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Constraint effect of enterprise productivity based on constrained form variational computing

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Abstract

As the basic component of the national economic construction and development, the production benefits shown by enterprises directly determine the stable operation of the national economy. In recent years, the pace of enterprise economic construction innovation, as it is affected by a variety of factors and restrictions, has been the attention of the whole society. On the basis of understanding the variational calculation of constraint forms, according to the impact of financing constraint on the production efficiency of enterprises, this paper conducts an in-depth discussion on the actual constraint effects by building the corresponding research model and proposes corresponding solutions from the perspective of the development of the new era.

Keywords: constraint form, variational calculation, financing, nonparametric frontier analysis, parameters, the weight, financing policy, credit monitoring.

AMS 2010 codes: 76U05

1 Model building

Based on the analysis of the basic organisational structure of enterprises shown in Figure 1, it can be seen that financing constraints, as the main factor affecting the production efficiency of enterprises, are mainly caused by three aspects: First, information is not symmetrical. Some financial institutions, such as banks, will ask financiers to provide more guaranteed information or interest in order to guarantee their own capital safety,

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which will not only increase financing costs but also produce new influences on the internal capital allocation of enterprises. Second, the central bank will limit the credit ratio of other banks and financial intermediaries. Generally speaking, state-owned enterprises are more inclined to finance, while the financing level of some small- and medium-sized enterprises is relatively low. Third, at present, China's financial market development is not perfect, and some small and medium-sized enterprises do not have direct financing channels, so in the practical development of the inevitable phenomenon of financing constraints. The impact path of financing constraints on enterprise production efficiency is mainly shown in Figure 2. Therefore, this paper combined the variational calculation of constraint form to study the constraint effect of production efficiency.

Fig. 1 Organisational chart of the enterprise.

Fig. 2 Analysis of the impact of financing production on enterprise production efficiency.

1.1 Scenario assumptions

It specifically involves the following points: First, some enterprises produce the same kind of products, so that in the limited market conditions of the non-cooperative game, the ultimate purpose is to maximise their own interests. Second, the market has the law of conservation of energy. Third, the production cost of all enterprises will be affected by the number of products, scientific research investment, factor allocation, pollutant emission and other factors. Fourth, the product price will be limited by the market supply quantity. Fifth, there is a negative correlation between pollution emission loss and research investment.

1.2 Symbols and definitions

Definition 1. In this study, m represents the number of enterprises participating in the game, I represents a certain enterprise participating in the game, and $i \in \{1, 2, \dots, m\}$, n represents the total demand market, j represents a certain demand market, and $j \in \{1, 2, \dots, n\}$, R_+ represents a non-negative real number, and R_m refers to a matrix of $1 \times m$, in which all elements are selected values in the range of real numbers.

Theorem 1. R_{m+} is a 1 by m matrix where all the elements are non-negative, R_{n+} is a 1 by n matrix where all the elements are non-negative, R_+^δ is a 1 by δ matrix where all the elements are non-negative, R_+^{mn} is an m by n matrix where all the elements are non-negative.

Proof. T_{ij} represents the quantity of products supplied from firm I to market demand j , and T_i represents the combination of product vectors from firm I to all markets in demand, which meets the requirement of $T_i = (T_{i1}, T_{i2}, \dots, T_{in}) \in R_+^m$.

Proposition 2. The $m \times n$ matrix of products supplied by T for m enterprises to n demand markets is shown as follows:

$$T = \begin{pmatrix} T_{11} & T_{12} & \dots & T_{1n} \\ T_{21} & T_{22} & \dots & T_{2n} \\ \dots & \dots & \dots & \dots \\ T_{m1} & T_{m2} & \dots & T_{mn} \end{pmatrix} \in R_+^{mn}$$

At the same time, Q_i represents the total amount of products produced by enterprise I , and $q_i = \sum_{j=1}^n T_{ij}$ represents the total amount of products produced by enterprise I equal to the total amount of products delivered by these enterprises to all markets in demand.

