Government Subsidies and Firm-Level Markups: Impact and Mechanism

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Abstract: This paper investigates the impact of government subsidies on the firm-level markups and its mechanism of action by measuring the firm-level markups based on a micro dataset of Chinese manufacturing firms from 2000 to 2007. The findings suggest that government subsidies significantly reduce the markups of Chinese firms. Moreover, there is significant heterogeneity in the negative impact of government subsidies among different types of firms. Furthermore, analysis of the impact mechanism based on the mediation effect model shows that the increase in rent-seeking cost is an important way for government subsidies to reduce the firm-level markups. Finally, based on the dynamic decomposition of the aggregate markup of the Chinese manufacturing industry, it is found that government subsidies significantly reduce the industry-level aggregate markup through within-firm and cross-firm effects. This study enriches the literature on government subsidies and markups, and provides a new perspective for understanding the micro-performance of government subsidies.

Keywords: government subsidy; firm-level markups; rent-seeking; mediating effect

1. Introduction

As a traditional and widely used industrial policy, government subsidies are an important factor in promoting economic development. Many developing countries often support economic growth and industrial upgrading through interventions, such as government subsidies, at the economic take-off stage [1]. The tremendous economic achievements China has made since the reform and opening up are inseparable from the leading role played by the government in economic growth. The relatively unique administrative system and GDP competition between local governments have induced large subsidies for firms by Chinese governments at all levels. In particular, since the fiscal decentralization reform in 1994, Chinese local governments have gained clear local benefits (i.e., local taxes). This has granted high autonomy in resource allocation to local governments. Moreover, the focus of performance assessment of local officials has been gradually shifted from political to economic indicators. Consequently, local governments have been motivated to stimulate firms to engage in production through government subsidies, thereby promoting local economic development. Government subsidies have become one of the major government interventions in the economy after the tax reform in China. According to preliminary statistics from the Annual Survey of Industrial Firms (ASIF) compiled by the National Bureau of Statistics of China, 172,000 times (subsidies granted to one firm in one year is counted as one time) of government subsidies were granted to state-owned industrial enterprises, and those of other ownership types with sales above RMB 5 million between 1998 and 2007, amounting to a total subsidy of 227.8 billion yuan. It is generally believed that government subsidies to firms have played an important role in promoting investment and economic growth, adjusting the industrial structure, guiding economic trends, maintaining social stability, and creating employment opportunities [2]. However, the non-transparent subsidy process and even rent-seeking have made the motivation and...
efficiency of government subsidies controversial [3]. Therefore, it is particularly important to evaluate
the effect of subsidies reasonably and scientifically from multiple angles.

To this end, this paper aims to provide an in-depth understanding of the micro-effects of
government subsidies from the perspective of firm-level markups. This perspective was chosen
based on the following reasons: The markups reflect the ability of firms to maintain prices above
the marginal cost. The ability to maintain high markups is one of the key indicators of the dynamic
competitiveness of firms. The primary reason for the domination of the industry development pattern
by multinational firms is their dynamic competitiveness characterized by “high markups, high profit,
and continuous innovation” [4]. Then, as the most direct means of government support, can subsidies
help local Chinese firms to enhance this ability? Do subsidized firms have higher markups than
those unsubsidized? Moreover, the decision-making regarding the level of subsidy by Chinese local
governments reflects the tendency of “protecting the weak” [2], that is, local governments tend to
give higher subsidies to firms with lower competitiveness. So, do firms receiving a higher level of
government subsidy have higher markups? Evidently, scientific judgment and interpretation of these
issues can not only enrich the study of the effect of government subsidies, but also provide clear policy
implications for the government to formulate subsidy policies and improve the efficiency of subsidies.

Given this background, this paper analyzes the impact of government subsidies on firm-level
markups measured by following the method of De Loecker and Warzynski [5], and its mechanism of
action using a dynamic panel model with a micro dataset of Chinese manufacturing firms from 1999 to
2007. Furthermore, based on the dynamic decomposition of the changes in the aggregate markup of
the Chinese manufacturing industry according to the decomposition method proposed by Melitz and
Polanec [6] (referred to as the MP decomposition method), this paper also examines the relationship
between government subsidies and the changes in the aggregate markup at the industry level.

Section 2 the literature review. Section 3 describes the empirical model, measurement of variables,
and data. Section 4 presents and discusses the benchmark regression results. Section 5 explores
the mechanism of government subsidies affecting firm-level markups using the mediation effect model.
Section 6 discusses the heterogeneous impact of government subsidies on the markups of different
types of firms. Section 7 examines the relationship between government subsidies and the changes in
the aggregate markup at the industry level. The last section presents conclusions.

2. Literature Review

Currently, many studies have discussed the influence factors of firm’s markups from different
perspectives. A few studies have been conducted on how government subsidies influence firm-level
markups. For example, Sheng and Wang found that the phenomenon that the markup of China’s
export firms was lower than that of non-export firms generally existed in different industries, different
regions and different ownership firms. They further pointed out that long-term export tax rebates
and subsidy policies were important reasons for the low markups of Chinese exporters [7]. Ren and
Zhang measured the difference in the markups between subsidized and non-subsidized firms using
propensity score matching based on panel data of Chinese equipment manufacturing firms from 1999 to
2007. They found that the markups of subsidized firms were lower than those of non-subsidized firms,
which generally existed in various sub-sectors of the equipment manufacturing industry. Therefore,
they confirmed that subsidies did not bring about the improvement of the competitiveness of equipment
manufacturing firms. At the same time, they pointed out that the government subsidies reduced
firm-level markups by increasing the rent-seeking costs of firms [4]. Sun et al. extended the sample
to all manufacturing firms in the ASIF and estimated the impact of subsidies on firm-level markups
using the system and generalized difference method of moments (GMM). They also found that the
markups of subsidized firms were lower than those of non-subsidized firms, and that every doubling
of the subsidy rate would result in a 0.21 unit increase in firm markups [8]. Based on China’s industrial
enterprises-customs matched data, Xu utilizes a two-tier stochastic frontier analysis method to estimate
and verify the extent that the selection effect and competition effect influences exporting firms’ markup.
He finds that the policy incentives (e.g., subsidy) to encourage firms to export are major contributors to the low export markups [9]. Chen and Yu find that government subsidies strengthen the markups in the dairy industry of China by constructing a parametric model and using the firm-level panel data, specifically the top eight dairy firms [10]. However, previous studies on the impact of government subsidies on firm-level markups either are limited by an incomplete sample (for one specific industry), or lack a detailed analysis of the mechanism of government subsidies affecting firm-level markups.

Compared with the existing literature, the main contributions of this paper are as follows: Firstly, a dynamic panel model was constructed to examine the impact of government subsidies on firm-level markups based on a micro dataset of Chinese manufacturing firms from 1999 to 2007. The possible endogeneity problem in the regression was solved using the system GMM estimator. With these efforts, this paper demonstrates that the markups of Chinese firms are significantly reduced by government subsidies, which is supported by robustness checks (i.e., by replacing the key measure and controlling other policy changes) and heterogeneity tests for the industry sector, ownership type, and geographical regions.

Secondly, the internal mechanism of government subsidies affecting the markups of Chinese firms is identified using a mediational model: Government subsidies have a negative impact on firm markups by inducing an increase in rent-seeking costs. An in-depth analysis of the impact mechanism is clearly conducive to a better understanding of the relationship between government subsidy policy changes and firm markups.

Thirdly, by decomposing the changes in the aggregate markup of the Chinese manufacturing industry into within-firm, cross-firm, entry, and exit effects, this paper provides micro-evidence at the industry level on how government subsidies affect the changes in the industry-level markup, and provides a new perspective for understanding the actual effect of government subsidies, which will undoubtedly contribute to the existing literature.

Lastly, although the micro-effects of government subsidies have been analyzed from different perspectives, such as export behavior [11,12], firm innovation [13,14], most studies have focused on the impact of government subsidies on firm productivity [15–18]. Admittedly, this is related to the fact that total factor productivity (TFP) is the most important indicator of competitiveness in the process of economic development. However, it should be noted that because of data constraints, it is common to estimate firm productivity based on income-side data on inputs and outputs in the literature on how government subsidies influence firm productivity. As a result, the estimated firm productivity is often influenced by the price factor. De Loecker pointed out that in order to completely eliminate the influence of price factor, it was necessary to deflate incomes and expenditures with a specific firm-level price deflator [19]. Unfortunately, such data are almost not available. Therefore, numerous previous studies attempted to deflate incomes and expenditures using an industry-level price deflator. Although this method can eliminate the influence of price factor to some extent, the productivity measured in this way is still likely to capture both the firm productivity and markups [5,20]. Therefore, when the productivity estimated from income data is used to investigate the impact of government subsidies on firm productivity, the estimated coefficient for government subsidies may reflect the impact of government subsidies not only on actual firm productivity, but also on firm-level markups. For this reason, in this case, it is necessary to examine and emphasize the importance of firm-level markups, which will help to better define the impact of government subsidies on actual firm productivity. From this perspective, an in-depth analysis of the impact of government subsidies on firm-level markups is also of great significance for more accurately identifying the true impact of government subsidies on firm productivity. Therefore, this paper is also a useful enrichment of literature on the impact of government subsidies on firm productivity.

