumption-based VAT, expanded the scope of enterprise input tax deduction, and the "replacement of business tax with VAT" has opened up the VAT deduction chain of manufacturing and service industries, and promoted tax fairness to a large extent. It should be emphasized that although the difference in VAT tax burden among different manufacturing sub-industries is shrinking in China, there are still tax distortions among the sub-industries, and the resulting imbalance has become a restricting factor for the high-quality development of China's manufacturing industry and economy.

2.2. Characteristics and Causes of Industrial Linkage in Manufacturing Industry

With reference to the research of Fan and Peng (2017), this paper calculates the linkage between 15 manufacturing sub-industries in China and the industries that provide intermediate inputs for them from 2007 to 2014, and formulates the trend chart of the changes in industrial linkage.

According to Figure 2, the industrial linkage of China's manufacturing industry shows an obvious upward trend overall, indicating that the input-output correlation between manufacturing sub-industries is becoming closer, and the advantages of vertical specialized division of labor are gradually emerging. In addition, the industrial linkage of the manufacturing industry has obvious hierarchical characteristics in China. The industries with a linkage degree higher than 25% are mostly technology intensive, and the industries with a linkage degree lower than 25% are mostly labor intensive or resource intensive. The reason is that under the vertical specialized division of labor system, the intermediate goods required by the manufacturing sub-industries are more dependent on external purchases rather than production in the industry. The value chain of technology-intensive industries is long, and there are many kinds and large quantities of outsourced intermediate goods, hence the backward linkage between such industries and other industries are closer. In contrast, the value chain of production activities in labor-intensive industries is short, and the characteristics of specialized division of labor are not obvious, thus the industrial linkage is low.