Lemma 3. Q represents the vector combination constituted by the quantity of products produced by M enterprises respectively, which is in line with $q = (q_1, q_2, \dots, q_m) \in R_+^m$.

1.3 Nash equilibrium problem

According to the analysis of Nash equilibrium definition, if this paper wants to study whether there is a strategic combination $(T^*, E^*, l^*, \theta^*, \xi^*)$ under the influence of environmental constraints, scientific and technological innovation and factor agglomeration, and make this game reach an equilibrium state, it is necessary to make:

Lemma 3. At this point, $I = 1, 2, 3 \dots M$, and $(T_i, E_i, l_i, \theta_i, \xi_i \in K_i)$, where

$$K_i = \{(T_i, E_i, l_i, \theta_i, \xi_i) | T_i \in R_+^n, E_i \in R_+, l_i \in R_+^\delta \in R_+, \xi_i \in R_+, h_{ik} E_i \leq l_{ik}, G_i(E_i) \leq g(\theta_i, T_i)\}$$

Conform to the

$$\begin{aligned} u_i(T_i^*, E_i^*, l_i^*, \theta_i^*, \xi_i^*, \hat{T}_i^*, \hat{E}_i^*, \hat{l}_i^*, \hat{\theta}_i^*, \hat{\xi}_i^*) &\geq \\ u_i(T_i, E_i, l_i, \theta_i, \xi_i, \hat{T}_i^*, \hat{E}_i^*, \hat{l}_i^*, \hat{\theta}_i^*, \hat{\xi}_i^*) &\end{aligned}$$

Corollary 4. The study selects the game situation of two enterprises for analysis. It is assumed that the competition between enterprise 1 and enterprise 2 is to find $(T_1, E_1, l_1, \theta_1, \xi_1)$ and $(T_2, E_2, l_2, \theta_2, \xi_2)$ when building the

Table 1 Input–output evaluation indicators

	Index	Unit
Input indicators	Current depreciation of fixed assets	Ten thousand yuan
	Selling expenses	Ten thousand yuan
	Financial expenses	Ten thousand yuan
	Overheads	Ten thousand yuan
	Main business costs	Ten thousand yuan
	Number of employees	people
Output indicators	Total profit	Ten thousand yuan
	Main business income	Ten thousand yuan
	Gross industrial output	Ten thousand yuan

equilibrium state, then when enterprise 1 promotes the former solution, enterprise 2 promotes the latter solution, it can obtain the maximum profit.

Conjecture 5. At the same time, when enterprise 2 promotes such schemes as $(T_2, F_2, l_2, \theta_1, \xi_1)$, enterprise 1 promotes such schemes as $(T_1, E_1, l_1, \theta_1, \xi_1)$, which will maximise profits. Thus, it can be called that the game at this time reaches Nash equilibrium, which is also called the enterprise implementation plan under equilibrium state.

Example 6. Combined with the analysis of the components of the current enterprise production efficiency, it can be seen that the enterprise belongs to the production decision unit with multiple inputs and multiple outputs, and its input elements involve two parts: labour on the one hand and capital on the other. The output further verifies the output value of the enterprise. As can be seen from this, the specific evaluation indexes to measure the above input–output are shown in Table 1.

1.4 Evolution trend

According to the various domestic enterprises in recent years production operation analysis, production efficiency the evolution trend of the change trend of adult show continued volatility, and will be affected by the policies of the time and is influenced by social and economic development level and so on are shown in Figure 3, as the evolution of enterprise production efficiency trend chart in recent years, based on the change form constraint variational calculation effect analysis, More valuable information can be found.

Fig. 3 Evolution trend of production efficiency of enterprises.