3. Empirical Model and Data

In this section, we describe how to measure the key variable, the firm-level markup, and then present a regression model for evaluating the impact of government subsidies on the firm-level markups.
3.1. Estimation of Firm-level Markups

With reference to De Loecker and Warzynski [5], the firm-level markup is defined as the ratio of the product price to marginal cost. Then, the markup $\mu_i$ of firm $i$ in period $t$ is defined as:

$$\mu_i = \theta_i^m (\alpha_i^v)^{-1}$$

(1)

where $\alpha_i^v$ is the proportion of total expenditure of variable input, $v_i$ in the total sales revenue of the firm. Generally, $\alpha_i^v$ can be directly calculated from the production data of the firm. Therefore, in order to measure the firm-level markups, it is only necessary to estimate the output elasticity, $\theta_i^m$, of one (or several) variable input(s) in the production.

For the sake of simplicity, assuming that the production function of the firm is translog and the technological progress is Hicks neutral, the output is measured by the total output value:

$$y_i = \beta_0 l_i + \beta_1 k_i + \beta_2 m_i + \beta_3 l_i^2 + \beta_4 k_i^2 + \beta_5 m_i^2 + \beta_6 l_i k_i + \beta_7 l_i m_i + \beta_8 k_i m_i + \beta_9 l_i k_i m_i + \omega_i + \epsilon_i$$

(2)

where $y_i$ is the logarithm of the total output of firm $i$ in period $t$, $l_i$ is the logarithm of labor input, $m_i$ is the logarithm of intermediate inputs, $k_i$ is the logarithm of capital stock, $\omega_i$ is the TFP, and $\epsilon_i$ is a random error term. According to Lu and Yu [21], labor is not a variable input for Chinese firms, especially for state-owned firms. As capital is a dynamic input, the firm markup needs to be calculated by estimating the output elasticity $\theta_i^m$ of the intermediate inputs ($m_i$). The output elasticity of intermediate inputs can be easily derived from Equation (2):

$$\theta_i^m = \beta_2 + 2\beta_6 l_i + \beta_7 k_i + \beta_8 k_i l_i$$

(3)

Evidently, in the trans-log production function, the output elasticity of intermediate inputs depends not only on $\beta_m$, but also on the inputs, $l_i$, $m_i$, and $k_i$, used by the firm. Hence, even if two firms have the same production function, the $\theta_i^m$ will be different because of their different $l_i$, $m_i$, and $k_i$ used in production.

In order to measure the output elasticity of intermediate inputs, we must first estimate the firm production function in Equation (2). However, the endogeneity between inputs and TFP in production function estimation will invalidate the traditional OLS. In this study, the semi-parametric estimation method developed by Ackerberg et al. [22] (referred to as the ACF method) is used to solve the endogeneity problem in production function estimation.

3.2. Econometric Model

In view of the possible continuity of firm-level markups, the following dynamic panel model was developed to explore the impact of government subsidies on the markups of Chinese firms:

$$\text{Markup}_{ijt} = \beta_1 \text{Markup}_{ijt-1} + \beta_2 \text{Subsidy}_{ijt} + \delta X_{ijt} + \nu_i + \alpha_i + \mu_{ijt}$$

(4)

where the explained variable $\text{Markup}_{ijt}$ is the logarithm of the markup of firm $i$ in industry $j$ in period $t$. The firm markup is calculated according to Equation (1). $\text{Markup}_{ijt-1}$ is the logarithm of the one-period lagged markup of firm $i$ in industry $j$. $\text{Subsidy}_{ijt}$ measures the government subsidies received by firm $i$ in industry $j$ in period $t$, which is the core explanatory variable in this study. There are three main methods in the literature that have been used to measure the government subsidies received by firms. The first is to use the dummy variable $S_{\text{dummy}_{ijt}}$. When the firm receives government subsidies in the current year, $S_{\text{dummy}_{ijt}} = 1$; otherwise, $S_{\text{dummy}_{ijt}} = 0$. The second is to measure government subsidies as the logarithm of the number of government subsidies received by the firm in the current year. The third is to measure government subsidies as the proportion of government subsidies received by the firm to its total industrial sales ($\text{Subsidy}_{ijt}$). However, the dummy variable does not properly reflect the number of government subsidies received by the firm. Moreover, it is not
entirely appropriate to directly measure the government subsidies by directly using the logarithm of the government subsidy amount received by the firm. It is because the same number of government subsidies has a different importance for firms of different sizes (for example, large firms have high output values, and small firms have low ones). To this end, the third method was used in this study to measure government subsidies. In order to check robustness, the other two methods were also employed to measure government subsidies in the later empirical analysis. \( X_{ijt} \) is a set of other control variables; \( \nu_t \) is a year fixed effect that captures unobservable related factors (such as macro policy changes) that affect the markups of all firms, due to changes in time; \( \alpha_i \) is a firm fixed effect; and \( \mu_{ijt} \) is a random disturbance term.

Following the related research of Ren and Zhang [4], the following control variables are introduced into Equation (4): (a) Firm-level total factor productivity (TFP). In order to obtain the firm-level TFP, the firm-level production functions that include capital, labor, and intermediate inputs are estimated for each industry. The ACF method is used to solve the endogeneity problem in production function estimation. (b) Firm size (Size). In the existing literature, firm size is mainly measured as the logarithm of sales, the logarithm of the number of employees, and the logarithm of the total assets. In this study, the logarithm of the number of employees is used. (c) Firm age (Age), which is measured as the logarithm of the number of years, since the establishment of the firm. (d) Factor intensity (\( K_l \)), which is measured as the logarithm of the capital-labor ratio. Capital is expressed as the annual balance of net fixed assets deflated by the price index, and labor as the annual number of employees. (e) Average wage (Wage), which is measured as the logarithm of the ratio of total wages payable (including benefits payable) to the number of employees. (f) Industry concentration (HHI), which is measured in quartiles using the Herfindahl-Hirschman index.

3.3. Data

The data used in this study came from the Annual Survey of Industrial Firms (ASIF) compiled by the National Bureau of Statistics of China. The ASIF covers all state-owned industrial firms and those of other ownership types with sales above RMB 5 million. The sample spans from 1999 to 2007, which is consistent with the previous research. For the reliability of the results, firms in the manufacturing industry were selected. Similar to the approach of Feenstra et al. [23], and Yu [24], we processed the industrial firm data by excluding firms with missing variables, with less than eight employees, or that violate accounting common sense (e.g., total assets less than the net fixed assets, and paid-in capital less than or equal to zero).

To obtain firm-level markups, the first step is to estimate the firm-level production functions. In order to better reflect the differences in production technology between industries, all firms are classified according to the 2-digit industry code of the ASIF database. The production function shown in Equation (2) is then estimated by the ACF method for each industry (see Table 1 for industry names). Based on the estimated production function, the output elasticity of intermediate inputs can be easily obtained from Equation (3). On this basis, firm-level markups can be computed from Equation (1). Table 1 reports the average markups (simple average) and quantiles for each industry during the sample period. It can be seen that the average markups in almost all industries are between 1 and 2.
Table 1. Average markups and quantiles for each industry.

