A Study of Effective Methods to Promote Foreign Trade Base on Mathematical Analysis: A Case Study of Small and Medium-sized Enterprises in China

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Abstract: In the post-epidemic era, how to effectively use the export tax rebate policy, expand the foreign trade of small and medium-sized enterprises, and accelerate the formation of a new pattern of mutual promotion in both domestic and international circles is one of the problems that the Chinese government urgently needs to solve. From the mathematical analysis of nine cases before and after narrowing the gap between export trade levy and return, it can be found that the effect of tax refund depends on the speed of tax refund. With the continuous empowerment of digital technology and the promotion of tax service facilitation measures such as "Paperless", "Non-contact" and "Processing of tolerance and shortage", the average processing cycle of export tax rebate has been continuously compressed, on the premise of not increasing the financial pressure of governments at all levels, the financial support to small and medium-sized production enterprises has been realized. Production enterprises can set export tax rebate risk point through digital technology to avoid the loss of export tax rebate benefits.

1 INTRODUCTION

In the post-epidemic era, how to effectively use the export tax rebate policy, expand the foreign trade of small and medium-sized enterprises, and accelerate the formation of a new pattern of mutual promotion in both domestic and international circles is one of the problems that the Chinese government urgently needs to solve. The export tax return is one of commonly means of state intervention in the economy. It reduces the cost of products, avoids repeat taxation, enhances the competitiveness of goods in the international market, and achieves the purpose of promoting international trade through returning of part of the tax on goods. In recent years, the state has continuously increased the strength of export tax return, improved the export tax return policy, and narrowing the gap between export trade levy and return in China. But on the other hand, the implementation of the policy has also brought huge financial pressure to the central and local governments.

1.1 Universality

Domestic scholars mostly analyze the impact of export rebate on export trade in a single province or a single commodity. (Luo, 2021) Some scholars analyze the specific quantitative relationship between export tax rebate and export trade of mechanical and electrical products in Shanxi Province, and give some policy suggestions. (Liu 2021, Ren, 2021) Other scholars combed through China's agricultural export tax rebate policy changes, analysis of the current problems, put forward policy recommendations. (Xie, 2021) Based on the above analysis, this paper hopes to find out the foreign trade promotion policy which is suitable for all small and medium-sized enterprises and all commodities in China.

1.2 Sustainability

In the post-epidemic era, various countries experienced different degrees of economic downturn and the financial pressure of governments at all levels increased. (Dai, 2018) To support the development of China's foreign trade in the post-epidemic era, some

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scholars also mentioned that the tax policy of lowering the tax base standard should not be used for a long time. (Wang, 2021, Wang, 2021) Based on the above analysis, this paper hopes to find out the feasible policy that can effectively promote the foreign trade of all small and medium-sized enterprises without increasing the existing financial pressure of governments at all levels.

2 MATERIALS AND METHODS

The export tax rebate policy of production enterprises is different from that of foreign trade enterprises in China. The export tax rebate for foreign trade enterprises is the product of the purchase amount and the export tax rebate rate. The export tax rebate policy of production enterprises is more complicated. This paper tries to find out the key factors that influence the effect of policy through mathematical analysis of the economic impact of narrowing the gap between export trade levy and return of the production enterprises.

2.1 Production Enterprises under the General Trade Mode of " CDR"(Cancel Deduct Return) Policy

Under the general trade mode of production enterprises, the "CDR" policy includes: "Cancel" refers to the exemption from VAT on export sales, "Deducted" refers to the amount of return payable against the amount of tax payable, and "Return" refers to the return of the part not covered by the amount of deducted.

Under this policy, the accounting method of the tax return for the production enterprise is as follows:

Suppose that the export sales in the current month is α1, the sale tax is α2, the purchase tax is α3, the leave tax for the previous period is α4, the sale tax rate is ω1, the export tax return rate is ω2, the tax cannot be cancelled and deducted for the current period is α5, the tax payable for the current period is α6, the "CDR" tax for the current period is α7, and the tax return for the current period is α8. The "CD" tax for the current period is α9, and the leave tax for the next period is α10.