2 Model construction

2.1 Regression model

Note 7. Based on the analysis of related concepts of formal variational calculation, it can be seen that if $\{u_i(x), \dots, u_N(x)\}$ is a set of independent functions of X , and A represents the polynomial algebra of $u_a^{(i)} \equiv D^i u_a$ on complex domain C , then $D = d/dz$ can be regarded as the total derivative operator, and it can be obtained as $A^N = \{f | f = (f_1, \dots, f_N), f_i \in A\}$

At this point, the vector fields corresponding to all $f \in A^N$ are:

$$\partial_f = \sum f_a^{(i)} \partial / \partial u_a^{(i)}, f_a^{(i)} = D^i f_a$$

In particular, under the condition that $D_u = (Du_i)$ corresponds to $\partial_{Du} = \sum_{a \in t} u_a^{(i+1)} \partial / \partial u_a^{(i)} = d/df = D$ we can get:

$$\partial_{jg} = \sum f_a^{(i)} \partial g / \partial u_a^{(i)} = (dg(u + \varepsilon f) / d\varepsilon)_{\varepsilon=0} \quad \text{Thus, represents the commutator } [\partial_f, \partial_g], \text{ and } [f, g]_a = \partial_f g_a - [\partial_f, \partial_g] = \partial_{[f, g]},$$

Open Problem 8. Combined with the above formula analysis, it can be seen that the vector field set $\Pi = \{\partial_f | f \in A^N\}$ is closed in the commutative suboperation and can form the Lie algebra. The definition is shown below, where W refers to linearity in relation to AI :

$$q - \text{theshape} : C^0(\Pi, A) = A,$$

$$C^q(\Pi, A) = \{\omega(a_1, \dots, a_q) | a_1 \in \Pi, \omega(a_1, \dots, a_q) \in A\}$$

$$d : C^q \rightarrow C^{q+1},$$

$$\text{External Differential: } (d\omega)(a_1, \dots, a_{q+1}) = \sum_i^{(df)a=af, f \in C^0} (-1)^{i+1} a_i \omega(a_1 \dots \partial_i \dots a_{q+1}) \\ + \sum_{i < j} (-1)^{i+j} \omega([a_i, a_j], a_1, \dots, \partial_i, \dots, \partial_j, \dots, a_{q+1})$$

where A represents that the corresponding term does not appear.

Inner product:

$$i_a : C^{q+1} \rightarrow C^q, \\ i_a f = 0, f \in C^0, \\ (i_a \omega)(a_1 \dots a_q) = \omega(a, a_1, \dots, a_q)$$

$$\text{Li derivative: } L_a = i_a d + di_a Q^q(A) = \{\omega | \omega \in C^q, \omega(fa_1, a_2, \dots, a_q) = f \omega(a_1, \dots, a_q), f \in A\}$$

At this point, Q -shaped infinity is equivalent to 0 and can be regarded as infinity ~ 0 . Assuming $\omega_1 \in Q^q$ and $\omega = L_D \omega_1$, then we can get $Q_0^q = \{\omega | \omega \in Q^q, \omega \sim 0\}$ and $\tilde{Q}^q = Q^q / Q_0^q$. And when q is equal to 0, you get $Q_C^0 = DA = \{Df | f \in A\}$ and $\tilde{Q}^0 = A/DA$. The middle element is called functional $\tilde{Q}^0$, and its element has $Dhdef \int f dx$, which can be written as $(f, g) \equiv \int_a f_a g_a dx, f, g \in A^N$.

The usual form of the element in $Q^*(A)$ is:

$$\omega = \sum_{ai} \omega_a^i du_a^{(i)} \sim \hat{\omega} = \sum_a \xi_a du_a, \xi_a = \sum_i (-D)^i \omega_{a*}^i$$

$$\text{If } w = df, \text{ then we can get } df = \sum_{ai} (\partial f / \partial u_a^{(i)}) du_a^{(i)} \sim \sum_a (\partial f / \partial u_a) du_a$$

And we can specify $\delta f / \delta u_a = \sum_i (-1)^i \left(\partial f / \partial u_a^{(i)} \right)$, which is also called the variational derivative of F with respect to $U\alpha$. According to $f \sim g$, $\delta f / \delta u \Leftrightarrow \delta f / \delta u$ can be calculated, so $\partial f / \partial u \Leftrightarrow \partial f / \partial u$ can be defined. Similarly, $d\hat{f} = d\tilde{f}$ can be obtained by combining $f \sim g \rightarrow df \sim dg$ and defining $\tilde{d}f = \int_a (\delta f / \delta u_a) du_a$. The final derivation is given as

$$\partial_h \int f dx = \int \left(\sum_a (\delta f / \delta u_a) h_a \right) dx = (\delta f / \delta u, h)$$