| Industry Sector                                      | P5      | P25     | P50     | P75     | P95     | Mean   |
|-----------------------------------------------------|---------|---------|---------|---------|---------|--------|
| Food manufacturing                                   | 1.032   | 1.234   | 1.375   | 1.521   | 1.771   | 1.384  |
| Beverage manufacturing                              | 1.072   | 1.278   | 1.425   | 1.586   | 1.834   | 1.436  |
| Tobacco products                                     | 1.119   | 1.355   | 1.557   | 1.756   | 1.970   | 1.552  |
| Textiles                                            | 1.049   | 1.210   | 1.318   | 1.435   | 1.654   | 1.330  |
| Manufacture of textile garments, shoes, and hats    | 1.122   | 1.320   | 1.440   | 1.568   | 1.811   | 1.449  |
| Leather, fur, feather, and related products         | 1.126   | 1.318   | 1.442   | 1.579   | 1.808   | 1.451  |
| Wood processing and wood, bamboo, rattan, palm, and straw products | 1.162   | 1.394   | 1.518   | 1.643   | 1.837   | 1.514  |
| Furniture manufacturing                             | 1.147   | 1.364   | 1.495   | 1.624   | 1.832   | 1.492  |
| Paper and paper products                            | 1.022   | 1.194   | 1.318   | 1.447   | 1.662   | 1.327  |
| Printing and copying of recording media             | 1.054   | 1.230   | 1.354   | 1.505   | 1.779   | 1.376  |
| Educational and sporting goods manufacturing        | 1.047   | 1.201   | 1.307   | 1.424   | 1.665   | 1.324  |
| Petroleum processing, coking, and nuclear fuel processing | 1.047   | 1.252   | 1.397   | 1.535   | 1.771   | 1.399  |
| Chemical raw materials and chemical products         | 1.046   | 1.260   | 1.400   | 1.540   | 1.774   | 1.403  |
| manufacturing                                       |         |         |         |         |         |        |
| Pharmaceutical manufacturing                        | 1.088   | 1.299   | 1.437   | 1.592   | 1.843   | 1.448  |
| Chemical fiber manufacturing                        | 1.008   | 1.179   | 1.316   | 1.448   | 1.680   | 1.323  |
| Rubber products                                      | 1.069   | 1.250   | 1.365   | 1.488   | 1.714   | 1.374  |
| Plastic products                                     | 1.043   | 1.226   | 1.348   | 1.478   | 1.710   | 1.359  |
| Non-metallic mineral products                        | 1.061   | 1.239   | 1.361   | 1.495   | 1.729   | 1.374  |
| Smelting and pressing of ferrous metals             | 1.050   | 1.256   | 1.381   | 1.501   | 1.702   | 1.379  |
| Smelting and pressing of nonferrous metals           | 1.046   | 1.255   | 1.391   | 1.524   | 1.748   | 1.392  |
| Fabricated metal products                            | 1.025   | 1.186   | 1.294   | 1.412   | 1.647   | 1.309  |
| General equipment manufacturing                     | 1.052   | 1.228   | 1.350   | 1.489   | 1.737   | 1.367  |
| Special equipment manufacturing                     | 1.046   | 1.234   | 1.362   | 1.512   | 1.778   | 1.381  |
| Transportation equipment manufacturing               | 1.046   | 1.232   | 1.360   | 1.500   | 1.758   | 1.374  |
| Electrical machinery and equipment                   | 1.110   | 1.321   | 1.457   | 1.599   | 1.835   | 1.462  |
| Manufacture of communication equipment, computers and other electronic equipment | 1.034   | 1.209   | 1.334   | 1.485   | 1.766   | 1.357  |
| Instruments, meters and cultural and office machinery manufacturing | 1.046   | 1.238   | 1.380   | 1.543   | 1.826   | 1.400  |
| Crafts and other manufacturing                       | 1.042   | 1.214   | 1.334   | 1.471   | 1.729   | 1.352  |

4. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

4.1. Benchmark Regression

Equation (4) is estimated using a micro dataset at the level of Chinese manufacturing firms from 1999 to 2007. The regression results are reported in Table 2. There is an endogeneity problem if the least-square method is used for estimation as the regression Equation (4) is a dynamic panel model (the explanatory variables include the one-period lagged value of the explained variable, Markup). To this end, the system GMM is employed to estimate Equation (4). In column (1) of Table 2, the firm-level markup (Markup) is directly used to regress the government subsidy (Subsidy) without any control variables. The results show that the coefficient on government subsidy is significantly negative. It indicates that the firm-level markups are decreased with the increase in government subsidies. In column (2), the control variable, firm-level TFP, is included. The regression results are similar to those in column (1): The coefficient on government subsidy remains significantly negative. In column (3), six control variables, including firm-level TFP, firm size, firm age, input intensity, average wage, and industry concentration, are included. The regression results show that the coefficient on government subsidy remains significantly negative. This indicates to some extent that the impact of
government subsidies on firm-level markups does not change with the control variables. Specifically, as shown in the regression results in column (3), the coefficient on government subsidy is $-0.0299$, with significance at the 1% level. It indicates that every 0.1 increase in the proportion of subsidy to total sales ($\text{Subsidy}$) of the firm is associated with a 0.299% decrease in the firm-level markup.

### Table 2. Benchmark regression results.

| Dependent Variable | System GMM       |
|--------------------|------------------|
|                    | (1)              | (2)              | (3)              |
| Markup             |                  |                  |                  |
| LMarkup            | 0.7913***        | 0.6298***        | 0.2766***        |
|                    | (0.0751)         | (0.0656)         | (0.0480)         |
| Subsidy            | $-0.0431$***     | $-0.0595$***     | $-0.0299$***     |
|                    | (0.0137)         | (0.0069)         | (0.0063)         |
| TFP                | 0.2423***        | 0.3466***        |                  |
|                    | (0.0110)         | (0.0032)         |                  |
| Size               | $-0.0178$***     |                  |                  |
|                    | (0.0005)         |                  |                  |
| Age                | $-0.0042$***     |                  |                  |
|                    | (0.0006)         |                  |                  |
| Kl                 | $-0.0003$*       |                  |                  |
|                    | (0.0001)         |                  |                  |
| Wage               | 0.0087***        |                  |                  |
|                    | (0.0005)         |                  |                  |
| HHI                | 0.1643***        |                  |                  |
|                    | (0.0077)         |                  |                  |
| AR(1)              | 0.000            | 0.000            | 0.000            |
| AR(2)              | 0.000            | 0.000            | 0.000            |
| AR(3)              | 0.156            | 0.448            | 0.776            |
| Hansen test        | 0.205            | 0.195            | 0.470            |
| Observations       | 629,156          | 628,736          | 623,051          |

Note: (1) Year fixed effect and firm fixed effect are included in all regression. (2) AR(1), AR(2), and AR(3) are the P values of the first-, second- and third-order serial correlation tests of the residuals of the difference equation, respectively. The null hypothesis is no serial correlation. (3) The Hansen test row contains the P values of the over-identification test of the instrumental variables. The null hypothesis is no over-identification. (4) The values in parentheses are standard deviations. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The same applies to subsequent tables.

As mentioned above, system GMM is employed to estimate the dynamic panel model shown in Equation (4). In this case, great attention needs to be paid to the validity of instrumental variables. To this end, it is generally necessary to perform a serial correlation test of the difference model residuals and an over-identification test of the instrumental variables. The Arellano-Bond autocorrelation test (abbreviated as AB test) is common for the former, and the Hansen test (i.e., J statistic) for the latter. The null hypothesis of the Hansen test is that the instrumental variables are not over-identified. As evidenced the AB test results of the regression equation in Table 2, there are first-order and second-order, but not third-order serial correlation problems for the residuals of each difference equation. Therefore, the third-order or higher-order lagged values can be used as instrumental variables. Moreover, the Hansen test does not reject the null hypothesis even at the 10% level. This indicates that the instrumental variables used in the system GMM, with no over-identification problems.

For other control variables, it can be seen from column (3) of Table 2 that the coefficients in front of the one-period lagged markups are all significantly positive. It indicates that a higher firm-level markup in the previous period is associated with a higher markup in the current period. The coefficient on firm-level TFP ($\text{TFP}$) is positive, with significance at the 1% level. It indicates that a higher TFP is conducive to the increase of firm-level markups. This accords with the conclusion of the theoretical model developed by Melitz and Ottaviano [25] that the higher the productivity of the firm, the higher the markups. The coefficient on firm size ($\text{Size}$) is significantly negative. It indicates that the large firms
have relatively low markups. The coefficient on firm age (Age) is significantly negative, indicating that the older the firm, the lower the markup. The possible reasons are as follows. First, the firms may fail to effectively increase their productivity through learning by doing with the increase of age. Second, older firms need to pay high wages for senior employees, which is a serious financial burden. In addition, older firms tend to be less innovative, and thus, have lower markups compared to newer firms. The coefficient on factor intensity (KI) is also significantly negative. It indicates that the higher the capital-labor ratio, the lower the markup. The coefficient on average wage (Wage) is significantly positive, indicating that the higher the average wage, the higher the markup. The possible reason is that the average wage can be regarded as an approximate substitute for the quality of labor. Firms with higher average wages are more likely to attract employees with higher production and management skills. The use of highly skilled labor can help the firms to improve production efficiency, which in turn will help reduce marginal production costs and increase the markups. In addition, the coefficient on industry concentration (HHI) is also significantly positive, indicating that firms with higher industry concentration have higher markups.

Overall, the regression results in Table 2 reveal that firm-level markups are decreased with increasing government subsidies; that is, government subsidies have a significant negative impact on the markups of Chinese firms.

