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Government Intervention and Automobile Industry Structure: Theory and Evidence from China

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Abstract: The development of the automobile maintenance industry less developed to satisfy the increasing demand for automobile maintenance service as the automobile manufacturing industry increased rapidly in China. This is not conducive to the sustainable development of the automobile industry. Besides the factors of market behavior that can affect the automobile industry structure, like an investment, operation structure or economic development stage, the structure is also influenced by government intervention. We investigated the unbalanced development of automobile structure from the perspective of government incentives, and provide a logical framework for analyzing the industrial policies on the automobile industry. We first established a two-sector theoretical model with government intervention, and we found that the governments' GDP incentive induced the biased intervention policy. More preferential policies are given to enterprises of automobile manufacturing industries as they contribute more to intermediate goods and capital. The greater the government's GDP incentive, the more biased the intervention will be. Then we test the differential impact of GDP incentive on tax avoidance of the two kinds of firms empirically. The empirical results show that GDP incentive of the government induced more preferential treatment to automobile manufacturing enterprises, and thus, increased their tax avoidance. This phenomenon is more significant in SOEs, larger firms and firms belong to local governments. Understanding the incentive and implementation of industrial policy can help us know the evolution of automobile industrial structure better, and then improve industrial policy better to promote the transformation and upgrading of automobile industrial structure.

Keywords: automobile manufacturing; automobile maintenance; government incentive; government intervention; tax avoidance

1. Introduction

The economic development process of various countries in the world shows that vehicle ownership gradually increases with the development of economy, especially GDP per capita [1]. Although the automobile manufacturing industry increased rapidly in China, automobile maintenance industry less developed compared with developed countries and has not received enough attention [2]. The auto care industry is developing quickly in the United States in recent years. According to the data of Auto Care Association, the number of people employed in the auto care industry is 4.6 million, and the number of automobiles in operation is 278.6 million in early 2018, and the average annual sales value

of auto care industry is now 381 billion. Chain operation mode, which has been developed rapidly in 30 years, was adopted in automobile after-sales service companies in the United States [3]. The supply chain not only includes the automobile manufacturer, but also the after-sales service market of auto parts supply and an integrated maintenance service provider [4]. This pattern not only makes the price of service more transparent, but also can integrate the auto parts resources of each brand and break the vertical monopoly [5].

The situation of auto care is less encouraging in China. According to the China Automotive Aftermarket Blue Book (2013–2017) [6], the average annual growth rate of China's automotive aftermarket will exceed 30% in the future, and the market size is expected to exceed one trillion Yuan after 2018. According to the news of research and markets [7], Chinese automotive aftermarket revenue is expected to record a compound annual growth rate of 7.7%, increasing from $290.44 billion in 2017 to $523.80 billion in 2025. During this period, the vehicles in operation for Chinese passenger vehicles are expected to grow from 185 million units to 401.7 million units. However, the development of automotive aftermarket is not sufficient to satisfy the increasing demand for automobile maintenance service in China. 4S stores (store for automobile sale, spare parts, service, and survey) is the leading form of after-sales service market in China [8], and it needs a large investment to develop well. However, many of them with limited sales in the market are unable to cover their costs with intense competition and the gradual increase of investment [6]. The development of domestic automobile maintenance enterprises in the initial stage will also be impacted by the external competitive environment because foreign enterprises bring more new technologies and new business models when they enter the market.

The ignorance of maintenance and service will have a negative impact on the automobile industry, which is not conducive to the sustainable development of the automobile industry. Firstly, the quality and development of auto maintenance industry will affect customer loyalty, which has been paid attention by the American automobile industry [9,10]. There are a large number of single stores and brand chains providing high-quality maintenance and customer service in the United States, and automobile service is insurance of financial and strategic advantages to help the company survive in this highly competitive industry [11,12]. Secondly, from the perspective of market sustainability, automobile maintenance will satisfy and promote the development of new kinds of vehicles. The market share of shared vehicles, electric vehicles and autonomous driving is increasing, and maintenance process of these kinds of vehicles is different with the conventional ones, for example, the annual maintenance cost of vehicles will increase as the annual mileage of shared cars increases. In addition, customers' expectations and requirements on the automotive maintenance industry are also constantly rising with the development of economy, science and technology. So it is necessary for the automotive service industry to constantly improve its development mode and introduce new technologies, which presents challenges and opportunities for the whole industry. Thirdly, lack of attention to maintenance will make China's maintenance industry lag behind in the Internet era. Nowadays, the popularization of the internet brought business opportunities for shopping and O2O (Online to Offline) service industry [13,14], and the automobile maintenance industry should also grasp the opportunities of the internet era and realize the transition of traditional industries. Finally, from the perspective of sustainable regional growth, the diversity of aftermarket growth in different regions reflects the market maturity to a large extent. The growth rate of emerging markets will exceed that of mature markets, and the rapid growth of China's vehicle ownership will drive the share of Asia in the global aftermarket. According to the experience of North American and European markets, the more developed the post-market is, the higher the degree of integration in the transaction level of the industry is. Therefore, it is of great significance to understand the reasons of the slow development of the automobile maintenance industry in China and to make the automobile maintenance and automobile manufacturing industry develop and integrate in a balanced way. What's more, automobile maintenance industry is an important part of the service industry, which is critical to national competitiveness and industrial structure [15,16]. The appropriate industrial structure adjustment will promote economic growth because of the "structure bonus" brought by the movement of production

factors in different sectors [17,18], especially for developing countries [19,20]. Although it's right to develop the automobile manufacturing industry more than the automobile maintenance industry in the initial phase of the development of the automotive industry, China should pay more attention to the balanced development of the two industries after passing this first phase.

As an important part of the service industry, there are some reasons why China's automobile maintenance industry has not developed enough. Firstly, the imperfect investment and financing environment lead to the fact that most maintenance firms lack external financial support and the investment is far away from enough for development. Secondly, China is still in early stage of vehicle ownership development process, and the ratio of vehicle ownership per thousand people is only 172 according to the data of World Road Statistics dataset (WRS) [21]. This number is far away from saturation level, 807, according to Dargay and Sommer [22], and there is still a lot of space for the automobile industry to develop. Thirdly, some researchers believe customer recognition is the most serious barrier at present in the external environment [9,10]. Most of China's automobile maintenance businesses do not pay sufficient attention to information resources, and they have not yet formed a unique business model that is closely connected with the market [6]. What's more, some market factors that affect industrial structures, such as the change of demand, technology improvement, endowment and trade [23–26], can affect the automobile maintenance industry as well. According to the theory of development economics, industrial structure changes with economic development; however, the industrial structure varies in countries that share similar development stages. Although the economy grows rapidly, industry accounts for the largest share of GDP for years until 2015 in China, and the ratio of the service industry is still far away from that of developed countries, even some developing countries. According to the data of Statistical Yearbook of the World [27], service sector accounts 70.9% on average all over the world, 74.3% in the high-income countries in 2010, and 55.6% in middle income countries, 55.5% in low income countries, while, it is only 44.6% in China. So, are there any other reasons that can explain these facts?

Since the marketization degree in China is not very high, and the government plays a great role in the economy, we think that government intervention is another important factor that can affect industry structure in China. Some researchers proposed that in early stage of economic development, industrial policies may accelerate the industrial structural change and improve resource allocation [28,29]. It is also found that the industrial policy can enhance competition among enterprises and promote the growth of enterprises [30]. Local governments are important participants in promoting China's economic development in the process of China's industrial transformation. Therefore, in addition to the natural evolution of market behavior, the industrial structure is also subject to government intervention. We try to explain the problem from the perspective of government incentives and provide a logical framework for analyzing the industrial structure. Some researchers proposed incentives for self-interest and for electoral success in public choice theory [31,32]. Some researchers believe that local governments have fiscal revenues, GDP and promotion incentives under the centralized political and decentralized fiscal institute in China [33]. Thus, many stimulus measures are adopted to boost economies [34,35] and then affected industrial structure [36]. However, the mechanism of the process has not been systematically studied because existing researches pay more attention to the evaluation of policy effects. Therefore, we try to explain the mechanism of the impact of the government incentives on automobile industrial structure.

The government can use different kinds of interventions, which take many forms, including explicit subsidies and bonus, such as research and development subsidies [37–39], but more of them are invisible, such as granting loan guarantees and loan preferences to enterprises to reduce their capital costs and financing constraints [40]. Another example is effective tax rates, which can be affected by tax preference and taxation intensity so that a firm's tax burden can be affected as well, although the tax rate is legal [41,42]. This kind of intervention changes with government incentives and varies in different enterprises.

We found both theoretically and empirically that the governments' GDP incentive induced the biased intervention policy on automobile manufacturing and maintenance industries. In the theoretical model, the government's GDP incentive leads to the more patience of the government than the consumer. The government doesn't care about current consumption, but care about whether enough investment and capital can be generated to promote economic growth. Thus, the enterprises of different industries that have different contributions to investment and capital accumulation will inevitably be subject to different government intervention. More preferential subsidies are given to automobile manufacturing firm whose production serve as intermediate goods and capital. Moreover, the greater the government's GDP incentive, the more biased the intervention will be. Then we test the differential impacts of GDP incentive on tax avoidance of the two kinds of firms empirically. The empirical results show that the government GDP incentive induced more preferential treatment to automobile manufacturing enterprises, and thus, increased their tax evasion compared with automobile maintenance firms.

