ISSN: 2688-9323

Government Subsidies, Innovation Performance, and Total Factor Productivity: Evidence from China's Strategic Emerging Industries

Xin Wang, Hao Chen

School of International Economics and Trade, Anhui University of Finance and Economics, Bengbu, Anhui 233030, China

Abstract

Based on 2007–2020 panel data on listed companies active in China's strategic emerging industries, this paper analyzes the impact of government financial subsidies on the total factor productivity (TFP) of enterprises. The study finds that government subsidies significantly inhibit the TFP of enterprises in strategic emerging industries. This effect varies greatly among the seven sub-industries represented in the dataset. Government subsidies have a significant positive impact only on the TFP of enterprises in the information technology industry, while a negative effect is most obvious in the new energy industry. An intermediary effect model test shows that innovation quality (measured by the number of patent applications for inventions) is an important channel through which government subsidies inhibit enterprise TFP, while the intermediary effect of innovation quantity (measured by the total number of patent applications) is not significant. In addition, group empirical analysis finds that government subsidies have a more prominent effect in promoting innovation quantity in state-owned enterprises than in non-state-owned enterprises, and a more significant inhibitory effect on the innovation quality of enterprises with weak innovation ability than those with strong innovation ability. The study has some important policy implications: the government should formulate and implement targeted subsidy policies based on industrial development trends and the characteristics of different sub-industries, and focus on innovation quality rather than blindly pursuing innovation quantity.

Keywords

Government Subsidies; Innovation Performance; Total Factor Productivity; Strategic Emerging Industry.

1. Introduction

China's economic development has shifted from a phase of high-speed growth to one of high-quality development. The driving force of economic growth has shifted from factor-driven to innovation-driven. Promoting the structural transformation of industry, and improving total factor productivity (TFP) are key to changing the driving force of economic growth. Strategic emerging industries are based on major technological breakthroughs and development needs, and play a leading role in economic and social development in the long term. They are characterized by intensive input of knowledge and technology, lower consumption of material resources, and great growth potential. Cultivating strategic emerging industries is not only conducive to the transformation of the industrial structure but also to the development of an innovative economy.

Strategic emerging industries usually face high research and development (R&D) risks, uncertainty, technical complexity, and spillover. These factors can weaken enterprises' enthusiasm for R&D and innovation activities (Tassey, 2004). In order to stimulate the

ISSN: 2688-9323

development of strategic emerging industries, supportive policies such as tax relief and subsidies were introduced by central and local governments. Although the governments has various means to support strategic emerging industries, it has prioritized direct subsidies (Lu et al., 2014). As the main means for central and local governments to guide the development of emerging industries, subsidies aim to make up for market failures, correct external problems, and encourage enterprises to develop technological innovations independently. However, some studies have shown that government subsidies are often ineffective due to information asymmetry and the reverse selection behavior of enterprises (Busom, 2000; Yan and Huang, 2020). Do government subsidies have an inhibitory or promoting effect on the TFP of strategic emerging industries? Is the effect of subsidy policies heterogeneous among different sub-industries? What is the mechanism by which government subsidies affect enterprise TFP? These questions need to be answered urgently.

2. Literature Review

The impact of government subsidies on innovation performance has always been an important research topic in the field of policy effect. Academics have proposed different theories, including the “crowding-in effect” and the “crowding-out effect.” The crowding-in effect posits that R&D activities will inevitably face underinvestment due to the spillover characteristics of public goods (Arrow, 1962). Hence, based on the view of correcting externalities, government innovation subsidies are necessary (Aschhoff, 2009; Ozcelik and Taymaz, 2008). From the perspective of signal theory, subsidies signal the government’s support of certain enterprises or industries, thus alerting private investors that the investment climate is favorable. As a result, financing pressure on enterprises is reduced when they must raise research funds (Kleer, 2010; Liu et al., 2020). Compared to traditional industries, strategic emerging industries are more technology-oriented, as only through continuous R&D investment can the core competitiveness of enterprises be strengthened. Therefore, government subsidies can alleviate the negative impact of enterprise financing constraints and encourage enterprises to expand the scale of their R&D investment.

The crowding-out effect posits that the government cannot have sufficient information about the development of enterprise technology due to the information asymmetry that exists between governments and private businesses. Therefore, the government has great difficulty in identifying which enterprises have strong innovation potential and which new technologies may be effective. In the process of being screened as subsidy candidates, it is likely that enterprises will release false information in order to obtain the subsidy and even cause “rent-seeking” problems, thereby reducing the focus on enterprise innovation (Jiao and Chen, 2018). In addition, as the government cannot supervise the use of subsidies effectively, enterprises may transfer the funds to other purposes instead of investing in R&D, resulting in the failure of the subsidy policy (An et al., 2020).

Scholars have conducted research on the impact of government subsidies on the TFP of enterprises, but they have reached different conclusions. Some scholars believe that government R&D subsidies promote the TFP of enterprises. They point out that government subsidies can improve the average productivity level of enterprises by reducing innovation costs and improving the input–output elasticity and technological efficiency of products (Mccloud and Kumbhakar, 2008; Yan et al., 2011; Sun and Wang, 2021). Other scholars believe that government subsidies fail to significantly promote the TFP of enterprises and even have an inhibitory effect. Bernini and Pellegrini (2011), for example, show that there is no significant positive relationship between government subsidies and the TFP of enterprises in Italy.

In recent years, researchers have begun to focus on the effect of government innovation subsidies on TFP in the context of China’s transitioning economy. Zhang et al. (2015) find that

ISSN: 2688-9323

enterprises that rely too heavily on government subsidies are not able to follow up their R&D investment. On the contrary, subsidy policies may cause dependence on subsidy funds and weaken enterprises' ability to innovate independently. Based on data from listed companies in strategic emerging industries, Ren and Wang's (2014) empirical study shows that the large number of subsidies awarded to strategic emerging industries has caused excess production capacity, leading to a situation in which technological innovation is ignored while scale expansion is emphasized. Studies have also revealed that there exists a non-linear relationship between government subsidies and enterprise TFP. By analyzing the database of Chinese industrial enterprises, Shao and Bao (2012) show that there is an inverted-U relationship between government subsidies and enterprise TFP. Once a critical point is exceeded, the promotional effect of the subsidy begins to shift to an inhibitory effect. Hu and Wang (2020) have investigated the effect of government subsidies on the development of new products by employing a difference-in-differences(DID)approach. Their research shows that only moderate subsidies significantly encourage enterprises'new product innovation, while high subsidies inhibit it.

