Government Subsidies, Resource Misallocation and Manufacturing Productivity

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Government subsidies for some firms will have effects on the market entry, exit and scale of firms, result in misallocation of resource between firms, and reduce manufacturing productivity. Using data of Chinese industrial enterprises from 1998 to 2007, this paper studies the effect and micro-mechanism of misallocation caused by government subsidy on manufacturing productivity. Decomposition of manufacturing productivity indicates there is resource misallocation between firms and decreasing of manufacturing productivity. Empirical study shows that government subsidies constitute an important factor inducing this resource misallocation. Subsidies change extensive and intensive margins of market, distort resource allocation between firms and reduce manufacturing productivity, and the resource misallocation is more serious in industries with higher proportion of state-owned assets. Specifically, subsidies hinder entry and exit of firms in extensive margins, with subsidized firms having lower propability of market entry and exit compared with unsubsidized firms; subsidies promote scale of subsidized firms and crowds out market share of unsubsidized firms in intensive margins. The implication of this paper is that when providing subsidies government should take into consideration their effect on the firms' dynamic and resource allocation in the frame of general equilibrium.

Keywords: government subsidies, resource misallocation, manufacturing productivity

1. Introduction

In China's economic development, industrial policies represented by subsidies have played an important role in the overcoming of market failures, the guiding of resource allocation, the stimulating of firm innovation and technological advancement and the progress of economic development, and they are considered as an essential driving

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force for the rapid development of China's manufacturing industry. However, their negative effects are also gradually emerging in industrial upgrading. Subsidies can lead to firms' over-dependence and rent-seeking, and the intervening of economy with subsidies may also result in the misallocation of resources and affect manufacturing productivity. Therefore, it is vital to analyze the impact and mechanism of government subsidies on resource allocation and manufacturing productivity, and to facilitate subsidy policies' guidance on the effective allocation of resources and promotion on industrial upgrading.

In recent years, studies have emphasized the impact of resource allocation on productivity. It is pointed out that the productivity of manufacturing industry depends not only on the productivity among different firms in the industry, but also the allocation of resources (Brandt *et al*., 2012; Nie and Jia, 2011). From the micro perspective, even if the productivity of all firms remains constant, the entry of high-productivity firms and the exit of low-productivity ones, and the enlargement of high-productivity firms and the shrinking of low-productivity ones, the allocation of resources will also increase the productivity of the entire industry, this is called the allocation effect of resources. Subsidies, as an important policy tool for government regulation, have selective and directional features. In addition, differences exist in the access to government subsidies between different industries. In 2007, for example, only 12% of manufacturing firms received subsidies, and a large quantity of subsidies were given to a few firms. When some firms are subsidized, inefficient firms that should have withdrawn from the market would be given the chance to survive or even expand the scale with subsidies while the unsubsidized firms will face greater competition to shrink the scale or even exit the market, resulting in the misallocation of resources between firms. Even worse, local governments may subsidize firms with losses and inefficient firms for the reason of GDP and the stability of employment (Shao and Bao, 2012), hindering the entry and exit of firms, leading to failure to facilitate the effective allocation of resource, the even worse misallocation of resource and the decrease of manufacturing productivity caused by subsidies, which are intended to overcome market failures.

At present, there are mainly two types of research on government subsidies and manufacturing productivity, of which one is to study the impact of subsidies on productivity from the perspective of micro-firms (Bernini and Pellegrini; Shao and Bao, 2012; Xu and Xie , 2015; Yan and Yu , 2017). However, these studies mainly focus on the study of the impact of subsidies on subsidized firms and do not identify the effects of resource misallocation of subsidies. The other is to study the impact of subsidies on resource allocation and aggregate productivity from an industry perspective (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Jian and Zhang, 2015). Restuccia and Rogerson (2008) theoretically revealed that government subsidies would distort resource allocation and reduce the productivity of the industry; Jiang

and Zhang (2015) empirically analyzed that the subsidy differentiation could cause resource misallocation with the application of the data of Chinese industrial firms.

This paper is based on the second kind of literature with the focus on the impact of subsidized resource misallocation on aggregate productivity. The existing literature has carried out theoretical explanations and empirical tests on the misallocation effects of subsidies. However, there are still some issues that need further research. Firstly, in the measurement of resource misallocation, the resource misallocation is explained by the dispersion of productivity in the industry, which would fail to achieve the specific composition of resource misallocation. Secondly, the subsidized resource misallocation is demonstrated without the identification of the micro-mechanism that causes the resource misallocation. At present, subsidies are an important part of China's industrial policy, so what is the effect of their implementation? What are the positive and negative effects? There is an urgent need to empirically assess the effects of subsidies. Compared with previous research, the innovation and contribution of this paper are mainly reflected in the following aspects. One is the decomposition of manufacturing productivity, measuring the misallocation and composition of resources in manufacturing productivity. The other is the identification of the scale of resource misallocation and the micro-mechanisms therein through the analysis of effects of misallocation and the research of firms' dynamics of resources.

The paper is organized as follows. The second part establishes a theoretical model to analyze the mechanism by which subsidies affect manufacturing productivity. The third part quantitatively measures the misallocation of resources in the manufacturing industry. The fourth Part empirically examines the impact of subsidies on the misallocation of resources in manufacturing productivity. The fifth part further examines the impact of subsidies on the market entry, exit and scale of the firms and analyzes the micro-mechanism of how subsides cause resource misallocation. The last part is the conclusion and policy recommendation.

2. Theoretical Model

A general equilibrium model is established to analyze the impact of government subsidies on firm dynamics and resource allocation based on the study of Melitz (2003) and Qian *et al*. (2016). Suppose there are two types of firms in the monopolistic competition market: subsidized firms and non-subsidized firms, the subsidy rate is s, and the total subsidy amount of the government is B. If a firm aims to enter the market, it needs to pay the sunk cost f_e, and randomly gets the productivity φ, and assume that the productivity of both types of firms is subject to the Pareto distribution, with the same shape parameters and endogenous scale parameters. The productivity distribution functions of the two types of firms are: $G_{n(\varphi)} = 1-(b_n/\varphi)^k$ and $G_{s(\varphi)} = 1-(b_s/\varphi)^k$

respectively, where the shape parameter $k>\sigma-1$, subscripts n and s represent unsubsidized firms and subsided ones respectively. Firms apply labor as the only input factor, wages are standardized to 1, and the labor demand of firms producing $l = f + q/\varphi$, where f is a fixed cost, which is the same for all firms.