Our study makes several contributions to the existing literature. First, we explained why China's automobile manufacturing and maintenance industry is unbalanced from the perspective of government intervention and incentives. Some researchers analyzed government intervention instruments and their effects on economic variables, such as resource misallocation, total factor productivity and costs [43,44], but little literature involves the motivation of government policies. The literature on optimal policy [30–32], which adds government policy in the general equilibrium model are more about the fiscal policy, monetary policy or tax policy on consumption or capital; little is about industrial policy in different sectors. Therefore, we investigated the impact of government incentive on industrial policy and industry structure, and provide a framework to study the interaction of government and the market, which also applies to other countries. Second, the growth rate of GDP is converging from the perspective of the development economics [45], and since automobile industry has always been a pillar industry and in China, how to promote the automobile industry to develop in a balanced way is crucial to the sustainable development of the automobile industry and even the whole economy in the future. Although some researchers focus on sustainable district development [46], balanced development of industry structure is also important. Finally, the research about China's automobile industry mainly focus on the manufacturing industry currently, such as the prediction of vehicle ownership [1,47,48], study on life cycle cost of electric vehicle [49–52], the bottleneck in the development of electric vehicles [53–55], and research on the development and market scale of ride-hailing [56,57]. There is little literature on automobile maintenance industry; however, we need to fully understand the development of the automobile industry, including the maintenance industry to promote sustainable development.

The remainder of the paper is organized as follows. Section 2 presents the theoretical model and the development of the empirical hypothesis. Section 3 introduces the empirical model, variable definitions and data resources. Section 4 provides the empirical evidence. Section 5 provides several robustness checks to make sure our results are robust. Section 5 concludes and presents policy implications.

2. Theoretical Model and Empirical Hypothesis

We build a general equilibrium model with government incentive to investigate the effect of government intervention on the automobile industry. The general equilibrium model is widely used in modern economic research, especially the macroeconomic research about economic growth and industry structure [15,17,18,23–25]. Furthermore, the method of adding government policy in the general equilibrium model is usually used in the literature of optimal policy [30–32]. However, the literature is more about the fiscal policy, monetary policy or tax policy on consumption or capital, little is about industrial policy in different sectors. Thus, we also investigate the impact of government intervention on the automobile industry structure and its mechanism in this framework.

2.1. Theoretical Model

We assume that there are four participants in the economy: A representative consumer, two representative producers (i.e., one is an automobile manufacturing firm and the other is automobile maintenance firm) and a government. The market is completely competitive. The products of automobile manufacturing firm produce the finished automobile and auto parts, which can be formed capital in the economy, while the products or service of automobile maintenance firm can be consumed. Thus, the automobile manufacturing firm is more likely to be the upstream firm, and while the automobile maintenance firm is a downstream firm in the input-output production connections. Both of the two firms use capital and labor as input in the production process. We use subsidies as tools of government intervention and omit other intervention methods, such as tax rate. The subsidy rate for the automobile maintenance firm is denoted as s_1, and the subsidy rate for the automobile manufacture firm is denoted as s_2. The subsidy rates can be explained as the degree of government preferential, such as the relaxation of taxation [42]. The representative consumer is the providers of capital and labor. He provides capital and labor to producers and obtains rents and wage at the same time. Then the consumer uses the income to consume maintenance service to maximize utility for all periods of time. The utility maximization problem of the representative consumer can be expressed as:

$$\max_{c_t, K_{t+1}} u = \sum\nolimits_{t=0}^{\infty} \beta^t u(c_t), \tag{1}$$

$$c_t + p_t(K_{t+1} - K_t + \delta K_t) \leq r_t K_t + w_t L - T_t, \tag{2}$$

here, u is the utility of the consumer, and $u(\cdot)$ is the utility function; c_t is the consumption of the consumer at time t; K_t is the capital stock at time t; L is the fixed labor supply per period; β is the discount rate, and δ is the depreciation rate of capital. Since there are only two products in the economy, we might as well set the price of the automobile maintenance service as one and the price of the automobile manufacturing production as p_t. The wages of the labor and the rent of capital are w_t and r_t, respectively. T_t is the lump-sum tax on consumer's income. We list the definition of each parameter in Table 1. If we set the Lagrangian multiplier of each period is λ_t, then the first-order condition of the consumer problem is:

$$u'(c_t) = \lambda_t, \tag{3}$$

$$\lambda_t p_t = \beta \lambda_{t+1}(p_{t+1} + r_{t+1} - \delta p_{t+1}). \tag{4}$$

Thus, the Euler Equation is obtained from Equations (3) and (4):

$$\frac{p_t}{r_{t+1} + (1-\delta)p_{t+1}} = \frac{\beta u'(c_{t+1})}{u'(c_t)}. \tag{5}$$

We assume that the production function of the automobile maintenance firm is $F_1(K_{1t}, L_{1t})$ and the production function of the automobile manufacturing firm is $F_2(K_{2t}, L_{2t})$. The production functions satisfy $F_{iK} > 0$, $F_{iL} > 0$, $F_{iKK} < 0$, $F_{iLL} < 0$, $F_{iKL} > 0$, $i = 1, 2$. The producers in each sector maximize the profits of each period:

$$\max_{K_{1t}, L_{1t}} \pi_1 = (1 + s_{1t})F_1(K_{1t}, L_{1t}) - w_t L_{1t} - r_t K_{1t}, \tag{6}$$

$$\max_{K_{2t}, L_{2t}} \pi_2 = p_t(1 + s_{2t})F_2(K_{2t}, L_{2t}) - w_t L_{2t} - r_t K_{2t}, \tag{7}$$

here, π_1 and π_2 represent the profit of automobile maintenance and manufacturing firms, respectively. Then the first-order conditions for the capital of the automobile maintenance firm and automobile manufacture firm are:

$$(1 + s_{1t})F_{1K} = r_t, \tag{8}$$

$$p_t(1 + s_{2t})F_{2K} = r_t, \tag{9}$$

here, we omit the subscript of time t of the production functions for briefness. The first-order conditions for labor of the automobile maintenance firm and automobile manufacture firm are:

$$(1 + s_{1t})F_{1L} = w_t, \tag{10}$$

$$p_t(1 + s_{2t})F_{2L} = w_t. \tag{11}$$

We can know from Equations (8)–(11) that the government can influence the marginal production of labor and capital and then the production decisions of the firms, and then determine the capital flows between the two sectors by setting different subsidy rates. The government's subsidy expenditure comes from the lump-sum tax T_t imposed on consumers. Thus, the government's budget constraint is

$$T_t = s_{1t}F_1(K_{1t}, L_{1t}) + s_{2t}p_{2t}F_2(K_{2t}, L_{2t}). \tag{12}$$

As a social planner, the government's goal is certainly to maximize social welfare. However, the local governments have the promotion pressure in their career under the decentralization institute in China, so their goal is not entirely social welfare maximization, but the short-term GDP in their tenure. This incentive makes the government's time preference different from the consumer's in the market. The government is more willing to spend in the future and save currently to promote short-term growth of GDP. We set the government's short-term GDP incentive intensity to be a, which satisfies $1 < a < 1/\beta$. Then the discount rate of government is $a\beta$, and the larger the value of a, the greater the GDP incentive the government has. Therefore, the government's objective function is:

$$\max u_g = \sum\nolimits_{t=1}^{\infty} (a\beta)^t u(c_t), \tag{13}$$

here, u_g is the utility of the government. Given the subsidy rates s_{1t} and s_{2t} for the automobile maintenance firm and automobile manufacturing firm, the equilibrium of market can be determined by Equations (2), (5), (8)–(11) and the market clear conditions of the products of the two sectors, capital and labor, which is the Equations (14)–(17) below. The market clear condition for automobile maintenance service market is:

$$F_1(K_{1t}, L_{1t}) = c_t. \tag{14}$$

The market clear condition for automobile manufacturing market is:

$$F_2(K_{2t}, L_{2t}) = K_{1,t+1} + K_{2,t+1} - (1 - \delta)(K_{1t} + K_{2t}). \tag{15}$$

The market clear condition for capital is:

$$K_{1t} + K_{2t} = K_t. \tag{16}$$

The market clear condition for labor is:

$$L_{1t} + L_{2t} = L. \tag{17}$$

This system expressed the dynamic equilibrium relationships for variables $\{c_t, K_{1t}, K_{2t}, K_t, L_{1t}, L_{2t}, p_t, r_t, w_t, T_t\}$. Then the government will choose the optimal subsidy rates s_{1t} and s_{2t} constrained by the market equilibrium conditions. We solve this problem with the steps below. Firstly, using the Euler Equation, which is Equation (5) and budget constraint, which is Equation (2), we change the consumer's budget constraint, which is Equation (2), of each period into budget constraint of all periods (please see the detail calculation in Appendix A part), which is:

$$\sum\nolimits_{t=0}^{\infty} \beta^t \, u'(c_t)(c_t - w_t L + T_t) = u'(c_0)[r_0 K_0 + p_0(1 - \delta)K_0]. \tag{18}$$

