

# The Effect of Government Subsidies on The Teal Activity of Firms: Evidence from Chinese Listed Firms

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**Abstract.** We examine the effect of subsidies on the real activity of firms using a panel of Chinese listed firms from 2008 to 2013. Employing the Propensity Score Matching method (PSM) and Differences in Differences method (DID), the study showed that government subsidies were not only highly effective at promoting investment and job creation, but they enhanced short-term productive efficiency of firms. Meanwhile, we find that there was significant cross-sectional variation in firms' response to subsidies, and non-state-owned firms (non-SOEs) benefited more from subsidies than state-owned enterprises (SOEs) in the short term.

**Keywords:** Government Subsidies, Investment, Employment, Productive Efficiency.

## 1. Introduction

Subsidies, as a policy instrument, are used to help governments direct financial resources to specific industries and enterprises to pursue economic or social goals (Harford et al., 2014; Brealey et al., 2017). During the COVID-19 crisis, the central and its subordinate governments in China have considered and used numerous government fiscal and non-fiscal supplements to support corporate investments. Thus, can the government subsidies really achieve the desired effect, help firms alleviate the external financing constraints or stimulate the real activity of firms?

However, there is no theoretical consensus on the appropriate use of government subsidies and their impact on the real activity of firms is empirically underexplored so far. On the one hand, as a traditional and common financial instrument, government subsidy is an important measure to guide the development of emerging industries. It aims to encourage technological innovation and promote the healthy and rapid growth of industries. On the other hand, a large number of government subsidies to firms have not been significantly effective in reality. Faccio et al.(2006) argued that a fully efficient market was able to allocate funds where they were mostly needed and that the government's domination allocation of government subsidy funds was likely to lead to market failure. When allocating funds, government officials may tend to subsidize firms with greater expected success rate and higher return on capital in order to avoid wasting money. These firms are also favored by domestic and foreign funds. As a result, government subsidies may be redundant and crowd out firms' own R&D investment (Lach S., 2002). Moreover, when lending market is weak because projects have negative net present values, the subsidies encourage unviable projects (De Meza, 2002; Goodhart et al., 2020) and sustain "zombie firms" (Caballero et al., 2008).

It can be seen that government subsidies to firms have a complex and uncertain effect. Many studies focus on the impact of subsidies on economic output, employment and enterprise behavior, but the results basically show that subsidies have both positive and negative effects. In recent years, with the improvement of China's financial strength, both the number of firms that can obtain government subsidies and the scope and intensity of China's government subsidies have increased significantly (Lennox, Wu, and Zhang, 2016). Especially to reduce impact of the epidemic, the central and local governments have issued policies such as cash grants, tax returns and exemptions from certain requirements for stabilizing employment. Therefore, it is necessary to start from the perspectives of government-enterprise and examine the efficacy of subsidies at stimulating the real activity of firms.

Using a sample of 8,292 company-year observations of A-share listed companies in the Shanghai and Shenzhen Stock Exchanges of China from 2008 to 2013, this paper mainly studies the impact of

government subsidies on the invested capital, number of employees, and productive efficiency of companies over time. We find that subsidies not only increased investment and employment but enhanced their productive efficiency. And then by separating sample by firm's state ownership, we find that there is significant cross-sectional variation in firms' response to subsidies. Our study contributes to the literature in three ways. First, we comprehensively examine the efficacy of subsidies by assessing average and time trend effect of subsidies on the real activity of firms. Second, this study overcomes the limitation of ignoring the selection bias and endogeneity in assessing the impact of subsidies (for example, see Dunn and Arbuckle (2001); Hartarska and Nadolnyak (2008); Osa Ouma and Rambo (2013)). Third, we provide more evidence on the different economic results between different property rights firms.

The rest of the paper is organized as follows. Section 2 presents the data and methodology for the study. Section 3 reports and analyses the results. And section 4 concludes the paper.