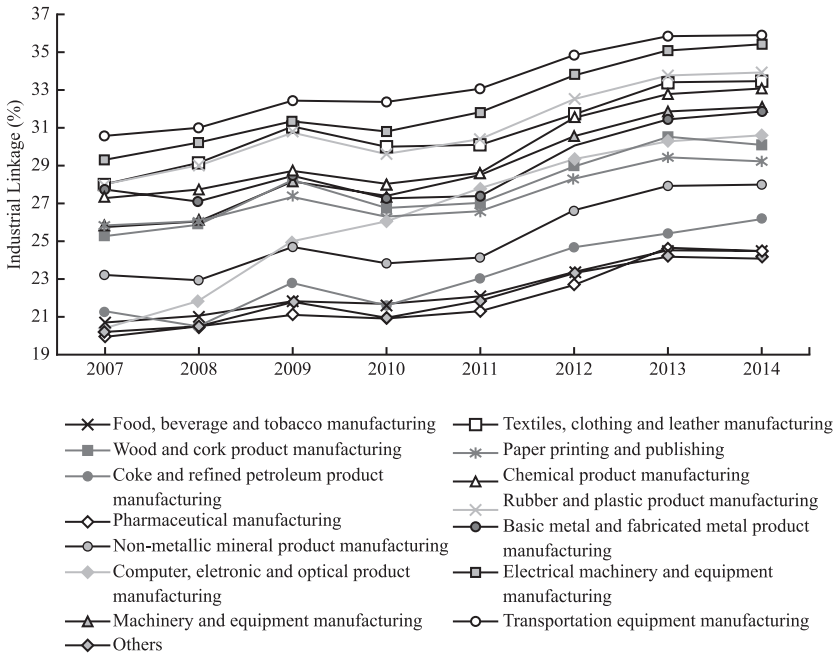

Figure 2. Linkage of Manufacturing Sub-Industries in China from 2007 to 2014

3.1. Data Source, Variable Selection and Model Setting

In terms of data sources, enterprise-related data come from the National Tax

Survey Database, industry-related data come from the World Input-Output Database (WIOD), and regional data come from the CEInet Statistics Database. Considering the availability of data, this paper selects the data of manufacturing enterprises from 2007 to 2014 as research samples.[1] Taking manufacturing enterprises as the research object is to exclude as much as possible the influence of the "replacement of business tax with VAT" on the research results. With reference to the international standard industry classification and the industry classification and codes of the national economy in China, this paper selects 15 manufacturing sub-industries for research: food, beverage and tobacco manufacturing, textiles, clothing and leather manufacturing, wood and cork product manufacturing, paper printing and publishing, coke and refined petroleum product manufacturing, chemical product manufacturing, pharmaceutical manufacturing, rubber and plastic product manufacturing, non-metallic mineral product manufacturing, basic metal and fabricated metal product manufacturing, computer, electronic and optical product manufacturing, electrical machinery and equipment manufacturing, machinery and equipment manufacturing, transportation equipment manufacturing and others.

This paper deals with the data as follows: (1) Exclude all non-manufacturing enterprises, and select continuous enterprise samples existing between 2007 and 2014 as research objects from the retained manufacturing enterprise samples; (2) Exclude samples where major variables are severely missing; (3) Exclude samples where value-added of enterprises, operating income and total assets at the end of the period are zero; (4) Exclude samples where total assets of the enterprise at the end of the period and VAT paid are negative; (5) Carry out 1% winsorize for the major variables. Considering that balanced panel data can well ensure the continuity and comparability of samples, and avoid the impact of the entry or exit of some enterprises within the sample interval on the empirical results, this paper finally selects the balanced panel data of 5,204 manufacturing enterprises from 2007 to 2014 for empirical analysis.

3.2. Variable Selection and Calculation

3.2.1. Actual Tax Burden of VAT

This paper takes the actual VAT tax burden borne by manufacturing enterprises as the explained variable. In existing literatures, the effective tax rate of VAT is usually used to represent the actual VAT tax burden of enterprises (Ni *et al*., 2020), namely,

[1] Since the data of the national tax survey include the enterprise tax data from 2007 to 2015, and WIOD includes the world input-output table from 2000 to 2014, this paper chooses 2007–2014 as the sample interval.

$$Taxburden_{ijt} = \frac{Tax_{ijt}}{Va_{ijt}} \quad (1)$$

Wherein, $Taxburden_{ijt}$ refers to the effective tax rate of VAT of enterprise i in industry j in year t; Tax_{ijt} refers to the value-added tax paid by enterprise i in industry j; Va_{ijt} refers to the value-added of enterprise i in industry j.

3.2.2. Industrial Linkage (*Indulink*)

With reference to the research of Fan and Peng (2017), this paper takes the complete consumption coefficient of each industry as the weight to calculate the weighted VAT rate at the industry level, and takes it as the proxy variable of the industrial linkage index. The calculation formula is as below:

$$Indulink_{jt} = \sum_{k=1}^{n} VAT_{kt} \times Input_{kjt} \quad (2)$$

Wherein, k, j both refer to the industry, and $Indulink_{jt}$ refers to the weighted VAT rate of industry j, that is, the industrial linkage index; VAT_{kt} refers to the statutory tax rate of VAT of intermediate goods industry k related to industry j; $Input_{kjt}$ refers to the complete consumption coefficient of to intermediate goods industry k required by one unit production in industry j; n refers to the number of intermediate goods industries.

3.2.3. Control Variable (*Control*)

Referring to the research of Richardson and Lanis (2007), this paper takes enterprise size (*Size*), return on assets (*Roa*), inventory intensity (*Inveintensity*), capital intensity (*Capintensity*), asset-liability ratio (*Lev*), etc. as enterprise-level control variables, and selects per capita GDP growth rate (*Pgdp*), industrial structure (*Industr*) and other variables to control regional factors. Based on the research of Tian *et al*. (2020), this paper uses the proportion of the value added of the primary industry in GDP and the proportion of the value added of the secondary industry in GDP to represent the industrial structure.

