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Promotion or inhibition of different incubation services? Evidence from government funding of China

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Abstract

Purpose – The purpose of this paper is to investigate the relationship between the characteristics of the incubation industry, government funding, and the intensity of funding for different services. Because the incubation industry has particular characteristics, government funding varies for different services, and its intensity varies with service.

Design/methodology/approach – Government funding is classified as incubation subsidy and incubation incentive. Besides, incubation services include property management, business mentoring as well as investment and financing. Based on this, this study examines the influence mechanism of different subsidy and incentive on incubation services by using the generalized propensity score matching method.

Findings – The empirical results show that subsidy and incentive have an inverse-U shape effect on property management service, but a linear effect on business guidance service. Furthermore, subsidy does not affect investment and financing service, but incentive that can have a significant impact.

Originality/value – The theme of government funding and incubator services plays an important role in helping entrepreneurs expand their businesses. Incubation subsidy and incentive can provide important support to help enterprises obtain more preferential loans, technical services and technical support in the incubator. Applying it to incubator services can provide better technology and entrepreneurship guidance. These services can help new entrepreneurs understand products and markets, and how to develop more successfully in the early stage. In short, incubators supported by government funds can provide important support to entrepreneurs to help them successfully realize their business plans.

Keywords Government funding, Incubation services,
The generalized propensity score matching method

Paper type Research paper

1. Introduction

Since the 21st century, innovation in science and technology has characterized a period of intense activity (Popkova *et al.*, 2019). In recent decades, the global economy has been

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undergoing a new round of industrial revolution. A series of practices have shown that scientific and technological innovation has become one of the main battlefields of national strategic games, as well as an invaluable way for countries to gain a competitive edge in worldwide competition. From the USA leading the chip industry by its founding position to China leading the 5G era by its leading position in the chip field (Johnson, 2019). Start-ups can reduce costs and risks by using technology business incubators to access physical space, infrastructure and incubation services (Sullivan *et al.*, 2021). Furthermore, the incubator plays an instrumental role in strengthening innovation strategies (Kruger and Steyn, 2020). As a result, incubator staff should be scientifically and technologically sensitive and capable of identifying and discovering new trends, as well as providing entrepreneurial guidance services to help incubated enterprises grasp the market direction, so as to foster an innovation ecosystem (Dee *et al.*, 2019). Batavia, the world's first incubator, was founded by Joseph Mancuso in 1959 in New York, then started to expand internationally (Kilcrease, 2012). Incubators are largely quasi-public welfare institutions, and government funding has become one of the most significant methods of promoting their development (Clayton *et al.*, 2018). Subsidy and incentive are the main modes of implementation of the policy (Lalkaka and Abetti, 1999). Many incubators receive subsidies based on total expenditures in a certain proportion, which reduces costs and fosters incubation activity (Phillips, 2002). On the other hand, incentives are funds that are freely allocated by the government to incubators based on their results to stimulate their performance (Tseng *et al.*, 2020). Thus, government funding with driver attributes can effectively enhance the incubator's service efficiency, thereby speeding up the construction of a globally influential science and technology innovation center (Hausman and Johnston, 2014).

The first science and technology business incubator in China was established in Wuhan, Hubei Province, in 1987 (Jamil *et al.*, 2016). With more than 30 years of development, incubators have evolved into a major force in cultivating small- and medium-sized technology-based businesses, transforming scientific and technological achievements, and fostering entrepreneurship, contributing significantly to the development of the economy and society (Hong *et al.*, 2019). As a consequence, the incubator industry contributes greatly to China's vision of becoming a technologically advanced country. Government funding is one of the most vital policies driving the development of incubators, which is supported by various national and regional policies (Chandra *et al.*, 2007). Besides, China is in a period of economic transition, and supporting industry development through government-led policies is one of the tools it uses to support industrial development. It is therefore essential to judge the government's driving effectiveness for incubation services to optimize its financial support (Jian *et al.*, 2021). From 2016 to 2018, the accumulated subsidies of the 10 incubators listed on the New Third Board exceeded 10 million, and four incubators exceeded 15 million, accounting for more than 50% of the net profits (Jolly, 2022). Nevertheless, the large number of subsidies has induced incubators to engage in inappropriate behavior, such as excessive investment and rent-seeking, which caused not only unreasonable resource allocation, but also a structural imbalance of government funding (Van Rijnsoever and Eveleens, 2021). Therefore, we raise the following research question:

RQ1. To what extent can the government provide incubator services?

The study finds that there are some differences in the driving effectiveness of government funding at the incubator level (Djordjevic and Mihic, 2022). Although the funds provided by the government have certain universality, different regions distinguish according to the operating years, profitability, the use of sites for incubators, the number of enterprises and the cumulative number of graduated enterprises. In addition, the main research object of government funding is incubators, and the main purpose is to meet the growing needs of

technology enterprises and gather various resources (Dee *et al.*, 2019). The government has not only set up employment subsidies, incubator tutor subsidies and technical service subsidies, but also provided incubation incentives based on performance (Abetti, 2004; Adhana, 2020). From the perspective of policy evaluation, it is necessary to check whether incubation subsidy and incentive have effectively improved the incubation service. Examine whether incubation subsidy and incentive have improved different types of incubation services, which is not only related to government support, but also related to the intensity of obtaining incubation subsidy and incentive (Wonglimpiyarat, 2016). Therefore, we use incubation intensity to estimate the improvement effect of incubation services.

The current research focuses on the effect of fiscal and tax policies on start-up innovation (Qi *et al.*, 2020; Liu and Bai, 2021; Jiang *et al.*, 2022). There has been only limited research into how fiscal and tax policies affect incubator performance, which makes it difficult for the government and society to evaluate the real effect of incubator support policies, as well as hindering the adjustment and improvement of incubator support policies (Wonglimpiyarat, 2016). Therefore, to supplement and compensate for the lack of incubator research, we use the generalized propensity score (GPS) matching method to classify government funding into subsidy and incentive. There are two main research contributions in this paper. First, this study focuses on the analysis of incubation subsidy and incentive intensity, which is well aligned with current policy orientations, making the study more practical. Because the objects and methods of incubation subsidy and incentive are different, the effects are different. Second, because the traditional propensity score matching method can only identify the impact of whether there are incubation subsidy or incubation incentive on incubation services, we use the GPS matching method for empirical tests, which can better assess the processing effect of continuous variables, thereby making our study more theoretically valuable (Kluve *et al.*, 2012).

The remainder of the paper is arranged as follows. A literature review is presented in Section 2. Section 3 outlines the hypotheses. The data and method are described in Section 4. The empirical results are illustrated in Section 5. In Section 6, the findings and suggestions are summarized and supported.