By constructing the equivalence between the Nash equilibrium model and the problem of a variational inequality, we can get

$$K = \left\{ (T, E, l, \theta, \xi) \mid T \in R_+^{mn}, E \in R_+^m, l \in R_+^{m\delta}, \theta \in R_+^m, \xi \in R_+^m, h_{ik}E_i \leq l_{ik}; G_i(E_i) \leq g(\theta_i, T_i) \right\}$$

And let $u = (u_1, u_2, \dots, u_m)$, then $K \rightarrow R^m$ belongs to a concave mapping that is continuously differentiable, and let $(T^*, E^*, l^*, \theta^*, \xi^*) \in K$, then let all $i \in \{1, 2, \dots, m\}$, then $(T_i, E_i, l_i, \theta_i, \xi_i) \in K_i$ must satisfy the following conditions:

Equivalent to specifying $(T^*, E^*, l^*, \theta^*, \xi^*) \in K$, let the variational inequality as shown below hold, and then we get:

$$\begin{aligned} & \sum_{i=1}^m \sum_{j=1}^n \left\langle \frac{\partial f_i(T_i^*, \theta_i^*, \xi_i^*)}{\partial T_{ij}} - P_j(T^*) - \right. \\ & \left. \sum_{g=1}^n \frac{\partial P_g(T^*)}{\partial T_{ij}} T_{ig}^*, T_{ij} - T_{ij}^* \right\rangle + \sum_{i=1}^m \left\langle \frac{\partial G_i(E_i^*)}{\partial E_i}, E_i - E_i^* \right\rangle + \\ & \sum_{i=1}^m \sum_{k=1}^{\delta} \left\langle P'_{ik}, l_{ik} - l_{ik}^* \right\rangle + \sum_{i=1}^m \left\langle \frac{\partial f_i(T_i^*, \theta_i^*, \xi_i^*)}{\partial \theta_i} + 1, \theta_i - \theta_i^* \right\rangle + \\ & \sum_{i=1}^m \left\langle \frac{\partial f_i(T_i^*, \theta_i^*, \xi_i^*)}{\partial \xi_i} + 1, \xi_i - \xi_i^* \right\rangle \geq 0 \\ & \forall (T, E, l, \theta, \xi) \in K \end{aligned}$$

Also, clarify the following requirements for

$$\begin{aligned} K = \{ & (T, E, l, \theta, \xi) \mid T \in R_+^{mn}, E \in R_+^m, l \in R_+^{m\delta}, \theta \in R_+^m, \\ & \|T\| \leq t_0, \|E\| \leq f_0, \|l\| \leq l_0, \|\theta\| \leq \theta_0, \|\xi\| \leq \xi_0 \\ & h_{ik}E_i \leq l_{ik}; G_i(E_i) \leq g(\theta_i, T_i) \} \end{aligned}$$

Then, in $u = (u_1, u_2, \dots, u_m)$, $K \rightarrow R^m$ belongs to the concave mapping of the first continuous partial derivative. G_i with respect to E_i has continuous rows and is convex, and G with respect to (θ_i, ξ_i) also has this characteristic. Therefore, it is proved that the inequality obtained by Theorem 1 above has a Nash equilibrium point. In this process, the marginal cost will increase with the increase of the quantity of products, scientific research funds and the cost of factor allocation efficiency, and the marginal pollution cost of all enterprises will also increase with the increase of the amount of pollution discharged.