3.3. Model Setting

In order to study the influence of industrial linkage on the actual VAT tax burden of enterprises in the manufacturing industry, this paper builds an econometric model, as

shown in Equation (3).

$$Taxburden_{ijt} = \alpha_0 + \alpha_1 Indulink_{jt} + \sum_{m=2}^{n} \alpha_m Control_{mijt} + \mu_i + \delta_t + \varepsilon_{ijt} \quad (3)$$

Wherein, i refers to enterprise, j refers to industry (j=1, 2, ……,15), and t refers to year (t=2007, 2008, ……, 2014). $Taxburden_{ijt}$ refers to the actual VAT tax burden of manufacturing enterprises; $Indulink_{jt}$ is the industrial linkage of the manufacturing industry; $Control_{mijt}$ is the control variable; μ_i refers to individual effect; and δ_t refers to time effect.

4. Analysis of Benchmark Regression Results

4.1. Benchmark Regression Results

Table 1 shows the benchmark regression results of the influence of manufacturing industry linkage on the actual VAT tax burden. According to Table 1, the influence coefficient of the industry linkage on the actual VAT tax burden of enterprises is significantly negative. This indicates that the closer the intermediate input connection between an industry and other industries, the lower the actual VAT tax burden it bears. From the perspective of demand for intermediate goods, if a certain industry has a high degree of linkage with other industries, it means that there are close intermediate goods transactions between the industry and other industries. The quantity of intermediate inputs from other industries is large, and the demand for products from other industries is obvious. According to the principle of VAT deduction, enterprises in this industry will obtain a larger amount of VAT invoice for input tax deduction, thereby reducing the actual tax burden. At the level of intermediate production structure, if there is a strong linkage between intermediate inputs in an industry, it indicates that there are many kinds of intermediate inputs required for production and the share is large. The products produced by enterprises in this industry are generally characterized by a low content of value added. Considering that VAT is based on the value added, the smaller the share of value added is, the lighter the VAT burden the enterprise will bear. Therefore, enterprises actually pay lower VAT in an industry that is closely linked with other industries.

Table 1. Benchmark Regression Results of the Influence of Industrial Linkage on Actual VAT Tax Burden

Variables	(1)	(2)	(3)
	Taxburden		
Indulink	−0.165*	−0.172*	−0.159*
	(0.095)	(0.095)	(0.095)

Variables	(1)	(2)	(3)
		Taxburden	
Size		−0.019***	−0.018***
		(0.002)	(0.002)
Roa		−0.063***	−0.063***
		(0.009)	(0.009)
Inveintensity		−0.083***	−0.083***
		(0.009)	(0.009)
Lev		0.004	0.004
		(0.003)	(0.003)
Capintensity		−0.011	−0.011
		(0.008)	(0.008)
Pgdp			0.161**
			(0.066)
Industra			0.372**
			(0.152)
Industri			0.121**
			(0.048)
Individual effect	Control	Control	Control
Time effect	Control	Control	Control
N	41632	41631	41631
R2	0.010	0.015	0.015

Note: ***, **, * represent the significance at 1%, 5% and 10% respectively. The numbers in parentheses are standard errors. Since the constant term is not the focus of the analysis in this paper, this result is not included in the table. The same below.

4.2. Robustness Test

In order to ensure the reliability of research conclusions, this paper conducts a number of robustness tests, including changing the research samples, changing the measurement method of the actual VAT tax burden, changing the calculation method for the industrial linkage, and excluding other policy interference.[1] The results show that industrial linkage has a significant negative influence on the actual VAT tax burden of enterprises, and the benchmark regression results are robust.

4.3. Heterogeneity Analysis

This paper groups the sample data by region, industry factor intensity and enterprise

[1] Due to space constraints, the robustness test results are not provided in the paper, which can be requested from the author if necessary.

ownership type, and compares and analyzes the estimated results and the influential effect of different groups. The results of heterogeneity analysis are shown in Table 2.