$$\alpha5=\alpha1\times(\omega1-\omega2) \quad (1)$$

$$\alpha6=\alpha2-(\alpha3-\alpha5)-\alpha4 \quad (2)$$

$$\alpha7=\alpha1\times\omega2 \quad (3)$$

According to the accounting results, the tax return of production enterprises can be divided into three situations:

$$\text{If } \alpha6\geq0;\ \alpha8=0,\ \alpha9=\alpha7 \quad (4)$$

$$\text{If } \alpha6<0, \text{ and } -\alpha6\leq\alpha7;\ \alpha8=-\alpha6,\ \alpha9=\alpha7-(-\alpha6) \quad (5)$$

$$\text{If } \alpha6<0, \text{ and } -\alpha6>\alpha7;\ \alpha8=\alpha7,\ \alpha9=0,\ \alpha10=-\alpha6-\alpha7 \quad (6)$$

2.2 The Economic Impact of Narrowing the Gap between Export Trade Levy and Return on Production Enterprises

In order to explain the economic impact of narrowing the gap between export trade levy and return on the production enterprises, it is assumed that the new tax return rate is ω3, and ω3>ω2, the tax cannot be cancelled and deducted for the current period is $\alpha5^1$, the tax payable for the current period is $\alpha6^1$, the "CDR" tax for the current period is $\alpha7^1$, and the tax return for the current period is $\alpha8^1$. The "CD" tax for the current period is $\alpha9^1$, and the leave tax for the next period is $\alpha10^1$, and the rest is assumed as above. The following are the accounting results of Production enterprises under the new tax rate:

$$\alpha5^1=\alpha1\times(\omega1-\omega3) \quad (7)$$

$$\alpha6^1=\alpha2-(\alpha3-\alpha5^1)-\alpha4 \quad (8)$$

$$\alpha7^1=\alpha1\times\omega3 \quad (9)$$

$$\text{If } \alpha6^1\geq0;\ \alpha8^1=0,\ \alpha9^1=\alpha7^1 \quad (10)$$

$$\text{If } \alpha6^1<0, \text{ and-}\alpha6^1\leq\alpha7^1;\ \alpha8^1=-\alpha6^1,\ \alpha9^1=\alpha7^1-(-\alpha6^1) \quad (11)$$

$$\text{If } \alpha6^1<0, \text{ and-}\alpha6^1>\alpha7^1;\ \alpha8^1=\alpha7^1,\ \alpha9^1=0,\ \alpha10^1=-\alpha6^1-\alpha7^1 \quad (12)$$

After the change of tax return rate, Production enterprises may face nine situations. The following analyzes the economic impact of narrowing the gap between export trade levy and return on Production enterprises one by one.

Before and after the change of tax return rate, the conditions under which the enterprise all faces the first kind are:

$$\text{If } \alpha6\geq0, \text{ and } \alpha6^1\geq0$$

Namely:

$$\alpha2-(\alpha3-\alpha5)-\alpha4\geq0, \text{ and } \alpha2-(\alpha3-\alpha5^1)-\alpha4\geq0$$

After sorting out, we get:

$$\alpha3+\alpha4-\alpha2\leq\alpha1\times(\omega1-\omega3) \quad (13)$$

The economic impact of this situation is mainly reflected in the reduction of the tax payable in the current period:

$$\alpha6-\alpha6^1=\alpha2-(\alpha3-\alpha5)-\alpha4-[\alpha2-(\alpha3-\alpha5^1)-\alpha4] \quad (14)$$

After sorting out, we get:

$$\alpha1\times(\omega3-\omega2) \quad (15)$$

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the first kind to the second kind are:

If $\alpha6\geq0$, and $\alpha6^1<0$, $-\alpha6^1\leq\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4\geq0$, $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$ and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]\leq\alpha7^1$

After sorting out, we get:

$$\alpha1\times(\omega1-\omega3)<\alpha3+\alpha4-\alpha2\leq\alpha1\times(\omega1-\omega2) \quad (16)$$

The economic impact of this situation is mainly reflected in the reduction of the tax payable in the current period and the increase of the tax return:

$$\alpha6+\alpha8^1=\alpha2-(\alpha3-\alpha5)-\alpha4-[\alpha2-(\alpha3-\alpha5^1)-\alpha4] \quad (17)$$

After sorting out, we get:

$$\alpha1\times(\omega3-\omega2) \quad (18)$$

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the first kind to the third kind are:

If $\alpha6\geq0$, and $\alpha6^1<0$, and $-\alpha6^1>\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4\geq0$, $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$, and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]>\alpha7^1$

After sorting out, we get:

$$\alpha1\times\omega1<\alpha3+\alpha4-\alpha2\leq\alpha1\times(\omega1-\omega2) \quad (19)$$

Because: $\alpha1\times\omega1>\alpha1\times(\omega1-\omega2)$, the above conditions cannot be met, so it is not possible.