Suppose the product categories in the society can be aggregated into Ω, each firm produces one type of product, and the continuous type of products is obtained with the total output by the CES function. According to Dixit and Stiglitz (1977), the total output and price index are:

$$Q=\left(\int_{i\in\Omega} x_i^{\frac{\sigma-1}{\sigma}} di\right)^{\frac{\sigma}{\sigma-1}},\ P=\left(\int_{i\in\Omega} p_i^{1-\sigma} di\right)^{\frac{1}{1-\sigma}} \tag{1}$$

Where q is the product yield, p is the price, σ is the substitution elasticity and $\sigma>1$. We can get the output and income of each firm:

$$q_i = Q\left(\frac{p_i}{P}\right)^{-\sigma},\ r = R\left(\frac{p_i}{P}\right)^{1-\sigma} \tag{2}$$

The profits of the two types of firms are:

$$\begin{aligned}\pi_n &= p_n(\varphi)q_n(\varphi)-\left(f+\frac{q_n(\varphi)}{\varphi}\right)\\ \pi_s &= (1+s)p_s(\varphi)q_s(\varphi)-\left(f+\frac{q_s(\varphi)}{\varphi}\right)\end{aligned} \tag{3}$$

Based on the first-order condition of profit maximization, the pricing of two types of firms is:

$$p_n(\varphi)=\frac{\sigma}{(\sigma-1)\varphi},\ p_s(\varphi)=\frac{\sigma}{(1+s)(\sigma-1)\varphi} \tag{4}$$

When the firm' profit is zero, it will withdraw from the market. Based on the zero profit condition, the income of the firm in the critical situation is:

$$r_n(\varphi_n^*)=\sigma f,\ r_s(\varphi_s^*)=\frac{\sigma f}{1+s} \tag{5}$$

Among which φ_n^* and φ_s^* indicate the productivity of unsubsidized firms and subsidized ones at a critical state respectively, and because:

$$r_n\left(\varphi_n^*\right)=p_n\left(\varphi_n^*\right)q_n\left(\varphi_n^*\right)=R\left(\frac{\sigma-1}{\sigma}\varphi_n^*P\right)^{\sigma-1}$$
$$r_s\left(\varphi_s^*\right)=p_s\left(\varphi_s^*\right)q_s\left(\varphi_s^*\right)=R\left(\frac{\sigma-1}{\sigma}\varphi_s^*P\right)^{\sigma-1}\left(1+s\right)^{\sigma-1} \tag{6}$$

With equation (5) and (6) we can get:

$$\frac{\varphi_s^*}{\varphi_n^*}=\left(\frac{1}{1+s}\right)^{\frac{\sigma}{\sigma-1}} \tag{7}$$

In the market, firms are free to enter and exit. Only when the expected income of the firm can make up for the entry cost, will it enter the market. The free entry conditions of the two types of firms are:

$$f_e=\left[1-G\left(\varphi_n^*\right)\right]\overline{\pi}_n,\ f_e=\left[1-G\left(\varphi_s^*\right)\right]\overline{\pi}_b \tag{8}$$

Among which $\overline{\pi_n}$ and $\overline{\pi_s}$ are the average profits of unsubsidized firms and subsidized ones, with equation (8), we can get:

$$\left(\varphi_n^*\right)^k=\frac{(\sigma-1)f}{(k-\sigma+1)f_e}b_n^k,\ \left(\varphi_s^*\right)^k=\frac{(\sigma-1)f}{(k-\sigma+1)f_e}b_s^k \tag{9}$$

Then,

$$\frac{b_s}{b_n}=\frac{\varphi_s^*}{\varphi_n^*}=\left(\frac{1}{1+s}\right)^{\frac{\sigma}{\sigma-1}} \tag{10}$$

As σ>1, $\varphi_s^*<\varphi_n^*$ is obtained, that is, the subsidy reduces the critical productivity of the subsidized firm. In order to get the analytical solution, let b_n=1, then $b_s=(1+s)^{\sigma/1-\sigma}$, the critical productivity is:

$$\varphi_n^*=\left[\frac{(\sigma-1)f}{(k-\sigma+1)f_e}\right]^{\frac{1}{k}},\ \varphi_s^*=\left[\frac{(\sigma-1)f}{(k-\sigma+1)f_e}\right]^{\frac{1}{k}}\left(\frac{1}{1+s}\right)^{\frac{\sigma}{\sigma-1}} \tag{11}$$

The total wage of labor is equal to the income of all incumbents:

$$L=M_n\left[1-G\left(\varphi_n^*\right)\right]\overline{r}\left(\varphi_n^*\right)+M_s\left[1-G\left(\varphi_s^*\right)\right]\overline{r}\left(\varphi_s^*\right) \tag{12}$$

And the total amount of subsidies is equal to the income of subsidized firms:

$$B = sM_s\left[1-G\left(\varphi_s^*\right)\right]\bar{r}\left(\varphi_s^*\right) \tag{13}$$

With equation (12) and (13), we can get:

$$\begin{aligned} M_s &= \frac{\sigma-1}{\sigma k f_e}\left(\frac{1+s}{s}B\right) \\ M_n &= \frac{\sigma-1}{\sigma k f_e}\left(L-\frac{B}{s}\right) \end{aligned} \tag{14}$$

The equilibrium number of firms, critical productivity and productivity distribution are obtained.

When no firms are subsidized,

$$L = M\left(1-G\left(\varphi^*\right)\right)\bar{r}\left(\varphi^*\right) \tag{15}$$

The number of firms is:

$$M = \frac{\sigma-1}{\sigma k f_e}L \tag{16}$$

Comparing equation (14) and (16), we can get $M_n + M_s > M$, that is, the subsidy increases the number of firms in the market, and as the subsidy amount increases, the number of subsidized firms will increase and the crowding effect is generated on firms not subsided, reducing the number of unsubsidized ones.