Table 2. Results of Heterogeneity Analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Regional Heterogeneity			Industry Heterogeneity			Ownership Type Heterogeneity	
	Eastern region	Central region	Western region	Labor intensive	Capital intensive	Technology intensive	State-owned enterprise	Non-state-owned enterprise
Indulink	−0.174*	−0.899***	−0.378	0.864	−0.365	−0.459***	−0.011	−0.167*
	(0.100)	(0.326)	(0.317)	(0.542)	(0.366)	(0.116)	(0.469)	(0.097)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual effect	Control	Control	Control	Control	Control	Control	Control	Control
Time effect	Control	Control	Control	Control	Control	Control	Control	Control
N	31346	5216	4968	8080	11216	22335	1832	39799
R^2	0.018	0.018	0.013	0.012	0.020	0.018	0.020	0.016

4.3.1. Heterogeneity Analysis for Different Regions

This paper divides the samples into three categories according to their regions: eastern region, central region and western region.[1] Table 2 shows the estimated results. According to Table 2, the improvement of the linkage among manufacturing sub-industries in the eastern and central regions can significantly reduce the actual VAT tax burden of enterprises, while the industrial linkage in the western region may not significantly affect the tax burden of enterprises. Affected by factor endowment, market conditions and other factors, the spatial distribution of different types of manufacturing enterprises is unbalanced. For example, in the western region, manufacturing sub-industries mostly involve basic production activities, and the influence of industrial linkage on the actual VAT tax burden is not prominent. From

[1] With reference to the research of Wang and Fan (2004), this paper divides eastern, central and western regions as follows: Eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Henan; Central region includes Shanxi, Anhui, Jiangxi, Henan, Hubei, Jilin, Heilongjiang and Hunan; Western region includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

the perspective of inter-regional input-output correlation, compared with the western region, eastern and central regions have more convenient transportation conditions and denser transportation networks, thus expanding the source and scale of intermediate inputs of enterprises. Relatively speaking, the constraints of transportation conditions and infrastructure lead to limited types and quantities of intermediate inputs from manufacturing enterprises in the western region to other regions. As a result, the industrial linkage of the manufacturing industry in the region is not enough to alleviate the actual tax burden pressure on enterprises.

4.3.2. Heterogeneity Analysis for Different Industries

This paper divides the manufacturing industry into three categories: labor intensive, capital intensive and technology intensive.[1] Columns (4)-(6) of Table 2 show that in technology-intensive industries, industrial linkage has a significant negative influence on the actual tax burden of VAT. One possible explanation is that during the sample period of the study, China's technology-intensive industries feature "high input rate and low added value" (Fu *et al*., 2016), which leads to a lower actual VAT tax burden for technology-intensive industries. In labor-intensive and capital-intensive industries, enterprises have a relatively simple intermediate input structure, there are few channels of VAT input tax deduction and the amount is small. In addition, China's labor-intensive and capital-intensive industries have a higher proportion of value added in total output, which indirectly leads to higher VAT. As a result, labor-intensive and capital-intensive industries have smaller scale of intermediate inputs from other industries and higher value-added rate of products, therefore they bear higher actual tax burden of VAT.

4.3.3. Heterogeneity Analysis for Different Ownership Types

According to the taxpayer registration type indicator in the national tax survey data, this paper divides sample enterprises into state-owned enterprises and non-state-owned enterprises, and analyzes the heterogeneous influence of industrial linkage on VAT tax burden in enterprises with different types of ownership. It can be seen from columns (7) and (8) of Table 2 that industrial linkage mainly reduces the tax burden of

[1] According to the research of Dai (2015), labor-intensive manufacturing sub-industries include food, beverage and tobacco manufacturing, textiles, clothing and leather manufacturing, wood and cork product manufacturing, other manufacturing sub-industries; Capital-intensive manufacturing sub-industries include paper printing and publishing, coke and refined petroleum product manufacturing, rubber and plastic product manufacturing, non-metallic mineral product manufacturing, basic metal and fabricated metal product manufacturing; Technology-intensive manufacturing sub-industries include chemical product manufacturing, pharmaceutical manufacturing, computer, electronic and optical product manufacturing, electrical machinery and equipment manufacturing, machinery and equipment manufacturing and transportation equipment manufacturing.

non-state-owned enterprises. Compared with state-owned enterprises, non-state-owned enterprises face tighter financing constraints. In this case, non-state-owned enterprises tend to improve the use efficiency of production factors and optimize the capital allocation of intermediate inputs. A possible solution is to expand the scope of input tax deduction by establishing links with more intermediate goods industries. In contrast, because of soft budget constraints, the production relationship between state-owned enterprises and the intermediate goods industry is relatively stable, and it is difficult to form more deduction projects by changing the production mode of enterprises, the division of labor mode or the organizational structure. Industrial linkage has no significant influence on the actual tax burden of state-owned enterprises.