## 2. Data and Methodology

### 2.1 Data

We utilize corporate financial data from Accounting Research (CSMAR) database for the sample period from 2008 to 2013. Following the literature, we process the final data as follows. (1) We exclude financial and insurance companies as the accounting data of financial corporations are different from those of nonfinancial corporations. (2) We also exclude delisted firms and firms that have been treated specially due to financial or other unusual circumstances. (3) We delete observations with missing key accounting variables such as total assets or total sales. (4) We winsorize corporate financial continuous variables at the 2% level. Following these steps, our sample comprises 8,292 firm-year observations from 1,382 firms from 2008 to 2013.

### 2.2 Methodology

Performing an empirical analysis on subsidies is challenging because of the non-random selection process inherent to subsidies origination. Government screen applicants and decide which firms to fund based on fundamental characteristics. Thus, subsidies may be affected by firms' own investment level or productivity.

To overcome the selection bias and identify the subsidies' effect, we employed a counterfactual approach based on Propensity Score Matching (PSM) and Difference in Difference design with two groups of companies: applicants receiving monetary support and a control group. We use binary variable  $T_i \in \{0,1\}$  to represent participation in programme (treatment). If  $T_i = 1$  then firm  $i$  that did not receive subsidies in 2008 but received them in 2009, that is, the subject is 'Treated'. If  $T_0 = 0$  then the firm was not subsidized from 2008 to 2013.

We denote the observed outcome as  $Y$  (i.e., investment, employment, and productivity). Accordingly,  $Y_1$  and  $Y_0$  are the outcome of the subsidy recipients and subsidy non-recipients respectively. The effect of government subsidies on the outcomes of a firm  $i$  is the difference between the outcomes obtained with and without subsidies:

$$\Delta Y_i = Y_{1i} - Y_{0i} \quad (1)$$

This study defines the three dependent variables to estimate the subsidies' effect on the real activity of firms, which are investment, employment, and productivity. The first dependent variable is investment, defined as the new investment cash expenditures of a firm  $i$  at the year  $t$ . It is calculated as a firm's annual cash expenditures associated with the purchase of fixed assets, intangible assets, and other long-term assets minus the cash received from the disposal of fixed assets, intangible assets and other long-term assets, divided by total assets. The second dependent variable is the logarithm number of employees. The transformation of the dependent variables by taking logarithms has the advantage of reducing the range of the variables and making estimates less sensitive to extreme values

(Wooldridge, 2009). The third dependent variable is China's firm level total factor productivity (TFP), which measures how well firms utilize their human and capital resources to generate revenues. Existing empirical researches provide five methodologies to measure TFP, and they are Superlative Index Numbers, System-GMM, Olley and Pakes (1996), Levinsohn and Petrin (2003) and Akerberg et al. (2015). We employ the Levinsohn and Petrin (2003) method (LP) to measure the TFP for corporate productivity. In the robustness test, we also employ the Olley and Pakes (1996) method (OP) to construct another measure of TFP.

### 2.2.1 Propensity Score Matching (PSM)

PSM matches participants and non-participants of a program using identical observable characteristics ( $X$ ) to address the selection bias (see Baker (2000); Oh et al. (2009); Quaye and Hartarska (2016) for example). We implement propensity score matching in two steps. The first step involves estimating the propensity score from observed characteristics  $X$  that can affect the probability of the firms to receive subsidies. This can be done by running a logit regression on a set of variables that significantly affect subsidy participation. Referring to the relevant literature, we have chosen the following covariates: firm size, firm age, cash flow, EBIT over sales, book leverage, state-ownership (see Table 1). The PSM matching creates a new data set consisting of the participants and non-participants, where the unmatched comparison unit is discarded.

The second step requires the estimation of the average treatment effect on the treated (ATT) to determine the effect of subsidy recipients' outcomes. ATT measures the difference in the outcomes of the treated firms when they are treated and not been treated (Caliendo & Kopeinig, 2008).

$$\tau_{ATT} = E[Y_1 | Treated = 1] - E[Y_0 | Treated = 1] \quad (2)$$

### 2.2.2 Differences in Differences Method

In order to improve the precision of the estimation, we combine matching with DID methodology based on the matching sample after PSM. DID compares before (b) and after (a) estimates for the subsidy recipients and non-subsidy recipients.