4.2. Robustness Checks

Replacement of the measure. In the above analysis, government subsidies were measured by the proportion of government subsidies received by the firm to its total industrial sales. For robustness, in this section, government subsidies are measured by a dummy variable and the logarithm of the number of government subsidies received by the firm in the current year, respectively. Firstly, the dummy variable $S_{dummy_{ijt}}$ is defined. If the firm receives government subsidies in the current year, $S_{dummy_{ijt}} = 1$; otherwise, $S_{dummy_{ijt}} = 0$. Secondly, the number of government subsidies received by the firm in the current year is indicated by $Subsidy_{ijt}$. Since many firms in the ASIF do not receive government subsidies (for firms that do not receive government subsidies, $Subsidy_{ijt} = 0$), many samples will be lost if the logarithm of $Subsidy_{ijt}$ is used directly (i.e., firms that do not receive government subsidies cannot be included as a logarithm cannot be taken when $Subsidy_{ijt} = 0$). To this end, $S_{value_{ijt}} = \ln(Subsidy_{ijt} + 1)$ is defined. $S_{value_{ijt}}$ is used to approximate the logarithm of the number of government subsidies received by the firm in the current year to minimize the reduction in the number of samples. Using the newly defined measures ($S_{value_{ijt}}$ and $S_{dummy_{ijt}}$) of government subsidies, Equation (4) is re-estimated by system GMM. The regression results are shown in columns (1) and (2) of Table 3. Similar to the benchmark regression results in column (3) of Table 2, the coefficients for both $S_{value_{ijt}}$ and $S_{dummy_{ijt}}$ are significantly negative. This again indicates that government subsidies significantly decrease the firm-level markups. Thus, the regression results in Section 3.1 are robust.

Furthermore, in addition to the common cash grants, the government provides various forms of subsidies, such as tax incentives and low-interest loans, to firms. However, government subsidies are only measured by “subsidy income” recorded in the ASIF in the above analysis, which does not take into account the diversity of government subsidies. Therefore, in this section, another measure of government subsidy is constructed based on the possibility of the firm receiving low-interest loans according to the approach proposed by Aghion et al. [17] to check the robustness. First, the annual interest rate actually paid by each sample firm (defined as the ratio of the firm’s interest expense to its current liabilities) is calculated by referring to Aghion et al. [17]. Next, the dummy variable $S_{interest_{ijt}}$ is defined. If the actual interest rate paid by firm $i$ in industry $j$ during period $t$ is lower than the median interest rate paid by the sample firms in the same period, it is considered that firm $i$ receives low-interest loans during period $t$, and thus, $S_{interest_{ijt}} = 1$; otherwise, $S_{interest_{ijt}} = 0$. Equation (4) is re-estimated using the newly constructed measure of government subsidy. As shown by the regression results in column (3) of Table 3, the coefficient of $S_{interest_{ijt}}$ remains significantly negative.
It indicates that firms receiving low-interest loans from the government have relatively low markups. Thus, the previous regression results are robust.

### Table 3. Results of robustness checks.

| Dependent Variable | Measure Replacement | Lag Effect | Change of Sample Period | Balanced Panel |
|--------------------|---------------------|------------|------------------------|----------------|
|                    |                     |            |                        |                |
| Markup             |                     |            |                        |                |
| L.Markup           | 0.3522 ***          | 0.4826 *** | 0.1723 ***             | 0.2765 ***     | 0.5007 ***     | 0.2326 ***     |
|                    | (0.0568)            | (0.0922)   | (0.0216)               | (0.0480)       | (0.1443)       | (0.0342)       |
| S_dummy            | −0.0008 *           |            |                        |                |
|                    | (0.0004)            |            |                        |                |
| S_value            | −0.0026 *           |            |                        |                |
|                    | (0.0016)            |            |                        |                |
| S_interest         | −0.0005 **          |            |                        |                |
|                    | (0.0003)            |            |                        |                |
| L.Subsidy          | −0.0181 ***         |            |                        |                |
|                    | (0.0055)            |            |                        |                |
| Subsidy            |                     |            | −0.0298 *              | −0.0510 ***    |
|                    |                     |            | (0.0175)               | (0.0139)       |
| TFP                | 0.2912 ***          | 0.1889 *** | 0.4135 ***             | 0.3466 ***     | 0.2167 **      | 0.3089 ***     |
|                    | (0.0097)            | (0.0559)   | (0.0038)               | (0.0032)       | (0.0846)       | (0.0079)       |
| Size               | −0.0151 ***         | −0.0107 ***| −0.0327 ***            | −0.0178 ***    | −0.0134 **     | −0.0171 ***    |
|                    | (0.0008)            | (0.0027)   | (0.0010)               | (0.0005)       | (0.0057)       | (0.0007)       |
| Age                | −0.0046 ***         | −0.0025    | 0.0004                 | −0.0043 ***    | −0.0033 **     | −0.0107 ***    |
|                    | (0.0007)            | (0.0016)   | (0.0007)               | (0.0006)       | (0.0013)       | (0.0014)       |
| KI                 | −0.0001             | 0.0003     | −0.0068 ***            | −0.0003 *      | −0.0042        | −0.0004        |
|                    | (0.0001)            | (0.0004)   | (0.0012)               | (0.0001)       | (0.0031)       | (0.0004)       |
| Wage               | 0.0085 ***          | 0.0134 *** | 0.0055 ***             | 0.0087 ***     | 0.0285         | 0.0106 ***     |
|                    | (0.0008)            | (0.0016)   | (0.0003)               | (0.0005)       | (0.0263)       | (0.0010)       |
| HHI                | 0.1638 ***          | −0.2866    | 0.0119                 | 0.1643 ***     | 0.1281 **      | 0.2309 ***     |
|                    | (0.0099)            | (0.2176)   | (0.0116)               | (0.0077)       | (0.0581)       | (0.0225)       |
| AR(1)              | 0.000               | 0.000      | 0.000                  | 0.000          | 0.000          | 0.000          |
| AR(2)              | 0.000               | 0.000      | 0.126                  | 0.000          | 0.001          | 0.000          |
| AR(3)              | 0.689               | 0.562      | 0.776                  | 0.187          | 0.710          |                |
| Hansen test        | 0.437               | 0.222      | 0.124                  | 0.473          | 0.208          | 0.363          |
| Observations       | 623,051             | 623,051    | 539,957                | 623,051        | 510,265        | 95,248         |

**Considering lag effect.** As subsidy could impact firm’s performance with some lag, for robustness, in this section, Equation (4) is re-estimated when considering government subsidy at time \( t - 1 \) and not \( t \). As shown in column (4) of Table 3, the coefficient on government subsidy (\( L.Subsidy \)) remains significantly negative. This again indicates that government subsidies significantly decrease the firm-level markups. Therefore, even we consider that subsidy could impact firm’s performance with some lag, the benchmark regression results are robust.

**Controlled impact of other policy changes.** It is noteworthy that China joined the World Trade Organization (WTO) at the end of 2001, which is an important policy change during the sample period. As trade liberalization was further accelerated thereafter, the consequent import competition has significantly reduced the markups of Chinese firms [26]. For robustness, in this section, Equation (4) is re-estimated using a subsample to rule out the effects of WTO accession. The post-WTO accession subsample only consists of firm data in 2002 and later years. As shown in column (5) of Table 3, the coefficient on government subsidy (\( Subsidy \)) remains significantly negative. Therefore, in general, the previous benchmark regression results are less likely to be interfered by the policy change of WTO accession, and thus, are robust.

**Balanced panel.** Unbalanced panel data are used in the previous analysis. In the unbalanced panel data, the firm may enter and exit. The entry and exit of firms, especially short-term existence,
may affect the estimation results. In particular, system GMM estimation with the lagged variable as an instrument is used in this study. In this case, the short-term existence of the firms may further aggravate the bias of the regression results. In order to avoid the impact of the short-term existence of firms on the estimation results, balanced panel data are constructed by only retaining firms that existed throughout the sample period. Equation (4) is then re-estimated using the balanced panel data to test robustness. As shown in column (6) of Table 3, the coefficient on government subsidy (Subsidy) remains significantly negative. This again demonstrates that government subsidies have a significant negative impact on the firm-level markups. Thus, the previous core conclusions are robust.

5. Mechanism of Government Subsidies Affecting Firm-level Markups

As revealed by the above empirical results, the markups of Chinese firms are reduced by government subsidies. So how do government subsidies reduce the firm-level markups? In order to investigate more deeply the internal relationship between government subsidies and firm-level markups, this section attempts to explore the possible transmission mechanism by constructing a mediational model.

5.1. Possible Mechanism of Government Subsidies Affecting Firm-level Markups

Since the fiscal decentralization reform in China in 1994, local governments have been given authority and discretion. As a result, government officials have gradually controlled the economic and administrative resources needed by a large number of firms, thus, controlling the development of such firms. All firms operating under the governance of government officials wish to receive subsidies that “fall from the sky”. However, it is evident from empirical facts that not all firms can obtain government subsidies. The government has certain criteria for selection of subsidy recipients. The political connection caused by information asymmetry between government and firms can provide a signal indicative of a firm reputation [27].

As the establishment and maintenance of political connections are crucial for obtaining subsidies, rent-seeking for subsidies is inevitable. Especially in the case of information asymmetry and poor governance, in order to obtain more favorable subsidy resources, firms are bound to seek rents from the science and technology departments and local governments that have the authority to allocate resources. For firms, on the one hand, rent-seeking can overcome the obstacles caused by the law, property rights, backward financial development system, and government failure to their own development; on the other, if both expanded reproduction and rent-seeking can achieve the same increase in profit, the firms are willing to obtain subsidies by rent-seeking as long as the cost of rent-seeking is less than the investment in progress. For government officials, increasing the social and policy responsibilities of firms by creating greater rent-seeking space and enhancing interventions can help them improve political performance. All in all, rent-seeking has become the fastest and most effective way for firms to establish political connections and obtain subsidies, whether in terms of the institutional characteristics of China’s transitional economy or the firms’own will [4].