5. Study on Moderating Effect of Production Network Characteristics

Characteristics of the industrial production network are used to measure the position of an industry in the production network, including upstream degree, centrality degree and block characteristics. Specifically, production network indicators such as upstream degree, centrality degree, and block type are descriptions of industry characteristics from different dimensions. Upstream degree is used to measure the distance between an industry and the final demand end. The higher the upstream degree of an industry is, the further it is from the final demand end. Centrality degree is mainly used to indicate whether the industry is at the core of the production network or at the edge. Blocks are classified according to the ratio between the transfer from industries in the block to industries out of the block and imports by industries in the block from those outside. This paper calculates production network indicators of each manufacturing sub-industry to examine whether the position of the industry in the production network has a moderating effect on the relationship between the industrial linkage and the actual VAT tax burden.

This paper includes interaction terms of industrial linkage and production network characteristics on the basis of Model (3) to build the following econometric model:

$$\begin{aligned} Taxburden_{ijt} = {} & \alpha_0 + \alpha_1 Indulink_{jt} + \alpha_2 Net_{jt} + \alpha_3 Indulink_{jt} \times Net_{jt} \\ & + \sum_{m=4}^{n} \alpha_m Control_{mijt} + \mu_j + \delta_t + \varepsilon_{ijt} \end{aligned} \tag{4}$$

Wherein, Net_{jt} refers to production network characteristics of industry j. This paper uses upstream degree (*Upstr*), centrality (*Centr*) and block characteristics (*Block*) to represent production network characteristics, μ_j represents industry effect[1], and δ_t

[1] It should be noted that since production network characteristics are descriptions of location characteristics of sub-industries of the manufacturing industry, industry effect is fixed in this paper to avoid estimation biases due to missing variables, when studying the moderating effect of production network characteristics in the industry.

represents time effect. The analysis on the effect of production network characteristics in the manufacturing industry by introducing interaction terms can not only test the statistical significance of production network characteristic variables in a statistical sense, but also show whether production network characteristics can moderate the influence of industrial linkage on the actual VAT tax burden in an economic sense.

This study takes upstream degree, centrality and block characteristics as moderating variables and estimates the results of Model (4). Table 3 shows the results, wherein, column (1) shows the estimates with upstream degree (*Upstr*) as a production network characteristic variable (*Net*). Column (2) shows the estimates with centrality (*Centr*) as a production network characteristic variable. Column (3) shows the estimates with block characteristics (*Block*) as a production network characteristic variable.

Table 3. Moderating Effect of Production Network Characteristics: Upstream, Centrality and Block Characteristics

Variables	(1)	(2)	(3)
	Taxburden		
	Taking *Upstr* as a production network characteristic variable	Taking *Centr* as a production network characteristic variable	Taking *Block* as a production network characteristic variable
Indulink	−0.302*** (0.023)	−0.314*** (0.025)	−0.259*** (0.030)
Net	−0.027* (0.015)	−0.100*** (0.013)	0.023** (0.011)
Indulink×Net	0.058 (0.051)	0.300*** (0.045)	−0.093** (0.038)
Control variable	Yes	Yes	Yes
Industrial effect	Control	Control	Control
Time effect	Control	Control	Control
N	41631	41631	41631
Adj - R^2	0.040	0.042	0.040