The foregoing literature review demonstrates that assessing the impact of government subsidies on productivity is a complex and uncertain endeavor. This paper breaks new ground in three ways. First, there are only a few empirical analyses in the existing literature that focus on policies targeted at strategic emerging industries. This paper examines the effect of government subsidy policies from the perspective of enterprise TFP, thus adding to the evaluation indicators of strategic emerging industry policies. It provides evidence for the academic disputes on the effect of industrial policy. Second, most of the existing literature focuses on the direct impact of government subsidies on enterprise TFP but ignores the intermediate transmission mechanism of policy implementation. This paper examines the influence of government subsidy policies from the perspective of enterprise innovation performance, which helps us understand the transmission mechanism from macroeconomic policy to the behavior of microeconomics. Third, most prior studies have analyzed the variation in productivity caused by government subsidies at industry level. These studies use industry-level data for OLS estimation, which inevitably leads to problems of sample selection and endogenous bias. This paper investigates the influence of government subsidy policies on enterprise TFP based on enterprise data, and thus enriches the empirical evidence on enterprises.

Based on panel data on listed companies in strategic emerging industries in China during 2007–2020, this paper empirically investigates the impact of government subsidies on enterprise TFP and analyzes the heterogeneity of the policy impact among seven sub-industries by constructing a fixed-effect model. To control sample selection bias and endogeneity issues, the robustness test uses a generalized method of moments (GMM) estimation. Employing an intermediary effect model, we then reveal that innovation performance is an important channel through which government subsidies affect enterprise TFP. Furthermore, based on enterprise innovation ability and ownership types, we examine the influence of enterprise heterogeneity on the innovation incentive effect of government subsidies. Finally, we propose countermeasures and suggestions.

3. Institutional Background and Hypotheses

3.1. Institutional Background

In October 2010, China's State Council announced the "Decision on Accelerating the Cultivation and Development of Strategic Emerging Industries," which specified seven sub-industries-energy conservation and environmental protection, new-generation information technology, biology, high-end equipment manufacturing, new materials, new energy, and new energy

ISSN: 2688-9323

vehicles-as key strategic emerging industries. In October 2012, "The 12th Five-Year Plan for the Development of National Strategic Emerging Industries" was issued, emphasizing once again that innovation is the main driving force for the development of strategic emerging industries. Since the release of "The 13th Five-Year Plan for the Development of National Strategic Emerging Industries" in November 2016, the policy support system for strategic emerging industries has been continuously improved at both national and local levels. In November 2018, the National Bureau of Statistics announced "the Strategic Emerging Industries Categorization (2018)," which added digital creativity and related service industries to the original seven classified industries to meet the statistical needs. With the introduction of "The 14th Five-Year Plan for the Development of National Strategic Emerging Industries" (2020) and a series of special plans for sub-industries, guidance and support for the development of strategic emerging industries will be further strengthened.

3.2. Hypotheses

Increasing government subsidies does not necessarily achieve the expected innovation incentive effect. In developing countries like China, which market economy system is not yet perfect, due to certain defects in both the technology evaluation and information disclosure systems, information on the technical abilities of enterprises is not transparent, and widespread rent-seeking behavior may distort the government's subsidy policies (Gill and Kharas, 2007). The excess profits generated by rent-seeking induces enterprises to use a large amount of manpower and other resources to maintain government–enterprise relations, while ignoring innovation activities, thus seriously weakening the incentive effect of subsidies (Yu et al., 2010). Moreover, due to the information asymmetry between government and enterprises, government subsidies may bring about reverse selection behavior in enterprises. In order to obtain more government subsidies, enterprises may cater to the policy provisions by undertaking only simple innovations or prioritizing innovation quantity. These "strategic innovation" behaviors do not promote the technological progress of enterprises effectively and are not conducive to TFP improvement. In addition, China's industrial policies are characterized by economic catch-up and direct intervention. The goal of most local governments' industrial policies is short-term economic gain. Considering that innovation is usually time-consuming and high-risk, production capacity expansion in strategic emerging industries is easier for local governments to achieve for political purposes, thus resulting in the neglect of technological innovation in those industries (Yan and Yu, 2017). To conclude, information asymmetry and rent-seeking problems in the implementation of industrial policies make the effect of subsidies run counter to their objectives.

Hypothesis 1: Government subsidies inhibit the improvement of TFP for enterprises in strategic emerging industries, and their impact is heterogeneous among different sub-industries.

According to the theory of endogenous growth, technological progress and innovation are the driving forces of sustainable economic development, which fundamentally comes from corporate behavior. If government subsidies can help an enterprise obtain resources to improve its innovation performance, then the enterprise's technology and new product innovation can have a positive impact on enterprise TFP through the spillover effect. However, due to "subsidy-seeking" investment behavior, moral risk, and reverse selection, government subsidies do not necessarily translate to enterprise R&D investment, so they do not effectively improve the innovation performance of enterprises (Shao and Bao, 2012).

Hypothesis 2: Innovation performance is an important channel through which government subsidies affect enterprise TFP.

Compared with non-state-owned enterprises (non-SOEs), state-owned enterprises (SOEs) are more incentivized to increase innovation quantity. When SOEs expect greater government subsidies, their patent applications increase significantly, especially for non-invention patents

ISSN: 2688-9323

(Li and Zheng, 2016). The innovation strategy of SOEs shows that the government requires SOEs to achieve a certain number of patent applications, while ignoring substantial patent applications, such as invention patents. This is just a funding strategy rather than a genuine pursuit of technological advancement or quality improvement (Tong et al., 2014).

Technical ability also conditions the effect of government subsidies on an enterprise's innovation performance. Enterprises with strong innovation ability usually implement innovation strategies according to market competition, and their innovation activities are active and sustainable. These enterprises have a weaker incentive to transform existing technology investment structures and technology tracks in order to obtain R&D subsidies, so their innovation activities are less affected by government policies. Enterprises with weak innovation ability are limited in capital, talent, and other resources, therefore their innovation activities tend to be random and passive, resulting in low expectations of innovation income. Enterprises are motivated to seek more subsidies through a "strategic innovation strategy" by increasing innovation quantity (Yang and Rui, 2020). Subsidies further distort the price mechanism of innovation input, resulting in enterprises becoming more dependent on direct government subsidies to maintain strategic innovation output.

Hypothesis 3: Government subsidies have a more prominent effect in promoting innovation quantity in SOEs and groups with weak innovation ability than in non-SOEs and groups with strong innovation ability.

4. Research Design

4.1. Measure of TFP

We assume that the production function of strategic emerging industry enterprises is a Cobb–Douglas production function. The equation is as follows:

$$\mathrm{Y}_{it} = F\,(K_{it}\,,\mathrm{L}_{it}) \equiv \mathrm{TFP}_{it} K_{it}^{\partial_i} L_{it}^{\beta_i} \tag{1}$$

where Y_{it} represents the output, K_{it} and L_{it} represent capital input and labor input, respectively, and TFPit represents the total factor productivity of an enterprise. We take the logarithm of equation (1) and convert it into a linear form:

$$y_{it} = \partial k_{it} + \beta l_{it} + \varepsilon_{it} \tag{2}$$

where y_{it}, l_{it}, and k_{it} represent the log forms of Y_{it}, L_{it}, and K_{it}, respectively. The residual of equation (2) contains information on the TFP log form of enterprises. We can estimate equation (2) to obtain an estimate of TFP.