However, rent-seeking has a cost. This cost is an unproductive expenditure, that is, the expenditure that cannot directly or indirectly contribute to the production of products or services from the perspective of social production [28]. Therefore, the rent-seeking to obtain subsidies increases the unproductive expenditure, and consequently, the cost of firms, thereby having a negative impact on the firm-level markups.

5.2. Analysis of the Impact Mechanism Based on a Mediation Model

According to the above analysis, government subsidies can affect firm-level markups through the rent-seeking cost. To verify the potential impact mechanism proposed in Section 5.1, a mediation effect model is estimated using the rent-seeking cost of firms as a mediator. This approach consists of three steps: First, the dependent variable (markup) is regressed on the basic independent variable (government subsidy). Second, the mediator (rent-seeking cost) is regressed on the basic independent
variable. Finally, the dependent variable is regressed on both the basic independent variable and mediator. The complete mediation effect model is specified as follows:

\[
\text{Markup}_{ijt} = a_1 \text{Markup}_{ijt-1} + a_2 \text{Subsidy}_{ijt} + \delta X_{ijt} + \nu_t + \mu_{ijt} \tag{5}
\]

\[
\text{Cost}_{ijt} = b_1 \text{Cost}_{ijt-1} + b_2 \text{Subsidy}_{ijt} + \delta X_{ijt} + \nu_t + \mu_{ijt} \tag{6}
\]

\[
\text{Markup}_{ijt} = d_1 \text{Markup}_{ijt-1} + d_2 \text{Subsidy}_{ijt} + d_3 \text{Cost}_{ijt} + \delta X_{ijt} + \nu_t + \mu_{ijt} \tag{7}
\]

where the subscripts \(i, j,\) and \(t\), respectively, denote the firm, industry, and year; \(\nu_t\) is a year fixed effect fixed effect for the year; \(\text{Markup}_{ijt}\) is the logarithm of the firm-level markup; and \(\text{Cost}_{ijt}\) is the logarithm of the rent-seeking cost of the firm. The ratio of administrative cost to total output in the current year is taken as a measure of the cost-seeking cost of firms referring to Anderson et al. [29].

Table 4 reports the results of estimating the mediation effect model. Column (1) presents the regression results of Equation (5). It can be seen that the coefficient on subsidy is significantly negative, indicating that the firm-level markups are reduced by government subsidies. Column (2) displays the estimation results of Equation (6), with the dependent variable being the rent-seeking cost of firms. It can be seen that the coefficient on subsidy is significantly positive, indicating that the rent-seeking cost of firms increases with the increase of government subsidies. Column (3) reports the regression results of the firm-level markup on the basic independent variable (Subsidy) and the mediator. It can be seen that the estimated coefficient on the mediator, Cost, is significantly negative, demonstrating that the firm-level markup is significantly reduced by the increase in rent-seeking cost. This result is consistent with our previous expectation. Furthermore, by comparing the estimation results in columns (1) and (3), it is clear that the estimated coefficient on subsidy remains negative, but not significantly, after inclusion of the mediator, Cost. This suggests that the increase in rent-seeking cost is an important way for government subsidies to affect firm-level markups.

The first three columns in Table 4 report the estimation results using unbalanced panel data. In order to avoid the impact of the entry and exit of firms on the estimation results of the mediational model, balanced panel data are constructed by only retaining firms that existed throughout the sample period. Equations (5)–(7) are then re-estimated using the balanced panel data. The corresponding results are shown in columns (4) to (6) of Table 4. The estimation results using the balanced panel data are very similar to those shown in the first three columns of Table 4: Government subsidies significantly promote the increase in the rent-seeking cost, which, in turn, reduces the firm-level markups; and the estimated coefficient on subsidy is no longer significantly negative after the inclusion of the mediator, Cost. The estimation results using the balanced panel demonstrate, to some extent, that the test results of the impact mechanism based on the mediational model are relatively robust. Namely, the increase in rent-seeking cost is an important way for government subsidies to affect firm-level markups.

In order to further confirm whether the increase in rent-seeking cost is a mediator affecting the firm-level markups, it is necessary to conduct a more rigorous test. We begin with testing whether \(H_0 : b_2 = 0\) and \(H_0 : d_3 = 0\). If both are rejected, the mediating effect is significant; otherwise, it is not significant. From the regression results in Table 4, it can be seen that Cost is a significant mediator. However, this test has a high probability of type II error. Given this shortcoming, we also test whether the product of the regression coefficients in the path of the mediator is significant; that is, whether \(H_0 : b_2d_3 = 0\). If the null hypothesis is rejected, the mediating effect is significant; otherwise, it is not significant. Specifically, we calculate the standard deviation of the product, \(b_2d_3\), to be 0.00138955 by reference to Sobel [30]. Based on the estimation results in Table 5, it is not difficult to obtain \(Z_{b_2d_3} = -6.0560744\), with significance at the 1% level. This further verifies the mediating effect of “rent-seeking cost”; that is, the increase in rent-seeking cost is a possible way for government subsidies to reduce the firm-level markups.
### Table 4. Mediating effect test results.

| Dependent Variable | Markup (1) | Cost (2) | Markup (3) | Markup (4) | Cost (5) | Markup (6) |
|--------------------|------------|----------|------------|------------|----------|------------|
| LMarkup            | 0.2780 *** | 0.2289 ***| 0.2302 *** | 0.1901 *** |          |            |
|                    | (0.0481)   | (0.0501) | (0.0343)   | (0.0505)   |          |            |
| LCost              | 0.9303 *** |          | 0.9241 *** |            |          |            |
|                    | (0.0333)   |          | (0.0381)   |            |          |            |
| Cost               |            | 0.0832 ***|            |            | 0.0949 ***|            |
|                    |            | (0.0041) |            |            | (0.0090) |            |
| Subsidy            | −0.0285 ***| 0.1339 ***| −0.0304    | −0.0501 ***| 0.1234 ***| 0.1989     |
|                    | (0.0066)   | (0.1035) | (0.01082)  | (0.0149)   | (0.0267) | (0.1759)   |
| TFP                | 0.3463 *** | −0.0039  | 0.3496 *** | 0.3091 *** | −0.0042  | 0.3589 *** |
|                    | (0.0032)   | (0.0010) | (0.0033)   | (0.0079)   | (0.0008) | (0.0048)   |
| Size               | −0.0178 ***| −0.0012  | −0.0182 ***| −0.0171 ***| −0.0010  | −0.0148 ***|
|                    | (0.0005)   | (0.0010) | (0.0033)   | (0.0079)   | (0.0016) | (0.0025)   |
| Age                | −0.0041 ***| 0.0035 **| −0.0018 ***| −0.0107 ***| 0.0019   | −0.0078 ***|
|                    | (0.0006)   | (0.0015) | (0.0007)   | (0.0014)   | (0.0024) | (0.0020)   |
| KI                 | −0.0002*   | 0.0000   | −0.0003*   | −0.0004    | 0.0000   | −0.0003    |
|                    | (0.0001)   | (0.0001) | (0.0002)   | (0.0004)   | (0.0002) | (0.0004)   |
| Wage               | 0.0087 *** | 0.0011 **| 0.0099 *** | 0.0107 *** | 0.0015 ***| 0.0106 *** |
|                    | (0.0005)   | (0.0004) | (0.0005)   | (0.0010)   | (0.0006) | (0.0010)   |
| HHI                | 0.1661 *** | 0.0136 **| 0.1816 *** | 0.2305 *** | −0.0017  | 0.2138 *** |
|                    | (0.0077)   | (0.0060) | (0.0076)   | (0.0225)   | (0.0082) | (0.0198)   |
| Balanced panel     | No         | No       | Yes        | Yes        | Yes      |            |
| AR(1)              | 0.000      | 0.000    | 0.000      | 0.000      | 0.000    | 0.000      |
| AR(2)              | 0.000      | 0.000    | 0.001      | 0.000      | 0.000    | 0.000      |
| AR(3)              | 0.811      | 0.750    | 0.834      | 0.774      | 0.303    | 0.944      |
| Hansen test        | 0.475      | 0.850    | 0.114      | 0.307      | 0.328    | 0.489      |
| Observations       | 621,648    | 621,648  | 621,648    | 94,942     | 94,942   | 94,942     |