When no firms are subsidized, the average productivity of the manufacturing industry is:

$$\bar{\varphi}\left(\varphi_n^*\right) = \left[\frac{1}{1-G\left(\varphi_n^*\right)}\int_{\varphi_n^*}^{\infty}\varphi^{\sigma-1}g\left(\varphi\right)d\varphi\right]^{\frac{1}{\sigma-1}} = \left(\frac{k}{k-\sigma+1}\right)^{\frac{1}{\sigma-1}}\left[\frac{(\sigma-1)f}{(k-\sigma+1)f_e}\right]^{\frac{1}{k}} \tag{17}$$

When some firms are subsided, the average productivity of the manufacturing industry is:

$$\bar{\varphi}\left(\varphi_n^*,\varphi_b^*\right) = \frac{1}{M_n+M_s}\left[M_n\bar{\varphi}\left(\varphi_n^*\right)+M_s\bar{\varphi}\left(\varphi_s^*\right)\right]^{\frac{1}{\sigma-1}} \tag{18}$$

As $\bar{\varphi}(\varphi_n^*) > \bar{\varphi}(\varphi_s^*)$, it is obvious that $\bar{\varphi}(\varphi_n^*, \varphi_s^*) < \bar{\varphi}(\varphi_n^*)$, that is, subsidies reduce the total manufacturing productivity in equilibrium.

The general equilibrium mathematical model above demonstrates that subsidies can affect the allocation of resources between firms and reduce the productivity of the entire industry. Specifically speaking, on the one hand, subsidies reduce the exit critical productivity of subsidized firms. For firms that are not subsidized, when the productivity is lower than φ_n^*, they will withdraw from the market; for subsidized ones, when $\varphi_s^* < \varphi < \varphi_n^*$, firms can still obtain positive profits with those subsidies and are able to survive in the market. These low-productivity firms that rely on subsidies to survive will reduce the productivity of the entire industry. On the other hand, subsidies also crowd out the resources of unsubsidized ones. In the general equilibrium, subsidies for some firms will crowd out those for unsubsidized ones, causing the misallocation of resources among firms.

3. Measurement and Decomposition of Manufacturing Productivity

3.1. Data Description

Manufacturing firm data comes from the *China Industrial Firm Database* from 1998 to 2007, which includes all state-owned and non-state-owned industrial ones with annual sales of more than 5 million yuan. The manufacturing industry and supply industry of the mining industry, electric power, gas and water vary greatly in terms of subsidies and industry characteristics. Therefore, the research object focuses on the manufacturing industry, and the non-manufacturing industrial firms are excluded.

Because the cross-year firm code and the name of the industrial firm database are inconsistent, as well as the abnormality of indicators and the lack of key indicators, this paper processes data based on the methods provided by Brandt *et al.* (2012) and Nie *et al.* (2012), and finally retains 94% of the samples. Besides, due to changes in the national industry classification standards in 2002, the industrial firm database was adopted in GB/T4754-1994 in 1998-2002 and GB/T4754-2002 in 2002-2007 respectively. In order to keep the consistent statistical scope, this paper's classification standard is unified to GB/T4754-2002.

3.2. Measurement of Manufacturing Productivity

In the macroscopic study, the TFP is usually measured by OLS regression to estimate the production function, and the obtained Soro residual value is taken as

TFP. However, in measuring micro-firm productivity, the OLS method will cause two deviations: simultaneous bias and sample selection bias. To eliminate these two biases, the OP method (Olley and Pakes, 1996) and the LP method (Levinsohn and Petrin, 2003) are usually used in empirical research to estimate the productivity of business. Considering that China's firms enter the market and exit frequently and the sample selection problem is serious, this paper uses the OP method to estimate the productivity of manufacturing firms.

According to the existing literature, the output is measured by the industrial added value of the firm. The capital input is measured by the annual average balance of the net value of the fixed assets, and the labor input is measured by the average number of employees. There is no fixed asset investment data in the industrial firm database. According to the macro capital accounting $I_t=K_t-K_{t-1}+D_t$, K is the annual average balance of the net fixed assets and D is the depreciation. Taking into account the various price in difference regions, this paper uses the producer price index of the province in which the firm is located to deflate the industrial added value, and the fixed asset investment price index to deflate the net value of the fixed assets. The price indexes are all from the *China Economic Information Network Statistics Database*.

After estimating the firm TFP through the IP method, referring to the method of Nie and Jia (2011), weighted according to the industry share of the firm to obtain the TFP of the manufacturing 4-digit industry:

$$A_t = \sum_{i \in Z} s_i \omega_i \tag{19}$$

Among them, i means the firm, and Z means all the existing firms in the current period. s is the share of the firm, which is represented by the proportion of the number of the employed of the firms of that of the industry in this paper, and ω is the firm TFP estimated by the OP method.

3.3. Decomposition of Manufacturing Productivity

The static manufacturing TFP is the sum of the TFPs in the current year, but when the dynamic TFP growth is measured, the industry TFP changes are different from the simple sum of the firm TFP changes due to the market entry, exit and the scale of the firms. Instead, the industry TFP change should be the difference between the weighted incumbent firm TFP and the previous period as it's scale in the calculation period. More specifically, the industry TFP can be decomposed into the contribution of the incumbent, the entering and exiting firms.

Based on the methods of Griliches and Regev (1995), the manufacturing TFP growth rate can be decomposed into:

$$TFPCH_t = \frac{1}{A_{t-1}}\left(\sum_{i\in Z_t} s_{it}\omega_{it} - \sum_{i\in Z_{t-1}} s_{it-1}\omega_{it-1}\right)$$
$$= \frac{1}{A_{t-1}}\left(\sum_{i\in N_t} \bar{s}_{it}\Delta\omega_{it} + \sum_{i\in N_t}\left(\bar{\omega}_{it} - \bar{A}_t\right)\Delta s_{it} + \sum_{i\in E_t} s_{it}\left(\omega_{it} - \bar{A}_t\right) + \sum_{i\in X_t} s_{it-1}\left(\bar{A}_t - \omega_{it-1}\right)\right) \quad (20)$$

Among them, Z is all the firms in the current period, N, E and X represent the number of incumbent firms, entering firm and the exiting firms respectively. A is the sum of manufacturing TFP of the industry, and s is the scale of the firm in the industry, ω is the firm TFP, which represents the average of the beginning and end of the period.