To select an estimation method, we refer to the research of Lu and Lian (2012). The OP semi-parametric estimation method (Olley and Pakes, 1996) can overcome the synchronization deviation problem, which cannot be solved by the traditional OLS method. Since an enterprise can adjust the factor input level according to its productivity partially observed in the current period, the residual representing TFP in equation (2) may affect the choice of factor input. That is, the residual is related to the explanatory variable, and thus the resulting endogenous problem will lead to a partial error of OLS estimation. The OP semi-parametric estimation method adopts the current investment as the proxy variable of unobservable productivity impact, thus solving the problem of synchronicity deviation. The production function is constructed as follows:

ISSN: 2688-9323

$$y_{it} = \beta_i l_{it} + \partial_i k_{it} + h(i_{it}, k_{it}) + \lambda_{it} \tag{3}$$

Where h represents the investment decisions made by the enterprise according to their own productivity, y represents the main business income of a listed company, l represents the listed company's labor investment measured by the total number of employees, k represents the listed company's capital investment measured by the original value of fixed assets, and i represents the investment expenditure on fixed assets measured as the difference between the value of a listed company's fixed assets at the end of the year and the value at the beginning of the year. Using the estimated coefficients of labor and capital of the productivity function, we can estimate equation (1) to obtain the log value of the residual, which is the log of TFP.

4.2. Model Specification

To examine the impact of government subsidies on the TFP of strategic emerging enterprises, we construct the benchmark model as follows:

$$\ln TFP_{it} = \beta_0 + \beta_1 \ln \mathrm{Sub}_{it} + \sum_j \beta_j Control_{it} + \lambda_i + \lambda_t + \lambda_p + \varepsilon_{it} \tag{4}$$

where i represents the enterprise, t represents the year, TFPit represents the TFP level of enterprise i in year t , and Subit represents government subsidies. The estimation coefficient β 1 is the focus of this paper; it measures the intensity of the impact of government subsidies on an enterprise's TFP. If β 1 significantly, then government subsidies show a positive promotion effect on enterprise TFP; if β 1 0 significantly, then government subsidies inhibit the improvement of enterprise TFP. Control represents a set of control variables, including age of the enterprise (Age), enterprise size (Size), capital intensity (Capint), rate of return on capital (ROA), asset liability ratio (Lev), a dummy variable for export (Export) and a dummy variable for ownership type (SOE). λ_i, λ_t, and λ_p represent industry individual effect, time effect, and regional effect, respectively, while ε_{it} represents the random error.

Regarding the selection of a regression method, this paper uses the Hausman test to determine whether to use a fixed-effect model (FE) or a random-effect model (RE).

4.3. Definition of Variables

This paper uses the OP method to estimate the explained variable, which is the TFP of an enterprise. We take the logarithmic form of the TFP value to reduce the volatility of the data. The explanatory variable is the natural logarithm of government subsidy (lnSub).

In order to control the influence of other factors on the explained variables, this paper refers to previous research (Li and Zheng, 2016) on the TFP of enterprises to control the following variables: (1) age, calculated from the year of establishment; (2) size, the natural logarithm of operating revenue; (3) capital density, measured by the ratio of fixed assets to total assets; (4) return on assets, measured by the ratio of enterprise net profit to total assets; (5) asset-liability ratio, defined as the ratio of the enterprise's total liabilities to its total assets; (6) export, which is equal to 1 for an export enterprise and 0 for a non-export enterprise; and (7) ownership, which is equal to 1 for a state-owned holding enterprise and 0 for a non-state holding enterprise based on the difference in the enterprise's ownership structure.

The variables and their calculation methods are summarized in Table 1.

Table 1. Variables and their calculation methods

Variable property	Variable name	Variable symbol	Calculation method
Explained variable	Total factor productivity	TFP	Measured by OP method
Explanatory variable	Government subsidy	Sub	Natural logarithm of government subsidies received
Control variable	Enterprise age	Age	Natural logarithm of the number of years since establishment
	Enterprise size	Size	Natural logarithm of the operating revenue
	Capital intensity	Cap int	Ratio of fixed assets to total assets
	Return on assets	Roa	Ratio of net profit to total assets
	Asset-liability ratio	Lev	Ratio of total liabilities to total assets
	Export	Export	1 for export enterprises, 0 for non-export enterprises

4.4. Sample Selection and Data Sources

Based on the Classification of Strategic Emerging Industries (2018) standard issued by the National Bureau of Statistics and referring to the main business of the listed companies, this paper selected the A-share listed companies in Chinese strategic emerging industries from 2007 to 2020 as the research sample. After eliminating the abnormal data and ST-type samples, 227 eligible samples were obtained. Furthermore, combined with the Guidelines on Industry Classification of Listed Companies issued by the China Securities Regulatory Commission (CSRC, revised in 2012), the sample enterprises were classified into seven sub-industries: energy conservation and environmental protection, new-generation information technology, biology, high-end equipment manufacturing, new energy, new materials, and new energy vehicles. To eliminate the effects of extreme values, this paper also performs tail processing (winsorize) of continuity variables, excluding observations located below 1% of the total sample and above 99% of the quantile. Financial data on the listed companies were obtained mainly from the Wind Economic Database, and the sample data are collated with and supplemented by each company's annual report.

5. Empirical Results

5.1. TFP Trends

In order to analyze the trends of TFP in seven sub-industries, this paper calculates the overall annual TFP for each sub-industry during 2007–2020, taking the operating income of enterprises in various industries as the weight . As shown in Figure 1, the TFP in the new-generation information technology industry has had a relatively stable growth trend since 2007 and peaked in 2017. It declined slightly thereafter, but was still significantly higher than other industries. TFP in new energy vehicles, new materials, and biological industries showed slowly increasing trends during the sample period. The TFP in high-end equipment manufacturing, energy conservation and environmental protection, and new energy industries showed an increasing trend at first, followed by a decrease. After the government launched a strategic emerging industry development plan in 2010, the trend of TFP in abovementioned sub-industries showed that the industrial policy may have had a crowding-out effect on the market.