2. Literature review

Researchers have examined incubators from a service perspective (Imanberdiev *et al.*, 2018; Good *et al.*, 2019; Shokeir and Alsukaity, 2019; Stephens and Lyons, 2022). Lai and Lin (2015) argue that business incubators can help start-ups with office facilities and basic consulting services, as well as provide tenants with advanced services such as developing business plans, executing strategies and institutionalizing organizations (Chandra and Medrano Silva, 2012). Alishiri *et al.* (2018) point out that technology parks play an important role in accelerating the process of turning ideas into actual products. Firdaus *et al.* (2019) find that incubators serve start-ups by building network services and improving the quality of information dissemination. Van der Spuy (2019) proves that business incubators can maximize the success of graduate entrepreneurs and sustainable start-ups by providing a full range of services (Murray, 2019; Halim, 2020). Gerdsri *et al.* (2021) believe that business incubators can provide a supportive, facilitating and nurturing environment for start-ups (Amelia *et al.*, 2021). In an open innovation environment, the services provided by incubators are a dynamic process (Fernández *et al.*, 2015; Öberg *et al.*, 2020) and different incubators develop different strategies (Tang *et al.*, 2021; Qi and Taoyong, 2022). In addition, Nicholls-Nixon and Valliere (2021) explain how the entrepreneurial logic used by incubators affects the incubation process and performance. Woolley and MacGregor (2021) explore the role of incubators in influencing the success of nanotechnology start-

ups as an example (Machado *et al.*, 2018). In the background of information technology, Hermanto and Kusnanto (2019) build an innovative service system for social entrepreneurship business incubators by integrating a library of information technology infrastructure as a support tool for managing business incubators. In addition, Woolley and MacGregor (2021) explore improvements in business incubator services through thousands of technology-based start-ups (Hewitt and Van Rensburg, 2020).

While studies on government-driven effects and incubation services have been conducted by several scholars from different perspectives. Dvouletý *et al.* (2018) argue that policymakers should have stricter control over the funding input and effectiveness of incubators. Tomczyk and Spychalska-Wojtkiewicz (2018) find the synergies of entrepreneurial ecosystems with the involvement of local authorities. Sultana and Gupta (2020) propose a conceptual model for assessing the quality of business incubator services, which is supported by government funding for supportive policies, thus helping to enrich the evolving paradigm of entrepreneurial ecosystems. Beckett and Dalrymple (2020) consider incubators as service entities that can take different forms and analyze the impact on the development of start-ups from the perspective of ecosystem participants. Ahmed *et al.* (2020) point out that government funding can help incubators to assist incubates in terms of networking services and training services. Van Rijnsoever (2020) argues that policymakers shape an entrepreneurial ecosystem that promotes technology entrepreneurship by providing funding. Anwar *et al.* (2022) believe that in the digital background, business incubator services should be activated together with the government as a stakeholder. Jing (2022) finds that the incubator industry model has evolved from government-led to integrated government participation and further validates the positive impact of market orientation and government subsidy on incubator services.

3. Hypotheses development

The endogenous growth theory argues that economic growth is endogenous and depends on the accumulation of human capital and knowledge (Romer, 1986). There are three mechanisms through which incubator subsidy and incubator incentive are used to improve incubation services. Specifically, these incubation services can be classified as property management, business mentoring and investment and financing services.

For property management service, government funding provides a resource attribute, i.e. government funding can be used as the source of income for incubators. The government funding program not only reduces the cost of incubators, but also improves incubator performance indirectly. Supporting incubators would encourage them to provide basic services and thus gain short-term benefits (Khorsheed *et al.*, 2014). In addition, government support has a spillover effect on business mentoring service. Through special subsidy and incentive, private meetings, seminars and lectures organized by the incubator can not only guide the incubatees, but also offer market channels, information and even financing, thus indirectly improving the incubation services (Wang *et al.*, 2020). For investment and financing service, government funding has a halo effect. By increasing policy support for incubators, external universities, technology transformation institutions and venture capital corporations can participate more effectively (Pauwels *et al.*, 2016). Through these three mechanisms, incubators can receive subsidy and incentive to invest more in incubation, leading to better incubation services.

According to rent-seeking theory, incubator rent-seeking behavior [1] can negatively impact incubator services (Chen and Ku, 2016). For a higher level of government funding, incubators can use market information resources and adjust property management service based on their preferences, decreasing the efficiency of incubation (Tang *et al.*, 2014). In addition, incubators try to bribe government officials, which constrains external investment

and financing (Dimant and Schulte, 2016). Therefore, incubators' rent-seeking behavior would adversely affect the enhancement of investment and financing services. The following hypotheses are proposed based on the discussion above:

H1a. The relationship between incubation subsidy and property management service shows an inverse-U shape as the incubation fund increases.

H1b. There is a positive relationship between incubation subsidy and business mentoring service.

H1c. With the increase of incubation funds, there is an inverse-U shape relationship between incubation subsidy and investment and financing service.

H2a. With the increase in incubation funds, the relationship between incubation incentives and property management service shows an inverse-U shape.

H2b. There is a positive relationship between incubation incentives and business mentoring service.

H2c. With the increase of incubation funds, there is an inverse-U shape relationship between incubation incentives and investment and financing service.

4. Data and method

4.1 Sample selection and data sources

We use data from 2018 and 2019. Due to the scattered nature of incubators, data is gathered from the National Bureau of Statistics, the China Torch Statistical Yearbook and incubator associations throughout the province. We chose 2,681 incubators with complete data in 2018, which received both subsidy and incentive in that year, accounting for 15.81% of the total. Moreover, incubators with subsidies and incentives below the 1% quantile or higher than the 99% quantile are excluded from the sample, resulting in 2,321 incubators in the research sample, with average subsidy and incentive rates of 4.19% and 3.12%, respectively. Furthermore, the GPS matching method eliminates sample selectivity bias.

4.2 Variable description and measurement

We use incubator services as an explanatory variable. As of December 2018, the Chinese Ministry of Science and Technology published revised measures for the management of science and technology business incubators, which focused on the growing needs of science and technology enterprises by gathering a variety of factor resources, to promote innovation and entrepreneurship in science and technology (Xiong and Li, 2022). Specifically, this paper focuses on the incubation services of nonrental property services, which mainly include three aspects: property management service, business mentoring service and investment and financing service. Incubation services are represented according to its human, material and financial resources, the number of management staff with bachelor's degrees or above in the incubator (Rice, 2002; Meru and Struwig, 2011), the number of private meetings, seminars and lectures organized by the incubator (Sá and Lee, 2012; Cohen, 2013; Battistella *et al.*, 2018) and the total incubation funding (Evans, 2010; Xiao and North, 2017), which covers the incubator's main services.

The two main explanatory variables are subsidy and incentive of government funding. The amount of government funding varies between incubators based on the intensity of subsidy and incentive (Block *et al.*, 2018). The subsidy intensity is calculated by dividing the number of government subsidies by the income of the incubator. In addition, the incentive

intensity is determined by dividing the amount of government incentives by the income of the incubator. In addition, we introduce the nature of the incubator, the age of the incubator, the incubation space, the scale of incubation and the province of incubation. The specific indicators are shown in Table 1.