The first term on the right side of the equation is the horizontal effect, which indicates the contribution of the firm's own TFP growth to the industry TFP; the second to fourth are the configuration effect, indicating the contribution of resource allocation to the TFP. Specifically, the second item is the contribution of the scale change of the firm to the industry TFP, the scale of the high TFP firm is increased, the scale of the TFP firm is reduced, and the TFP of the industry is increased; the third item is the entering firm's contribution to the industry TFP, the entry of high TFP firms increases the total TFP; the fourth item is the exiting firm's contribution to the industry TFP, and the low TFP firms withdrawing from the industry can also increase the total TFP.

The decomposition of manufacturing TFP changes can help identify the contribution of resource misplacement to manufacturing TFP changes, and the misplacement of resources generated by incumbent, entry, and exit firms to the manufacturing TFP. Table 1 lists the manufacturing TFP growth rates from 1998 to 2007 and their four respective contributions.

Table 1. TFP Growth Rate and Decomposition of Manufacturing 4-Digit Industry from 1998 to 2007

Years	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
1998	—	—	—	—	—
1999	0.032	0.016	0.011	–0.006	0.013
2000	0.039	0.009	0.012	–0.002	0.020
2001	0.038	0.006	0.009	0.002	0.021
2002	0.037	0.019	0.007	–0.003	0.015
2003	0.040	0.019	0.008	–0.003	0.017
2004	0.024	0.009	0.004	–0.004	0.015
2005	0.032	0.026	0.007	–0.007	0.007
2006	0.024	0.023	0.004	–0.009	0.006
2007	0.036	0.032	0.004	–0.008	0.007
mean	0.034	0.018	0.007	–0.004	0.013

4. Impact of Subsidies on Manufacturing Productivity

4.1. Empirical Model

Based on the previous theoretical analysis, the impact of subsidies on manufacturing productivity depends on horizontal effects and allocation effects. To test the impact of subsidies on manufacturing productivity and the effects in manufacturing productivity, the following measurement model is established:

$$y_{it} = \beta_1 \ln sub_{it} + \sum_j \gamma_j \ln x_{ijt} + \mu_i + \varepsilon_{it} \tag{21}$$

In different models, the explained variables are the manufacturing TFP growth rate and the decomposition parts of it. The core explanatory variable is the logarithm of government subsidies (ln*sub*), and its estimated coefficient indicates the impact of 1% change in government subsidies on the growth rate of TFP. Control variables include major industry characteristics that affect TFP changes and control industry fixed effects. The data comes from the *China Business Performance Database*, which aggregates firm data into a four-digit manufacturing industry. μ is the individual effect of the industry, and ε is the random disturbance term. Table 2 lists the meanings and descriptive statistics of the main variables.

Table 2. Descriptive Statistics of Variables in the Regression Analysis of the Effect of Subsidies on Manufacturing Productivity

Variable name	Mean	Quantity	Mean	Standard deviation	Minimum	Maximum
tfpch	TFP growth rate	3811	0.033	0.077	–1	1.408
year	Years	4260	2003	2.873	1998	2007
sub	Subsidy income (billion yuan)	4260	66.911	211.806	0	4751.399
kl	Capital intensity (ten thousand yuan/person)	4240	75.192	64.196	5.167	745.082
k_state	The proportion of state-owned capital	4240	0.187	0.200	0	1
k_forgn	Foreign capital	4240	0.352	0.279	0	1
hhi	Herfindahl index	4260	0.050	0.087	0	1

4.2. Empirical Analysis

Table 3 shows the values of the regression coefficients. Panel A is the regression

result of the explained variables only with government subsidies, and Panel B is the regression result after adding the control variables. As can be seen from the first column, the impact of government subsidies on manufacturing productivity is generally negative, with government subsidies increasing by 1% and manufacturing productivity falling by 0.2%. This effect is still significant after excluding the influence of other factors. This is consistent with the conclusions of Xu and Xie (2015), Yan and Yu (2017). Due to the various distortions in government subsidies, overall subsidies are not beneficial to manufacturing productivity.

To further explore the micro-mechanism behind this influence, we decompose the manufacturing productivity changes into horizontal effect, scale effect, entry effect and exit effect, and respectively regress the government subsidies. The results show that the horizontal effect of subsidies is positive, while the scale, entry and exit effects are negative, indicating that although subsidies are generally beneficial to the increase of manufacturing firms productivity, they will lead to the misallocation of resources between different firms, hindering the expansion of high-productivity firms and market entry, as well as the market exit of low-productivity firms. This resource misallocation effect even exceeds the horizontal effect, which ultimately causes subsidies to inhibit the increase in manufacturing productivity. After adding the control variables, the estimated subsidy has a weakened effect on resource misallocation. Although the scale effect and the entry effect remain unchanged, they are still negative effects, but they become no longer significant, and the exit effect is still very significant. In general, to a certain extent, subsidies have led to the misallocation of resources between firms, which has reduced the productivity of manufacturing industries. This misallocation is mainly reflected in subsidies preventing the exit of low-productivity firms.

The regression results confirm the negative effect of government subsidies on improving manufacturing productivity. Further decomposition shows that this negative effect mainly comes from the obstacle to the market exit of firms. The fundamental reason behind this micro-mechanism is the spillover effect of subsidies. Under the general equilibrium framework, the government subsidizes some firms. On the one hand, this affects the subsidized firms, and on the other hand, it affects the unsubsidized firms in scale changes, market entry and market exits. When subsidies are provided to low-productivity firms, low-productivity firms continue to survive through subsidies, hindering the market entry and the expansion of high-productivity firms, distorting the allocation of resources, and reducing the productivity of the entire manufacturing industry.