The DID regression is given as:

$$Y_{i,t} = \alpha_0 + \alpha_1 Treated_{i,t} + \alpha_2 T_{i,t} + \alpha_3 Treated_{i,t} \times T_{i,t} + \beta X_{i,t-1} + \lambda_r + \lambda_t + \lambda_i + \varepsilon_{it} \quad (3)$$

Where,  $Y_{it}$  is the outcome of company  $i$  at period  $t$ .  $Y$  is proxied by the firms' investment, employment, and TFP, respectively. The time dummy variable is represented by  $T$ , which equals 1 if year  $\geq 2009$  and 0 otherwise.  $Treated$  is a group dummy variable, which equals 1 if company received subsidy in 2009, and 0 otherwise.  $X$  is a vector of control variables (including firm size, firm age, cash flow, EBIT over sales, book leverage, capital-labour ratio and state-ownership).  $\lambda_r$  captures industry fixed effects,  $\lambda_t$  captures time effects and  $\lambda_i$  captures city fixed effects. Finally,  $\varepsilon$  is the error term.

Table 1 Variables description

| Variable   | Definition                            | Measurement                                                                                                                                                                                                                       |
|------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investment | Investment cash expenditures          | Cash expenditure on fixed assets, intangible assets and other long-term assets minus the cash received from the disposal of fixed assets, intangible assets and other long-term assets, scaled by the book value of total assets. |
| Employment | Employee number<br>China's firm level | Natural logarithm of the number of employees                                                                                                                                                                                      |
| TFP        | total factor productivity             | Natural logarithm of the TFP based on LP method                                                                                                                                                                                   |
| Treated    | Treated dummy                         | Dummy variable, equals 1 if firms receive subsidies, and 0 otherwise                                                                                                                                                              |
| T          | Time dummy                            | Dummy variable, equals 1 if year $\geq$ 2009 (post-shock), 0 otherwise.                                                                                                                                                           |
| Size       | Firm size                             | Natural logarithm of total assets.                                                                                                                                                                                                |
| Age        | Firm age                              | Survey year minus year of establishment                                                                                                                                                                                           |
| Cash flow  | Operating cash flows                  | Operating cash flows over total assets                                                                                                                                                                                            |
| EBIT_S     | EBIT over sales                       | Earnings before interests and taxes over net sales.                                                                                                                                                                               |
| Lev        | Book leverage                         | Total liabilities over total assets                                                                                                                                                                                               |
| KL         | Capital-labour ratio                  | Natural logarithm of the tangible fixed assets over the number of employees.                                                                                                                                                      |
| State      | State-ownership                       | Dummy variable, equals 1 for firms ultimately controlled by China's governments or their Affiliations, and 0 otherwise                                                                                                            |

### 3. Results

#### 3.1 Descriptive statistics

Table 2 reports descriptive statistics for the main variables in the full sample.

Table 2 Sample descriptive statistics.

| Variable   | Obs   | Mean   | Max    | Min    | Median | Std. Dev. |
|------------|-------|--------|--------|--------|--------|-----------|
| Investment | 8,292 | 0.063  | 0.515  | -0.101 | 0.039  | 0.087     |
| Employment | 8,292 | 7.678  | 11.094 | 3.912  | 7.712  | 1.422     |
| TFP        | 8,292 | 2.707  | 2.888  | 2.512  | 2.707  | 0.074     |
| Size       | 8,292 | 22.080 | 26.061 | 19.330 | 21.948 | 1.350     |
| Age        | 8,292 | 2.462  | 3.219  | 0.693  | 2.639  | 0.486     |
| Cash flow  | 8,292 | 0.169  | 0.681  | 0.011  | 0.136  | 0.124     |
| EBIT_S     | 8,292 | 0.117  | 0.835  | -0.869 | 0.088  | 0.192     |
| Lev        | 8,292 | 0.515  | 0.987  | 0.054  | 0.519  | 0.209     |
| KL         | 8,292 | 12.595 | 15.759 | 9.410  | 12.526 | 1.181     |
| State      | 8,292 | 0.595  | 1.000  | 0.000  | 1.000  | 0.491     |