We denote the right hand of Equation (18) as $A = u'(c_0)[r_0K_0 + p_0(1-\delta)K_0]$, which is constant. Then the government will optimize Equation (13) conditioning on Equations (14)–(18), and choose the optimal value of variables $\{c_t, K_{1t}, K_{2t}, L_{1t}, L_{2t}\}$. The Lagrange function of this problem is:

$$\begin{aligned}\Gamma = &\sum_{t=0}^{\infty}(a\beta)^t\left\{\begin{array}{l} u(c_t)+\eta_{1t}[F_1(K_{1t},L_{1t})-c_t] \\ +\eta_{2t}[F_2(K_{2t},L_{2t})-K_{1t+1}-K_{2t+1}+(1-\delta)(K_{1t}+K_{2t})] \\ +\eta_{3t}[L-L_{1t}-L_{2t}]\end{array}\right\}, \\ &+\sum_{t=0}^{\infty}[\beta^t\phi u'(c_t)(c_t-w_tL+T_t)]-\phi A\end{aligned} \tag{19}$$

here, the parameters $\eta_{1t}, \eta_{2t}, \eta_{3t}$, ϕ are Lagrange multipliers for the constraints. We can get the dynamic equilibrium system for $\{c_t, K_{1t}, K_{2t}, L_{1t}, L_{2t}, \eta_{1t}, \eta_{2t}, \eta_{3t}, \phi\}$ using the first order conditions of variables c_t, $K_{1,\,t+1}, K_{2,t+1}, L_{1t}, L_{2t}$ of Equation (19) and constraints, which is Equations (14), (15) and (17). Specially, according to the analysis of the first order conditions at steady state we can get this conclusion below.

Proposition 1. *When $a > 1$, we have $s_2 > 0$; the greater the government's GDP incentives, the larger the subsidy s_2 to the automobile manufacturing sector, and the greater the gap of government's preferential support for automobile manufacturing sector and that for automobile maintenance sector.*

Proof. We only focus on the first order conditions of variables $K_{1,\,t+1}$, $K_{2,t+1}$ and c_t, at the steady state, which means we can omit the subscript of time, and they can be expressed as:

$$\eta_2 = a\beta[\eta_1F_{1K} + (1-\delta)\eta_2], \tag{20}$$

$$\eta_2 = a\beta[\eta_2F_{2K} + (1-\delta)\eta_2], \tag{21}$$

$$\eta_1 = u'(c) + \frac{\phi u''(c)(c-wL)+u'(c)}{a^t}. \tag{22}$$

From the steady state of Euler Equation, which is Equation (5), we can get:

$$\frac{1}{\beta} = 1-\delta+\frac{r}{p}. \tag{23}$$

From the first order condition of the automobile maintenance sector, which is Equation (8), at the steady state, we can get:

$$F_{1K} = r/(1+s_1). \tag{24}$$

From the first order condition of the automobile manufacturing sector, which is Equation (9), at the steady state, we can get:

$$pF_{2K} = r/(1+s_2). \tag{25}$$

Substituting the conditions of Equations (8) and (23) into Equation (20), we can get:

$$\frac{1}{a\beta}-\frac{1}{\beta}+\frac{r}{p} = \frac{\eta_1 r}{\eta_2(1+s_1)}, \tag{26}$$

and substituting the conditions of Equations (9) and (23) into Equation (21), we can get:

$$\frac{1}{a\beta}-\frac{1}{\beta}+\frac{r}{p} = \frac{r}{p(1+s_2)}. \tag{27}$$

Then from Equation (27), since we assume as $a > 1$, the subsidy rate for the automobile manufacturing sector $s_2 > 0$, and s_2 increases with the increasing of a, which means the government

indeed give subsidy to the automobile manufacturing firm, and the subsidy increases with the increasing of short term GDP incentive.

Then we will analyze the subsidy to the automobile maintenance firms. Dividing Equation (27) by Equation (26), we can get:

$$\frac{1+s_1}{1+s_2} = \frac{p\eta_1}{\eta_2}. \tag{28}$$

We can know that η_1 decreases with parameter a, while η_2 does not change with parameter a according to Equation (22) assuming $u''(c)$ is small enough, and the term $\phi u''(c)(c - \varpi L) + u'(c)$ is positive. This means the shadow value of automobile maintenance service decrease when the government' GDP incentive is large. So $\frac{1+s_1}{1+s_2}$ will decrease with a, which means the gap of government's preferential support for automobile manufacturing sector and automobile maintenance sector increases with government's GDP incentive. □

These results can be interpreted as that the government pays more attention to future consumption and production, due to short-term GDP incentives and the limited tenure, which means the government utility is different with the consumer's because the consumer prefers the current consumption. Then the government subsidizes the firms in the automobile manufacturing sector that can be formed as capital and then more capital will produce more product and GDP because the capital is the necessity of the production process and has the multiplier effect in the process. Moreover, the larger the short-term GDP incentives, the larger the subsidies on the automobile manufacturing sector, and the larger gap between the subsidy given to the automobile manufacturing firm and the subsidy given to the automobile maintenance firm. That's why the government with short-term GDP incentive will intervene differently in the different sectors.

In the empirical part in Section 3, we will test the positive correlation of the government's short-term GDP incentives on the biased subsidy between the firms of automobile manufacture sector and firms of automobile maintenance sector. So we firstly propose the empirical hypothesis in Section 2.2 before the empirical research design.

2.2. Empirical Hypothesis

According to the theoretical analysis in Section 2.1, we know that when the government has short-term GDP incentives, he intervenes differently in automobile industries. In order to provide more capital for the entire economy to drive more output of all industries because of the multiplier effect of the capital in macroeconomics, the government will support the development of the automobile manufacturing sector with more subsidies, while the subsidies implemented in the automobile maintenance industry will be relatively less. The differential subsidies can reduce consumption and promote capital accumulation, thus, contribute to GDP growth. To prove the mechanism of our theoretical model and conclusion, we will give some empirical evidence about how the government's short term GDP incentive can affect the biased government intervention between the firms of automobile manufacture sector and firms of automobile maintenance sector. Furthermore, we will find the appropriate proxies of government intervention and government's short-term GDP incentives.

As for the measure of government intervention, the government subsidy is a kind of government intervention, and it is usually carried out in the form of preferential treatment or hidden subsidies for firms, which cannot be seen directly, however, the preferential treatment can be reflected in the degree of tax avoidance of firms. Although the tax collection is stipulated by the law of tax, the tax law also allows the government to implement tax reduction and tax preference accordingly, which induced that the actual tax rates of enterprises may not the actual tax rate ruled by the tax law. In addition, the government can use different taxation intensity; thus, the degrees of tax evasion of different enterprises are different. Thus, when the government has more GDP incentive, more preferential treatment will be given to automobile manufacturing enterprises, and the tax avoidance of these enterprises should be larger. So we use the tax avoidance of the firm to represent the

degree of government intervention, and the larger tax avoidance, the large degree of government intervention. Since the government intervention is biased to automobile manufacturing enterprises and the biased gap increases with the government's GDP incentives, we have the following empirical hypothesis below.

Hypothesis 1. *The higher government's GDP incentives will increase the gap of tax avoidance between the automobile manufacturing enterprises and automobile maintenance enterprises.*

Table 1. Notation list.

Notifications	Definitions
u	Utility of the consumer.
$u(\cdot)$	Utility function.
c_t	Consumption of the consumer at time t.
K_t	Capital stock at time t.
K_{1t}	Capital used in automobile manufacturing production at time t.
K_{2t}	Capital used in automobile maintenance production at time t.
L	Fixed labor supply per period.
L_{1t}	Labor used in automobile manufacturing production at time t.
L_{2t}	Labor used in automobile maintenance production at time t.
β	Discount rate.
δ	Depreciation rate of capital.
p_t	Price of the automobile manufacturing production.
w_t	Wages of the labor.
r_t	Rent of capital.
T_t	Lump-sum tax on consumer's income.
λ_t	Lagrangian multiplier in consumer's problem of each period.
$F_1(\cdot)$	Production functions of automobile manufacturing firm.
$F_2(\cdot)$	Production functions of automobile maintenance firm.
π_1	Profit of automobile manufacturing firm.
π_2	Profit of automobile maintenance firm.
s_{1t}	Government subsidy ratios for automobile manufacturing firm.
s_{2t}	Government subsidy ratios for automobile maintenance firm.
a	Government's short-term GDP incentive intensity.
u_g	Utility of the government.
Γ	Lagrangian equation notation.
η_{1t}	Lagrange multipliers for automobile maintenance market constraint of each period.
η_{2t}	Lagrange multipliers for automobile manufacturing market constraint of each period.
η_{3t}	Lagrange multipliers for labor market constraint of each period.
ϕ	Lagrange multipliers for consumer's budget constraint.
A	Constant, and $A = u'(c_0)[r_0K_0 + p_0(1-\delta)K_0]$

3. Empirical Method

3.1. Setting up of Empirical Model

According to the theoretical model, it can be known that the greater the government's short-term GDP incentives, the greater the difference in preferential subsidies between the two kinds of firms. Since most of the preferential subsidies are invisible, we use indirect methods to measure the biased intervention policies of the government. Specifically, we use the difference between the actual income tax rates in the two kinds of firms to reflect the difference in government intervention bias. The gap of actual income tax rate and the statutory tax rate, induced by taxation intensity, can reflect the degree of government intervention. The lower the actual income tax rate, the greater the government's preferential subsidy. Since the pre-tax profit is usually not the real profit of the enterprise, the proportion of the income tax in pre-tax profit does not accurately reflect the actual income tax rate of the enterprise. Some researchers use tax avoidance to measure the actual tax rate of the firms [41,42], because the larger the tax evasion equals the lower actual tax rate, which also indicates the smaller government

taxation intensity and the larger extent of the government intervention. We use the method of [41,42] to calculate the tax avoidance degree of the enterprise.