The regression model designed in this paper is as follows:

$$\begin{aligned} te_i &= a_0 + a_1fc_1 + a_3X_3 + \partial \dots \dots \dots model1 \\ te_i &= a_0 + a_1fc_1 + a_2int1_i + a_3X_3 + \partial \dots \dots \dots model2 \\ te_i &= a_0 + a_1fc_1 + a_2int2_i + a_3X_3 + \partial \dots \dots \dots model3 \\ te_i &= a_0 + a_1fc_1 + a_2int3_i + a_3X_3 + \partial \dots \dots \dots model4 \\ te_i &= a_0 + a_1fc_1 + a_2int4_i + a_3X_3 + \partial \dots \dots \dots model5 \end{aligned}$$

Model 1 is mainly used to study the effect of financing constraints on the production efficiency, model 2 is mainly used to study the effect of R&D financing constraints on the production efficiency, model 2 is a measure of financing constraints on investment – cash flow sensitivity of the influence on the production efficiency, model 4 is used to evaluate the financing constraint in the act of export influence on production efficiency and model 5 is used to analyse the impact of financing constraints on productivity in employee compensation in Pingliang. Meanwhile, the corresponding control variable set formula is as follows:

$$X_i = y_1size_i + y_2alr_i + y_3den_i + y_4sub_i + y_5tax_i \quad (1)$$

Among them, a_1, a_2, a_3 and y_1 to y_5 , respectively, represent the influence levels of various control variables on production efficiency. For example, a_1 refers to the impact level of financing constraints on the production

efficiency of enterprises in R&D expenditure. If this value is positive, it means that financing constraints will have a negative impact on production efficiency, which requires the market to relax constraints. On the contrary, if the value is negative, the impact of financing constraints on production efficiency is positive. In this case, it is necessary to strengthen the practice of financing constraints so as to improve the actual production efficiency of enterprises. Table 2 shows the indicators and measurement methods to be defined in this study.

Table 2 Specific indicators and measurement methods

Index	The specific meaning	Calculation method
Te	Productivity	DEA model operation
Fr	Financing constraints	Financing constraint = interest expense/total assets
Int1	Financing constraints and R&D expenditure interaction	Interaction term = financing constraint * R&D investment
Int2	Interaction item between financing contract and investment behaviour	Interactivity = Financing Constraints 欵 簾ong-term Investment
Int3	Financing constraints and export behaviour interaction item	Interaction term = financing constraint * export delivery value
Int4	Interaction term between financing constraints and employee compensation	Interaction term = financing constraint * employee compensation
Size	The size of the business	Firm size = number of employees take logarithm
Air	Debt to asset ratio	Asset-liability ratio = total liabilities/total assets
Den	Asset intensity	Capital intensity = net fixed assets/number of employees
Sub	Government subsidies	Industrial Enterprise Database Direct Access to
Tax	Tax burden	Tax burden = tax expenditure/sales

2.2 Numerical simulation

Assuming that Enterprise 1 and Enterprise 2 only produce the same product, and there is only one demand market, the above analysis results show that the function relationship between the production cost of Enterprise 1 and the total amount of product T_1 , the research fund θ_1 and the cost of factor allocation efficiency ξ_1 is

$$f(T_1, \theta_1, \xi_1) = T_1 + \theta_1^2 - 4\theta_1 + \xi_1^2 - 3\xi_1 \quad (2)$$

The corresponding formula for the functional relationship between various elements of Enterprise 2 is:

$$f(T_2, \theta_2, \xi_2) = \frac{1}{2}T_2 + \frac{1}{2}\theta_2^2 - 2\theta_2 + \frac{1}{2}\xi_2^2 - 3\xi_2 \quad (3)$$