The results in Table 3 show that the estimated coefficient of the upstream degree characteristic of the manufacturing industry is significantly negative. It indicates that the closer an industry is to the upstream of the industrial chain, the lower the actual VAT tax burden it bears, because on the one hand, the actual VAT burden of upstream industries in the industrial chain is greatly affected by policy factors, and on the other hand, upstream industries are mostly engaged in basic production activities such as raw material processing, and the government usually provides more tax incentives to such industries. Therefore, the upstream degree of the industry has a significant negative

influence on its actual VAT tax burden. However, the interaction coefficient between industrial linkage and upstream degree is positive, but not significant. This indicates that the characteristic of upstream degree has no significant moderating effect on the relationship between industrial linkage and the actual VAT tax burden.

The interaction coefficient of industrial linkage and centrality is significantly positive. This indicates that the actual VAT tax burden of industries close to the center of the production network is less affected by the correlation of intermediate goods, compared to industries located at the edge of the production network. A possible explanation for this is that manufacturing enterprises with a higher degree of centrality have obvious information advantages in production activities, and can preferentially choose to cooperate with more outstanding enterprises, thus forming more stable input tax deduction for intermediate goods. In addition, because of the superior position, enterprises in industries with a higher degree of centrality bear lower communication and transaction costs with enterprises in other industries, which further enhances the stability of intermediate goods transactions between this industry and other industries. Therefore, the linkage of industries with a high degree of centrality has a relatively limited negative influence on the actual VAT tax burden.

As can be seen from Table 3, the interaction coefficient between industrial linkage and block characteristics is significantly -0.093, indicating that compared with the industries in the spillover block, the correlation of intermediate goods in industries of the beneficiary block has a more significant negative effect on the actual VAT tax burden. Most industries in the spillover block are basic industries of the national economy. The intermediate products of the industry in this block have obvious spillover effect. The deduction of the inflow of intermediate goods is not an important factor affecting its VAT tax burden. Therefore, for the industries in the spillover block, the linkage with other intermediate goods industries cannot significantly offset their actual VAT tax burden. An industry in the beneficiary block can receive intermediate goods from other industries within the block as well as those from industries in the overflow block (Li *et al*., 2014). The sources of intermediate inputs required for its production are more extensive. Hence, industrial linkage has a more significant influence on the actual VAT tax burden of industries in the beneficiary block.

6. Intermediate Mechanism Test

According to the study of Jiang (2022), there may be some errors in the analysis of the intermediate mechanism by using the traditional mediation model. Therefore, this paper mainly observes the influential effect of industrial linkage of the manufacturing industry on mediators to judge the action mechanism of industrial linkage on the actual VAT tax burden of manufacturing enterprises. The models built are shown in Equations (5) and (6) as below:

$$M_{ijt} = \beta_0 + \beta_1 Indulink_{jt} + \sum_{m=2}^{n} \beta_m Control_{mijt} + \mu_i + \delta_t + \varepsilon_{1ijt} \quad (5)$$

$$Taxburden_{ijt} = \gamma_0 + \gamma_1 Indulink_{jt} + \gamma_2 M_{ijt} + \sum_{m=3}^{n} \gamma_m Control_{mijt} + \mu_i + \delta_t + \varepsilon_{2ijt} \quad (6)$$

Wherein, M_{ijt} refers to the mediator. In this paper, variables such as corporate tax avoidance (*Taxavoid*), tax shifting ability (*Taxshift*) and substitution elasticity of intermediate inputs (*Es*) are selected successively for testing. Specifically, this paper determines whether an enterprise evades tax (*Taxavoid*) according to whether it pays additional VAT in the current year. Additionally, the integrative bargaining capability of an enterprise relative to its suppliers and customers is an important indicator reflecting its tax shifting ability (Anderson *et al*., 2001). In view of this, this paper takes integrative bargaining capability as the proxy variable of tax shifting, and uses the net trade credit of an enterprise to measure its integrative bargaining capability (Wei and Zhu, 2019). The greater the net trade credit, the higher the integrative bargaining capability. Meanwhile, with reference to the research of Atalay (2017) and Ni (2021), this paper estimates the substitution elasticity of intermediate inputs in China's manufacturing sub-industries, and tests it as a mediator.