#### 3.2 Propensity Score Matching Method Results

##### 3.2.1 Average Effect

On the basis of PSM processing, we apply the difference-in-differences approach to estimate the subsidy's effect on the investment, employment and productive efficiency. We present our main results in Table 3. After adding the control variables (columns 2, 4 and 6), the coefficient of the interaction term Treated\*T we focus on is still significantly positive, which shows that subsidies had a significant positive effect on the real activity of firms.

Considering that effective time lag of subsidies on the real activity of firms, we also did a time trend analysis.

Table 3: Baseline regression: The effects of subsidies on firms' investment, employment, and TFP

|                     | Investment          |                        | Employment           |                        | TFP                   |                        |
|---------------------|---------------------|------------------------|----------------------|------------------------|-----------------------|------------------------|
|                     | (1)                 | (2)                    | (3)                  | (4)                    | (5)                   | (6)                    |
| Treated*T           | 0.014***<br>(4.299) | 0.007*<br>(1.952)      | 1.027***<br>(21.935) | 0.241***<br>(8.417)    | 0.042***<br>(16.604)  | 0.009***<br>(5.222)    |
| Size                |                     | 0.003***<br>(2.848)    |                      | 0.899***<br>(117.069)  |                       | 0.044***<br>(98.954)   |
| Age                 |                     | -0.025***<br>(-11.553) |                      | -0.101***<br>(-5.582)  |                       | -0.001<br>(-1.155)     |
| Lev                 |                     | -0.010*<br>(-1.755)    |                      | -0.278***<br>(-5.928)  |                       | 0.023***<br>(8.485)    |
| Cash                |                     | 0.000<br>(0.022)       |                      | -0.751***<br>(-9.956)  |                       | 0.049***<br>(11.027)   |
| EBIT_S              |                     | 0.036***<br>(6.534)    |                      | -0.535***<br>(-11.659) |                       | -0.033***<br>(-12.271) |
| KL                  |                     | 0.001<br>(1.358)       |                      | -0.472***<br>(-54.952) |                       | -0.010***<br>(-19.735) |
| State               |                     | -0.004*<br>(-1.851)    |                      | 0.024<br>(1.308)       |                       | 0.006***<br>(5.199)    |
| _cons               | 0.018**<br>(1.971)  | 0.013<br>(0.610)       | 5.842***<br>(43.615) | -5.916***<br>(-31.927) | 2.632***<br>(366.158) | 1.835***<br>(169.724)  |
| Industry FE         | Yes                 | Yes                    | Yes                  | Yes                    | Yes                   | Yes                    |
| Year FE             | Yes                 | Yes                    | Yes                  | Yes                    | Yes                   | Yes                    |
| City FE             | Yes                 | Yes                    | Yes                  | Yes                    | Yes                   | Yes                    |
| N                   | 7773                | 7530                   | 8220                 | 7814                   | 8183                  | 7803                   |
| adj. R <sup>2</sup> | 0.078               | 0.106                  | 0.230                | 0.744                  | 0.202                 | 0.690                  |
| F                   | 12.722              | 15.244                 | 44.771               | 361.971                | 38.007                | 276.763                |

\*, \*\*, and \*\*\* indicate significance levels at 10%, 5%, and 1%, respectively.

### 3.2.2 Time trend analysis

To further explore the effect of subsidy over time, the interaction term Treated\*T is replaced by four new ones which multiply year dummy variables from 2009 to 2014 and Treated. Table 4 reports the test results. When the dependent variables are investment and TFP, the interaction term Treated\*T2009, Treated\*T2010, Treated\*T2011 has a significantly positive coefficient (columns 2 and 6), indicating that the policy boosts the investment and TFP of subsidy recipients more than those who do not receive subsidy in the first three years. After that, the coefficients of these two terms are still positive, but not statistically significant. But the coefficients of the interaction term (Treated\*Time) in columns 3 and 4 from 2009 to 2014 are significantly positive and show a decreasing trend, which means government subsidies promote the employment of employees.