According to the analysis of the negative correlation between product price and product quantity, the market selling prices of enterprise 1 and enterprise 2 are set as , $P(T_1, T_2) = 5 - T_1 - T_2$ while the losses caused by pollutant removal of enterprise 1 and enterprise 2 are, respectively, $G_1(E_1) = E_1^2 - E_1$ and $G_2(E_2) = E_2^2 - E_2$, at this time, due to the differences in geographical conditions. Therefore, the unit price of enterprise 1 supporting the purchase of pollutant discharge quantity is , and the price of enterprise 2 is $P'_2(l_2) = \frac{1}{2}l_2 - 2$. The choice of this method is that as the amount of pollution discharged changes in the development, the actual price and way of charging will also change, so as to better protect the environment. Assuming that the initial amount of pollution discharge is 0 in the calculation process, the function formula of profit obtained by enterprise 1 can be obtained as

$$u_1(T_1, T_2, \theta_1, \theta_2, \xi_1, \xi_2, E_1, E_2, l_1, l_2) = P(T_1, T_2)T_1 - f_1(T_1, \theta_1, \xi_1) - G_1(E_1) - P'_1(l_1)l_1 - \theta_1 - \xi_1 \quad (4)$$

The function formula for enterprise 2 to obtain profits is:

$$u_1(T_1, T_2, \theta_1, \theta_2, \xi_1, \xi_2, E_1, E_2, l_1, l_2) = P(T_1, T_2)T_2 - f_2(T_2, \theta_2, \xi_2) - G_2(E_2) - P'_2(l_2)l_2 - \theta_2 - \xi_2 \quad (5)$$

Since the four factors of the enterprise studied in this paper have a specified range in the actual development and are not close to infinity, the value range of these variables is assumed to be between 0 and 5, then the constraint set is defined as:

$$\begin{aligned} K = \{ & (T_1, T_2, \theta_1, \theta_2, \xi_1, \xi_2, E_1, E_2, l_1, l_2) \mid 0 \leq T_1 \leq 5, \\ & 0 \leq T_2 \leq 5, 0 \leq \theta_1 \leq 5, 0 \leq \theta_2 \leq 5, 0 \leq \xi_1 \leq 5, 0 \leq \xi_2 \leq 5, \\ & 0 \leq E_1 \leq 5, 0 \leq E_2 \leq 5, 0 \leq l_1 \leq 5, 0 \leq l_2 \leq 5, E_1 \leq l_1, \\ & E_2 \leq l_2, E_1^2 - E_1 \leq 10 - \theta_1 + T_1, E_2^2 - E_2 \leq 10 - \theta_2 + T_2 \} \end{aligned} \quad (6)$$

Then, in order to determine whether $(T_1^*, T_2^*, \theta_1^*, \theta_2^*, \xi_1^*, \xi_2^*, E_1^*, E_2^*, l_1^*, l_2^*)$ reaches the equilibrium state, it is necessary to convert the above equilibrium problem into inequality by combining it with Theorem 1. In other words, it is necessary to clarify $(T_1^*, T_2^*, \theta_1^*, \theta_2^*, \xi_1^*, \xi_2^*, E_1^*, E_2^*, l_1^*, l_2^*)$ and conform to $(T_1, T_2, \theta_1, \theta_2, \xi_1, \xi_2, E_1, E_2, l_1, l_2) \in K$. In this way, the following inequality is truly true:

By (1), and (6) (7)

$$\begin{aligned} & \langle 2T_1^* + T_2^* - 4, T_1 - T_1^* \rangle + \langle T_1^* + 2T_2^* - 4.5, T_2 - T_2^* \rangle + \langle 2\theta_1^* - 3, \theta_1 - \theta_1^* \rangle + \langle \theta_2^* - 1, \theta_2 - \theta_2^* \rangle + \\ & \langle 2\xi_1^* - 2, \xi_1 - \xi_1^* \rangle + \langle \xi_2^* - 2, \xi_2 - \xi_2^* \rangle + \langle 2E_1^* - 1, E_1 - E_1^* \rangle + \langle 2E_2^* - 1, E_2 - E_2^* \rangle + \\ & \langle l_1^* - 3, l_1 - l_1^* \rangle + \langle l_2^* - 2, l_2 - l_2^* \rangle \geq 0 \end{aligned}$$