The idea of this method is like this. Although the reported profit is not the real profit of the enterprise, it is related to the real profit, and we can calculate the estimated profit, which is also not exactly the real profit, but related to it. Then there will be a large error if we use the difference between the estimated profit and the reported profit as the hidden profit of the enterprise. However, we can know that the estimated profit is related to the reported profit, and the greater the correlation, the smaller degree of the enterprise's tax avoidance. Thus, [41] measured the degree of tax avoidance of enterprises by calculating the sensitivity of estimated profit, which is based on the method of national income accounting, and the reported profit. Firstly, the estimated profit of the enterprise is highly correlated with the real profit π_{it}. It is assumed that the relationship between the real profit and the estimated profit is expressed as:

$$\pi_{it} = \eta_{it} + PRO_{it} + \theta_{it}, \tag{29}$$

here, the subscripts i and t represent the enterprise and the year, respectively. η_{it} is a constant, θ_{it} is a random error, and PRO is the estimated profit. According to the principle of national income accounting, the estimated profit can be expressed as:

$$PRO_{it} = \frac{Y_{it} - MED_{it} - FC_{it} - WAGE_{it} - DEP_{it} - VAT_{it}}{TAS_{it}}, \tag{30}$$

here, Y represents the total industrial output value of the enterprise; MED represents the total industrial input; FC represents the financial expenses; $WAGE$ represents the expenditure of wage expressed by the total payable wage; DEP is the depreciation this year; VAT is the amount of payable value added tax and TAS indicates the total assets of the enterprise.

Secondly, the industrial enterprise database discloses the pre-tax profit reported by the company, which is the reported profit of the enterprise, denoted by $RPRO$, and the reported profit of the enterprise is also related to the real profit π_{it}, which can be expressed as:

$$RPRO_{it} = d_{it}\pi_{it} + e_{it} + \xi_{it}, \tag{31}$$

here the reported profit $RPRO$ is defined as the ratio of total profit and total assets; e_{it} is the constant term; ξ_{it} is the random disturbance term; d_{it} is the sensitivity between the reported profit and the real profit, and the smaller value of d indicating the higher the degree of tax avoidance. According to the theoretical model, the government's GDP incentives will affect the difference between the actual tax burden of automobile manufacturing enterprises and automobile maintenance enterprises, which is the difference of sensitivity between the two kinds of firms. Therefore, we can express this impact as:

$$d_{it} = \beta_0 + \beta_1 VEHM_{it} + \beta_2 GOV_{it} + \beta_3 VEHM_{it} \times GOV_{it} + \chi X_{it} + \lambda_t + \gamma_j + \nu_{it}, \tag{32}$$

here, GOV indicates the government's incentive; $VEHM$ is a dummy variable which equals one if the firm belongs to the automobile manufacturing industry and zero otherwise; X indicates the firm level characteristic variables; λ_t represents the year fixed effect, and γ_j represents province fixed effect. β_1 presents the difference of sensitivity of reported profits to real profits between the manufacturing industry and the maintenance industry; β_2 indicates the influence of government incentives on the sensitivity of reported profits and real profits, and the coefficient β_3 of the interaction term $VEHM \times GOV$ indicates the difference of the impact of government's GDP incentives on sensitivity between automobile manufacturing firms and maintenance firms. Since the real profit of the enterprise cannot be observed, Equation (32) cannot be estimated directly. Therefore, we substitute the real profit represented by the estimated profit, which is Equation (29), into the expression of the reported profit, which is Equation (31) and then we can get

$$RPRO_{it} = d_{it}PRO_{it} + d_{it}\eta_{it} + e_{it} + \varepsilon_{it}, \tag{33}$$

here, $\varepsilon_{it} = \xi_{it} + d_{it}\theta_{it}$. Then we take the expression of the sensitivity d_{it} between the profit and the real profit, which is Equation (32), into the relationship between the estimated profit and the reported profit, which is Equation (33) and we finally get this expression:

$$\begin{aligned} RPRO_{it} = (&\beta_0 + \beta_1 VEHM_{it} + \beta_2 GOV_{it} + \beta_3 VEHM_{it} \times GOV_{it} + \beta_4 X_{it} + \lambda_t \\ &+\gamma_j) \times PRO_{it} + \alpha_0 + \alpha_1 VEHM_{it} + \alpha_2 GOV_{it} + \alpha_3 VEHM_{it} \times GOV_{it} \\ &+\alpha_4 X_{it} + \lambda_t + \gamma_j + \mu_{it}. \end{aligned} \tag{34}$$

Thus, the coefficient β_3 of the triple interaction term $VEHM \times GOV \times PRO$ indicates the difference of the impact of government's GDP incentives on sensitivity between automobile manufacturing firms and automobile maintenance firms. If β_3 is negative, it means that automobile manufacturing firms have been given more preferential support under government incentives, which lead to their larger tax avoidance compared with the automobile maintenance companies.

Referring to the relevant literature [41,42], we control other firm level variables, including the firm size (*SIZE*), which is expressed in terms of the natural logarithm of the company's total assets; the liability-asset ratio (*LEV*), which equals the ratio of total liabilities to total assets of an enterprise; the age of the firm (*AGE*), which is the logarithm of the difference between the establishment year and the sample year; the financial expense (*LOAN*), which is the ratio of interest expense to total assets; the proportion of exports (*EXPT*), which is the ratio of export delivery value to the total assets; the ratio of industrial sales to the total value of industrial output (*SALE*) and the dummy variable (*SOE*) that indicates whether the enterprise is a state-owned enterprise or not.

3.2. Variable Definition of Government Incentive

Literature on political promotion tournaments, fiscal decentralization, fiscal revenue incentives and GDP growth [34,36] all mentioned that fiscal decentralization leads to GDP and fiscal incentives of the local government. In addition, stronger fiscal autonomy is most directly related to GDP incentives compared with other policies that can be used by local governments. Since China introduced to reform and opening policies, economic growth has been the main task of the government. When the promotion of officials depends more on the performance of economic growth under the horizontal competition among regions, the GDP incentive of local governments through fiscal approach becomes stronger [34,35]. Therefore, fiscal decentralization is the best measure of GDP incentive of local governments. It can be considered that the fiscal decentralization is a measure of autonomy of local governments on fiscal revenue and expenditure, and the larger the degree of fiscal decentralization, the stronger the fiscal autonomy of local governments because of the higher financial autonomy and the higher resource utilization capacity.

The fiscal decentralization system reflects the division of fiscal power and administrative power between the central and local governments, especially the revenue and expenditure power delegated by the central government to local ones. So the fiscal decentralization index should reflect the degree of local governments' control over fiscal power and administrative power. Oates firstly adopted three indicators of fiscal revenue and expenditure to represent the degree of fiscal decentralization [58]. Zhang and Gong [35] defined a group of indicators that represent the ratio of local government's income, or expenditure to the central government ability to measure fiscal decentralization. Lv et al. [42] used the tax decentralization index to measure the tax sharing incentives of local government. Since fiscal revenue, especially tax revenue, can represent a large part of the government's financial power, thus, tax sharing incentive is consistent with fiscal decentralization. So we use the following three tax sharing indicators to define the government's GDP incentive referring to Lv et al. [42].

1. The sharing rate of value added tax, denoted as *VAT*—which is defined as the ratio of the *VAT* revenue in the fiscal revenue of the province to the *VAT* revenue collected by the tax department of the province.
2. The sharing rate of income tax, denoted as *INC*—which is defined as the ratio of income tax revenue in the fiscal revenue of the province to the income tax revenue collected by the tax department of the province.
3. The sharing rate total tax, denoted as *TAX*—which is defined as the ratio of the total tax revenue in the fiscal revenue of the province to the total tax revenue collected by the tax department of the province.

3.3. Data

The data in our research comes from two resources. Firstly, the firm level data of automobile manufacturing and maintenance enterprises come from the database of Chinese Industrial Enterprises from 1998 to 2007. Researches using this database usually only cover these years because the sample in this period is believed to be more valid and reasonable. After excluding samples with missing values and samples with negative values in some important enterprise characteristic variables (such as total assets, total liabilities, total profit and industrial sales value), we get a total of 44,268 observations. Secondly, the data of macroeconomic variables, which includes the total tax revenue, VAT revenue, the income tax revenue in the fiscal income of each province, the total tax revenue, VAT revenue, the income tax revenue collected by the tax authorities of each province that are all used to calculate the provincial government incentives, come from Wind database, Chinese Tax Yearbook and Chinese Fiscal Yearbook. Wind database is a large financial database in China.