4.3 Descriptive statistical results

The characteristics of the incubators in Table 2 are listed below. There are 32% of government-led incubators among the sample, with an average age of 6.41 years. Besides, enterprises own RMB 19.221m worth of incubation funds on average, 43% of incubators invest in incubated companies and 64% introduce venture capital. The incubator has organized more private meetings, seminars and lectures in 2019 than in 2018, but the number of management staff with a bachelor's or higher degree is lower. As a result, incubators are more efficient in operations and using government funding more effectively.

To gain a preliminary understanding of the selectivity of the sample of government funding, the paper is divided into four intervals based on the subsidies and incentives received by incubators at the 25%, 50% and 75% quartiles. Among them, the incubation subsidy intensity can be classified as (0,0.023), (0.023,0.327), (0.327,0.511) and (0.511,1). Meanwhile, incubation incentive strength is divided into four intervals of (0,0.211), (0.211,0.492), (0.492,0.686) and (0.686,1). Furthermore, it can be seen that incubators with smaller incubator sizes as well as larger incubation spaces have a higher probability of receiving subsidies, and incubators with larger incubation sizes receive higher incubation

Category	Variable	Symbol	Explanation
Result variables	Property Management Service	Pro2019	Number of management staff with bachelor's degree or above in the incubator, processed as logarithm
	Business Mentoring Service	Ent2019	The number of private meetings, seminars and lectures organized by the incubator is processed as a logarithm
	Investment and Financing Service	Inv2019	Total incubation fund
Processing variables	Subsidy Intensity	subsidy	Amount of government subsidies received at all levels/incubator operating income for the year
	Incentive Intensity	incentive	Amount of incentives received from governments at all levels/ incubator's business revenue for the year
Control variables	Incubator Nature	gov	Whether it is a national incubator, 0–1 variable
	Incubator Age	year	Duration of establishment, logarithmically processed
	Incubator Space	space	Total incubation area, logarithmically processed
	Incubator Scale	scale	Number of incubations, logarithmic processing
	Province	prov	Whether located in a first-tier city, 0–1 variable

Table 1. Variable settings

Table 2.
Variable descriptive statistics

Variable	Mean	SD	Min	Max	(0,0.023)	(0.023,0.327)	(0.327,0.511)	(0.511,1)
subsidy	0.150	0.370	0	1	0.020	0.130	0.510	0.710
incentive	0.120	0.420	0	1	0.010	0.210	0.410	0.690
Pro2019	15.20	29.510	1	712	14.910	15.110	15.160	15.480
Pro2018	14.820	24.620	1	699	14.360	14.260	14.570	14.960
Ent2019	8.920	13.480	0	163	8.210	10.280	11.420	8.770
Ent2018	8.470	13.260	0	141	8.010	8.980	11.100	8.290
Inv2019	1,330	6156	0	89,561	1,210	1,369	1,143	3,854
Inv2018	1,210	5,982	0	87,124	1,131	1,256	1,008	3,389
gov	0.210	0.610	0	1	0.290	0.280	0.260	0.230
year	6.810	7.120	0	59	6.120	6.420	5.670	5.450
space	24,129	69,251	30	190,000	23,952	29,678	21,567	23,721
scale	61.310	71.020	1	3,600	66.210	72.910	62.370	63.480
prov	0.510	0.500	0	1	0.610	0.520	0.580	0.350

incentives. Overall, incubation subsidy and incubation incentive have a more pronounced sample selectivity in implementation.

4.4 Model construction

As compared to the traditional propensity score matching method, thereby, we use the GPS matching method in this paper, which can identify the impact effects of treatment variables with varying strengths (Kluve *et al.*, 2012; Haukoos and Lewis, 2015; Wu *et al.*, 2018), and the fractional-order logit method is used to estimate the impact effects (El-Sayed *et al.*, 2007; Wu and Baleanu, 2014). The steps for the GPS matching method are as follows.

The {0, 1} variable in the GPS matching method is extended to a continuous variable according to the method used by Caliendo and Kopeinig (2008), with government funding f in the range of values.

$$Y(f) \perp F \mid X \tag{1}$$

Let $r(d, x)$ be the conditional probability density equation of f: $r(f, x) = m_{f|x}(f \mid x)$, then the GPS is $\hat{M} = r(F, X)$(Hirano and Imbens, 2004), which represents the probability of F taking values under the condition $f \in \overline{F}$ that the covariates are controlled. Then the independence condition listed in equation (1) can be expressed as follows:

$$g_s\left(f \mid m(f, X), Y(f)\right) = g_s\left(f \mid m(f, X)\right) \tag{2}$$

Equation (2) indicates that the treatment variables are independent of corresponding outcome variables $Y(f)$ when the GPS is controlled. Next, the GPS matching method is performed in three steps.

The first step finds the conditional distribution of the continuous variable S, which is shown in equation (3).

$$E(F_i \mid X_i) = \beta_0 + \beta_1 X_i \tag{3}$$

The GPS of the sample incubation G are computed using great likelihood estimation. Where F_i denotes the biased policy intensity, for the sample greater than 1, the sample is treated

with tail reduction and deletion to make it conform to the fractional-order logit model. The conditional expectation model Y is calculated based on the treatment intensity F and score values M, i.e.

$$E\left(Y_i \mid F_i, \hat{M}_i\right) = \alpha + \beta F_i + \chi F_i^2 + \delta \hat{M}_i + \varphi \hat{M}_i^2 + \gamma F_i \hat{M}_i \tag{4}$$

Where the inclusion of quadratic and interaction terms is selected according to the estimation results. After the estimation of equation (4), the next estimation step can be performed to obtain the dose–response function and causal effect function, where the causal effect function is the marginal effect function of the dose–response function, as shown in equation (5).

$$\begin{aligned} \pi(f) &= E[Y(f)] \\ &= \frac{1}{N}\sum_{i=1}^{N}\left(\hat{\alpha} + \hat{\beta} f + \hat{\chi} f^2 + \hat{\delta} r(d, X_i) + \hat{\varphi} r(d, X_i) + \hat{\gamma} f \times r(d, X_i)\right) \end{aligned} \tag{5}$$

5. Empirical results

5.1 Fractional-order logit regression results

Using the fractional-order logit model, we estimate the selectivity of incubation subsidy and incentive, and the results can be seen in Table 3. As a result of adding the base period incubation service input levels to models (b), (c) and (d), we can produce more robust regression results. These numbers are the number of management staff at the incubator with a bachelor's degree in 2018 (taken as a logarithm), the number of private meetings, seminars and lectures organized by the incubator (taken as a logarithm), as well as the amount of investment and financing.