### Table 5. Regression results by ownership.

| Dependent Variable | State-Owned Firms | Private Firms | Foreign-Funded Firms |
|--------------------|-------------------|---------------|----------------------|
| Markup             | (1)               | (2)           | (3)                  |
| LMarkup            | 0.3297 ***        | 0.4401 ***    | 0.2186 ***           |
|                    | (0.0917)          | (0.1328)      | (0.0534)             |
| Subsidy            | −0.0463 ***       | −0.0246 *     | −0.0202              |
|                    | (0.0089)          | (0.0139)      | (0.0222)             |
| TFP                | 0.3348 ***        | 0.1640 ***    | 0.3593 ***           |
|                    | (0.0072)          | (0.0597)      | (0.0441)             |
| Size               | −0.0181 ***       | −0.0140 ***   | −0.0140 ***          |
|                    | (0.0016)          | (0.0020)      | (0.0006)             |
| Age                | −0.0106 ***       | −0.0042 ***   | 0.0008               |
|                    | (0.0020)          | (0.0012)      | (0.0011)             |
| KI                 | 0.0012 *          | −0.0005 **    | −0.0010 ***          |
|                    | (0.0006)          | (0.0002)      | (0.0003)             |
| Wage               | 0.0072 ***        | 0.0124 ***    | 0.0141 ***           |
|                    | (0.0011)          | (0.0017)      | (0.0014)             |
| HHI                | 0.1166 ***        | 0.1193 ***    | 0.1457 ***           |
|                    | (0.0131)          | (0.0321)      | (0.0227)             |
| AR(1)              | 0.000             | 0.000         | 0.000                |
| AR(2)              | 0.002             | 0.002         | 0.307                |
| AR(3)              | 0.106             | 0.760         | —                    |
| Hansen test        | 0.558             | 0.334         | 0.240                |
| Observations       | 90,768            | 381,525       | 96,275               |
6. Heterogeneous Impact of Government Subsidies on the Markups of Different Types of Firms

6.1. Analysis by Ownership

As China is a country in economic transition, there are significant differences in the operating environment between firms of different ownership. China’s unique institutional context makes ownership an important factor affecting the performance of Chinese firms [31]. To this end, all firms are divided into state-owned, private, and foreign-funded firms by ownership as determined by the proportion of registered capital ($\geq 50\%$). Using the subsamples divided by ownership, Equation (4) is re-estimated to assess if there is a difference in the impact of government subsidies on the firm-level markups between firms of different ownership. The estimation results are shown in Table 5.

It is clear that the coefficient on subsidy is significantly negative for both state-owned and private firms. This suggests that the markups of state-owned and private firms are significantly reduced by government subsidies. It is also noted that government subsidies have a greater negative impact on state-owned firms than on private firms. This may be related to the characteristics of state-owned firms. As previously demonstrated, government subsidies reduce the firm-level markups by inducing an increase in the rent-seeking cost. The state-owned firms have relatively overstuffed and inefficient administrative departments and close links with government departments. Therefore, state-owned firms may be more concerned about how to obtain more subsidies by rent-seeking, instead of how to improve production technology and increase efficiency with the subsidies received. As a result, the increase in government subsidies has a relatively greater negative impact on the markups of state-owned firms. It is also noted from Table 5 that for foreign-funded firms, the coefficient on government subsidy remains negative, but not significantly. This suggests that government subsidies do not affect the markups of foreign-funded firms. The reason behind this may be that foreign-funded firms tend to have relatively well-developed management systems and practices, and consequently, a higher production efficiency. Therefore, foreign-funded firms may be relatively less engaged in rent-seeking to obtain government subsidies. That is why government subsidies do not have a significant negative impact on the markups of foreign-funded firms.

6.2. Analysis by Region

There are differences in regional economic development in China. Compared with the central and western regions, the eastern region has greater economic openness, higher economic development levels, relatively developed transportation systems and infrastructures, and is more active in both attracting and making foreign investments. Regional differences are likely to result in different impacts of government subsidies on firm-level markups. To this end, all provinces are divided into four regions, i.e., eastern coastal, central, western, and northeastern regions, according to the National Bureau of Statistics of China. Equation (4) is re-estimated using the subsamples divided by region. The results are reported in Table 6. It can be seen that the coefficient on subsidy is significantly negative for eastern coastal and northeastern regions; whereas, it is negative, but not significantly, for central and western regions. It indicates that government subsidies have a significant negative impact on the firm-level markups in the eastern coastal and northeastern regions, but not in the central and western regions. The reason behind this may be the more intense competition, due to relatively greater openness and marketization in the eastern coastal and central regions compared with the central and western regions. To survive in fierce competition, firms in these two regions are more sensitive to government subsidies. The stronger competitive effect may induce more rent-seeking by firms in these two regions to obtain government subsidies, which, in turn, results in a significant negative impact of government subsidies on the firm-level markups.
Table 6. Regression results by region.

| Dependent Variable | Eastern Region | Northeastern Region | Central Region | Western Region |
|--------------------|----------------|---------------------|---------------|---------------|
| L.Markup           | 0.2281 ***     | 0.1598 ***          | 0.2824 *      | 0.4152 *      |
|                    | (0.0535)       | (0.0498)            | (0.1442)      | (0.2132)      |
| Subsidy            | −0.0221 **     | −0.0608 ***         | −0.0060       | −0.4625       |
|                    | (0.0104)       | (0.0164)            | (0.0108)      | (0.8702)      |
| TFP                | 0.3462 ***     | 0.3696 ***          | 0.3501 ***    | 0.2799 ***    |
|                    | (0.0037)       | (0.0057)            | (0.0081)      | (0.0324)      |
| Size               | −0.0169 ***    | −0.0222 ***         | −0.0205 ***   | −0.0176 ***   |
|                    | (0.0004)       | (0.0010)            | (0.0033)      | (0.0046)      |
| Age                | −0.0025 ***    | −0.0119 ***         | −0.0053 *     | −0.0081 *     |
|                    | (0.0006)       | (0.0015)            | (0.0030)      | (0.0046)      |
| KI                 | −0.0013 ***    | 0.0023 ***          | 0.0001        | 0.0041 ***    |
|                    | (0.0002)       | (0.0005)            | (0.0005)      | (0.0011)      |
| Wage               | 0.0115 ***     | 0.0074 ***          | 0.0065 ***    | 0.0079        |
|                    | (0.0008)       | (0.0010)            | (0.0014)      | (0.0053)      |
| HHI                | 0.1581 ***     | 0.0928 ***          | 0.2093 ***    | 0.1560 ***    |
|                    | (0.0092)       | (0.0228)            | (0.0153)      | (0.0388)      |
| AR(1)              | 0.000          | 0.000               | 0.001         | 0.012         |
| AR(2)              | 0.008          | 0.001               | 0.139         | 0.032         |
| AR(3)              | 0.328          | 0.318               | —             | 0.086         |
| AR(4)              | —              | —                   | —             | 0.541         |
| Hansen test        | 0.961          | 0.130               | 0.232         | 0.296         |
| Observations       | 451,736        | 30,388              | 92,372        | 48,548        |

6.3. Analysis by Industry

Given the differences, especially in production technology, between industries [32], the impact of government subsidies on the firm-level markups may be different between industries. To this end, based on data from Chinese manufacturing firms between 1999–2007, all 29 two-digit manufacturing industries are divided into labor-, capital-, and technology-intensive industries to analyze whether there is a significant difference in the impact of government subsidies on the firm-level markups between industries. Equation (4) is re-estimated using the subsamples of firms classified into labor-, capital-, and technology-intensive industries. The regression results are reported in Table 7. It is evident that the coefficient on government subsidies is significantly negative for all three industry categories. It demonstrates that firm-level markups are significantly reduced by government subsidies in labor-, capital-, and technology-intensive industries. Specifically, a greater negative impact is observed with the technology-intensive industries than with the labor- and capital-intensive industries.

6.4. Comparative Analysis of Exporters and Non-Exporters

Some studies have reported that the markups of Chinese exporters are significantly lower than those of non-exporters; that is, there is a paradox of low-price exports in Chinese firms [7]. Equation (4) is re-estimated using the subsamples of exporters and non-exporters, in order to explore whether there is a significant difference in the impact of government subsidies on the firm-level markups between exporters and non-exporters. From the regression results in Table 8, it can be seen that the coefficient on government subsidies is significantly negative for both exporters and non-exporters. It suggests that the markups of both exporters and non-exporters are significantly reduced by government subsidies. However, a greater negative impact is observed with exporters than with non-exporters. The possible reason is that due to the lower markups, and consequently, lower profits of exporters relative to non-exporters, exporters are more concerned about obtaining government subsidies, which may induce more rent-seeking.
Table 7. Regression results by industry.