ISSN: 2688-9323

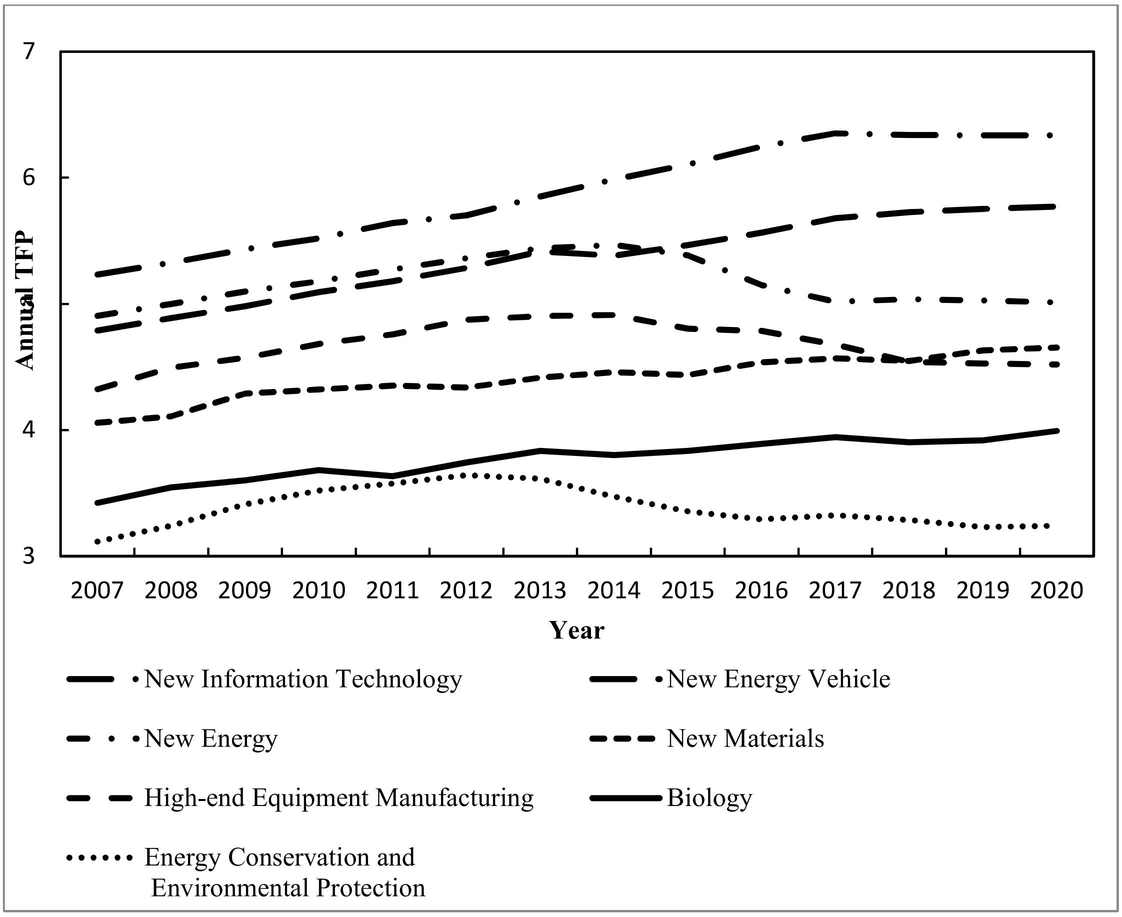

Figure 1. Annual TFP trends of strategic emerging sub-industries (2007–2020)

5.2. Baseline Results

Before regression, it is necessary to determine whether Equation (4) selects a random-effect model or a fixed-effect model. In this paper, the Hausman test result used as the basis for model selection shows that the selection of a fixed-effect model is appropriate. The baseline regression results are reported in Table 2, where column (1) contains the fixed-effect model results of the whole sample. The coefficient of the core explanatory variable lnSub is -0.024, which is significantly negative at 1% level, indicating that every 1% increase in government subsidies results in an enterprise TFP decrease of 0.024%. This empirical result reveals that for strategic emerging industries, the greater the subsidy received, the lower the TFP level. Therefore, the regression results support Hypothesis 1, indicating that the subsidy policy has an inhibitory effect on the improvement of enterprise TFP. This may be because the enterprises use the government's subsidies for the production and operation activities that could quickly create high profits other than R&D investment. Moreover, it may also be due to the low efficiency in the enterprise's use of limited government subsidy funds, or to a waste of funds. Section 6 of this paper analyzes the impact mechanism of this policy effect.

The control variables all passed the significance test, indicating that the selection of control variables in the model is reasonable. Specifically, the variables of age and size of the enterprise are positively related to TFP, representing the positive impact of scale efficiency and experience accumulation, respectively, especially in strategic emerging industries that require a high level of technology. The coefficient of capital density is significantly negative, indicating that with the increase of capital density and fixed-asset investment, the growth rate of TFP declines. This means that strategic emerging industries tend to emphasize the introduction of high-tech equipment and neglect utilization efficiency of factors. The ROA coefficient is positive, showing that internal financing, mainly based on the enterprise's own profit, is an important source of enterprise R&D investment. Sufficient capital reserves and lower financing costs can greatly reduce the R&D costs of enterprises, motivate the increase in R&D investment, and thus improve the TFP of enterprises.

The asset-liability ratio is positive at 0.004, indicating that the effect of debt financing on enterprise TFP is limited. On the one hand, this may be due to China's imperfect financial system and high financing costs, which may hinder innovation in enterprises. On the other hand, the funds obtained by external financing may be invested in the scale expansion of simple processing and manufacturing, rather than in technology R&D. This can lead to a decline in technological progress, resulting in an insufficient contribution of external financing to the TFP growth rate. The coefficient of the export dummy variable is significantly positive, indicating that the "learn-from-export effect" on TFP is significantly positive. The coefficient of the ownership variable is negative, indicating that SOEs show lower productivity, which is consistent with previous findings by Liu and Shi (2010) and Wu (2012).

Table 2. Baseline regression and sub-industry regression results

Variable	Full sample	New information technology	Biology	High-end equipment manufacturing	New energy	New materials	New energy vehicle	Energy conservation and environmental protection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnSub	-0.024***	0.073***	0.065	-0.053***	-0.067***	-0.016**	0.038	-0.049***
	(0.006)	(0.032)	(0.054)	(0.024)	(0.018)	(0.007)	(0.028)	(0.011)
Age	0.052**	0.042**	0.058**	0.064***	0.077***	0.072***	0.044**	0.061**
	(0.022)	(0.017)	(0.027)	(0.017)	(0.026)	(0.025)	(0.020)	(0.029)
Size	0.213***	0.106***	0.354***	0.506***	0.241***	0.283***	0.355***	0.166***
	(0.057)	(0.025)	(0.096)	(0.137)	(0.070)	(0.085)	(0.101)	(0.051)
Capint	-0.032**	0.041*	-0.018	-0.036**	-0.043***	-0.024**	-0.027**	0.032***
	(0.014)	(0.023)	(0.015)	(0.016)	(0.014)	(0.010)	(0.011)	(0.010)
ROA	0.085***	0.067***	0.075***	0.088***	0.046**	0.068***	0.057**	0.092***
	(0.019)	(0.022)	(0.021)	(0.029)	(0.021)	(0.022)	(0.023)	(0.021)
Lev	0.004**	0.012***	0.009***	0.003**	0.002**	0.003***	0.007**	0.002**
	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
Export	0.021***	0.009**	0.016**	0.037***	0.032***	0.020***	0.041***	0.015***
	(0.004)	(0.003)	(0.006)	(0.012)	(0.011)	(0.006)	(0.011)	(0.005)
SOE	-0.126***	-0.087**	-0.237***	-0.354***	-0.242***	-0.155***	-0.132**	-0.146**
	(0.023)	(0.041)	(0.083)	(0.096)	(0.078)	(0.052)	(0.060)	(0.066)
_cons	-3.278***	-3.427***	-3.358***	-3.156***	-3.066***	-3.221***	-3.36***	-3.121***
	(0.855)	(0.960)	(0.989)	(1.039)	(0.992)	(0.979)	(0.992)	(0.983)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.158	0.165	0.143	0.162	0.159	0.153	0.148	0.156
N	3178	952	336	910	308	280	224	168

Note : ***, **,* represent 1%, 5%, and 10% significance levels, respectively.