Table 3 shows that there has a positive effect of property management service with incubation subsidy in 2018 ($\beta = 0.317$, SD = 0.174), which passes the significance test at the 5% level, and the positive impact of this service with incubation incentive (−0.229, SD = 0.213). In addition, the study finds that at the 1% level, business mentoring service is positively correlated with incubation incentive but not significantly correlated with incubation subsidy. Furthermore, there is no significant correlation between investment and financing service. Besides, the evidence proves that whether the incubator is in first-tier cities [2] had a negative effect on whether the incubators received the subsidy. These first-tier cities have a larger base of incubators and more of them do not receive subsidies, thus incubators are stronger and require fewer subsidies. Moreover, incubators in first-tier cities have a positive impact on incentive, and all pass the significance test at the 5% level. In addition, incubator creation time and incubator subsidy are negatively correlated, but positively correlated with incubator incentive, all of which are significantly correlated. This indicates not only that the incubation subsidy protects the weak but that incubators are constantly improving their capacity in the process of continuous development, thereby obtaining more subsidies (Hughes *et al.*, 2007; Akçomak, 2011). In addition, the total area negatively affects the acquisition of the subsidy, but positively affects the incentive. The number of incubators significantly affects incubation subsidy and incentive at the 1% level. Conversely, government-led incubators have a negative relationship with incubation subsidy and incentive without passing the significance test.

Table 3.
Baseline regression analysis table

Variable	Incubation subsidy				Incubation incentive			
	Model a	Model b	Model c	Model d	Model a	Model b	Model c	Model d
gov	−0.041** (0.197)	−0.037** (0.185)	−0.152** (0.211)	−0.059** (0.191)	0.048** (0.177)	0.067*** (0.165)	0.099 (0.183)	0.057** (0.171)
year	−0.032*** (0.198)	−0.098*** (0.181)	−0.048*** (0.201)	−0.076*** (0.174)	0.061*** (0.213)	0.055*** (0.256)	0.062*** (0.191)	0.060*** (0.207)
lnspace	−0.098*** (0.067)	−0.121*** (0.051)	−0.089*** (0.056)	−0.091*** (0.067)	0.061*** (0.096)	0.066*** (0.099)	0.059*** (0.102)	0.057*** (0.084)
lnscale	0.412*** (0.112)	0.455*** (0.137)	0.491*** (0.128)	0.387*** (0.210)	0.715*** (0.241)	0.704*** (0.295)	0.791*** (0.257)	0.754*** (0.256)
prov	−0.412*** (0.158)	−0.528*** (0.161)	−0.388*** (0.179)	−0.507*** (0.174)	−0.531*** (0.181)	−0.514*** (0.163)	−0.482*** (0.175)	−0.477*** (0.168)
lnPro2018		0.317** (0.174)				0.229* (0.213)		
lnEnt2018			0.147 (0.117)				0.122*** (0.135)	
lnInv2018				0.101 (0.097)				0.078 (0.084)
_cons	−2.101*** (0.712)	−2.415*** (0.694)	−1.944*** (0.658)	−1.821*** (0.701)	2.874*** (0.988)	2.914*** (0.814)	2.612*** (0.612)	2.553*** (0.573)

Notes: *Indicates $p < 0.1$; **indicates $p < 0.05$; and ***indicates $p < 0.01$

5.2 Estimation results of equation (4)

After obtaining the GPS matching method values, equation (4) is calculated by taking into account the number of management staff with a bachelor's degree or higher in the incubator in 2019 (lnpro2019), the number of private meetings, seminars and lectures organized by the incubator (lnent2019), as well as the amount of investment and financing (lninv2019), respectively. As shown in Table 4, property management service and business mentoring service are positively correlated with the primary term of incubation subsidy and negatively correlated with the second term of subsidy. Investment and financing service is unrelated to the subsidy. A positive correlation is found between property management service and primary incubation subsidy, while business mentoring service is linearly correlated with it, while investment and financing service does not correlate with incubation subsidy. Following is the GPS matching method.

5.3 Generalized propensity score matching method

Figures 1 and 2 show the dose–response function and the causal effect function of incubation subsidy and incentive intensity with property management service, respectively. The dashed line indicates the 95% confidence interval for the mean dose–response function.

According to Figures 1 and 2, the property management service increases with the increase in incubation subsidy and intensity, showing an overall inverse-U shape relationship, thereby verifying *H1a* and *H2a*. The empirical results indicate that subsidy in the range of (0,0.492) have a positive impact on property management service. If the subsidy is in the range of (0.4921,1), the subsidy and property management service show a negative relationship. Likewise, when the incentive intensity is in the interval of (0,0.645) and (0.645,1), the incentive has both a positive and a negative impact on property management service. Incubators can improve property management service with government funding when the government-driven effect is low, which shows that subsidy and incentive are significant factors. It can be considered for the following reasons. Incubators lack sufficient incentives to invest more costs into incubation activities. Furthermore, excessive manpower investments can lead to more knowledge spillover as well as management redundancy to the detriment of the incubator (Goto and Suzuki, 1989; Kleynhans, 2016). Finally, high subsidy cause incubators to behave inappropriately, such as seeking political patronage and

Variable	lnpro2019	lnent2019	lninv2019
Incubation subsidy			
subsidy	0.971*** (0.415)	1.018*** (0.502)	0.743 (0.314)
gps	1.681*** (0.497)	1.751*** (0.588)	5.423 (1.741)
$subsidy^2$	−1.014*** (0.403)		−0.478 (1.512)
gps^2			−0.618 (3.914)
subsidy*gps			6.122 (9.762)
_cons	3.007*** (0.069)	1.214*** (0.082)	1.411** (0.274)
Incubation incentive			
incentive	1.191*** (0.387)	0.977*** (0.312)	1.013*** (0.378)
gps	1.512*** (0.371)	1.812*** (0.435)	2.287*** (0.512)
$incentive^2$	−1.011*** (0.421)		−0.947*** (0.847)
gps^2			
incentive*gps			
_cons	2.865*** (0.118)	1.167*** (0.486)	1.185** (0.344)

Notes: *indicates $p < 0.1$; **indicates $p < 0.05$; and ***indicates $p < 0.01$

Table 4. Step (4) estimation results

overinvesting in other aspects of incubation (Heath, 2009). In addition, positive incentive has a longer duration than subsidy, suggesting that the impact on property management service is longer-lasting (Hottenrott *et al.*, 2017). Unlike subsidy, the incentive has a wider scope of application because it is a type of discretionary funding.

As shown in Figures 3 and 4, incubation subsidy and incentive intensity are positively correlated with business mentoring service, and incubators invest 1.018 and 0.977 in business mentoring service for each 1% increase in incubation subsidy and incentive intensity, respectively. Thus, *H1b* and *H2b* are confirmed. The main reason is that incubators are far from realizing the extent of business mentoring service, which is evident that the number of private meetings, seminars and lectures organized by incubators does not reach saturation, which indicates that business mentoring service should be further developed. In addition, business mentoring service, a value-added service to incubators, not only solves information asymmetry and boosts market perception, but also increases the social standing of incubation. Therefore, incubators have a greater incentive to invest more of the subsidy and incentive they receive into these services.