4. Empirical Evidence

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics of variables in our regression. We can see that 90% of firms in our sample are in the automobile manufacturing industry, which is consistent with the situation that the automobile industry is less developed in China. The mean of the sharing rate of value added tax, income tax and total tax are 23%, 63%, and 50%, respectively. The average logarithm of firm age is 2, and the mean of leverage is 1%, with the standard deviation of 2% and a maximum value of 10%. The average proportion of the exports is 11%, with the standard error of 38%. Moreover, 25% of firms are SOEs and 6% foreign firms in our sample; 97% of firms are in normal operation; and 3% of the firms belong to the central government and 3% belong to large firms.

Table 2. Descriptive statistics of each variable.

Variables	Observations	Mean	SD	Min	Median	Max
RPRO	44,268	0.09	0.14	0.00	0.05	0.95
PRO	44,268	0.23	0.46	−0.39	0.10	2.92
VEHM	44,268	0.90	0.30	0.00	1.00	1.00
VAT	44,268	0.23	0.03	0.19	0.23	0.27
INC	44,268	0.63	0.17	0.37	0.61	0.90
TAX	44,268	0.50	0.08	0.39	0.51	0.69
SIZE	44,268	9.87	1.65	0.69	9.67	18.17
AGE	44,268	2.00	0.99	0.00	1.95	7.60
LOAN	44,268	0.01	0.02	0.00	0.00	0.10
EXPT	44,268	0.11	0.38	0.00	0.00	2.40
SALE	44,268	0.97	0.08	0.67	0.99	1.27
SOE	44,268	0.25	0.44	0.00	0.00	1.00
FOREG	44,268	0.06	0.24	0.00	0.00	1.00
OPRT	44,268	0.97	0.18	0.00	1.00	1.00
CENTR	44,268	0.03	0.18	0.00	0.00	1.00
LARGE	44,268	0.03	0.18	0.00	0.00	1.00

4.2. The Impact of Government Incentive on Tax Avoidance

According to the theoretical model, when the government's GDP incentive is large, the government will increase preferential treatment for enterprises, which will lower the actual tax burden of enterprises, and the government's preferential policies favors more to automobile manufacturing enterprises, which contribute more to capital accumulation. Table 3 shows the regression results of the impact of government incentives on the actual tax burden and the differences of this impact between automobile manufacturing and maintenance enterprises. We did not list the coefficients of intersection terms between the annual dummy variables and the calculated profit *PRO* in the table, and the intersection between provincial dummy variables and the calculated profit *PRO* are also omitted for simplicity. All regressions used the robust standard error to avoid heteroscedasticity problems. No government incentive variable is added In Column (1) of Table 2. The coefficient of intersection term of *VEHM* and *PRO* represents the difference of actual tax burden between automobile manufacturing enterprises and maintenance enterprises, and the coefficient is not significant, which means the actual tax burden difference between the two enterprises is not significant if the influence of government incentives is not controlled. The regression results of Column (2–4) show the regression results controlling the government incentives. The coefficients of the $GOV \times PRO$ in the column (2–4) are insignificant or negative, which indicates that the greater the government's GDP incentive is, the larger preferential to the enterprises, and thus, the actual tax burden of enterprises will be reduced. However, we care more about the coefficients of the triple intersection terms of $VEHM \times GOV \times PRO$. In the Column (2–4), the coefficients of these terms of are all significantly negative, which shows that although the government's GDP incentive leads to the reduction of the actual tax burden of enterprises, however, what more important is that the government's intervention is biased, and the government gives more preferential subsidies to firms of automobile manufacturing industries. The government's GDP incentive plays a bigger role in reducing the actual tax burden of enterprises for automobile manufacturing enterprises than for automobile maintenance enterprises. For example, the coefficient of the triple interaction term in Column (4) is −0.4934, which indicates that the negative effect of government incentives on firm's tax burden is about 0.5 lower in the automobile manufacturing firms compared with the automobile maintenance firms. These results confirm the hypothesis and prove the conclusion of theoretical model empirically as well.

Table 3. The influence of government incentive on the sensitivity of reported profit and real profit.

	Dependent Variable: *RPRO*			
	(1)	**(2)**	**(3)**	**(4)**
	No *GOV*	***GOV = VAT***	***GOV = INC***	***GOV = TAX***
PRO_VEHM	−0.0166 (−1.61)	0.1723 *** (3.40)	0.0578 * (1.65)	0.2273 *** (4.09)
PRO_SIZE	0.0011 (0.63)	0.0006 (0.29)	0.0002 (0.13)	0.0019 (0.96)
PRO_AGE	0.0066 ** (2.11)	0.0072 ** (2.32)	0.0064 ** (2.05)	0.0064 ** (2.07)
PRO_LOAN	0.1077 (1.19)	0.1132 (1.25)	0.1043 (1.16)	0.1257 (1.39)
PRO_EXPT	−0.0156 ** (−2.44)	−0.0155 ** (−2.39)	−0.0153 ** (−2.40)	−0.0167 *** (−2.61)
PRO_SALE	0.1015 *** (5.11)	0.0947 *** (3.26)	0.0763 *** (2.79)	0.1561 *** (5.15)
PRO_SOE	0.0045 (0.61)	0.0036 (0.49)	0.0042 (0.57)	0.0050 (0.68)
PRO_FOREG	−0.0028 (−0.15)	−0.0023 (−0.12)	−0.0016 (−0.09)	0.0029 (0.16)

Table 3. *Cont.*

	Dependent Variable: *RPRO*			
	(1)	**(2)**	**(3)**	**(4)**
	No *GOV*	***GOV* = *VAT***	***GOV* = *INC***	***GOV* = *TAX***
PRO	−0.0004 *** (−3.91)	−0.0005 *** (−4.56)	−0.0005 *** (−4.15)	−0.0006 *** (−5.16)
VEHM	0.0111 *** (5.66)	0.0338 ** (2.23)	0.0015 (0.16)	−0.0056 (−0.51)
SIZE	−0.0038 *** (−9.52)	−0.0037 *** (−9.08)	−0.0036 *** (−8.97)	−0.0039 *** (−9.65)
AGE	−0.0090 *** (−14.65)	−0.0091 *** (−14.78)	−0.0089 *** (−14.60)	−0.0090 *** (−14.70)
LOAN	−0.0008 *** (−3.34)	−0.0006 *** (−2.78)	−0.0007 *** (−3.16)	−0.0007 *** (−2.84)
EXPT	0.0091 *** (4.45)	0.0091 *** (4.37)	0.0091 *** (4.49)	0.0094 *** (4.67)
SALE	0.0015 (1.29)	0.0015 (1.30)	0.0016 (1.31)	0.0013 (1.25)
SOE	−0.0091 *** (−5.98)	−0.0091 *** (−5.98)	−0.0090 *** (−5.89)	−0.0088 *** (−5.78)
FOREG	0.0169 *** (5.40)	0.0165 *** (5.25)	0.0167 *** (5.31)	0.0166 *** (5.30)
PRO_VEHM_GOV		−0.7748 *** (−3.73)	−0.0953 ** (−2.19)	−0.4750 *** (−4.31)
VEHM_GOV		−0.1003 (−1.59)	0.0126 (1.08)	0.0323 (1.53)
PRO_GOV		−0.0671 (−0.45)	0.0514 (1.40)	−0.2954 *** (−3.23)
GOV		0.1660 ** (2.34)	−0.0115 (−0.95)	−0.5370 *** (−6.04)
Constant	0.1450 *** (27.96)	0.1078 *** (6.53)	0.1507 *** (14.00)	0.3666 *** (9.97)
YEAR	YES	YES	YES	YES
*PRO * YEAR*	YES	YES	YES	YES
PROVINCE	YES	YES	YES	YES
*PRO * PROVINCE*	YES	YES	YES	YES
Observations	44,268	44,268	44,268	44,268
Adjusted R^2	0.35	0.35	0.35	0.35

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3. The Influence of Government Incentive Changes on Tax Evasion of Different Types of Enterprises

4.3.1. Enterprises Ownership

The impact difference in government incentives varies in different types of enterprises. For example, it is generally believed that government interventions are different in enterprises with different ownership in the literature. On the one hand, state-owned enterprises will receive more preferential treatment and subsidies from the government. On the other hand, state-owned enterprises (SOEs) are mostly in the upstream industries, especially the manufacturing industry [59]. According to the theoretical model, enterprises in the automobile manufacturing industry, which is more likely to be the upstream industries, are more easily affected by the government incentives. So we conjecture that the difference of impact of government's GDP incentive tax avoidance between automobile manufacturing

enterprise and automobile maintenance enterprise will be more significant in state-owned enterprises. Therefore, we divided the samples into SOEs and non-SOEs to compare this impact difference. We define the SOEs as the firms whose registration types are state-owned, collective or wholly state-owned firms. Table 4 showed the regression results of Equation (28) in SOEs and non-SOEs. We can see that the coefficients of triple interaction term $VEHM \times GOV \times PRO$ are all significantly negative in the group of SOEs, which is Column (1) (3) and (5), and the absolute value is larger than the coefficients in Table 3. However, the coefficients of triple interaction term $VEHM \times GOVPRO$ are not significant in the group of non-SOEs, i.e., Column (2) (4) and (6), which indicates that the bias of preferential government subsidies caused by GDP incentives is more obvious in SOEs. The government, which is inspired by GDP incentive, gives more subsidizes to upstream enterprises, especially state-owned enterprises. This behavior will induce a larger amount of investment in industries that are more helpful to capital accumulation, which will promote economic growth. These results further prove our conclusion in the theoretical model.