Among the control variables, the capital intensity estimation coefficient is only positive in the horizontal effect estimation, indicating that the increase of capital intensity contributes to the improvement of the productivity of the manufacturing firms, but has no significant impact on the resource allocation between firms. The proportion of state-owned capital has no significant effect on productivity growth in general, and it is significantly negative in the horizontal effect. In the scale entry and the exit effect,

the coefficient is significantly positive, and the horizontal effect and resource allocation effect cancel each other out, which have no effect on the summation. The proportion of foreign capital is not significant in all regressions, and foreign capital has no significant impact on manufacturing productivity. The *hhi* index estimation coefficient which represents the market concentration is only positive in the entry and exit effect, which means the market concentration contributes to the allocation of resources.

Table 3. Impact of Government Subsidies on Manufacturing Productivity

	Explained variable	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
Panel A	ln*sub*	–0.002**	0.004***	–0.001**	–0.002***	–0.003***
		(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
	Constant	0.058***	–0.020***	0.022***	0.013***	0.044***
		(0.011)	(0.008)	(0.003)	(0.004)	(0.005)
	Sample size	3740	3740	3740	3740	3740
	Explained variable	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
Panel B	ln*sub*	–0.003**	–0.000	–0.000	–0.000	–0.002***
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
	ln*kl*	0.009	0.011***	0.001	–0.003	–0.000
		(0.006)	(0.004)	(0.002)	(0.002)	(0.003)
	ln*k_state*	0.002	–0.004***	0.002***	0.001***	0.002***
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
	ln*k_forgn*	–0.002	–0.000	–0.000	–0.001	0.000
		(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
	ln*hhi*	0.005	–0.002	0.001	0.003**	0.003*
		(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
	Constant	0.045*	–0.043***	0.013*	0.022***	0.053***
		(0.024)	(0.017)	(0.007)	(0.008)	(0.010)
	Sample size	3525	3525	3525	3525	3525

Notes: With the application of the panel fixed effect estimates, *, ** and *** indicate the significance level of 10%, 5% and 1%, respectively, the same in the following tables.

In addition, the ownership structure of the firm may also have an impact on the policy effect of the subsidy. Government subsidies are mainly to overcome market failures. If firms with positive externalities and spillover effects can be screened, appropriate subsidies will help to allocate resources. However, a large number of studies have found that Chinese state-owned firms are often more likely to receive subsidies through government-firm relations (Wang *et al*., 2015), while state-owned firms are often inefficient. Therefore, when a large amount of subsidy funds flow into inefficient state-owned firms, many inefficient firms will continue to survive through subsidies, which produce a large number of zombie firms (Nie *et al*., 2016), while

firms with positive externalities that should be subsidized face more severe market competition. Therefore, government subsidies may lead to more serious resource misplacement.

Table 4 adds the cross-product term of subsidies and the proportion of state-owned capital to test the marginal impact of ownership structure on the misplacement of the subsidy resources. In the regression results, the regression coefficients of other control variables did not change much. Due to the adding of the cross-product term of subsidies and the proportion of state-owned capital, the regression coefficient and the significance of subsidies changed, but the basic conclusion that resource misallocation caused by subsidies reduced manufacturing productivity remains the same, but the decomposition of resources is only significant for the entry effect. The regression coefficient of the cross-product term of the subsidy and the state-owned capital is not significant in the horizontal effect and the scale effect, and it is only negative in the entry effect. The cross-product term indicates the marginal effect of subsidies leading to resource misplacement, That is, as the proportion of state-owned capital increases, it hinders the entry of high-productivity firms. In the entry effect, the regression coefficient of the proportion of state-owned capital is positive, while the coefficient of the cross-product term of state-owned capital and subsidy is negative, indicating that although the proportion of state-owned capital itself contributes to resource allocation, subsidies for industries with a high proportion of state-owned capital may lead to resource misallocation.

Table 4. The Marginal Effect of Ownership Structure on Government Subsidies Affecting Manufacturing Productivity

Explained variable	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
ln*sub*	–0.005**	–0.001	–0.001	–0.002**	–0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Ln*sub*×ln*k_state*	–0.001	–0.001	0.000	–0.000**	0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
ln*kl*	0.009	0.011***	0.001	–0.003	0.000
	(0.006)	(0.004)	(0.002)	(0.002)	(0.003)
ln*k_state*	0.008	0.001	0.003*	0.006***	–0.003
	(0.006)	(0.004)	(0.002)	(0.002)	(0.003)
ln*k_forgn*	–0.002	0.000	0.000	–0.001	0.000
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
ln*hhi*	0.005	–0.001	0.001	0.003***	0.002*
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
Constant	0.062**	–0.029	0.017*	0.035***	0.038***
	(0.029)	(0.020)	(0.009)	(0.009)	(0.013)
Sample size	3525	3525	3525	3525	3525

Through the above empirical analysis, it is confirmed that government subsidies will lead to resource misallocation and further affect the manufacturing productivity. Empirical results show that, government subsidies will generally reduce manufacturing productivity. After further decomposition we find that subsidies have no significant impact on the productivity of firms. Instead, subsidies lead to resource misallocation between firms. The total effect is not conducive to aggregate manufacturing productivity. At the same time, it is also found that the higher the proportion of state-owned capital, the greater the effect of resources misallocation.

4.3. Robustness Test

There may be endogenous problems between government subsidies and manufacturing productivity. The empirical finding that the negative relationship between government subsidies and manufacturing productivity may be caused by the government subsidies for low-productivity firms, rather than subsidies leading to lower productivity. In order to solve this problem, the lagged item of government subsidy is used as the instrumental variable for estimation. Considering that the main reason of endogeneity is caused by mutual causality, the use of lag term can alleviate the endogeneity problem to a large extent.

Table 5 shows the results of the second stage of the instrumental variables. In this paper, we will only demonstrate the estimates of the core explanatory variables in the second-stage. In the case of subsidies and control variables (Panel A), the estimation coefficient and significance of subsidies obtained by using instrumental variables are not much changed, and the impact of subsidies on aggregated manufacturing productivity is negative. From the decomposition of productivity, the negative impact on manufacturing productivity is caused by scale effect, entry effect and exit effect, and all of them are significantly negative. When adding the cross-product term of subsidies and the proportion of state-owned capital (Panel B), although the impact of subsidies on aggregate manufacturing productivity is no longer significant, the misallocation of resources caused by scale effects and entry effects still reduces manufacturing productivity. The regression coefficient of the cross-product term of subsidy and the proportion of state-owned capital is only negatively negative in the entry effect. That is, when the proportion of state-owned capital is high, subsidies have a certain crowding out effect, hindering the entry of high-productivity firms in the market, which will reduce the aggregate manufacturing productivity.