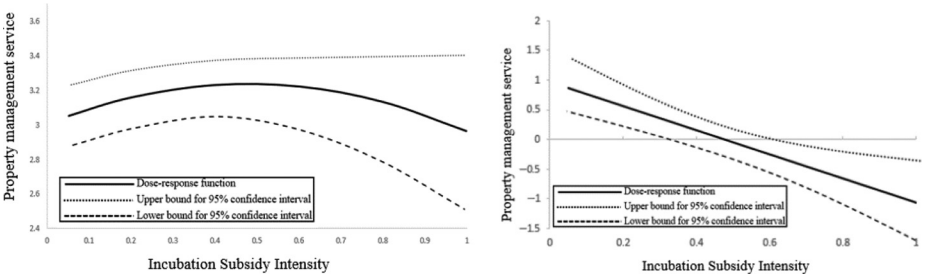

Figure 1.
Dose–response function and causal effect function of subsidy intensity and property management service

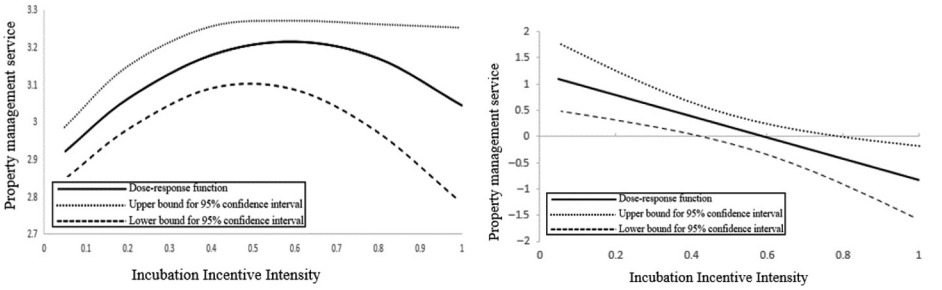

Figure 2.
Dose–response function and causal effect function of incentive intensity and property management service

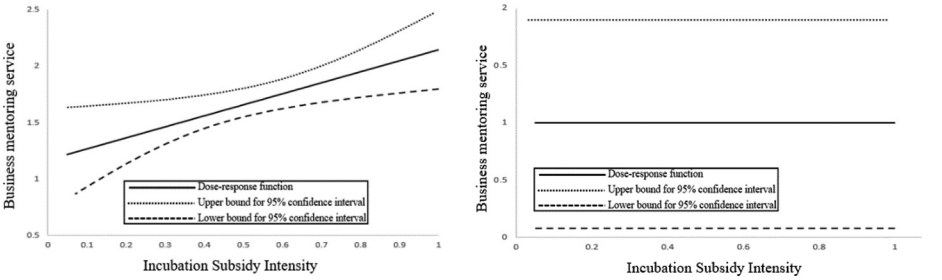

Figure 3.
Dose–response and causal effect function of subsidy intensity and business mentoring service

Table 4 shows that incubation subsidy do not significantly affect investment and financing service, thus *H1c* does not hold. First, incubator subsidy do not have a significant incentive effect to promote investment and financing service in incubators, which are more concerned about providing services needed for start-up growth. In addition, incubation subsidy and incentive have little impact on external investors and investment institutions, who are more concerned with the quality of start-ups. However, Figure 5 shows that incubation incentives have an inverse-U shape relationship with investment and financing service, which confirms *H2c*. Owing to information asymmetry, external investors cannot judge and select high-quality incubators accurately. As a result of government support, an incubator can increase its performance and attract external investment more easily.

Therefore, to deepen the implementation of the national innovation-driven development strategy and promote innovation and entrepreneurship, it is necessary to require both the effectiveness of local subsidies and the enthusiasm for policy implementation (Meng *et al.*, 2022). Due to the special characteristics of the incubation industry, subsidy and incentive levels differ for different incubation services, and subsidy and incentive intensity interact differently with service.

6. Discussion

6.1 Conclusion

We use the GPS matching method to test the effects of different subsidy and incentive on heterogeneous incubation services. When incubation subsidy and incentive intensity are low, they have a positive correlation with property management service, and there is a negative correlation when the policy intensity exceeds the inflection point value, which indicates an inverse-U shape relationship. In addition, incubation subsidy and incentive correlate linearly with business mentoring service, thereby increasing the subsidy and incentive intensity can further encourage incubators to organize private meetings, seminars and lectures. Furthermore,

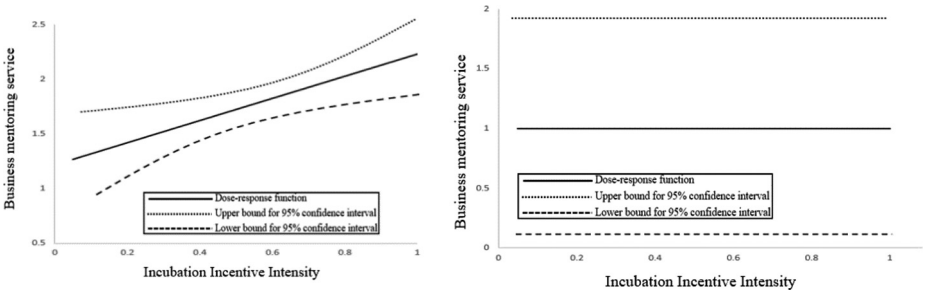

Figure 4.
Dose–response and causal effect function of incentive intensity and business mentoring service

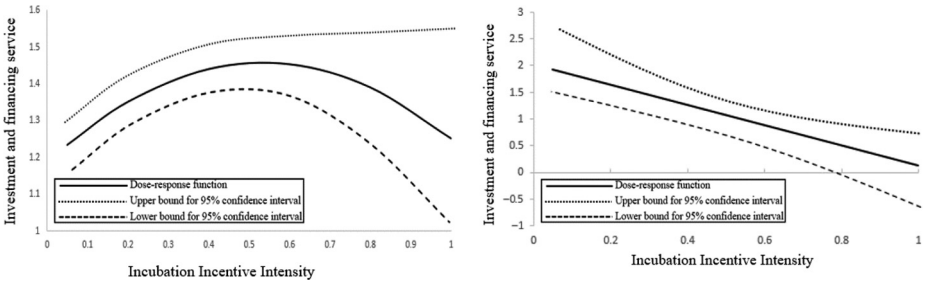

Figure 5.
Dose–response and causal effect function for incentive intensity and investment and financing service

there is no significant correlation between incubator-level government subsidy and investment and financing service, but incubator incentive is based on externalities and have an inverse-U shape relationship with investment and financing service.

6.2 Implication for practice and policy

The empirical results provide references for giving full play to the value of the incubation policy and promoting the efficient development of the incubation industry.