Table 4. Regression results of different ownership enterprises.

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	SOE	**nSOE**	**SOE**	**nSOE**	**SOE**	**nSOE**
PRO_VEHM_GOV	−2.2074 *** (−6.28)	0.5450 ** (1.98)	−0.3651 *** (−5.73)	0.2024 *** (3.28)	−0.7655 *** (−4.78)	0.0538 (0.33)
VEHM_GOV	−0.0227 (−0.26)	−0.1985 ** (−2.09)	0.0580 *** (3.77)	−0.0606 *** (−3.61)	0.0050 (0.17)	0.0157 (0.45)
PRO_GOV	0.1401 (0.50)	−0.4679 ** (−2.55)	0.1278 ** (2.20)	−0.1619 *** (−3.08)	0.1082 (0.66)	−0.4560 *** (−4.13)
PRO_VEHM	0.5187 *** (5.98)	−0.1198 * (−1.86)	0.2628 *** (5.23)	−0.1511 *** (−3.05)	0.3582 *** (4.51)	−0.0102 (−0.12)
PRO_SIZE	−0.0016 (−0.42)	0.0022 (0.95)	−0.0022 (−0.61)	0.0025 (1.09)	−0.0010 (−0.26)	0.0033 (1.42)
PRO_AGE	−0.0017 (−0.30)	0.0085 ** (2.26)	−0.0011 (−0.20)	0.0088 ** (2.36)	−0.0024 (−0.42)	0.0089 ** (2.39)
PRO_LOAN	0.4067 ** (2.42)	−0.0237 (−0.22)	0.3307 ** (2.09)	−0.0175 (−0.16)	0.4190 ** (2.52)	−0.0094 (−0.09)
PRO_EXPT	−0.0308 (−1.58)	−0.0141 ** (−2.11)	−0.0129 (−0.60)	−0.0142 ** (−2.12)	−0.0254 (−1.29)	−0.0151 ** (−2.25)
PRO_SALE	0.0169 (0.32)	0.1773 *** (5.35)	0.0169 (0.34)	0.1842 *** (5.60)	0.0140 (0.25)	0.2226 *** (6.69)
PRO	−0.0008 *** (−5.07)	0.0002 (0.12)	−0.0007 *** (−4.69)	0.0003 (0.14)	−0.0009 *** (−5.49)	0.0005 (0.25)
VEHM	0.0159 (0.73)	0.0585 *** (2.59)	−0.0323 *** (−2.68)	0.0597 *** (4.55)	0.0092 (0.63)	0.0030 (0.16)
GOV	0.0413 (0.38)	0.1610 (1.57)	−0.0498 *** (−3.15)	0.0560 *** (3.11)	−0.3299 ** (−2.03)	−0.4196 *** (−3.87)
SIZE	−0.0065 *** (−9.45)	−0.0024 *** (−4.74)	−0.0064 *** (−9.60)	−0.0024 *** (−4.83)	−0.0066 *** (−9.62)	−0.0026 *** (−5.17)
AGE	−0.0113 *** (−11.01)	−0.0077 *** (−10.11)	−0.0113 *** (−11.02)	−0.0078 *** (−10.20)	−0.0112 *** (−10.93)	−0.0078 *** (−10.23)
LOAN	0.1052 ** (2.37)	−0.0009 (−0.73)	0.1197 *** (2.77)	−0.0009 (−0.76)	0.1277 *** (3.00)	−0.0010 (−0.82)
EXPT	0.0244 ** (2.30)	0.0082 *** (3.76)	0.0217 ** (2.05)	0.0082 *** (3.69)	0.0230 ** (2.11)	0.0084 *** (3.83)
SALE	−0.0000 (−0.10)	0.0043 * (1.74)	−0.0000 (−0.09)	0.0042 * (1.74)	−0.0000 (−0.05)	0.0039 * (1.79)

Table 4. *Cont.*

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	SOE	**nSOE**	**SOE**	**nSOE**	**SOE**	**nSOE**
PRO_FOREG		−0.0054 (−0.29)		−0.0070 (−0.37)		−0.0044 (−0.23)
FOREG		0.0163 *** (5.16)		0.0168 *** (5.28)		0.0164 *** (5.18)
Constant	0.1691 *** (6.88)	0.0791 *** (3.29)	0.2144 *** (14.37)	0.0752 *** (5.06)	0.3103 *** (4.63)	0.2938 *** (6.46)
YEAR	YES	YES	YES	YES	YES	YES
*PRO * YEAR*	YES	YES	YES	YES	YES	YES
PROVINCE	YES	YES	YES	YES	YES	YES
*PRO * PROVINCE*	YES	YES	YES	YES	YES	YES
Observations	11,286	32,982	11,286	32,982	11,286	32,982
Adjusted R^2	0.45	0.32	0.44	0.32	0.44	0.32

Note: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3.2. Firm Size

Large enterprises playing a greater role in capital accumulation, and the government tend to "seize the large enterprises and release the small ones" [60], so large enterprises are more like to be the government's target and can promote GDP growth better. Therefore, if the government conducts a differential intervention on enterprises in different industries, due to the GDP incentive, we conjecture that the effect of a government tax incentive on reducing the actual tax burden of manufacturing enterprises will be more obvious in large enterprises. Therefore, we group the samples by firm size disclosed in the industrial enterprise database. The large firms include the enterprises with the label of "large scale", "super scale", "large type 1" and "large type 2", and the small firms include the enterprises with the label of "medium", "medium type 1", "medium type 2" and "small". Table 5 shows the regression results of the Equation (28) in firms with different size. We can see that all the coefficients of triple interaction terms are significantly negative, and the values are large in large firms' group. These results show that the phenomenon of the difference of intervention caused by government incentive is more apparent in large size enterprise, and the biased subsidies and preferential policies are given by the government to the automobile manufacturing industry are more likely to occur in large enterprises. These results prove our hypothesis, as well.

Table 5. Regression results of enterprises of different sizes.

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	LARGE	**SMALL**	**LARGE**	**SMALL**	**LARGE**	**SMALL**
PRO_VEHM_GOV	−1.3817 *** (−10.22)	−1.1970 *** (−4.54)	−0.1259 *** (−4.21)	−0.0886 *** (−3.17)	−0.4356 *** (−4.44)	−0.3980 *** (−7.65)
VEHM_GOV	0.0956 * (1.66)	−0.1238 (−1.58)	0.0081 (0.88)	0.0160 ** (2.20)	0.0732 *** (3.28)	0.0270 *** (2.59)
PRO_GOV	0.3859 *** (3.56)	0.2338 (1.21)	0.2129 *** (7.67)	0.0745 *** (2.95)	0.0594 (0.69)	0.1101 ** (2.50)
PRO_VEHM	0.3358 *** (10.12)	0.2780 *** (4.37)	0.0839 *** (3.61)	0.0531 ** (2.43)	0.2188 *** (4.25)	0.2030 *** (7.84)