5. Impact of Subsidies on Firm's Market Entry, Exit and Scale

The major approaches to achieve resource allocation include firm entry and exit at the extensive margin and the scale change at the intensive margin. From the

perspective of micro-dynamics, here are some issues: Do subsidies hinder firm entry and exit of market? Do subsidies promote the expansion of subsidized firms? In this section, the author adopts micro-firm data to analyze the impact of subsidies on the scale, entry and exit of firms, and further identify the micro-mechanisms that result in misallocation of resources.

Table 5. Estimation Results of Instrumental Variables of the Impact of Government Subsidies on Manufacturing Productivity

	Explained variable	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
Panel A	ln*sub*	–0.003**	0.001	–0.001**	–0.001***	–0.002***
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
	Control variable	yes	yes	yes	yes	yes
	Sample size	3135	3135	3135	3135	3135
	Explained variable	TFP growth rate	Horizontal effect	Scale effect	Entry effect	Exit effect
Panel B	ln*sub*	–0.003	0.002	–0.001*	–0.002***	–0.001
		(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
	Ln*sub*×ln*k_state*	0.000	0.000	–0.000	–0.000**	0.000
		(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
	Control variable	yes	yes	yes	yes	yes
	Sample size	3135	3135	3135	3135	3135

Note: Estimated with instrument variables. Results of the second stage estimate are shown in the table, other variables being controlled.

5.1. Impact of Government Subsidies on Firm's Market Entry and Exit

In order to analyze the impact of subsidies on firm's market entry and exit, we need to divide firms into three types according to the their status of existence: the incumbent firm, the entering firm and the exiting firm. When panel data is used to identify the firm condition, it is possible to classify firms from their existing period. Incumbent firm refers to a firm that exists in the current year, exists in the previous year and will exist the following year; entering firm refers to a firm that existed in the current year but did not exist in the previous year; exiting firm refers to a firm that exists in the current year and will exit from the market one year later. [1] It is worth noting that the industrial firm

[1] This division will also cause an issue. For companies that exist only in the current period but not in the previous and the latter period, they are both in line with the definition of entering and exiting companies, resulting in repeated definition. Considering that companies account for a very small proportion, this paper excludes such companies.

database includes state-owned firms and some non-state-owned industrial firms with annual sales of more than 5 million yuan. Therefore, the firm's market entry and exit is determined by whether the firm exists in the database.[1] In addition, a firm may re-enter the market after exiting, partly due to its temporary failure of annual sales to reach 5 million yuan, partly due to its real re-entering after exiting the market. In the latter scenario, these firms should be eliminated in case of misjudging the firm condition. Finally, firms existing for only one year should be excluded, because such firms, by definition, are both entering and exiting firms but they must be classified into one category of firm condition when it comes to empirical estimation.

A comparison of the proportion of the three statuses of existence in subsidized and unsubsidized firms (see Table 6) shows that in the subsidized group of firms, the proportion of entering and exiting firms is lower than that of unsubsidized firms, and the latter ones are inclined to maintain the status of existence, showing that subsidies are not conducive to the market entry and exit of firms.

Table 6. Proportion of Different Types of Firms

	Entering firms (%)	Incumbent firms (%)	Exiting firms (%)	Total (%)
Unsubsidized firms	23.68	64.07	12.25	100
Subsidized firms	15.96	75.86	8.17	100
Total	22.71	65.55	11.74	100

To exclude other interfering factors and to test the statistical significance of this deviation, an econometric model is further constructed. In estimating, the explained variables (the state of the firm) have three types. For this purpose, the multiple logit model is adopted.

$$state_{it} = \beta_1 D\_sub_{it} + \sum_j \gamma_j x_{jit} + \varepsilon_{it} \tag{22}$$

In the equation above, *state* represents the state of the firm. As for incumbent firms, *state*=1, as for entering firms, *state*=2, and as for exiting firm, *state*=3. The core explanatory variable is the dummy variable of whether to subsidize the firm (*D_sub*), if a firm accepts the subsidy that year, *D_sub*=1, otherwise, *D_sub*=0. The control variables include the firm productivity, capital intensity, the proportion of state-owned capital, the proportion of foreign capital and market concentration. These data are obtained in the previous OP algorithm. Descriptive statistics of related variables are

[1] This may be deviated from the reality of entry and exit performance, but the *China Business Performance Database* is the only comprehensive micro-enterprise data available to existing research institutes. Many similar studies use this method to judge the state of the companies (Mao and Sheng, 2013; Li and Jiang, 2015).

shown in Table 7. It can be seen from Table 7 that the average proportion of subsidized firms only accounts for 12.5%. China's subsidy policy only subsidizes a small number of firms. This subsidy will inevitably cause difference between subsidized and unsubsidized firms, which present different performance of entry and exit.

Table 7. Descriptive Statistical Results in the Dynamic Regression of Subsidy to Firms

Variables	Meanings	Sum	Average	Standard deviation	Minimum	Maximum
state	Firm state	1.171×10^6	1.890	0.577	1	3
scale	Firm scale (by employment)	1.171×10^6	262.7	935.5	8.000	166857
D_sub	Whether to subsidize	1.171×10^6	0.125	0.331	0	1
tfp_op	Firm productivity	1.171×10^6	4.041	1.056	–7.712	12.136
kl	Capital intensity	1.171×10^6	71.46	177.5	0.001	19805
k_state	The proportion of state capital	1.163×10^6	0.095	0.281	0	1
k_forgn	The proportion of foreign capital	1.163×10^6	0.073	0.240	0	1
hhi	Herfindahl-Hirschman index	1.171×10^6	0.013	0.025	0	1

Table 8 lists the regression results. The control group is the incumbent firm, and the estimated coefficients in the table have been converted into relative risk ratios. For entering firms, the regression coefficient of whether to subsidize firms is 0.569, indicating the probability that the firms accepting subsidies chooses to enter the market reduces by 43.1%, that is, subsidies are not conducive to the market entry of firms. The coefficient varies slightly when other factors are controlled, but it is still significant. For the exiting firm, the regression coefficient of whether to subsidize firms is 0.564, indicating the probability that the firms accepting subsidies chooses to exit the market reduces by 43.6%, that is, the subsidy is not conducive to the market exit of firms. This coefficient varies slightly when other factors are controlled, but it is still significant. Multiple Logit estimations indicate that government subsidies hinder the market entry and exits of a firm, which interferes the market allocation of resources and thus reduce manufacturing productivity as shown by the regression of productivity decomposition.