5.3. Comparison by Sub-Industry

In order to further compare the impact of government subsidies on the TFP of sub-industries, this paper also regresses the sub-industries data based on model (4). The results are shown in columns (2)–(8) of Table 2.

The results show that the impact of government subsidies on TFP can differ greatly. Specifically, government subsidies have a positive impact on TFP in the new-generation information technology industry. The coefficients for the biology and new energy vehicle industries are positive but not significant, indicating that government subsidies do not significantly promote or inhibit enterprise productivity in these two sub-industries. In all other sub-industries,

ISSN: 2688-9323

government subsidies have a significant negative impact on enterprise TFP, and only the estimated coefficients are different. Among them, the negative effect of subsidies in the new energy industry is the most obvious at -0.067, indicating that every 1% increase in government subsidies leads to a 0.067% decline in TFP.

The above results suggest, first, that although the intention of government support for strategic emerging industries is to encourage R&D activities, in the implementation process it triggers different degrees of excessive investment in the sub-industries. This not only fails to effectively promote innovation but also distorts the allocation of market resources. Second, the seven strategic emerging sub-industries show different technical characteristics and product upgrading speed. For instance, the technology updating speed in the new-generation information technology industry is high, the cycle of transformation of innovation results is relatively short, and the IT industrial cluster has formed. Therefore, the government's financial subsidy policy has effectively encouraged R&D investment and promoted the TFP of IT enterprises. In other sub-industries, however, especially energy conservation and environmental protection, biology, and new materials, most enterprises' R&D investments are in basic research, laboratory renovation, technical research and other fields. The commercialization of scientific and research findings usually requires a long period, and the rate of technology transfer is relatively low, thus resulting in the variation in policy effects among the sub-industries.

5.4. Robustness Checks

5.4.1. Alternative Measure of TFP

In order to ensure the reliability of the regression results, we used the semi-parametric estimation method developed by Levinsohn and Petrin (2003) to re-estimate the TFP of enterprises. Compared to the OP method, the LP method does not use the investment amount as a proxy variable; instead, it uses the intermediate product input as an instrumental variable for the unobservable productivity impact. Here, the amount of goods purchased by the enterprise and of labor services received are used to measure the intermediate product input indicator. We regress model (4) using the TFP estimated by the LP method instead of the OP method, with the results shown in column (1) of Table 3. The coefficient of government financial subsidies is significantly negative, indicating that government subsidies significantly inhibit the improvement of enterprise TFP. Compared with the previous results, the core explanatory variable does not substantially differ in significance despite the difference in coefficient, verifying the robustness of the baseline regression results.

5.4.2. GMM

To test the impact of government subsidies on enterprise TFP, we need to consider the possible endogeneity between variables. Some degree of endogeneity exists between most economic variables, but a serious endogeneity problem would compromise the unbiased nature and consistency of the results, leading to bias errors in the empirical analysis. In this research, the endogenous problem derives mainly from the possible two-way causal relationship between the explanatory variable and the explained variable. On the one hand, government subsidies have an impact on enterprise TFP; on the other hand, because the government has a strong incentive to support high-growth enterprises, enterprises with a productivity advantage may receive larger subsidy amounts, so there may be a reverse causal relationship between government subsidies and enterprise TFP. In addition, the effect of a government's subsidy policy often has a long lag period, that is, current government subsidies are unlikely to have an obvious effect in the current period. To overcome the estimation bias caused by endogeneity, this paper uses the difference GMM to test the robustness of the regression results.

Considering the impact of the lag one phase of the explained variable on the current phase, we add the lag term of the explained variable as the explanatory variable, and the following dynamic panel model is established:

$$\ln TFP_{i,t} = \beta_0 + \beta_1 \ln TFP_{i,t-1} + \beta_2 lnSub_{i,t} + \sum_j \beta_j Control_{i,t} + \lambda_1 + \lambda_t + \lambda_p + \varepsilon_{i,t} \quad (5)$$

where ln TFPi, t represents the logarithm of the TFP of enterprise i in year t , ln TFPi,t -1 represents the logarithm of the TFP of enterprise i in year $t-1$ and ln Subi, t represents the logarithm of government subsidies. Control represents a set of control variables including age of the enterprise (Age), enterprise size (Size), capital density (Capint), rate of return on capital (ROA), asset liability ratio (Lev), a dummy variable for export (Export) and a dummy variable for ownership type (SOE). The letters λ_i, λ_t, and λ_p represent represent industry individual effect, time effect, and regional effect, respectively, while ε it represents the random error.

We select the lag two phases of the explanatory variable ln Subi ,t as the tool variable for the difference equation. Arellano–Bond test results show that the error term of the difference equation only has a first-order sequence correlation and no second-order sequence correlation, indicating that the setting of the model is reasonable. The result of the Sargan overidentifying test of P value is 0.310, indicating that the use of the tool variable is reasonable.

The regression results of the difference GMM estimation in column (2) of Table 3 show that the coefficient of government subsidy is -0.017, significant at the 1% level, indicating that the government subsidy has a significant negative impact on enterprise TFP, and the elasticity coefficient value is smaller compared with the fixed-effect model. Blundell and Bond (1998) argue that system GMM estimation can improve the effectiveness of instrumental variables in differential estimation. Therefore, to ensure the reliability of the regression results, this paper further uses system GMM to estimate model (5). The results in column (3) of Table 4 show that neither the sign nor significance levels of the main variables change much compared to the difference GMM estimation, confirming the robustness of the regression results.

Table 3. Robustness checks

Variable	(1)	(2)	(3)
	LP method	difference GMM	system GMM
lnSub	-0.021*** (0.005)	-0.017*** (0.002)	-0.015*** (0.002)
L1.lnTFP		0.881*** (0.038)	0.892*** (0.038)
Controls	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
Province	Yes	Yes	Yes
AR(1)		0.011	0.001
AR(2)		0.232	0.231
Sargan Test		0.310	0.382
R^2	0.165		
N	2912	3052	3052

Note :*** represent a 1% significance level.