This study shows that only moderate incubation subsidy and incentive can promote the improvement of property management service in incubators, whereas the high intensity of government capital injection weakens the incentive of incubators to improve services. Therefore, the government needs to inject a moderate intensity of funds into the incubator. Specifically, a systematic and scientific assessment of the incubator operation (e.g. profits and development plans) should be conducted before subsidy and incentive is provided to the incubator. Besides, incubation subsidy should be linked to the actual needs to avoid excessive subsidy intensity. In recent years, in the wave of *Mass Innovation and Entrepreneurship*, the government should subsidize incubators to support the development of science and technology industries. These measures have weakened the incentive of incubators to improve services and invest in incubated enterprises to gain income. Instead, these incubators seek higher incentive funds through improper means, weakening the organizational competitiveness of incubators.

When using subsidy and incentive mechanisms, the government should pay attention to whether the invested funds substantially contribute to the improvement of incubation performance. The results show that incubation subsidy and incentive promote more incubator infrastructure, and the financing constraints of start-ups remain unimproved. It is especially important to make full use of the macroeconomic regulation, resource allocation and market guidance of fiscal policy to stimulate incubators to improve incubation services and promote the healthy development of the incubation industry. In addition, the direction of subsidy and incentive needs to shift from incubator hardware construction to incubation capacity construction, forming a reward and punishment mechanism oriented to incubation output performance, to promote innovation and entrepreneurship and economic growth.

The study concludes that subsidy do not significantly improve incubator investment and financing service. In contrast, a large literature has confirmed the importance of financial subsidies for investment and financing of start-ups. To a certain extent, this suggests that the government can play an active role in guiding the allocation of incubation resources, but such a role needs to be established in line with the market operation mechanism and the objective development law of resource allocation, and the blind use of fiscal tools would lead to waste of resources. Therefore, to solve the problem of difficult financing for start-ups, it is essential to focus on the level of start-ups, which can effectively improve the resource attributes and signaling role of government funding, thus promoting industrial and economic development.

An unchanging incubation fund is not an effective way to improve policy efficiency and recognition, which can lead to blind market behavior. Therefore, the government should conduct multiple studies and evaluations when formulating policies, respect the laws of innovation of science and technology enterprises and implement more precise policy guidance. Furthermore, the government should establish a flexible fault tolerance mechanism to avoid the negative impact of unstable policies on the industry while actively exploring policy tools. Besides, the incubators should establish an open and transparent qualification review mechanism, and explore the open and transparent channel for the public to supervise the incubators receiving government funds which would reduce information asymmetry and also help to form a strict reward and punishment mechanism. In addition, it is important to

improve the postmonitoring mechanism and link the evaluation results to the subsidy and incentive intensity in the next period.

Notes

1. The term rent-seeking refers to the behavior of economic agents seeking government protection or facilitation to obtain excess benefits.
2. There are four first-tier cities in China: Beijing, Shanghai, Guangzhou and Shenzhen.

References

Abetti, P.A. (2004), "Government-supported incubators in the Helsinki region, Finland: infrastructure, results, and best practices", *The Journal of Technology Transfer*, Vol. 29 No. 1, pp. 19-40.

Adhana, D. (2020), "Start-up ecosystem in India: a study with focus on entrepreneurship and university business incubators", available at: SSRN 3702510.

Ahmed, N., Li, C., Qalati, S., Khan, A. and Siddiqui, F. (2020), "Role of business incubators as a service provider in entrepreneurship development", *Journal of Entrepreneurship and Organization Management*, Vol. 9 No. 1, pp. 1-7.

Akçomak, İ.S. (2011), "Incubators as tools for entrepreneurship promotion in developing countries. Entrepreneurship", *Innovation, and Economic Development*, Oxford University, Oxford, pp. 228-264.

Alishiri, M.J., Makvandi, P. and Khamesh, A. (2018), "Identification and ranking the critical success factors of business incubator of science and technology parks–a case study: business incubator of Baqiyatallah University of Medical Sciences", *Journal of Applied Biotechnology Reports*, Vol. 5 No. 1, pp. 64-69.

Amelia, T.N., Thoyib, A., Irianto, G. and Rofiq, A. (2021), "Tech start-up incubation program: business model evaluation on government based incubator in Indonesia", *TEM Journal*, Vol. 10 No. 1, pp. 283-291.

Anwar, M.R., Yusup, M., Millah, S. and Purnama, S. (2022), "The role of business incubators in developing local digital startups in Indonesia", *Startupreneur Business Digital (SABDA Journal)*, Vol. 1 No. 1, pp. 1-10.

Battistella, C., De Toni, A.F. and Pessot, E. (2018), "Framing open innovation in start-ups' incubators: a complexity theory perspective", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 4 No. 3, p. 33.

Beckett, R. and Dalrymple, J. (2020), "A triadic actor view of value co-creation in business incubation", *Technology Innovation Management Review*, Vol. 10 No. 8, pp. 27-37.

Block, J.H., Colombo, M.G., Cumming, D.J. and Vismara, S. (2018), "New players in entrepreneurial finance and why they are there", *Small Business Economics*, Vol. 50 No. 2, pp. 239-250.

Caliendo, M. and Kopeinig, S. (2008), "Some practical guidance for the implementation of propensity score matching", *Journal of Economic Surveys*, Vol. 22 No. 1, pp. 31-72.

Chandra, A. and Medrano Silva, M.A. (2012), "Business incubation in Chile: development, financing and financial services", *Journal of Technology Management and Innovation*, Vol. 7 No. 2, pp. 1-13.

Chandra, A., He, W. and Fealey, T. (2007), "Business incubators in China: a financial services perspective", *Asia Pacific Business Review*, Vol. 13 No. 1, pp. 79-94.

Chen, T.J. and Ku, Y.H. (2016), "Rent seeking and entrepreneurship: internet startups in China", *Cato Journal*, Vol. 36, p. 659.

Clayton, P., Feldman, M. and Lowe, N. (2018), "Behind the scenes: intermediary organizations that facilitate science commercialization through entrepreneurship", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 104-124.

Cohen, S. (2013), "What do accelerators do? Insights from incubators and angels", *Innovations: Technology, Governance, Globalization*, Vol. 8 No. 3/4, pp. 19-25.

Dee, N., Gill, D., Lacher, R., Livesey, F. and Minshall, T. (2019), "A review of research on the role and effectiveness of business incubation for high-growth start-ups", *The Journal of Technology Transfer*, Vol. 44 No. 1, pp. 137-180.

Dimant, E. and Schulte, T. (2016), "The nature of corruption: an interdisciplinary perspective", *German Law Journal*, Vol. 17 No. 1, pp. 53-72.

Djordjevic, A. and Mihic, M. (2022), "Strategic importance and sustainable governance of high-tech business incubators: evidence from Serbia", *International Conference of Experimental and Numerical Investigations and New Technologies*, Springer, Cham, pp. 199-221.