Table 4: Time trend analysis results.

|                     | Investment          |                     | Employment           |                        | TFP                   |                      |
|---------------------|---------------------|---------------------|----------------------|------------------------|-----------------------|----------------------|
|                     | (1)                 | (2)                 | (3)                  | (4)                    | (5)                   | (6)                  |
| Treated*T2009       | 0.030***<br>(3.994) | 0.019**<br>(2.477)  | 1.091***<br>(10.254) | 0.356***<br>(5.526)    | 0.045***<br>(7.869)   | 0.018***<br>(4.658)  |
| Treated*T2010       | 0.018**<br>(2.480)  | 0.011<br>(1.429)    | 1.157***<br>(10.840) | 0.296***<br>(4.636)    | 0.044***<br>(7.619)   | 0.009**<br>(2.393)   |
| Treated*T2011       | 0.031***<br>(4.002) | 0.021***<br>(2.621) | 1.048***<br>(9.813)  | 0.167***<br>(2.583)    | 0.045***<br>(7.738)   | 0.008**<br>(2.080)   |
| Treated*T2012       | 0.013*<br>(1.869)   | 0.005<br>(0.671)    | 1.044***<br>(9.746)  | 0.231***<br>(3.545)    | 0.040***<br>(7.007)   | 0.003<br>(0.686)     |
| Treated*T2013       | -0.005<br>(-0.679)  | -0.005<br>(-0.641)  | 0.915***<br>(8.552)  | 0.195***<br>(3.135)    | 0.038***<br>(6.613)   | 0.006<br>(1.609)     |
| Treated*T2014       | -0.001<br>(-0.146)  | -0.007<br>(-1.022)  | 0.905***<br>(8.469)  | 0.203***<br>(3.297)    | 0.039***<br>(6.852)   | 0.009***<br>(2.599)  |
| Controls            | No                  | Yes                 | No                   | Yes                    | No                    | Yes                  |
| _cons               | 0.004<br>(0.377)    | 0.002<br>(0.105)    | 5.788***<br>(36.631) | -6.021***<br>(-31.237) | 2.629***<br>(308.073) | 1.826***<br>(162.36) |
| Industry FE         | Yes                 | Yes                 | Yes                  | Yes                    | Yes                   | Yes                  |
| Year FE             | Yes                 | Yes                 | Yes                  | Yes                    | Yes                   | Yes                  |
| City FE             | Yes                 | Yes                 | Yes                  | Yes                    | Yes                   | Yes                  |
| N                   | 7773                | 7530                | 8220                 | 7814                   | 8183                  | 7803                 |
| adj. R <sup>2</sup> | 0.080               | 0.107               | 0.230                | 0.744                  | 0.202                 | 0.690                |
| F                   | 12.058              | 14.327              | 41.172               | 335.514                | 34.907                | 256.686              |

\*, \*\*, and \*\*\* indicate significance levels at 10%, 5%, and 1%, respectively.

### 3.2.3 Corporate ownership

The effects of subsidies are likely to vary across firms due to differences in state ownership and legal environments in different regions of China. For instance, state-owned enterprises (SOEs) typically receive more subsidies than non-state-owned firms (non-SOEs) because they are expected to pursue sociopolitical goals such as job creation and stabilizing the local economy (O'Connor et al., 2006). Therefore, this paper further divides all the samples according to the state ownership and compare the subsidy effects for SOEs against those for non-SOEs.

The split-sample estimates in Table 5 show that SOEs' investment increased more from subsidies in the third year. While for non-SOEs, it only has a positive promotion effect in the first year (columns 1 and 2). Early literature found that non-SOEs lacking financing channels face with more severe financing constraints than state-owned enterprises (Song et al., 2011), especially after the financial crisis. Thus, the government subsidies to enterprises will quickly relieve the financing pressure of non-state-owned enterprises in a short time, and then promote the investment expenditure of enterprises.