It should be noted that the endogeneity of mediators is an important factor that leads to the judgment bias of traditional mediation models (Jiang, 2022). Based on this consideration, this paper focuses on the relationship between mediators and the actual VAT tax burden, so as to avoid endogenous problems caused by reverse causality. Specifically, the difference of actual VAT tax burden in manufacturing sub-industries may give rise to the tax avoidance motivation of enterprises, but it is not the factor that leads to the tax avoidance behavior of enterprises. Similarly, an enterprise's bargaining capability determines its capability of tax shifting which directly affects its actual VAT tax burden. The substitution elasticity of intermediate inputs is used to measure the difficulty of mutual substitution between different intermediate inputs, which depends on the nature of intermediate inputs. Therefore, all the mediators used in this paper are exogenous. Table 4 shows the results of the intermediate mechanism test.

Table 4. Intermediate Mechanism Test Results

Variables	鏃1鎬	鏃2鎬	鏃3鎬	鏃4鎬	鏃5鎬	鏃6鎬
	Taxavoid	*Taxburden*	*Taxshift*	*Taxburden*	*Es*	*Taxburden*
Indulink	0.843**	−0.049	0.479***	−0.158*	1.231***	−0.109
	(0.372)	(0.126)	(0.176)	(0.096)	(0.042)	(0.096)
Taxavoid		−0.004*				
		(0.002)				

Variables	錘1鍧	錘2鍧	錘3鍧	錘4鍧	錘5鍧	錘6鍧
	Taxavoid	*Taxburden*	*Taxshift*	*Taxburden*	*Es*	*Taxburden*
Taxshift				−0.005*		
				(0.003)		
Es						−0.040***
						(0.012)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Individual effect	Control	Control	Control	Control	Control	Control
Time effect	Control	Control	Control	Control	Control	Control
N	28470	28470	40572	40572	41631	41631
R^2	0.006	0.020	0.018	0.016	0.483	0.015

It can be seen from columns (1) and (2) of Table 4 that the influence coefficient of industrial linkage on corporate tax avoidance is significantly positive. Compared with the industries with a lower degree of linkage between intermediate inputs, the industries with a higher degree of linkage conduct transactions with other intermediate goods industries more frequently, and theoretically have more opportunities to evade tax. From the perspective of location, industries with a higher degree of linkage between intermediate inputs are mainly characterized by the production of final demand goods. The VAT input deduction rules are only applicable to different industries in the industrial chain. Even if the final demander obtains sales invoices of enterprises in downstream industries, they cannot be used for input tax deduction, and the final demander may lack the motivation to require enterprises to truthfully issue VAT invoices (Naritomi, 2019). On the contrary, the authenticity of VAT invoices issued by upstream industries determines the input tax deduction of downstream industries. There are checks and balances and mutual supervision between the upstream and downstream industries. It is unfeasible for upstream industries to evade tax artificially (Tian and Fan, 2016).

The influence coefficient of the linkage between the industry of the enterprise and other intermediate goods industries on the tax shifting ability is significantly positive. The dependence of the manufacturing industry on other industries is a key factor affecting its tax shifting ability (Ahern, 2012). Structural supply-demand imbalance exists in some manufacturing sub-industries in China (Dong *et al*., 2015), which is reflected in the low rate of capacity utilization of some basic industries, and the need to rely on external demand to absorb internal excess capacity. At this point, the supplier of intermediate goods is more dependent on the demander of intermediate goods, thus it is easier for the latter to lower the procurement costs and realize tax shifting. Namely, enterprises in the

industry closely linked to the intermediate goods industry are more able to carry out tax shifting. It should be noted that when enterprises shift the tax burden onto suppliers of intermediate goods by lowering the price of intermediate goods, it may lead to a decrease in input tax, and further result in an illusion of increased nominal VAT tax burden, but in fact, the actual tax burden of enterprises does not increase.