Among the control variables, the regression coefficient of *tfp_op* is less than 1, indicating that the increased productivity decreases the probability that a firm becomes an entering firm or exiting one, that is, the productivity of entering and exiting the firm is lower than that of an incumbent firm. The estimation coefficient of capital intensity is 1. The capital intensity has less impact on entering and exiting firms; the proportion of state-owned capital is not conducive to firm entry, but it helps firms to exit from the market, showing the gradual decrease of the proportion of state-owned capital in the market, and that the proportion of foreign capital is not conducive to the market entry and exit of firms; the coefficient of *hhi* index reflecting market concentration is beyond

1 in entering and exiting firms, and the market concentration increases the probability of entry and exit of firms.

Table 8. Multiple Logit Regression of Subsidies and Firm's Market Entry and Exit

	Entering firms		Exiting firms	
D_sub	0.569***	0.602***	0.564***	0.588***
	(0.004)	(0.005)	(0.006)	(0.006)
tfp		0.974***		0.689***
		(0.002)		(0.002)
kl		1.000***		1.000**
		(0.000)		(0.000)
k_state		0.292***		1.288**
		(0.030)		(0.012)
k_foreign		0.802***		0.503***
		(0.008)		(0.008)
hhi		1.416***		8.830***
		(0.135)		(0.938)
Constant	0.370***	1.021**	0.191***	0.790***
	(0.001)	(0.010)	(0.001)	(0.009)
Sample volume	1171143	1163492	1171143	1163492

Note: The control group in the table is the incumbent firm, the regression coefficient has been converted into the relative risk ratio, the standard error in parentheses.

5.2. Impact of Government Subsidies on the Scale of Firms

At the intensive margin, firms with different productivity will change the aggregate manufacturing productivity through scale changes. If the subsidy affects the scale of the firm, then the subsidy interferes the allocation of market resources and thus the manufacturing productivity. In order to analyze the impact of government subsidies on the scale of the firm, the following measurement model is constructed.

$$scale_{it} = \beta_1 D\_sub_{it} + \sum_j \gamma_j x_{jit} + \mu_i + \varepsilon_{it} \tag{23}$$

In the equation above, *scale* is the size of a firm, expressed in terms of the number of employees. Other explanatory variables have the same meaning, μ is the individual effect of the firm, and ε is the random disturbance term.

Table 9 lists the regression results, the coefficient of dummy variable of whether the firm is subsidized is significantly positive, indicating that the subsidy increases the scale of the firm and the estimation coefficient is still significant when other influencing factors

are controlled. Through government subsidies to firms, it is equivalent to increasing the income of subsidized firms and improving their competitiveness, which will help firms to further increase their scale; but at the same time, it will lead to unfair competition in the market and squeeze out the market share of unsubsidized firms, conducive to the expansion of the scale of unsubsidized firms. In the market-to-resource allocation, the high-productivity firm is larger than the low-productivity firm, and this resource allocation is efficient. Government subsidies will affect the scale of firms: the scale of subsidized firms will exceed that of unsubsidized firms. This arrangement interferes the effective allocation of resources and is not conducive to the productivity of manufacturing.

The regression coefficient of the control variable is consistent with the expectation, the estimation coefficient of productivity is positive; the scale of the high productivity firm is relatively larger; the estimation coefficient of capital intensity is negative; firms with a high proportion of state and foreign capital tend to have a larger scale; and in market-concentrated industries, the scale of firms is relatively large.

Table 9. Regression Results of Subsidies and Firm Scale

Explained variables	Firm scale (by number of employees)	
Dsub	30.941***	31.586***
	(1.436)	(1.439)
tfp		5.600***
		(0.543)
kl		–0.241***
		(0.004)
k_state		32.712***
		(3.012)
k_foreign		17.844***
		(3.057)
hhi		777.121***
		(34.747)
Constant	258.789***	238.885***
	(0.352)	(2.346)
Sample volume	1171143	1163492

Note: Panel fixed effect estimation, standard error in parentheses.

Through the dynamic empirical analyses above on the market entry, exit and scale of firms in a micro sense, the micro-mechanism of government subsidies' misleading the allocation of resource is further confirmed. The government subsidies to firms artificially interfered with the operation of micro-firms, which led to the hindrance of the market entry and exit of firms. The subsidized firms have a competitive advantage over unsubsidized firms due to government subsidies, which increases the scale of production, which will distort the market's allocation of resources. Market failures can

be overcome by government subsidies with positive externalities and spillover effects. However, the empirical results above show that the negative effects of misallocation brought by China's current subsidy policies outweigh the positive effects. In general, the policy is not conducive to manufacturing productivity.

6. Conclusion and Recommendations

As one of the most basic measures of government intervention in the micro-economy, subsidies can help get rid of market failures and serve as market signals. However, the outcomes of specific policies are not satisfactory. The reason lies in that productivity depends not only on the micro-firm, but also on the allocation of resources among them. Subsidies can cause the misallocation of resources with its negative effect exceeding the positive one and even reduce the productivity of manufacturing. In this paper, the micro data of China's manufacturing industry from 1998 to 2007 are applied for the study of the impact and mechanism of resource misallocation caused by subsidies on manufacturing productivity. With the conduction of the measurement and decomposition of manufacturing productivity, it is clear that a misallocation of resources does exist in China's manufacturing industry, leading to the reduction of the productivity of manufacturing. Empirical studies demonstrate that government subsidies are an essential factor of the misallocation in that they can change the marginal and intensive margins of the market, leading to the misallocation of resources between subsidized and unsubsidized firms and reducing the manufacturing productivity. The effect of this misallocation is more serious in industries with a high proportion of state-owned capital. In terms of specific micro-mechanisms, subsidies hinder market entry and market exit. At the intensive margin, subsidies can help with the enlargement of production scale subsidized firms and crowd out the market share of unsubsidized ones. Through the impact of subsidies on the micro-dynamics of firms, the misallocation of resources is created and the manufacturing productivity is restrained.