Dvouletý, O., Longo, M.C., Blažková, I., Lukeš, M. and Andera, M. (2018), "Are publicly funded Czech incubators effective? The comparison of performance of supported and non-supported firms", *European Journal of Innovation Management*, Vol. 21 No. 4, pp. 543-563.

El-Sayed, A.M.A., El-Mesiry, A.E.M. and El-Saka, H.A.A. (2007), "On the fractional-order logistic equation", *Applied Mathematics Letters*, Vol. 20 No. 7, pp. 817-823.

Evans, R.B. (2010), "Mutual fund incubation", *The Journal of Finance*, Vol. 65 No. 4, pp. 1581-1611.

Fernández, M.T., Blanco Jiménez, F.J. and Cuadrado Roura, J.R. (2015), "Business incubation: innovative services in an entrepreneurship ecosystem", *The Service Industries Journal*, Vol. 35 No. 14, pp. 783-800.

Firdaus, D., Priambodo, B. and Jumaryadi, Y. (2019), "Implementation of push notification for business incubator", *International Journal of Online and Biomedical Engineering*, Vol. 15 No. 14.

Gerdsri, N., Iewwongcharoen, B., Rajchamaha, K., Manotungvorapun, N., Pongthanaisawan, J. and Witthayaweerasak, W. (2021), "Capability assessment toward sustainable development of business incubators: framework and experience sharing", *Sustainability*, Vol. 13 No. 9, p. 4617.

Good, M., Knockaert, M., Soppe, B. and Wright, M. (2019), "The technology transfer ecosystem in academia. An organizational design perspective", *Technovation*, Vols 82/83, pp. 35-50.

Goto, A. and Suzuki, K. (1989), "R&D capital, rate of return on R&D investment and spillover of R and D in Japanese manufacturing industries", *The Review of Economics and Statistics*, Vol. 71 No. 4, pp. 555-564.

Halim, F. (2020), "Digital-based incubator framework modelling for university", *International Journal of E-Entrepreneurship and Innovation (IJEEI)*, Vol. 10 No. 1, pp. 14-27.

Haukoos, J.S. and Lewis, R.J. (2015), "The propensity score", *JAMA*, Vol. 314 No. 15, pp. 1637-1638.

Hausman, A. and Johnston, W.J. (2014), "The role of innovation in driving the economy: lessons from the global financial crisis", *Journal of Business Research*, Vol. 67 No. 1, pp. 2720-2726.

Heath, J. (2009), "The uses and abuses of agency theory", *Business Ethics Quarterly*, Vol. 19 No. 4, pp. 497-528.

Hermanto, A. and Kusnanto, G. (2019), "Developing sociopreneurship business incubator using ITIL to improve competitiveness advantage", *2019 Fourth International Conference on Informatics and Computing (ICIC)*, IEEE, pp. 1-6.

Hewitt, L.M. and van Rensburg, L.J.J. (2020), "The role of business incubators in creating sustainable small and medium enterprises", *The Southern African Journal of Entrepreneurship and Small Business Management*, Vol. 12 No. 1, p. 9.

Hirano, K. and Imbens, G.W. (2004), "The propensity score with continuous treatments", *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives*, Vol. 226164, pp. 73-84.

Hong, J., Yang, Y., Wang, H., Zhou, Y. and Deng, P. (2019), "Incubator interdependence and incubation performance in China's transition economy: the moderating roles of incubator ownership and strategy", *Technology Analysis and Strategic Management*, Vol. 31 No. 1, pp. 96-110.

Hottenrott, H., Lopes-Bento, C. and Veugelers, R. (2017), "Direct and cross scheme effects in a research and development subsidy program", *Research Policy*, Vol. 46 No. 6, pp. 1118-1132.

Hughes, M., Ireland, R.D. and Morgan, R.E. (2007), "Stimulating dynamic value: social capital and business incubation as a pathway to competitive success", *Long Range Planning*, Vol. 40 No. 2, pp. 154-177.

Imanberdiev, B., Cherep, A., Cherep, O. and Mostenska, T. (2018), "Peculiar features of business incubators functioning: Ukrainian and world experience", *Ukrainian Food Journal*, Vol. 7 No. 2, pp. 324-336.

Jamil, F., Ismail, K., Siddique, M., Khan, M.M., Kazi, A.G. and Qureshi, M.I. (2016), "Business incubators in Asian developing countries", *International Review of Management and Marketing*, Vol. 6 No. 4, pp. 291-295.

Jian, J., Fan, X., Zhao, S. and Zhou, D. (2021), "Business creation, innovation, and economic growth: evidence from China's economic transition, 1978–2017", *Economic Modelling*, Vol. 96, pp. 371-378.

Jiang, Y., Qin, J. and Khan, H. (2022), "The effect of tax-collection mechanism and management on enterprise technological innovation: evidence from China", *Sustainability*, Vol. 14 No. 14, p. 8836.

Jing, Y. (2022), "The relationship between business model innovation and operational performance of incubator enterprise", *International Journal of Science and Business*, Vol. 16 No. 1, pp. 153-191.

Johnson, J. (2019), "Artificial intelligence and future warfare: implications for international security", *Defense and Security Analysis*, Vol. 35 No. 2, pp. 147-169.

Jolly, D. (2022), "The Chinese national system of innovation", *The New Threat*, Palgrave Macmillan, Cham, pp. 29-57.

Khorsheed, M.S., Al-Fawzan, M.A. and Al-Hargan, A. (2014), "Promoting techno-entrepreneurship through incubation: an overview at BADIR program for technology incubators", *Innovation*, Vol. 16 No. 2, pp. 238-249.

Kilcrease, K. (2012), "The Batavia industrial center: the hatching of the world's first business incubator", *New York History*, Vol. 93 No. 1, pp. 71-93.

Kleynhans, E.P. (2016), "Factors determining industrial competitiveness and the role of spillovers", *Journal of Applied Business Research (JABR)*, Vol. 32 No. 2, pp. 527-540.

Kluve, J., Schneider, H., Uhlendorff, A. and Zhao, Z. (2012), "Evaluating continuous training programmes by using the generalized propensity score", *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, Vol. 175 No. 2, pp. 587-617.

Kruger, S. and Steyn, A.A. (2020), "Enhancing technology transfer through entrepreneurial development: practices from innovation spaces", *The Journal of Technology Transfer*, Vol. 45 No. 6, pp. 1655-1689.

Lai, W.H. and Lin, C.C. (2015), "Constructing business incubation service capabilities for tenants at post-entrepreneurial phase", *Journal of Business Research*, Vol. 68 No. 11, pp. 2285-2289.

Lalkaka, R. and Abetti, P. (1999), "Business incubation and enterprise support systems in restructuring countries", *Creativity and Innovation Management*, Vol. 8 No. 3, pp. 197-209.

Liu, W. and Bai, Y. (2021), "An analysis on the influence of R&D fiscal and tax subsidies on regional innovation efficiency: empirical evidence from China", *Sustainability*, Vol. 13 No. 22, p. 12707.