While for job creation, both state-owned and non-state-owned enterprises have an obvious increase in the number of employees after receiving government subsidies in the short term (columns 3 and 4). The TFP of both SOEs and non-SOEs is also improved (columns 5 and 6), but the interaction term coefficient of non-SOEs is higher than that of SOEs, which indicates the government subsidies promote the productivity of non-SOEs more than that of state-owned enterprises in the short term.

Table 5 Split-sample estimates of the subsidies' effect

|                     | Investment         |                    | Employment          |                     | TFP                |                     |
|---------------------|--------------------|--------------------|---------------------|---------------------|--------------------|---------------------|
|                     | SOEs               | non-SOEs           | SOEs                | non-SOEs            | SOEs               | non-SOEs            |
|                     | (1)                | (2)                | (3)                 | (4)                 | (5)                | (6)                 |
| Treated*T2009       | 0.011<br>(1.136)   | 0.022*<br>(1.795)  | 0.304***<br>(3.605) | 0.391***<br>(3.969) | 0.012**<br>(2.384) | 0.022***<br>(3.719) |
| Treated*T2010       | 0.003<br>(0.353)   | 0.016<br>(1.320)   | 0.297***<br>(3.510) | 0.309***<br>(3.196) | 0.006<br>(1.136)   | 0.013**<br>(2.151)  |
| Treated*T2011       | 0.023**<br>(2.256) | 0.018<br>(1.451)   | 0.302***<br>(3.574) | 0.026<br>(0.267)    | 0.007<br>(1.457)   | 0.008<br>(1.283)    |
| Treated*T2012       | 0.003<br>(0.346)   | 0.006<br>(0.525)   | 0.248***<br>(2.910) | 0.196**<br>(1.970)  | 0.002<br>(0.339)   | 0.001<br>(0.191)    |
| Treated*T2013       | 0.001<br>(0.112)   | -0.010<br>(-0.917) | 0.224***<br>(2.711) | 0.134<br>(1.429)    | 0.007<br>(1.435)   | 0.003<br>(0.567)    |
| Treated*T2014       | -0.004<br>(-0.428) | -0.013<br>(-1.143) | 0.113<br>(1.396)    | 0.260***<br>(2.779) | 0.011**<br>(2.347) | 0.007<br>(1.212)    |
| Controls            | Yes                | Yes                | Yes                 | Yes                 | Yes                | Yes                 |
| Industry FE         | Yes                | Yes                | Yes                 | Yes                 | Yes                | Yes                 |
| Year FE             | Yes                | Yes                | Yes                 | Yes                 | Yes                | Yes                 |
| City FE             | Yes                | Yes                | Yes                 | Yes                 | Yes                | Yes                 |
| N                   | 4473               | 3057               | 4660                | 3154                | 4658               | 3145                |
| adj. R <sup>2</sup> | 0.118              | 0.127              | 0.764               | 0.708               | 0.706              | 0.647               |
| F                   | 10.056             | 7.752              | 229.653             | 116.701             | 170.743            | 88.500              |

\*, \*\*, and \*\*\* indicate significance levels at 10%, 5%, and 1%, respectively.

#### 4. Conclusion

This study explores the effect of the Chinese government's subsidy on firms' real activity. Using a panel of Chinese public firms from 2008 to 2014, we show that subsidies significantly improve the investment, job creation and productive efficiency of firms. While the subsidy's effect is positive on average, there is significant cross-time variation in firms' response to subsidies. Government subsidies only in the short term have a significant boost to investment and productive efficiency, especially in the first three years after receiving subsidies. But they help improve long-term job creation of firms. Furthermore, the effects of subsidies vary across firms due to differences in state ownership. For SOEs, subsidies can promote job creation and productive efficiency of firms in the short term. While for non-SOEs, subsidies have a promotion effect on all real activities of firms in the short term, and their productivity benefited more from subsidies than SOEs.

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