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the second kind to the first kind are:

If $\alpha6<0$, and $-\alpha6\leq\alpha7$; $\alpha6^1\geq0$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, $-\alpha2+(\alpha3-\alpha5)+\alpha4\leq\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4\geq0$

After sorting out, we get:

$$\alpha3+\alpha4-\alpha2\geq\alpha1\times(\omega1-\omega2), \text{ and } \alpha3+\alpha4-\alpha2\leq\alpha1\times(\omega1-\omega3) \quad (20)$$

Because: $\alpha1\times(\omega1-\omega2)>\alpha1\times(\omega1-\omega3)$, the above conditions cannot be met, so it is not possible.

Before and after the change of tax return rate, the conditions under which the enterprise all faces the second kind are:

If $\alpha6<0$, and $-\alpha6\leq\alpha7$; $\alpha6^1<0$, and $-\alpha6^1\leq\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, $-[\alpha2-(\alpha3-\alpha5)-\alpha4]\leq\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$ and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]\leq\alpha7^1$

After sorting out, we get:

$$\alpha1\times(\omega1-\omega2)<\alpha3+\alpha4-\alpha2\leq\alpha1\times\omega1 \quad (21)$$

The economic impact of this situation is mainly reflected in the change of the tax return in the current period:

$$\alpha8^1-\alpha8=-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]+[\alpha2-(\alpha3-\alpha5)-\alpha4] \quad (22)$$

After sorting out, we get:

$$\alpha1\times(\omega3-\omega2) \quad (23)$$

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the second kind to the third kind are:

If $\alpha6<0$, and $-\alpha6\leq\alpha7$; $\alpha6^1<0$, and $-\alpha6^1>\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, $-[\alpha2-(\alpha3-\alpha5)-\alpha4]\leq\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$ and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]>\alpha7^1$

After sorting out, we get:

$$\alpha1\times\omega1<\alpha3+\alpha4-\alpha2\leq\alpha1\times\omega1 \quad (24)$$

The above conditions cannot be met, so it is not possible.

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the third kind to the first kind are:

If $\alpha6<0$, and $-\alpha6>\alpha7$; $\alpha6^1\geq0$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, $-[\alpha2-(\alpha3-\alpha5)-\alpha4]>\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4\geq0$

After sorting out, we get:

$$\alpha1\times\omega1<\alpha3+\alpha4-\alpha2\leq\alpha1\times(\omega1-\omega3) \quad (25)$$

Because: $\alpha1\times(\omega1-\omega3)<\alpha1\times\omega1$, the above conditions cannot be met, so it is not possible.

Before and after the change of tax return rate, the conditions under which the enterprise faces the change from the third kind to the second kind are:

If $\alpha6<0$, and $-\alpha6>\alpha7$; $\alpha6^1<0$, and $-\alpha6^1\leq\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, and $-[\alpha2-(\alpha3-\alpha5)-\alpha4]>\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$ and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]\leq\alpha7^1$

After sorting out, we get:

$$\alpha1\times\omega1<\alpha3+\alpha4-\alpha2\leq\alpha1\times\omega1 \quad (26)$$

The above conditions cannot be met, so it is not possible.

Before and after the change of tax return rate, the conditions under which the enterprise all faces the third kind are:

If $\alpha6<0$, and $-\alpha6>\alpha7$; $\alpha6^1<0$, and $-\alpha6^1>\alpha7^1$

Namely:

$\alpha2-(\alpha3-\alpha5)-\alpha4<0$, and $-[\alpha2-(\alpha3-\alpha5)-\alpha4]>\alpha7$; $\alpha2-(\alpha3-\alpha5^1)-\alpha4<0$, and $-[\alpha2-(\alpha3-\alpha5^1)-\alpha4]>\alpha7^1$

After sorting out, we get:

$$\alpha3+\alpha4-\alpha2>\alpha1\times\omega1 \quad (27)$$

The economic impact of this situation is mainly reflected in the increase of the tax return in the current period:

$$\alpha8^1-\alpha8 \quad (28)$$

After sorting out, we get:

$$\alpha1\times(\omega3-\omega2) \quad (29)$$

3 RESULTS & DISCUSSION

3.1 The Greater the Export Sales, the Stronger the Export Tax Rebate, the Greater the Financial Pressure

Summarizing the above analysis, the economic impact of narrowing the gap between export trade levy and return on the production enterprises as follows:

If $\alpha3+\alpha4-\alpha2\leqslant\alpha1\times(\omega1-\omega3)$,

The reduction of the tax payable in the current period:

$$\alpha1\times(\omega3-\omega2) \quad (29)$$

If $\alpha1\times(\omega1-\omega3)<\alpha3+\alpha4-\alpha2\leqslant\alpha1\times(\omega1-\omega2)$,

The reduction of the tax payable in the current period and the increase of the tax return in the current period:

$$\alpha1\times(\omega3-\omega2) \quad (30)$$

If $\alpha1\times(\omega1-\omega2)<\alpha3+\alpha4-\alpha2\leqslant\alpha1\times\omega1$,

The increase of the tax return in the current period:

$$\alpha1\times(\omega3-\omega2) \quad (31)$$

If $\alpha3+\alpha4-\alpha2>\alpha1\times\omega1$,

The increase of the tax return in the current period:

$$\alpha1\times(\omega3-\omega2) \quad (32)$$

For all enterprise, the reduction of the current tax payable is:

$$\alpha1\times(\omega3-\omega2) \quad (33)$$

It can be seen that if $\alpha1$ is increased, the reduction of tax payable will be increased. On the other hand, if $\omega3-\omega2$ is increased, the reduction of tax payable will also be increased. In the meantime, the financial pressure on governments at all levels will also increase.

3.2 The Government Uses Digital Technology to Expand the Effect of Export Tax Rebate Policy

Although in each case, the economic impact of the reduction of return difference on production enterprises is consistent in amount, the impact on capital flow is different. In the first case, the enterprise can reduce capital outflow; in the second case, it is reflected in the decrease of capital outflow and the increase of capital inflow; in the latter two cases, it is reflected in the increase of capital inflow. The longer the enterprise gets the export tax refund, the greater the difference of the tax refunds effect among different types of production enterprises. In the past, because the export tax rebate involved more government departments, and the need to submit more information, the return of export tax rebate production enterprises often longer time. With the continuous empowerment of digital technology and the promotion of tax service facilitation measures such as "Paperless", "Non-contact" and "Processing of tolerance and shortage", the average processing cycle of export tax rebate has been continuously compressed, on the premise of not increasing the financial pressure of governments at all levels, the financial support to small and medium-sized production enterprises has been realized.

3.3 Production Enterprises Use Digital Technology to Avoid the Loss of Export Tax Rebate Benefits

According to the above analysis, when $\alpha1$ remains constant, the economic benefits can be obtained as follows:

If $\alpha3+\alpha4-\alpha2\leqslant\alpha1\times(\omega1-\omega3)$,

The tax return in the current period is 0;

If $\alpha1\times(\omega1-\omega3)<\alpha3+\alpha4+\alpha2\leqslant\alpha1\times\omega1$,

The tax return in the current period is

$$-[\alpha2-(\alpha3-\alpha5^1)-\alpha4] \quad (34)$$

If $\alpha3+\alpha4-\alpha2>\alpha1\times\omega1$,

The tax return in the current period and the leave tax for the next period are:

$$-[\alpha2-(\alpha3-\alpha5^1)-\alpha4] \quad (35)$$

It can be seen that even if $\alpha1$ is unchanged, when the value of "$\alpha3+\alpha4-\alpha2$" is in different ranges, the economic benefits obtained by production enterprises are also different. In the first case, the enterprise

cannot get all tax return, especially when $\alpha 2-\alpha 3-\alpha 4<\alpha 2\times\omega 3$, part of the tax return cannot be offset by the sale tax, resulting in the reduction of economic benefits for the enterprise. Therefore, production enterprises can set export tax rebate risk point through digital technology to avoid the loss of export tax rebate benefits.

4 CONCLUSIONS

If the reduction of tax payable increases, production enterprises can enjoy export tax rebate benefits, but the financial pressure on governments at all levels will also increase. In the post-epidemic era, we need to adopt more effective, universal and sustainable export tax rebate preferential policies to promote foreign trade of small and medium-sized enterprises.

Through the above mathematical analysis, it can be found: the government uses digital technology to expand the effect of export tax rebate policy; production enterprises can use digital technology to avoid the loss of export tax rebate benefits.

The export tax rebate for foreign trade enterprises is the product of the purchase amount and the export tax rebate rate. The reduction of tax payable increases, the financial pressure on governments at all levels will also increase. The government uses digital technology to expand the effect of export tax rebate policy. However, foreign trade enterprises do not exist the above-mentioned export tax rebate benefits cannot enjoy the situation.

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