ISSN: 2688-9323

6. Empirical Analysis of the Impact Mechanism

Research shows that government subsidies can increase the R&D investment of enterprises and significantly improve their innovation performance (Wolff and Reinthaler, 2008; Lu et al., 2014; Zhu et al., 2021). The spillover effect of technology and product innovation has a positive impact on enterprise TFP. The goal of government subsidies for strategic emerging industries is to encourage enterprises to undertake independent innovation and to improve productivity. However, the empirical analysis above shows that higher government subsidies do not increase corporate TFP, but rather lead to a decline in corporate TFP. What causes this deviation from the desired policy effect? What is the impact channel? This subsection focuses on these issues.

In intermediary effect models, intermediary variables can be used to explain the impact mechanism behind the causal relationship between independent and dependent variables. This paper introduces innovative performance as an intermediary variable to test whether government subsidies affect enterprise TFP. We establish an intermediary effect model that consists of the following three equations:

$$\ln TFP_{it} = \beta_0 + \beta_1 \ln \mathrm{Sub}_{it} + \sum_j \beta_j Control_{it} + \lambda_\mathrm{i} + \lambda_t + \lambda_\mathrm{p} + \varepsilon_{it} \tag{6}$$

$$\ln \mathrm{Inno}_{it} = \partial_0 + \partial_1 \ln \mathrm{Sub}_{it} + \sum_j \partial_j Control_{it} + \lambda_\mathrm{i} + \lambda_t + \lambda_\mathrm{p} + \varepsilon_{it} \tag{7}$$

$$\ln TFP_{it} = \gamma_0 + \gamma_1 \ln \mathrm{Sub}_{it} + \gamma_2 \ln \mathrm{Inno}_{it} + \sum_j \beta_j Control_{it} + \lambda_\mathrm{i} + \lambda_t + \lambda_\mathrm{p} + \varepsilon_{it} \tag{8}$$

where equation (6) is the benchmark regression model used to test the causal relationship of the independent variable ln Sub and the dependent variable ln TFP . Equation (7) regresses the independent variable ln Sub to the intermediary variable of innovation performance ln Inno , where ln Inno represents the natural logarithm of enterprise innovation performance. Equation (8) tests whether the influence of the independent variable on the dependent variable changes after controlling the intermediary variable. The intermediary effect is measured by β_1-γ_1.

In previous studies on the measurement of enterprise innovation performance, most scholars used R&D investment indicators to measure an enterprise's innovation ability. However, some scholars have pointed out that because the R&D activities of strategic emerging industries are characterized by high risk and long cycles, innovation output can more directly reflect the degree of innovation achieved by an enterprise than R&D investment (Dosi et al., 2006). There are two main measures of innovation output: (1) number of patent applications of enterprises, and (2) the value of newly developed products and products that have been upgraded. Due to the difficulty of obtaining data on new products, we select the number of patent applications to measure innovation output.

The application period is different depending on the type of application. The period from application to disclosure and authorization is only 18 months for utility models and appearance designs, which is obviously shorter than the 3–4 years typically necessary for invention patents. Moreover, there is no strict review in the application process of utility models and appearance design patents. Moreover, the scientific and technological content in an invention patent is much higher than that of a utility model and appearance design. Therefore, this paper measures innovation quantity by taking the overall number of patent applications, including inventions, utility models, and appearance designs, defined as InnoPatent. We measure the innovation

ISSN: 2688-9323

quality by the number of invention patent applications only, defined as InnoInvention. The data on patent applications come from the China Stock Market & Accounting Research (CSMAR) database and the National Intellectual Property Office (NIPO) website. Referring to the research by Hall and Harhoff (2012), we perform a winsorize process on the 1% and 99% percentiles of InnoPatent and InnoInvention data, respectively, and compute their natural logarithms.

Column (1) in Table 4 reports the regression results of equation (6), indicating that government subsidies inhibit the TFP of enterprises, which mirrors the baseline regression result. Columns (2) and (3) report regression results for equation (7) with innovation quantity and innovation quality as dependent variables, respectively. The results show that the coefficient of government subsidy in column (2) is significantly positive, indicating that government subsidies are conducive to an increase in innovation quantity, while the coefficient of government subsidy in column (3) is significantly negative, indicating that government subsidies significantly inhibit the improvement of innovation quality. These results show that enterprises, inspired by industrial policies, have increased their patent applications, but only in the category of non-invention patents. This means that enterprise innovation appears to be in pursuit of quantity rather than quality. Enterprises signal their engagement in innovation by emphasizing the quantity and speed of innovation; rather than pursuing genuine technological progress and product upgrades, they endeavor to obtain more subsidies.

Table 4. Impact mechanism analysis

Variable	lnTFP	InnoPatent	InnoInvention	InTFP	
	(1)	(2)	(3)	(4)	(5)
lnSub	-0.024^{***}	0.056^{***}	-0.017^{**}	-0.020^{***}	-0.013^{***}
	(0.006)	(0.014)	(0.007)	(0.004)	(0.002)
InnoPatent				0.085	
				(0.067)	
InnoInvention					0.132^{**}
					(0.062)
Controls	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes
R2	0.158	0.706	0.675	0.176	0.183
N	3178	3076	3076	3076	3076

Note :***, **represent 1% and 5% significance levels, respectively.

The regression results of equation (8) are reported in columns (4) and (5) of Table 4. Column (4) shows that the coefficient of innovation performance measured by innovation quantity is positive but not significant, indicating that an increase in innovation quantity cannot significantly improve enterprise TFP. After adding the intermediary variable, government subsidies have a significant negative impact on enterprise TFP. However, as the impact of innovation quantity on enterprise TFP is insignificant, a further Sobel test is required. The result of the Sobel test is smaller than the critical value of 0.97 at the 5% significance level, indicating that the intermediary effect of innovation quantity is not significant. The results in column (5) show that the coefficient of innovation performance measured by innovation

ISSN: 2688-9323

quality is significantly positive, indicating that an improvement in innovation quality can significantly promote the TFP of an enterprise. This paper focuses on whether the impact of government subsidies on enterprise TFP changes after controlling the intermediary variables. The intermediary effect of innovation quality can be identified by comparing the coefficient of government subsidy in columns (1) and (5). We can see that the estimated coefficient of government subsidy in column (1) is -0.024 and passes the significance test at 1% level. After adding innovation quality, the coefficient of government subsidy in column (5) changes to -0.013, dropping by about half in absolute value compared to column (1). The regression results support Hypothesis 2, indicating that innovation quality is an important channel through which government subsidies inhibit the TFP of enterprises. Empirical results show that for strategic emerging industries, government subsidies weaken innovation quality, thus inhibiting the improvement of enterprise TFP.

7. Additional Analyses

7.1. Firm Ownership Type

This paper further investigates whether government subsidies have a heterogeneous impact on the innovation performance of enterprises with different types of ownership . In order to verify this impact, we divide the sample into two groups according to enterprise property type (state-owned or non-state-owned) and repeat the regression of model (7). Central government holding enterprises and local government holding enterprises are considered SOEs, while private enterprises are classified as non-SOEs. Other ownership types (such as enterprises that are majority-owned by foreign firms and enterprises from Hong Kong, Macao, and Taiwan) account for a very small proportion of the overall number of enterprises in strategic emerging industries, and are therefore ignored in this analysis.