| Dependent Variable Markup | Technology-Intensive Industries | Labor-Intensive Industries | Capital-Intensive Industries |
|---------------------------|---------------------------------|---------------------------|------------------------------|
|                           | (1)                             | (2)                       | (3)                          |
| LMarkup                   | 0.2767 ***                      | 0.1463 ***                | 0.3628 *                    |
|                           | (0.0754)                        | (0.0540)                  | (0.2181)                    |
| Subsidy                   | −0.0492 ***                     | −0.0220 *                 | −0.0339 ***                 |
|                           | (0.0100)                        | (0.0123)                  | (0.0116)                    |
| TFP                       | 0.3731 ***                      | 0.4934 ***                | 0.2825 ***                  |
|                           | (0.0054)                        | (0.0107)                  | (0.0089)                    |
| Size                      | −0.0132 ***                     | −0.0180 ***               | −0.0128 ***                 |
|                           | (0.0028)                        | (0.0029)                  | (0.0019)                    |
| Age                       | −0.0100 ***                     | 0.0024 **                 | −0.0052 ***                 |
|                           | (0.0017)                        | (0.0010)                  | (0.0020)                    |
| Kl                        | 0.0017 ***                      | −0.0188 ***               | 0.0034 ***                  |
|                           | (0.0002)                        | (0.0036)                  | (0.0005)                    |
| Wage                      | 0.0087 ***                      | 0.0199 **                 | 0.0066 ***                  |
|                           | (0.0010)                        | (0.0100)                  | (0.0014)                    |
| HHI                       | −0.0404 ***                     | −0.0067                   | 0.4299 ***                  |
|                           | (0.0063)                        | (0.0192)                  | (0.0555)                    |
| AR(1)                     | 0.000                           | 0.000                     | 0.014                       |
| AR(2)                     | 0.000                           | 0.000                     | 0.132                       |
| AR(3)                     | 0.744                           | 0.320                     | —                           |
| Hansen test               | 0.110                           | 0.625                     | 0.264                       |
| Observations              | 286,672                         | 134,275                   | 202,104                     |

Table 8. Regression results for exporters and non-exporters.

| Dependent Variable Markup | Non-Exporters | Exporters | Pure Exporters Excluded |
|---------------------------|---------------|-----------|-------------------------|
|                           | (1)           | (2)       | (3)                     |
| LMarkup                   | 0.3542 ***    | 0.2008 ** | 0.2775 **               |
|                           | (0.0629)      | (0.0996)  | (0.1149)                |
| Subsidy                   | −0.0344 ***   | −0.0406 ***| −0.0358 **              |
|                           | (0.0078)      | (0.0119)  | (0.0150)                |
| TFP                       | 0.3321 ***    | 0.3634 ***| 0.3522 ***              |
|                           | (0.0044)      | (0.0072)  | (0.0098)                |
| Size                      | −0.0175 ***   | −0.0166 ***| −0.0173 ***             |
|                           | (0.0007)      | (0.0008)  | (0.0012)                |
| Age                       | −0.0040 ***   | −0.0029 ***| −0.0026 **              |
|                           | (0.0009)      | (0.0009)  | (0.0011)                |
| Kl                        | 0.0007 ***    | −0.0025 ***| −0.0013 ***             |
|                           | (0.0002)      | (0.0004)  | (0.0004)                |
| Wage                      | 0.0074 ***    | 0.0131 ***| 0.0124 ***              |
|                           | (0.0006)      | (0.0019)  | (0.0025)                |
| HHI                       | 0.1855 ***    | 0.1082 ***| 0.1383 ***              |
|                           | (0.0107)      | (0.0150)  | (0.0163)                |
| AR(1)                     | 0.000         | 0.000     | 0.000                   |
| AR(2)                     | 0.000         | 0.362     | 0.093                   |
| AR(3)                     | 0.574         | —         | 0.251                   |
| Hansen test               | 0.362         | 0.237     | 0.157                   |
| Observations              | 398,203       | 180,320   | 136,454                 |

Moreover, it is noted that pure exporters with an export intensity of 1 between 1999 and 2007 account for a very large proportion of all Chinese exporters. It means that the majority of Chinese exporters do not serve the domestic market. These large number of exporters with high export intensity (especially pure exporters) are mainly engaged in processing trade. Processing trade firms import raw
materials or intermediate inputs from abroad and then export the products, and mostly only earn processing fees. They receive relatively fewer subsidies. Therefore, the existence of processing trade firms may affect the corresponding regression results. In order to test whether the pure exporters, most of which are engaged in processing trade, have a significant impact on the previous main regression results, the pure exporters are excluded here to create a new subsample. Equation (4) is re-estimated using the new exporter subsample. The regression results are reported in column (3) of Table 8. It is apparent that they are very similar to those shown in column (2) of Table 8. Namely, the coefficient on subsidy remains significantly negative. Although it is smaller in absolute value than that in column (2), it is still greater than that calculated with non-exporters in column (1). To some extent, this indicates that the existence of a large number of pure exporters does not affect the previous main conclusions.

7. Extended Analysis: Government Subsidies and Changes in the Industry-Level Markup

In the previous sections, we assessed the impact of government subsidies on the firm-level markups and its mechanism of action at a micro level. Our findings show that firm-level markups are significantly reduced by government subsidies. Another question we want to examine is whether the industry-level aggregate markup is also reduced by government subsidies. From the perspective of micro-foundation, the changes in the industry-level aggregate markup can be attributed to two sources. The first is the changes in the markups of incumbent firms, which we call the intensive margin changes in the markups. The second is the changes in the markups of entering and exiting firms, which we call the extensive margin changes in the markups. The question that arises, then, is whether government subsidies affect the aggregate markup of the Chinese manufacturing industry through intensive or extensive margin. In this section, we first describe the decomposition of the changes in the industry-level aggregate markup. We then analyze in depth how government subsidies affect the industry-level markup using the firm-level micro data of the Chinese manufacturing industry.

7.1. Dynamic Decomposition of Aggregate Markup

The aggregate markup of an industry is computed as the average of the markups of all firms in the industry weighted by market share:

\[ \Psi_t = \sum_i s_{it} \mu_{it} \]  

where \( s_{it} \) denotes the market share of firm \( i \) in industry in period \( t \), with \( s_{it} \geq 0 \) and \( \sum_i s_{it} = 1 \); \( \mu_{it} \) is the markup of firm \( i \) in period \( t \), and \( \Psi_t \) is the aggregate markup of the whole industry in period \( t \). \( \Delta \Psi = \Psi_2 - \Psi_1 \) represents the changes in the industry-level aggregate markup in the two periods. Drawing on the approach developed by Melitz and Polanec [6] for decomposing aggregate TFP, we apply the MP method to dynamically decompose the changes in the aggregate markup of the Chinese manufacturing industry.

The MP decomposition method is developed based on the decomposition method proposed by Olley and Pakes [33]. According to Olley and Pakes [33], the industry-level aggregate markup can be decomposed as follows:

\[ \Psi_t = \overline{\mu}_t + \sum_i (s_{it} - \overline{s}_i)(\mu_{it} - \overline{\mu}_t) = \overline{\mu}_t + \text{cov}(s_{it}, \mu_{it}) \]

where \( \overline{\mu}_t = \frac{1}{n_t} \sum_{i=1}^{n_t} \mu_{it} \) is the arithmetic mean of unweighted firm-level markups, and \( \overline{s}_i \) is the average market share of the firms.

The MP decomposition method considers the entry and exit of firms on the basis of Olley and Pakes [33]. The aggregate markup is, thus, rewritten as follows:

\[ \Psi_1 = s_{S1} \Psi_{S1} + s_{X1} \Psi_{X1} = \Psi_{S1} + s_{X1}(\Psi_{X1} - \Psi_{S1}) \]
\[ \Psi_2 = s_{S2} \Psi_{S2} + s_{E2} \Psi_{E2} = \Psi_{S2} + s_{E2} (\Psi_{E2} - \Psi_{S2}) \]  \tag{10}

where \( \Psi_{St} = \sum_{i \in S} (s_i / s_{it}) \mu_{it} \) and \( s_{St} = \sum_{i \in S} s_i s_{S1} \Psi_{S1} = \sum_{i \in S} s_i \mu_{it} \) represents the contribution of the surviving firms to the aggregate markup in the first period; and \( s_{X1} \Psi_{X1} = \sum_{i \in X} s_i \mu_{it} \) is that of the exiting firms. Therefore, Equation (9) essentially breaks Equation (8) into two parts: The markups of the surviving firms (\( \Psi_{S1} \)) as the basis for calculation, and the markups of the exiting firms (\( s_{X1} (\Psi_{X1} - \Psi_{S1}) \)) as an auxiliary correction for calculating the aggregate markup in the first period. Equation (10) can be understood in a similar way.