According to columns (5) and (6) of Table 4, the estimated coefficient of the influence of industrial linkage on the substitution elasticity of intermediate inputs is significantly positive. This indicates that highly linked industries have stronger substitution elasticity for intermediate inputs required for production. The production linkage between manufacturing sub-industries is becoming closer, which means that the professional division of labor system is becoming increasingly perfect, the vertical production mode is gradually formed, and a large number of intermediate goods enterprises are gathered in each production link, resulting in that enterprises with strong industrial linkage can obtain intermediate inputs from more channels. Therefore, the higher the linkage of manufacturing sub-industries is, the greater the substitution elasticity of intermediate inputs will be. It can be seen that the substitution elasticity of intermediate inputs determines the flow direction of intermediate inputs and is an important factor affecting the types of intermediate inputs and the level of tax burden for manufacturing enterprises. Also, it shows that the greater the substitution elasticity of intermediate inputs, the more serious the distortion of VAT tax burden (Ni, 2021).

7. Conclusions and Policy Implications

Studying the differences of actual VAT tax burden among different sub-industries of the manufacturing industry in China and their causes from the perspective of industrial linkage is not only a practical basis for improving the fiscal and tax incentive policies related to the manufacturing industry, but also a basis for addressing the differences of actual VAT tax burden in the manufacturing industry. From the perspective of industrial linkage, this paper studies the differences of actual VAT tax burden among different sub-industries of the manufacturing industry in China and their causes, discusses the important role of manufacturing production network characteristics in explaining the differences of actual VAT tax burden, and draws the following main research conclusions:

Industrial linkage has a significant negative influence on the actual VAT tax burden of the manufacturing industry, that is, the closer the intermediate input connection between an industry and other industries, the lower the actual VAT tax burden it bears. The characteristics of production network have a significant moderating effect on the relationship between the linkage of manufacturing sub-industries and the actual VAT tax burden. Industries in the center of the production network realize a relatively stable deduction of input tax by optimizing the source of intermediate inputs, and further

weaken the impact of industrial linkage changes on their actual VAT tax burden. Compared with the industries in the spillover block, industries in the beneficiary block achieve a greater degree of VAT deduction through a widely connected input-output network, further reducing the actual VAT tax burden of the industries in the block.

According to the mechanism test results, enterprises in industries of the downstream industry chain lack the supervision of VAT invoices from the final demand side, hence they have the motivation to reduce tax burden through tax avoidance. The demander of intermediate goods tends to shift its tax burden onto the supplier of intermediate goods, thus effectively easing the VAT tax burden. Enterprises with a higher industrial linkage are more able to carry out tax shifting. In addition, the substitution elasticity of intermediate inputs is an important factor affecting the types of intermediate inputs and the tax burden of manufacturing enterprises. The substitution elasticity of intermediate inputs required in the production process is greater for highly linked manufacturing sub-industries, so they can adjust the types of intermediate goods to reduce the actual tax burden.

According to this study, on the one hand, structural tax reduction policies should be implemented in a targeted manner to improve the accuracy and effectiveness of VAT related policies on the basis of fully considering the location characteristics of various industries in the production network. For example, for industries at the core of the production network, larger fiscal subsidies or tax incentives should be given to give full play to their basic or key supporting role for the overall manufacturing industry, while for industries at the edge of the production network, fiscal and tax support policies should be appropriately reduced to ensure the relative fairness of the actual tax burden of various industries in the production network to the maximum extent. On the other hand, efforts should be made to improve or protect the integrity of the VAT deduction chain and prevent the distortion of tax burden that may occur in the process of tax collection and administration, such as improving the VAT supervision mechanism among enterprises in the upstream and downstream industries, building external constraints of joint supervision by the government and society, mobilizing the internal circulation mechanism of the production network in the manufacturing industry, and optimizing the connection mode of the upstream, midstream and downstream of the manufacturing industry, forming the internal motivation of tax compliance and mutual checks and balances of various industries in the production network, and ensuring high-quality development of the manufacturing industry and stable economic growth with tax equity.

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