Table 5. *Cont.*

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	LARGE	**SMALL**	**LARGE**	**SMALL**	**LARGE**	**SMALL**
PRO_SIZE	−0.0139 *** (−11.65)	−0.0055 * (−1.75)	−0.0130 *** (−11.08)	−0.0036 ** (−2.21)	−0.0126 *** (−8.36)	−0.0076 *** (−7.17)
PRO_AGE	−0.0008 (−0.48)	0.0068 (1.63)	−0.0005 (−0.27)	0.0062 *** (3.00)	0.0007 (0.34)	0.0016 (1.20)
PRO_LOAN	−0.1972 *** (−4.42)	0.0786 (0.57)	−0.1941 *** (−4.28)	0.0961 (1.17)	−0.1060 * (−1.88)	0.1929 *** (3.45)
PRO_EXPT	−0.0434 *** (−11.67)	0.0074 (0.63)	−0.0440 *** (−12.05)	0.0001 (0.02)	−0.0441 *** (−9.74)	0.0032 (0.77)
PRO_SALE	0.2440 *** (12.56)	0.0438 (1.23)	0.2221 *** (11.31)	0.0522 *** (3.14)	0.2634 *** (10.17)	0.0746 *** (5.71)
PRO_SOE	−0.0218 *** (−5.24)	0.0140 (1.49)	−0.0267 *** (−6.51)	0.0154 *** (3.13)	−0.0222 *** (−4.38)	0.0061 * (1.82)
PRO_FOREG	0.0620 *** (6.01)	−0.0039 (−0.14)	0.0538 *** (5.17)	0.0172 (1.22)	0.0418 *** (2.92)	0.0246 *** (2.76)
PRO	−0.0043 (−1.43)	−0.0007 *** (−5.23)	−0.0022 (−0.71)	−0.0012 * (−1.76)	−0.0004 (−0.15)	−0.0017 *** (−5.04)
VEHM	−0.0204 (−1.47)	0.0381 ** (2.00)	−0.0036 (−0.49)	−0.0058 (−1.03)	−0.0333 *** (−2.88)	−0.0112 ** (−2.10)
GOV	−0.0523 (−0.84)	0.2415 *** (2.68)	−0.0217 ** (−2.30)	−0.0254 *** (−3.21)	−0.4713 *** (−6.59)	−0.0537 (−1.16)
SIZE	−0.0041 *** (−15.01)	−0.0118 *** (−15.75)	−0.0042 *** (−15.29)	−0.0076 *** (−19.22)	−0.0039 *** (−11.98)	−0.0065 *** (−25.58)
AGE	−0.0080 *** (−19.26)	−0.0079 *** (−9.42)	−0.0080 *** (−19.25)	−0.0062 *** (−12.19)	−0.0078 *** (−15.94)	−0.0042 *** (−12.46)
LOAN	0.0009 (0.45)	0.1756 *** (3.80)	−0.0005 (−0.23)	0.1404 *** (4.47)	−0.0016 (−0.98)	0.1659 *** (9.09)
EXPT	0.0195 *** (13.61)	0.0060 ** (2.36)	0.0194 *** (13.60)	0.0064 *** (4.96)	0.0169 *** (7.77)	0.0074 *** (8.42)
SALE	0.0073 *** (3.06)	0.0004 (0.54)	0.0075 *** (3.01)	0.0002 (0.40)	0.0089 *** (2.87)	0.0025 * (1.82)
SOE	−0.0089 *** (−8.87)	−0.0036 * (−1.65)	−0.0088 *** (−8.75)	−0.0053 *** (−4.03)	−0.0100 *** (−8.40)	−0.0029 *** (−3.36)
FOREG	0.0185 *** (9.32)	0.0214 *** (4.55)	0.0195 *** (9.77)	0.0137 *** (5.29)	0.0238 *** (9.44)	0.0127 *** (7.40)
Constant	0.1509 *** (10.04)	0.1355 *** (6.35)	0.1543 *** (18.46)	0.1557 *** (20.84)	0.3339 *** (11.27)	0.1345 *** (7.11)
YEAR	YES	YES	YES	YES	YES	YES
*PRO*YEAR*	YES	YES	YES	YES	YES	YES
PROVINCE	YES	YES	YES	YES	YES	YES
*PRO*PROVINCE*	YES	YES	YES	YES	YES	YES
Observations	18,283	22,135	18,271	21,413	20,269	19,038
Adjusted R^2	0.66	0.34	0.66	0.44	0.56	0.56

Note: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3.3. Firm Belongs

The short-term GDP incentive of the government mainly refers to the incentive of local governments. The government tends to implement policies more effectively for enterprises that are close to it considering asymmetric information; thus, the enterprises far away are more likely to be decentralized to lower level of local governments [61]. Therefore, the local governments tend to give more intervention to enterprises that are in their jurisdiction for GDP growth. So we grouped the samples into local and non-local enterprises groups according to the level of enterprise registration authorities disclosed in the industrial enterprise database. Local enterprise refers to the firms whose enterprise registration authority is not a state. Table 6 shows the regression results in the different groups. We can see that the coefficient of triple interaction terms is all significantly negative in the local group, which are the Column (2) (4) and (6). However, they are insignificant in the group of central government authorized firms, which are the Column (1) (3) and (5). The results also suggest that the phenomenon of differential intervention caused by government incentives is more obvious in local firms. This may because the biased subsidies and preferential policies that the government gives to the automobile industry are more likely to occur in the local firm under jurisdiction.

Table 6. Regression results of central and local enterprises.

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	CENTR	**LOCAL**	**CENTR**	**LOCAL**	**CENTR**	**LOCAL**
PRO_VEHM_GOV	−0.2966 (−0.48)	−0.7750 *** (−3.67)	0.0913 (0.50)	−0.0811 *** (−2.70)	−0.0114 (−0.02)	−0.4638 *** (−4.06)
VEHM_GOV	0.0353 (0.37)	−0.0920 (−1.37)	0.0066 (0.28)	0.0006 (0.08)	0.0325 (0.53)	0.0371 (1.60)
PRO_GOV	0.1970 (0.42)	−0.0716 (−0.47)	0.1946 (1.19)	0.0566 ** (2.25)	0.5439 (1.24)	−0.2408 *** (−2.60)
PRO_VEHM	0.0500 (0.35)	0.1627 *** (3.15)	−0.1222 (−0.93)	0.0339 (1.42)	−0.0438 (−0.20)	0.2126 *** (3.68)
PRO_SIZE	0.0141 *** (4.15)	0.0004 (0.17)	0.0191 ** (2.24)	0.0015 (1.18)	0.0177 ** (1.99)	0.0013 (0.64)
PRO_AGE	0.0146 * (1.86)	0.0070 ** (2.21)	−0.0038 (−0.25)	0.0099 *** (5.17)	−0.0043 (−0.27)	0.0063 ** (1.98)
PRO_LOAN	−1.7017 ** (−2.16)	0.0874 (0.97)	−1.8410 (−0.82)	0.1293 * (1.89)	−1.8837 (−0.88)	0.1005 (1.11)
PRO_EXPT	−0.0951 (−1.39)	−0.0161 ** (−2.50)	−0.0588 (−0.59)	−0.0184 *** (−4.16)	−0.0492 (−0.48)	−0.0171 *** (−2.69)
PRO_SALE	−0.0410 (−0.41)	0.1053 *** (3.56)	−0.1465 (−1.12)	0.0577 *** (3.26)	−0.1975 (−1.22)	0.1510 *** (4.92)
PRO_SOE	−0.1054 *** (−3.98)	0.0069 (0.93)	−0.1440 *** (−3.37)	−0.0001 (−0.03)	−0.1482 *** (−3.38)	0.0073 (0.99)
PRO	−0.0318 *** (−3.05)	−0.0005 *** (−4.72)	−0.0204 (−0.93)	−0.0003 *** (−6.30)	−0.0208 (−0.92)	−0.0006 *** (−5.35)
VEHM	−0.0029 (−0.12)	0.0327 ** (2.02)	0.0015 (0.08)	0.0086 (1.42)	−0.0102 (−0.35)	−0.0071 (−0.59)
GOV	−0.1764 (−1.28)	0.1571 ** (2.09)	−0.0345 (−1.31)	−0.0037 (−0.46)	0.1539 (0.77)	−0.5295 *** (−5.80)
SIZE	−0.0011 * (−1.68)	−0.0039 *** (−8.86)	−0.0025 * (−1.72)	−0.0010 *** (−3.34)	−0.0024 (−1.56)	−0.0041 *** (−9.24)
AGE	−0.0041 *** (−3.22)	−0.0091 *** (−14.43)	−0.0061 *** (−2.71)	−0.0085 *** (−18.85)	−0.0063 *** (−2.79)	−0.0091 *** (−14.39)

Table 6. *Cont.*

	Dependent Variable: *RPRO*					
	GOV = VAT		***GOV = INC***		***GOV = TAX***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	CENTR	**LOCAL**	**CENTR**	**LOCAL**	**CENTR**	**LOCAL**
LOAN	−0.0668 (−0.90)	−0.0006 *** (−2.61)	0.1081 (0.43)	0.0565 *** (2.63)	0.0977 (0.40)	−0.0006 *** (−2.72)
EXPT	−0.0152 (−0.79)	0.0093 *** (4.49)	−0.0381 (−1.57)	0.0091 *** (5.89)	−0.0390 (−1.60)	0.0096 *** (4.76)
SALE	0.0009 (0.42)	0.0015 (1.27)	0.0039 (0.76)	0.0016 (1.35)	0.0040 (0.74)	0.0013 (1.24)
SOE	−0.0220 *** (−6.03)	−0.0087 *** (−5.51)	−0.0158 *** (−2.94)	−0.0084 *** (−7.41)	−0.0156 *** (−2.83)	−0.0084 *** (−5.28)
PRO_FOREG		−0.0012 (−0.07)		0.0228 ** (2.13)		0.0036 (0.19)
FOREG		0.0168 *** (5.29)		0.0147 *** (6.77)		0.0168 *** (5.34)
Constant	0.1089 *** (3.70)	0.1130 *** (6.40)	0.1179 *** (4.95)	0.1107 *** (15.34)	0.0299 (0.37)	0.3658 *** (9.68)
YEAR	YES	YES	YES	YES	YES	YES
*PRO*YEAR*	YES	YES	YES	YES	YES	YES
PROVINCE	YES	YES	YES	YES	YES	YES
*PRO*PROVINCE*	YES	YES	YES	YES	YES	YES
Observations	1488	42,744	1524	41,775	1524	42,744
Adjusted R^2	0.30	0.35	0.21	0.43	0.21	0.35

Note: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Robustness Check

We do robustness check to make sure that our results are invalid. We used only the sample firms whose business status is normal operation. The business status of enterprises can be divided into business, closure, preparation, the closed, the bankruptcy, and other six states, according to the database of China's industrial enterprises. The enterprise in the state of abnormal operating may have biased tax avoidance, and the only enterprise in the state of normal operating can reflect the actual level of government intervention. Therefore, we only keep the firms who are in normal business status. There are 1492 companies are dropped, and Table 7 shows the regression results. We can see that the regression results are similar to the results in Table 3. For example, the first coefficient of triple interaction term $PRO \times VEHM \times VAT$ in Column (2) is −0.8267, which is significant. These results show that the intervention on automobile manufacturing firms is biased as well, which is consistent with our previous results.