Table 5. Additional analysis of firm ownership

Variable	SOEs		Non-SOEs	
	(1) InnoPatent	(2) InnoInvention	(3) InnoPatent	(4) InnoInvention
InSub	0.083^{***} (0.018)	-0.023^{**} (0.011)	0.037^{***} (0.008)	-0.009^{**} (0.004)
Controls	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
R2	0.733	0.689	0.702	0.654
N	1316	1316	1750	1750

Note :***, **represent 1% and 5% significance levels, respectively.

Table 5 reports the regression results of the analysis of ownership. They show that from the perspective of innovation quantity, the coefficients of government subsidy of SOEs and non-SOEs (0.083 and 0.037, respectively) are both significantly positive, indicating that government subsidies promote the increase of innovation quantity in both ownership classes. Considering that model (7) is a logarithmic linear model, it shows that every 1% increase in government subsidies can increase innovation quantity by 0.083% for SOEs and 0.037% for non-SOEs, suggesting that government subsidies have a more obvious impact on innovation quantity in the former group. SOEs are more likely than non-SOEs to ramp up their innovation quantity because their desire to obtain additional subsidies is greater. The group empirical results support Hypothesis 3, according to which government subsidies have a more prominent effect in promoting innovation quantity in SOEs than in non -SOEs.

From the perspective of innovation quality, the coefficients of government subsidy in SOEs and non-SOEs are -0.023 and -0.009, respectively, and both pass the significance test at the 5% level. The regression shows that every 1% increase in government subsidies will result in a decline of 0.023% in innovation quality in SOEs, and this impact is deeper than in non-SOEs by a margin of 0.014 of a percentage point. This means that government subsidies lead to an increase in the quantity of enterprise innovation rather than in quality improvements. SOEs are less willing to invest in high technology to compete with non-SOEs. Compared with SOEs, non-SOEs face fiercer market competition. In order to win market share, non-SOEs are more motivated to devote their time and capital to substantive research and development and to improve the quality of innovation.

7.2. Innovation Ability of Firms

This paper uses the total number of invention patent applications in 2007 to measure the innovation ability of enterprises. The sample is divided into large-patent and small-patent enterprises, which represent enterprises with strong innovation ability and weak innovation ability, respectively, to further explore whether government subsidies have a heterogeneous impact on the innovation performance of enterprises with different innovation abilities.

The results in Table 6 show that in terms of innovation quantity, the coefficients of government subsidy are significantly positive in both groups, indicating that government subsidies promote an increase in the innovation quantity of enterprises with different innovation capabilities. As for the quality of innovation, the coefficient of government subsidy is only significantly negative at the 5% significance level for enterprises with weak innovation ability. This means that government subsidies have a significantly negative impact on the innovation quality of enterprises with weak innovation ability, but not on those with strong innovation ability.

Table 6. Additional analysis of firms' innovation ability

Variable	Strong Innovation Ability		Weak Innovation Ability	
	(1)	(2)	(3)	(4)
	InnoPatent	InnoInvention	InnoPatent	InnoInvention
InSub	0.046^{***} (0.011)	0.005 (0.003)	0.058^{***} (0.009)	-0.038^{**} (0.017)
Controls	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
R2	0.706	0.612	0.742	0.664
N	1484	1484	1568	1568

Note :***, **represent 1% and 5% significance levels, respectively.

8. Conclusion and Implications

In recent years, Chinese government subsidies to strategic emerging industries have been increasing continuously as the country tries to enhance its innovation capacity and international competitiveness. The improvement of enterprise TFP is an important factor in achieving sustainable economic growth. Hence, whether government subsidies significantly improve enterprise TFP is an important aspect of evaluating the effect of subsidy policies. This paper analyzes the impact of government subsidies on the enterprise TFP of listed companies in China during the period 2007–2020. The results show that government subsidies have an inhibitory effect on enterprise TFP as a whole. Various robustness tests, such as replacing the dependent variable measurement method and eliminating endogeneity by GMM methods, leave the results substantially unchanged. Further analysis shows that the influence of government subsidies on TFP varies among the seven sub-industries. Government subsidies only have a significantly positive impact on the TFP of the new-generation IT industry and a significantly negative impact on the new materials, energy conservation and environmental protection, high-end equipment manufacturing, and new energy industries, with the negative effect on the latter being the most obvious. The intermediary effect model reveals that innovation quality is an important channel through which government subsidies inhibit the improvement of enterprise TFP, while the intermediary effect of innovation quantity is not significant. Thus, government subsidies distort the motivation for corporate patent applications, leading to a large number of non-invention patents. Further analysis finds that government subsidiehave a more significant promoting effect on the innovation quantity in SOEs than non-SOEs. Moreover, government subsidies have a more significant inhibitory effect on innovation quality in enterprises with weak innovation ability than in those with strong innovation ability.

The results presented in this paper have the following policy implications. First, the government needs to improve the subsidy mechanism and establish a more open and transparent review system for subsidy qualification so that subsidy resources can be allocated more efficiently. Second, the government should formulate subsidy policies that are targeted to the characteristics of individual sub-industries. It is necessary to change the traditional "one size fits all" subsidy model and improve the utilization efficiency of subsidy funds. Third, the government should be more cautious when deploying large subsidies and strictly supervise their use. It should also dynamically adjust the subsidy plan to avoid causing enterprise growth dependence on subsidies, and thus lack of motivation to improve productivity. Fourth, the development of strategic emerging industries should be market-driven, and the endogenous motivation of the market should be encouraged to avoid excessive intervention by the government. The market competition mechanism of "survival of the fittest" should be used to select the enterprises with strong innovation ability, and these enterprises should be awarded R&D subsidies to improve their innovation quality, while reducing excessive subsidies for the ones with low ability to innovate. Fifth, the government should lower the threshold on market access for private enterprises and provide convenient conditions for R&D investment, thereby stimulating their independent innovation potential.

Acknowledgments

This work was supported by the Key Project of Anhui University Humanities and Social Sciences Research (Grant no.SK2021A0221).

References

[1] T.L. An, J. Wei, and X. Shu, "The Measurement of Innovation in Chinese Manufacturing Enterprises-An Intertemporal Comparison Based on Innovation Micro-Surveys," Social Sciences in China, no. 12, pp. 99- 122, 2021.

[2] K.J. Arrow, Economic Welfare and the Allocation of Resources to Invention, In R. R. Nelson (ed.), The Rate and Direction of Inventive Activity: Economic and Social Factors, Princeton, NJ: Princeton University Press, pp. 609-626, 1962.

[3] B. Aschhoff, "The Effect of Subsidies on R&D Investment and Success. DoSubsidy History and Size Matter?" ZEW Discussion Paper, no. 09-032, 2009.