At this point, the industry-level aggregate markup can be written as:

\[
\Delta \Psi = (\Psi_{S2} - \Psi_{S1}) + s_{E2} (\Psi_{E2} - \Psi_{S2}) + s_{X1} (\Psi_{S1} - \Psi_{X1})
\]

\[
= \underbrace{\Delta \Psi_\text{S}}_{\text{within-firm effect}} + \underbrace{\Delta \text{cov}_\text{S}}_{\text{across-firm effect}} + \underbrace{s_{E2} (\Psi_{E2} - \Psi_{S2}) + s_{X1} (\Psi_{S1} - \Psi_{X1})}_{\text{entry effect, exit effect}} \tag{11}
\]

As shown in Equation (11), the MP method divides the changes in the aggregate markup into four parts: \( \Delta \Psi_\text{S} \) denotes the changes in the average firm-level markups (arithmetic average) for the firms that exist in both periods, which is called “within-firm effect”; \( \Delta \text{cov}_\text{S} \) represents the combined impact of market share redistribution and changes in the markups, which is called “cross-firm effect”; \( s_{X1} (\Psi_{S1} - \Psi_{X1}) \) represents the impact of the exiting firms on the changes in the aggregate markup, which is called “exit effect”; and \( s_{E2} (\Psi_{E2} - \Psi_{S2}) \) is the impact of the entering firms on the changes in the aggregate markup, which is called “entry effect”. In addition, the sum of the first and second terms of Equation (11) is defined as intensive margin changes, and the sum of the third and fourth terms as extensive margin changes.

By ensuring the independence and stability of calculation of each part, the MP decomposition method is more scientific and reasonable than the BHC [34], GR [35], and FHk [36] decomposition methods, all of which cannot avoid the inter-period interference between the markups of various types of firms. In the MP decomposition method, the contribution of entering firms to the aggregate markup is positive only if their markups are higher than those of surviving firms in the same period \( (s_{E2} (\Psi_{E2} - \Psi_{S2}) > 0) \); and the contribution of exiting firms to the aggregate markup is positive only if their markups are lower than those of surviving firms in the same period \( (s_{X1} (\Psi_{S1} - \Psi_{X1}) > 0) \). Therefore, the impact of exiting firms on the changes in the aggregate markup is not related to the entering firms or the markups of surviving firms in the next period. Similarly, the impact of entering firms on the changes in the aggregate markup is only related to the markups of surviving firms in the current period. In this way, no interference is caused by inter-period changes using the MP decomposition method.

### 7.2. Impact of Government Subsidies on Changes in the Industry-Level Aggregate Markup

To further assess the impact of government subsidies on changes in the industry-level aggregate markup, we first calculate the aggregate markup according to the following equation:

\[ \Psi_{kjt} = \sum_i s_{ikjt} \text{markup}_{ikjt} \]  \tag{12}

where the subscript \( k \) denotes province, \( j \) denotes 2-digit industry, \( i \) denotes firm, and \( t \) denotes year. \( \text{markup}_{ikjt} \) is the markup of firm \( i \) in industry \( j \) in province \( k \) in period \( t \); \( \Psi_{kjt} \) is the aggregate markup of industry \( j \) in province \( k \) in period \( t \); and \( s_{ikjt} \) is the market share of firm \( i \) in industry \( j \) in province \( k \) in period \( t \).

Based on Equation (11), the changes in the aggregate markup at the province-industry level are decomposed into within-firm, cross-firm, entry, and exit effects using the MP decomposition method.
On this basis, the following econometric model is constructed to investigate through which effects government subsidies influence the changes in the aggregate markup of the Chinese manufacturing industry:

\[ Y_{kt} = \beta_0 + \beta_1 \text{Subsidy}_I + \alpha_{kj} + \nu_t + \varepsilon_{kt} \]  

(13)

where \( Y_{kt} \) is the dependent variable, represented by the changes in the aggregate markup, and the within-firm, cross-firm, entry, and exit effects, respectively; \( \text{Subsidy}_I \) denotes the number of government subsidies received by industry \( j \) in province \( k \) in period \( t \), which is measured as the average government subsidy received by all firms in industry \( j \) in province \( k \) in period \( t \); \( \alpha_{kj} \) is the province-industry fixed effect; \( \nu_t \) is the year fixed effect; and \( \varepsilon_{kt} \) is a random disturbance term.

Table 9 contains the results of estimating Equation (13). Column (1) presents the regression results using the changes in the aggregate markup as the dependent variable. It is found that the coefficient on government subsidies is significantly negative. This suggests that government subsidies have a significant negative impact on the changes in the industry-level aggregate markup. Therefore, even at the industry level, the markups are significantly reduced by government subsidies. The remaining columns of Table 9 report the regression results with each decomposition term as the dependent variable. It can be seen from column (2) that government subsidies also have a significant negative impact on the within-firm effect. Namely, the average markup of surviving firms is significantly reduced by government subsidies, which provides evidence for our previous conclusions at the industry level.

In the estimation model of cross-firm effect (column (3) of Table 9), the estimation coefficient on subsidy is negative, with significance at the 1% level. It indicates that government subsidies promote the reallocation of market share from high-markup to low-markup firms and thereby reduce the cross-firm effect. As can be seen from columns (3) and (4) of Table 9, the coefficient on subsidy is not significant with the entry or exit effect as the dependent variable. Thus, there is no clear evidence that the entry and exit effects are important ways for government subsidies to affect the changes in the industry-level aggregate markup. To sum up, government subsidies significantly reduce the industry-level markup through within-firm and cross-firm effects. In other words, government subsidies mainly influence the changes in the industry-level markup through intensive rather than extensive margin.

| Dependent Variable | Changes in the Aggregate Markup | Within-Firm Effect | Cross-Firm Effect | Exit Effect | Entry Effect |
|--------------------|---------------------------------|-------------------|------------------|------------|-------------|
|                    | (1)                             | (2)               | (3)              | (4)        | (5)         |
| Subsidy_I          | -0.2525 ***                     | -0.1011 ***       | -0.1315 ***      | 0.0136     | -0.0335     |
|                    | (0.0483)                        | (0.0361)          | (0.0492)         | (0.0169)   | (0.0283)    |
| Province and       | Yes                             | Yes               | Yes              | Yes        | Yes         |
| industry fixed     |                                 |                   |                  |            |             |
| fixed effects      |                                 |                   |                  |            |             |
| Year fixed effects | Yes                             | Yes               | Yes              | Yes        | Yes         |
| Observations       | 4,577                           | 4,577             | 4,577            | 4,577      | 4,577       |
| R²                 | 0.014                           | 0.028             | 0.005            | 0.013      | 0.006       |

8. Conclusions

Since the fiscal decentralization reform in 1994 in China, the relatively unique administrative system and GDP competition between local governments have induced large subsidies for micro-enterprises by governments at all levels. However, how do the widespread government subsidies affect the micro-performance of Chinese firms? It is clearly important to evaluate the effect of subsidies reasonably and scientifically from multiple angles. The results can provide useful policy implications for the government to formulate and adjust subsidy policies and improve the efficiency of subsidies. To this end, we investigate the micro-effects of government subsidies from the perspective of firm-level markups.

We first measure the firm-level markups using a micro dataset of Chinese manufacturing firms from 1999 to 2007. Next, we investigate the impact of government subsidies on the firm-level markups and its
mechanism of action using a dynamic panel model. Finally, based on the dynamic decomposition of the changes in the aggregate markup of the Chinese manufacturing industry using the MP decomposition method, we also examine the relationship between government subsidies and the changes in the aggregate markup at the industry level. The main conclusions are as follows: (1) The markups of Chinese manufacturing firms are significantly reduced by government subsidies. This conclusion remains valid when the key measure is replaced, and other policy changes are controlled. (2) The test results of the mediation effect model show that the increase in government subsidies has a negative impact on the firm-level markups by inducing an increase in rent-seeking costs. Namely, the increase in rent-seeking cost is an important way for government subsidies to affect firm-level markups. (3) A comparative analysis of different types of firms shows that (a) the markups of state-owned and private firms, but not foreign-funded firms, are significantly reduced by government subsidies; (b) government subsidies have a significant negative impact on the firm-level markups in the eastern coastal and northeastern regions, but not in the central and western regions; (c) the firm-level markups are significantly reduced by government subsidies in labor- capital-, and technology-intensive industries, but a greater negative impact is observed with the technology-intensive industries; and (d) the increase in government subsidies has a greater negative impact on the firm-level markups of exporters than non-exporters. (4) Government subsidies significantly reduce the industry-level markup through within-firm and cross-firm effects. In other words, government subsidies mainly influence the changes in the industry-level markup through intensive rather than extensive margin.

This study not only provides a new approach to understanding the micro-performance of government subsidies from the perspective of firm-level markups, but also has important policy implications. High subsidies not only increase the financial burden of the government, but also distort the behavior of firms. The rent-seeking for subsidies increases the unproductive expenditure, and consequently, the cost of firms, thereby inducing a negative impact on the firm-level markups. Therefore, the government should determine the form and level of subsidies according to the industry, region, and ownership, optimize the competitive environment, and reduce the incentives for rent-seeking, so as to enhance the role of government subsidies in promoting firm development.

It should be noted that the data used in this study came from the Annual Survey of Industrial Firms (ASIF) compiled by the National Bureau of Statistics of China. The sample spans from 1999 to 2007. Due to the limitation of data, this paper cannot use the latest firm-level data to study the impact of government subsidies on China’s firms markup, which has to be said to be a major limitation of this study. Therefore, in future research, using the latest firm-level data to examine the impact of government subsidies on the firms markup will undoubtedly provide more timely policy implications.

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