Using the variational inequality projection shrinkage algorithm, combined with the MATLAB language software to write the calculation, the final product output of enterprise 1 is $T_1^* = 1.21$ and the product output of enterprise 2 is $T_2^* = 1.76$. The investment capital of firm 1 is $\theta_1^* = 1.49$ and the investment capital of firm 2 is $\theta_2^* = 1.02$. The cost of improving factor allocative efficiency of firm 1 is $\xi_1^* = 0.98$ and the cost of improving factor allocative efficiency of firm 2 is $\xi_2^* = 2.00$. The sewage discharge quantity of enterprise 1 is $E_1^* = 0.47$ and the sewage discharge quantity of enterprise 2 is $E_2^* = 0.47$. The pollutant purchase quantity of Enterprise 1 is $l_1^* = 2.98$ and the pollutant purchase quantity of Enterprise 2 is $l_2^* = 2.00$.

3 Discussion

3.1 Data sources

The data selected in this paper are the information stored in the enterprise database from 2018 to 2020, and the selected indicators involve the total assets, R&D expenditure, the number of employees, subsidy income and other contents. It should be noted that in the process of sorting out the relevant data, it must be clearly recognised that there are also problems such as missing or errors in the database reserve information. Therefore, it is necessary to preprocess the relevant data information before the research and detection, and then to conduct an in-depth discussion on the results generated.

3.2 Result analysis

Combine in Table 3 shows the financing constraints on production efficiency of regression result analysis shows that the influence of the use of fixed effects regression model and stata software regression study found that financing constraints, the key variables under the condition of 1% of the change is very significant, negative and symbols, proving the financing scale continues to expand the negative effect to enterprise production efficiency. In this process, financing constraints can effectively improve the production efficiency of enterprises, thus verifying Model 1 proposed in the analysis of this paper. However, the output efficiency in a short period

of time cannot reach the best, and the output increment should be lower than the input increment, which will inevitably reduce the actual production efficiency. At the same time, due to the excessive investment behaviour of enterprises, the continuous expansion of their production scale, resulting in the actual production efficiency, is not effectively improved. Although the variable of capital intensity presents a positive correlation, it has no significant influence on the composition of production efficiency, and the sign of tax variable is negative, which proves that the increase of tax burden will further reduce the production efficiency of the enterprises.

Table 3 Analysis of regression results

Variables	Te
Fe	-0.1791*** (0.0294)
Size	-0.0243*** (0.0030)
Alr	-0.0275*** (0.0060)
Den	0.0000*** (0.0000)
Sub	-0.0056* (0.0031)
Tax	-0.0080 (0.0268)
Observations	223.198
R ²	0.5278

Note: *, ** and *** indicate significant at the level of 10%, 5% and 1%, respectively. The parentheses indicate robust standard errors.

According to the content and the final result in this paper, analysis shows that although the Nash equilibrium under the enterprise can get optimal value from the perspectives of its own development, the whole industry sees this state is not to maximise value, which requires companies to build good relations of cooperation in the development of the practice, and only in this way, can we truly achieve benefit maximisation. At the same time, enterprise development should also focus on improving the efficiency of factor allocation, so that high-tech enterprises can be concentrated in developed areas, while low-end manufacturing can also be concentrated in backward areas, which plays a positive role in promoting the overall development of the social economy. Therefore, it is necessary to increase research and exploration in this aspect in future development.

4 Conclusion

In conclusion, under the background of the new era, the production efficiency of enterprises shows a trend of continuous decline. At this time, the level of financing constraint has a profound impact on the production efficiency of enterprises. Therefore, both the national government and the market economy should put forward clear solutions after clarifying the relationship between financing constraints and enterprise production efficiency and cannot directly reduce the degree of financing constraints. At the same time, the corresponding analysis model should be built according to the variational calculation of constraint form, and the degree of influence under different conditions can be obtained accordingly. Then, according to the accumulated experience in the past, the constraints management work in the subsequent development should be analysed. In addition, the enterprise production management needs to foster more high-quality high-level professional talents and reference more modern management ideas and technologies and learn from excellent research literature at home and abroad, in

such a way not only to make effective solutions based on different situations but also to further encourage the enterprises to promote the efficiency of production.

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