At present, the key issue for China's industrial upgrading is to improve the efficiency of resources allocation. Government subsidies are supposed to guide the resources allocation, support the development of high-growth industries and those with positive spillover effects and to avoid market failures. However, China's subsidy policy is mainly aimed at affiliated firms and state-owned ones, inefficient firms with ineffective operations and even zombie firms, causing a large quantity of high-growth and high-efficiency firms' facing high barriers to entry while some inefficient firms and zombie firms are able to survive with subsidies, which is detrimental to the disposal of backward production capacity and zombie firms and is a distortion of resource allocation, hindering the upgrading of the industry. That's why when formulating subsidy policies, the government needs to change the existing subsidy policies, to clarify the policy objectives of subsidies, to make subsidies for subsidies sake and to

take their impact on all participants into consideration. Specifically speaking, firstly, change the industrial policy that relies too much on subsidies. Although subsidies are essential in the overcoming of market failures and the supporting of industrial development, government usually lacks necessary information for the selection of firms, causing the difficulty in the selection of firms with positive externalities and high efficiency. Instead, subsidies often go to state-owned firms and inefficient ones, resulting in inefficient resource allocation. Industrial policies are supposed to focus on the establishment of platforms, the creation of proper business environment and the establishment of incentive mechanisms to reduce direct intervention in the operation of micro-firms. Secondly, improve the subsidy system and select industries with comparative advantages rather than firms in that it is easier to select industries than firms, and it can avoid corporate subsidy behavior caused by the close relation between government and firms. This would be conducive to the subsidy funds' flow into firms with positive externalities and the spillover effect and enable subsidies' supporting of industries and promoting of technological progress. Thirdly, to change the form of subsidies. The core of subsidies are supposed to support the industry, so firms in the industry shall be treated equally, preventing subsidies to some firms from crowding out others and causing resource misallocation and unfair market competition.

References

Bernini, C., & Pellegrini, G. (2011). How are Growth and Productivity in Private Firms Affected by Public Subsidy? Evidence from a Regional Policy. *Regional Science and Urban Economics*, 41(3), 253-265.

Brandt, L., Van Biesebroeck, J., & Zhang, Y. (2012). Creative Accounting or Creative Destruction? Firm-level Productivity Growth in Chinese Manufacturing. *Journal of Development Economics*, 97(2), 339-351.

Dixit, A. K., & Stiglitz, J. E. (1977). Monopolistic Competition and Optimum Product Diversity. *American Economic Review*, 67(3), 297-308.

Griliches, Z., & Regev, H. (1995). Firm Productivity in Israeli Industry 1979–1988. *Journal of Econometrics*, 65(1), 175-203.

Hsieh, C., & Klenow, P. J. (2009). Misallocation and Manufacturing TFP in China and India. *Quarterly Journal of Economics*, 124(4), 1403-1448.

Jiang, W., & Zhang., L. P. (2015). The Effect of Resources Misallocation of Subsidies Differentiation—An Analysis Based on the Perspective of Productivity Distribution. *China Industrial Economics (Zhongguo Gongye Jingji)*, 2, 31-43.

Levinsohn, J., & Petrin, A. (2003). Estimating Production Functions Using Inputs to

Control for Unobservables. *Review of Economic Studies*, 70(2), 317-341.

Li, K., & Jiang, W. (2015). Market Entry and Economic Growth: An Empirical Analysis of China's Manufacturing Industry. *Economic Research Journal (Jingji Yanjiu)*, 5, 48-60.

Mao, Q. L., & Sheng, B. (2013). The Entry and Exit of Chinese Manufacturing Firms and the Dynamic Evolution of Productivity. *Economic Research Journal (Jingji Yanjiu)*, 4, 16-29.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6), 1695-1725.

Nie, H. H., & Jia, R. X. (2011). Productivity of Chinese Manufacturing Firms and Resource Misallocation. *The Journal of World Economy (Shijie Jingji)*, 7, 27-42.

Nie, H. H., Jiang. T., & Yang, R. D. (2012). The Usage Condition and Potential Problems of China's Industrial Databases. *The Journal of World Economy (Shijie Jingji)*, 5, 142-158.

Nie, H. H., Jiang, T., Zhang, Y. X., & Fang, M. Y. (2016). China Zombie Firms' Research Report: Status, Causes and Countermeasures. Serial Reports of National Academy of Development and Strategy, Renmin University of China, No. 9.

Olley, G. S., & Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica*, 64(6), 1263-1297.

Qian, X. F., Mao, H. T., & Xu, X. C. (2016). A New Framework for China's Trade Interest Assessment—Based on the Perspective of Resources Misallocation Caused by Double Bias Policy. *Social Sciences in China (Zhongguo Shehui Kexue)*, 12, 83-108.

Shao, M., & Bao, Q. (2012). Government Subsidy and Firm Productivity: An Empirical Analysis Based on China's Industrial Firms. *China Industrial Economics (Zhongguo Gongye Jingji)*, 7, 70-82 .

Restuccia, D., & Rogerson, R. (2008). Policy Distortions and Aggregate Productivity with Heterogeneous Establishments. *Review of Economic Dynamics*, 11(4), 707-720.

Wang, H. J., Li, Q. Y., & Liu, F. (2015). Government Subsidies: Saving the Emergency or the Poor—Empirical Evidence from Samples of Losing Firms. *Nankai Management Review (Nankai Guanli Pinglun)*, 18(5), 42-53.

Xu, B. C., & Xie, J. G. (2015). Government Quality, Government Subsidies and Industry Total Factor Productivity. *Economic Review (Jingji Pinglun)*, 4, 45-56.

Yan, Z. J., & Yu, J. P. (2017). Government Subsidies and Industry Total Factor Productivity—A Comparative Analysis Based on Emerging Industries and Traditional Manufacturing Industries. *Industrial Economics Research (Chanye Jingji Yanjiu)*, 1, 1-13.