Table 7. Robust Check: Only firms in operation.

	(1)	**(2)**	**(3)**	**(4)**
	RPRO	***RPRO***	***RPRO***	***RPRO***
PRO_VEHM	−0.0163 (−1.57)	0.1854 *** (3.57)	0.0537 (1.53)	0.1997 *** (3.43)
PRO_SIZE	−0.0003 (−0.18)	−0.0011 (−0.52)	−0.0013 (−0.67)	0.0003 (0.16)
PRO_AGE	0.0059 * (1.84)	0.0066 ** (2.07)	0.0057 * (1.78)	0.0057 * (1.77)

Table 7. *Cont.*

	(1)	(2)	(3)	(4)
	RPRO	***RPRO***	***RPRO***	***RPRO***
PRO_LOAN	−0.0698 (−0.70)	−0.0577 (−0.58)	−0.0720 (−0.72)	−0.0590 (−0.58)
PRO_EXPT	−0.0250 *** (−3.91)	−0.0249 *** (−3.85)	−0.0246 *** (−3.84)	−0.0242 *** (−3.76)
PRO_SALE	0.1188 *** (5.86)	0.1108 *** (3.80)	0.0921 *** (3.40)	0.1582 *** (5.24)
PRO_SOE	0.0066 (0.88)	0.0052 (0.70)	0.0060 (0.81)	0.0071 (0.96)
PRO_FOREG	0.0024 (0.13)	0.0031 (0.17)	0.0035 (0.19)	0.0050 (0.27)
PRO	−0.0003 (−0.26)	−0.0005 (−0.38)	−0.0006 (−0.43)	0.0001 (0.07)
VEHM	0.0103 *** (5.16)	0.0353 ** (2.30)	0.0004 (0.05)	−0.0019 (−0.18)
SIZE	−0.0034 *** (−8.39)	−0.0033 *** (−7.93)	−0.0032 *** (−7.81)	−0.0035 *** (−8.51)
AGE	−0.0090 *** (−14.57)	−0.0091 *** (−14.69)	−0.0090 *** (−14.55)	−0.0090 *** (−14.58)
LOAN	0.1037 *** (3.49)	0.0989 *** (3.30)	0.1028 *** (3.47)	0.1034 *** (3.49)
EXPT	0.0113 *** (5.63)	0.0114 *** (5.53)	0.0113 *** (5.65)	0.0112 *** (5.55)
SALE	0.0013 (1.25)	0.0014 (1.26)	0.0015 (1.28)	0.0012 (1.21)
SOE	−0.0071 *** (−4.63)	−0.0070 *** (−4.59)	−0.0070 *** (−4.54)	−0.0072 *** (−4.69)
FOREG	0.0162 *** (5.19)	0.0157 *** (5.01)	0.0159 *** (5.08)	0.0159 *** (5.10)
PRO_VEHM_GOV		−0.8267 *** (−3.90)	−0.0897 ** (−2.05)	−0.4221 *** (−3.67)
VEHM_GOV		−0.1098 * (−1.73)	0.0128 (1.11)	0.0237 (1.13)
PRO_GOV		−0.0618 (−0.41)	0.0543 (1.48)	−0.2367 ** (−2.51)
GOV		0.1651 ** (2.31)	−0.0054 (−0.45)	−0.1055 (−1.16)
Constant	0.1398 *** (27.33)	0.1024 *** (6.15)	0.1408 *** (13.43)	0.1873 *** (5.03)
YEAR	YES	YES	YES	YES
*PRO*YEAR*	YES	YES	YES	YES
PROVINCE	YES	YES	YES	YES
*PRO*PROVINCE*	YES	YES	YES	YES
Observations	42,776	42,776	42,776	42,776
Adjusted R^2	0.35	0.35	0.35	0.35

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Conclusions

The automobile manufacturing industry developed rapidly in China; however, the automobile maintenance industry less developed. In addition to the factors from the demand and supply side in

the market, we tried to explain this fact from the perspective of government incentive and intervention in China. Firstly, we established a two-sector model with government incentives and government intervention, and then we analyzed the game between the government and market, and the optimal subsidy policy under the government's GDP incentive is obtained. The results of the theoretical model show that the government gives more preferential policies to automobile manufacturing firms compare to firms in automobile maintenance industries under short term GDP incentive. That's why the development of the automobile manufacturing and maintenance industry is unbalanced. Secondly, we use three indicators to represent the government GDP incentive under fiscal decentralization and test the differential impact of GDP incentive on tax avoidance of the two kinds of firms empirically. The empirical results show that the GDP incentive of the government caused by fiscal decentralization induced more preferential treatment to automobile manufacturing enterprises, and thus, increase their tax evasion degree, which proves the mechanism of government incentive in our theoretical model.

Understanding the incentive and implementation of industrial policy can help us understand the evolution mechanism of China's automobile industrial policy and automobile industrial structure better. Well-developed automobile maintenance industrial can improve customer loyalty that can help the automobile manufacture company survive in this highly competitive industry; with the increase of new kinds of vehicles and customer's requirements, it is necessary for the automotive service industry to constantly improve its development mode and introduce new technologies; and the balanced growth of automobile manufacturing and maintenance industry is one of the driving forces for market sustainability of automobile industry and sustainable regional growth. Based on these facts, we propose that, in an initial phase of the development of the automotive industry, the automobile manufacturing industry, which is upstream industry, should be encouraged to develop more than automobile maintenance industry, which is downstream industry, because the latter would have no reason to exist if the upstream industries did not exist. However, China may pay more attention to rebalancing the weight of the two industries after passing this first phase as economic develops. In this new phase, some measures,, such as reducing the short term GDP incentive of local government and making the performance evaluation more diversified, will lead to better policy that promotes the transformation and upgrading of the whole automobile industrial structure, even the whole industrial structure optimization and economic growth.

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Appendix A

Proof of the result of Equation (18).

Proof. The consumer's budget constraint when $t = 0$ is:

$$c_0 - w_0 L + T_0 = p_0 \left[\frac{r_0}{p_0} K_0 + (1 - \delta) K_0 - K_1 \right]. \tag{A1}$$

The consumer's budget constraint when $t = 1$ is:

$$c_1 - w_1 L + T_1 = p_1 \left[\frac{r_1}{p_1} K_1 + (1 - \delta) K_1 - K_2 \right]. \tag{A2}$$

The consumer's budget constraint when $t = 2$ is:

$$c_2 - w_2 L + T_2 = p_2\left[\frac{r_2}{p_2}K_2 + (1-\delta)K_2 - K_3\right]. \tag{A3}$$

From the Equation (5), we can get

$$\frac{\beta u'(c_{t+1})}{u'(c_t)} = \frac{p_t}{p_{t+1}}\frac{1}{r_{t+1}/p_{t+1} + (1-\delta)}. \tag{A4}$$

Therefore, we can know that $\frac{\beta u'(c_1)}{u'(c_0)} = \frac{p_0}{p_1}\frac{1}{r_1/p_1+(1-\delta)}$. Multiply the left hand of Equation (A2) by $\frac{\beta u'(c_1)}{u'(c_0)}$ and multiply the right hand of Equation (A2) by $\frac{p_0}{p_1}\frac{1}{r_1/p_1+(1-\delta)}$, and then we can get:

$$\frac{\beta u'(c_1)}{u'(c_0)}(c_1 - w_1 L + T_1) = p_0\left[K_1 - \frac{K_2}{\frac{r_1}{p_1} + (1-\delta)}\right]. \tag{A5}$$

Multiply the left hand of Equation (A3) by $\frac{\beta^2 u'(c_2)}{u'(c_0)}$ and multiply the right hand of Equation (A3) by $\frac{p_1}{p_2}\frac{1}{r_2/p_2+(1-\delta)} \times \frac{p_0}{p_1}\frac{1}{r_1/p_1+(1-\delta)}$, and then we can get:

$$\frac{\beta^2 u'(c_2)}{u'(c_0)}(c_2 - w_2 L + T_2) = p_0\left[\frac{K_2}{r_1/p_1 + (1-\delta)} - \frac{K_3}{[r_2/p_2 + (1-\delta)][r_1/p_1 + (1-\delta)]}\right], \tag{A6}$$

and so on. We add up all the results from Equation (A1), i.e., (A1) + (A5) + (A6) + . . . , and we can get

$$\sum_{t=0}^{\infty}\beta^t \frac{u'(c_t)}{u'(c_0)}(c_t - w_t L + T_t) = [r_0 K_0 + p_0(1-\delta)K_0]. \tag{A7}$$

This is the same with Equation (18) in Section 2. □

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