[4] C. Bernini and G. Pellegrini, “How are Growth and Productivity in Private Firms Affected by Public Subsidy? Evidence from a Regional Policy,” Regional Science and Urban Economics, vol. 41, no. 3, pp. 253-265, 2011.

[5] R. Blundell and S. Bond, “Initial Conditions and Moment Restrictions in Dynamic Panel Data Models,” Journal of Econometric, vol. 87, no. 1, pp. 115- 143, 1998.

[6] I. Busom, “An Empirical Evaluation of the Effects of R&D Subsidies, Economics of Innovation and New Technology,” Economics of Innovation and New Technology, no.9, pp. 111-148, 2000.

[7] G. Dosi, L. Marengo and C. Pasquali, “How Much Should Society Fuel the Greeof Innovators? On the Relations between Appropriability, Opportunities and Rates of Innovation,” Research Policy, vol. 35, no. 8, pp. 1110- 1121, 2006.

[8] I. Gill and H. Kharas, An East Asian Renaissance: Ideas for Economic Growth, Washington DC, World Bank Publications, 2007.

[9] B.H. Hall and D. Harhoff, “Recent Research on the Economic of Patents,” Annual Review of Economics, no. 4, pp.541-565, 2012.

[10] C.Y. Hu and Z.X. Wang, “How Fiscal Subsidies Affect Corporate TFP? Also on the “Moderate Range” of Fiscal Subsidies for the Manufacturing Industry,” Contemporary Finance and Economics, vol.427, no. 6, pp. 28-41, 2020.

[11] C.H. Jiao and Y.F. Chen, “R&D Subsidy, Rent-seeking and Up-grading of Total Factor Productivity,” Statistical Research, vol. 35, no. 12, pp. 81-91, 2018.

[12] R. Kleer, “Government R&D Subsidies as a Signal for Private Investors,” Research Policy, vol. 39, pp. 1361- 1374, 2010.

[13] J. Levinsohn and A. Petrin, “Estimating Production Functions Using Inputs to Control for Unobservable,” Review of Economic Studies, vol. 70, no.2, pp. 317-341, 2003.

[14] W.J. Li and M.N. Zheng. “Is it Substantive Innovation or Strategic Innovation?-Impact of Macroeconomic Policies on Micro-enterprises’ Innovation,” Economic Research Journal, no. 4, pp. 60-73, 2016.

[15] R.M. Liu and L. Shi, “The Dual Efficiency Loss of State-Owned Enterprises and Economic Growth,” Economic Research Journal, no. 1, pp. 127- 137, 2010.

[16] X.M. Liu, H.R. Song and L. Fan, “Signaling Effects of R&D Subsidy and Enterprise Innovation on Investor’s Investment Decisions of Technology-based SMEs,” Science & Technology Progress and Policy, no. 1, pp.26-33, 2020.

[17] X.D. Lu and Y.J. Lian, “Estimation of Total Factor Productivity of Industrial Enterprises in China: 1999-2007,” China Economic Quarterly, no. 1, pp.541-558, 2012.

[18] G.Q. Lu, Z. Wang and C.Y. Zhang, “Research on the Performance of Subsidizing Innovation for Chinese Strategic Emerging Industry,” Economic Research Journal, no.7, pp. 44-55, 2014.

[19] N. Mccloud and S.C. Kumbhakar, “Do Subsidies Drive Productivity? A Cross-Country Analysis of Nordic Dairy Farms,” Advances in Econometrics, vol. 23, no.8, pp.245-274, 2008.

[20] S. Olley and A. Pakes, “The Dynamics of Productivity in The Telecommunications Equipment Industry,” Econometrical, vol.64, no. 6, pp. 1263- 1297, 1996.

[21] E. Ozcelik and E. Taymaz, “R&D Support Programs in Developing Countries: the Turkish Experience,” Research Policy, vol.37, no. 2, pp.258-275, 2008.

[22] B.Q. Ren and L.L. Wang, “Are Strategic Emerging Industries Becoming High-end?” The Journal of Quantitative and Technical Economics, no. 3, pp. 38-55, 2014.

[23] M. Shao and Q. Bao, “Government Subsidies and Firm’s Productivity-An Empirical Study Based on Chinese Industrial Plants,” China Industrial Economics, no.7, pp.70-82, 2012.

[24] Y.Y. Sun and D.M. Wang. “The Impact of Government Subsidies on the Total Factor Productivity of Strategic Emerging Enterprises-Testing the Mediation Effect Based on Innovation Incentives,” Journal of Industrial Technological Economics, no. 12, pp.3- 13, 2021.

[25] G. Tassey, “Policy Issues for R&D Investment in a Knowledge-Based Economy,” The Journal of Technology Transfer, vol. 29, pp. 153-185, 2004.

[26] T.W. Tong, Z.L. He and J. Lu, “Patent Regime Shift and Firm Innovation: Evidence from the Second Amendment to China’s Patent Law,” In Academy of Management Proceedings, no. 1, pp. 14174, 2014.

[27] G.B. Wolff and V. Reinthaler, “The Effectiveness of Subsidies Revisited: Accounting for Wage and Employment Effects in Business R&D,” Research Policy, vol.37, no. 8, pp. 1403-1412, 2008.

[28] Y.B. Wu, “The Dual Efficiency Losses in Chinese State-Owned Enterprises,” conomic Research Journal, no.3, pp. 15-27, 2012.

[29] X.C. Yan and G.T. Huang, “Government Subsidies, Enterprise Economic and Innovation Performance, and Overcapacity: An Empirical Research Based on Strategic Emerging Industries,” NanKai Economic Studies, no. 1, pp. 176- 198, 2020.

[30] J.Z. Yan, N.N. Qi and C. Tong, “How Do Government Subsidies and Financial Support Influence Innovation Efficiency,” Soft Science, no. 12, pp. 41-46, 2020.

[31] Z.J. Yan and J.P. Yu, “Government Subsidy and Firm’s Total Factor Productivity: A Comparative Analysis of Emerging Industry and Traditional Manufacturing Industry,” Industrial Economics Research, no. 1, pp. 1- 13, 2017.

[32] G.C. Yang and M. Rui, “The Incentive Effect and Catering Effect of Tax-reducing Policy for High-tech Enterprises,” Economic Research Journal, no.9, pp. 174- 191, 2010.

[33] M.G. Yu, Y.P. Hui and H.B. Pang, “Political Connections, Rent Seeking, and the Fiscal Subsidy Efficiency of Local Governments,” Economic Research Journal, no.3, pp. 65-77, 2010.

[34] J. Zhang, Z.Y. Chen, L.X. Yang and F. Xin, “On Evaluating China’s Innovation Subsidy Policy: Theory and Evidence,” Economic Research Journal, no. 10, pp. 4- 17, 2015.

[35] Z.J. Zhu, X.Y. Song, S.L. Zhang and L.F. Chen, “Industrial Policy, Innovation Behavior and Firm’s Markups: Research on the Policy of Strategic Emerging Industries,” Journal of Financial Research, no. 6, pp. 59-75, 2021.