Machado, P.R.S., Treptow, I.C., Oliveira Roveder, M.D., Bichueti, R.S. and Zampieri, N. (2018), "The role of a business incubator in supporting the needs of innovative business", *International Conference on Innovation, Engineering and Entrepreneurship*, Springer, Cham, pp. 1031-1035.

Meng, S., Gao, X. and Duan, L. (2022), "Facing the COVID-19 pandemic and developing a sustainable entrepreneurial ecosystem: the theory and practice of innovation and entrepreneurship policies in China", *International Journal of Environmental Research and Public Health*, Vol. 19 No. 14, pp. 8797.

Meru, A.K. and Struwig, M. (2011), "An evaluation of the entrepreneurs' perception of business-incubation services in Kenya", *International Journal of Business Administration*, Vol. 2 No. 4, p. 112.

Murray, A. (2019), "Supporting academic entrepreneurship: a blueprint for a university based business incubator", *Journal of Higher Education Service Science and Management*, Vol. 2 No. 2, pp. 1-9.

Nicholls-Nixon, C.L. and Valliere, D. (2021), "Entrepreneurial logic and fit: a cross-level model of incubator performance", *International Journal of Entrepreneurial Behavior and Research*, Vol. 27 No. 7, pp. 1696-1723.

Öberg, C., Klinton, M. and Stockhult, H. (2020), "Inside the incubator–business relationship creations among incubated firms", *Journal of Business and Industrial Marketing*, Vol. 35 No. 11, pp. 1767-1784.

Pauwels, C., Clarysse, B., Wright, M. and Van Hove, J. (2016), "Understanding a new generation incubation model: the accelerator", *Technovation*, Vols 50/51, pp. 13-24.

Phillips, R.G. (2002), "Technology business incubators: how effective as technology transfer mechanisms?", *Technology in Society*, Vol. 24 No. 3, pp. 299-316.

Popkova, E.G., Ragulina, Y.V. and Bogoviz, A.V. (Eds) (2019), *Industry 4.0: Industrial Revolution of the 21st Century*, Vol. 169, Springer, New York, NY, p. 249.

Qi, L. and Taoyong, S. (2022), "Impact of incubator knowledge services on innovation incubation performance", *Science Research Management*, Vol. 43 No. 1, p. 98.

Qi, Y., Peng, W. and Xiong, N.N. (2020), "The effects of fiscal and tax incentives on regional innovation capability: text extraction based on python", *Mathematics*, Vol. 8 No. 7, p. 1193.

Rice, M.P. (2002), "Co-production of business assistance in business incubators: an exploratory study", *Journal of Business Venturing*, Vol. 17 No. 2, pp. 163-187.

Romer, P.M. (1986), "Increasing returns and long-run growth", *Journal of Political Economy*, Vol. 94 No. 5, pp. 1002-1037.

Sá, C. and Lee, H. (2012), "Science, business, and innovation: understanding networks in technology-based incubators", *R&D Management*, Vol. 42 No. 3, pp. 243-253.

Shokeir, I.F. and Alsukaity, A.S. (2019), "The role of business incubators in supporting small and medium enterprises in Saudi Arabia-with reference to some international and arb experiences", *The Business and Management Review*, Vol. 10 No. 2, pp. 192-203.

Stephens, S. and Lyons, R.M. (2022), "The changing activities of business incubation clients: an Irish case study", *Journal of Science and Technology Policy Management*.

Sullivan, D.M., Marvel, M.R. and Wolfe, M.T. (2021), "With a little help from my friends? How learning activities and network ties impact performance for high tech startups in incubators", *Technovation*, Vol. 101, p. 102209.

Sultana, N. and Gupta, N. (2020), "Service quality: business incubation and supportive policy intervention", *SCMS Journal of Indian Management*, Vol. 17 No. 4, pp. 30-37.

Tang, M.F., Lee, J., Liu, K. and Lu, Y. (2014), "Assessing government-supported technology-based business incubators: evidence from China", *International Journal of Technology Management*, Vol. 65 Nos 1/2/3/4, pp. 24-48.

Tang, M., Walsh, G.S., Li, C. and Baskaran, A. (2021), "Exploring technology business incubators and their business incubation models: case studies from China", *The Journal of Technology Transfer*, Vol. 46 No. 1, pp. 90-116.

Tomczyk, M. and Spychalska-Wojtkiewicz, M. (2018), "Boosting innovative entrepreneurial ecosystem in regions for young entrepreneurs–regional perspective of entrepreneurship", *European Journal of Service Management*, Vol. 27, pp. 499-504.

Tseng, F.C., Huang, M.H. and Chen, D.Z. (2020), "Factors of university–industry collaboration affecting university innovation performance", *The Journal of Technology Transfer*, Vol. 45 No. 2, pp. 560-577.

Van der Spuy, S.J. (2019), "The state of business incubation in the Northern Cape: a service spectrum perspective", *The Southern African Journal of Entrepreneurship and Small Business Management*, Vol. 11 No. 1, pp. 1-16.

Van Rijnsoever, F.J. (2020), "Meeting, mating, and intermediating: how incubators can overcome weak network problems in entrepreneurial ecosystems", *Research Policy*, Vol. 49 No. 1, p. 103884.

Van Rijnsoever, F.J. and Eveleens, C.P. (2021), "Money don't matter? How incubation experience affects start-up entrepreneurs' resource valuation", *Technovation*, Vol. 106, p. 102294.

Wang, Z., He, Q., Xia, S., Sarpong, D., Xiong, A. and Maas, G. (2020), "Capacities of business incubator and regional innovation performance", *Technological Forecasting and Social Change*, Vol. 158, p. 120125.

Wonglimpiyarat, J. (2016), "The innovation incubator, university business incubator and technology transfer strategy: the case of Thailand", *Technology in Society*, Vol. 46, pp. 18-27.

Woolley, J.L. and MacGregor, N. (2021), "The influence of incubator and accelerator participation on nanotechnology venture success", *Entrepreneurship Theory and Practice*, Vol. 46 No. 6, pp. 1717-1755.

Wu, G.C. and Baleanu, D. (2014), "Chaos synchronization of the discrete fractional logistic map", *Signal Processing*, Vol. 102, pp. 96-99.

Wu, X., Mealli, F., Kioumourtzoglou, M.A., Dominici, F. and Braun, D. (2018), "Matching on generalized propensity scores with continuous exposures", arXiv preprint arXiv:1812.06575.

Xiao, L. and North, D. (2017), "The graduation performance of technology business incubators in China's three tier cities: the role of incubator funding, technical support, and entrepreneurial mentoring", *The Journal of Technology Transfer*, Vol. 42 No. 3, pp. 615-634.

Xiong, Y. and Li, S. (2022), "Can the establishment of university science and technology parks promote urban innovation? Evidence from China", *Sustainability*, Vol. 14 No. 17, p. 10707.

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