R&D MANAGEMENT

How "Belt and Road" Initiative Implementation Has Influenced R&D Outcomes of Chinese Enterprises: Asset-exploitation or Knowledge Transfer?

Journal:	*R&D Management*
Manuscript ID	SI-4978.R1
Wiley - Manuscript type:	Special Issue Paper
Topic:	Research and Development < New Product Development, International Management < Strategy and Management
Theory:	
Methodology:	
Industry:	Manufacturing
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ACKNOWLEDGEMENTS

This work was supported by the National Natural Science Foundation of China (Grant Numbers 71532013, 71871210, 71850014 and 71972174). The authors would also like to acknowledge the gracious hospitality of the Stanford University Center for Sustainable Development and Global Competitiveness during their stay at Stanford University. M. Lepech would like to acknowledge support from the Thomas V. Jones Engineering Faculty scholarship at Stanford University.

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ABSTRACT

As an Outward Foreign Direct Investment (OFDI) promotion policy which aims to transform and upgrade Chinese firms, the “Belt and Road” (B&R) Initiative has been widely discussed with regard to its influence on R&D activities. Many studies have associated this topic with the relationship between OFDI and R&D activities, however, the difference between the OFDI promotion policy and the OFDI has been neglected, resulting in little understanding of the effects of B&R implementation on R&D activities related to established OFDIs. By analyzing how the implementation of B&R affects asset-exploitation and knowledge transfer, this paper provides a new perspective to help understand if and how Chinese firms that have affiliates in B&R countries gain positive R&D outcomes from such a policy. This study examines a sample of Chinese-listed manufacturing firms from 2013 to 2017. Propensity Score Matching is used to construct a counterfactual framework and control for confounding problems from new OFDI entries. Difference-in-Differences is used to infer the policy effect of B&R implementation on R&D outcome of Chinese firms that have affiliates in B&R countries. Results show a continuously positive effect on R&D outcomes mediated by the increase in R&D expenditure, along with a directly weak-positive effect on R&D outcomes in the short-run. The continuously positive effect may be viewed as a result of an improvement in asset-exploitation, while the directly weak-positive effect is more a result of an increase in knowledge transfer, leaving out technology transfer. Regarding differences among Chinese firms that invest in B&R countries with varying levels of economic development, this study also found no differences between firms that have B&R affiliates in developed versus developing countries. This finding implies that Chinese firms have experienced little or no increase in technology transfer through B&R implementation. Overall, these findings, to some extent, illustrate Chinese firms’ behavior patterns in R&D management related to established OFDIs in light of OFDI promotion policies and help policy makers assess and understand the effects of the B&R implementation more deeply.

Keywords: Belt and Road; R&D activities; knowledge transfer; asset-exploitation; policy effect

1. INTRODUCTION

The "*Belt and Road*" (B&R)[1] Initiative is a large-scale, outward-facing strategy announced by President Xi Jinping in 2013, initially implemented in 2015, and has since aroused worldwide attention (e.g., Djankov and Miner, 2016). Through the B&R Initiative, the Chinese government looks to address challenges of industrial upgrading and sustainable economic growth (Cheng, 2016), while the United Nations Educational, Scientific and Cultural Organization (UNESCO) looks to the B&R Initiative as a platform for international collaboration in science and technology. Given this intent, R&D activities, as an important foundation of innovation and economic growth, have often been discussed as a primary facet of B&R implementation.

With regard to the implications of an OFDI promotion policy like B&R Initiative for R&D activities, a plethora of research has been published in the literature focusing on the relationship between OFDI and R&D activity because such a policy can often motivate OFDI entries (Florida, 1997; Iammarino and McCann, 2013). Within this literature, transnational *knowledge diffusion* has been widely viewed as a process that transfers knowledge from innovation-leading to technology-following countries (e.g., Tanaka et al., 2007; Urban et al., 2015). With this rationale, some scholars believe that OFDI promotion policies initiated by technology-following countries can improve R&D activities of their firms by motivating investment in developed countries. Evidence from China`s "*Go Global*" strategy also support this viewpoint (e.g., Luo and Tung, 2007; Li et al., 2012; Piperopoulos et al., 2018). While such a rationale is plausible, questions remain because the OFDI promotion policy is different to the actual OFDI. In addition to boosting new OFDI entries, an OFDI promotion policy may influence R&D activities related to established OFDIs through other channels. Moreover, the type of knowledge diffusion mentioned above may have weak explanatory power when an OFDI promotion policy pays little attention to innovation-leading countries. Although the policy effect has been mentioned in literature with respect to a general analysis of the content of the B&R Initiative (Liu et al., 2019), these questions remain to be examined at the firm level using empirical evidence. Consequently, to fully study the influence of the implementation of B&R Initiative to R&D activities related to established OFDIs, an important question arises: for Chinese firms that have established affiliates in B&R countries, does B&R implementation cause any change to their R&D outcomes[2]?

To address this question, R&D activities related to established OFDIs that may influence R&D outcomes

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[1] This policy is also called "New Silk Road" or "One Belt One Road" in some literature. "Belt and Road" is the formal name offered by the Chinese government.

[2] In this paper, unless noted, R&D outcomes and R&D investments are measured at the whole-firm level. At the same time, the term "B&R implementation" denotes the issuing of the "Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road" at the beginning of 2015, which distinguishes the implementation of B&R Initiative from the initial public announcement of the initiative in 2013.

must first be summarized. Along with two common types of OFDIs, *asset-exploitation* and *asset-seeking*, a well-known proposition is that firms could make a difference to their R&D outcomes by investing in exploitation of their own technological advantages to accommodate to host countries, or acquiring technology and other knowledge directly through *knowledge transfer* (Stopford and Wells, 1972; Saggi, 1999; Fagerberg et al., 2005; Kotabe et al., 2007). Following this logic, an OFDI promotion policy could lead to changes in R&D outcomes by influencing these two types of R&D activities related to established OFDIs. However, such a proposition is too ambiguous to be identified and intervened. To evaluate the policy effect statistically, and to understand the underlying mechanism more deeply, another question must be asked with respect to the specific policy: for the B&R implementation, does its policy effect on R&D outcomes of Chinese firms that have established affiliates in B&R countries only observed through an improvement of *asset-exploitation*, or is it also observed in an increase in *knowledge transfer*? Furthermore, unlike OFDI promotion policies initiated with definite motivations and target destinations such as the "Go Global" strategy (Jia, 2017), the B&R Initiative is unique because it only focuses on geographical location and does not target countries with other specific characteristics. As seen in **Figure 1**[3], firms having affiliates both in developed and developing countries are covered by the B&R Initiative. As the above mentioned R&D activities along with established OFDIs in developing and developed countries are usually regarded to be different, it is reasonable to further ask whether, as an OFDI promotion policy with a general-purpose, does B&R implementation influence R&D activities differently among firms having affiliates in developed countries versus developing countries?

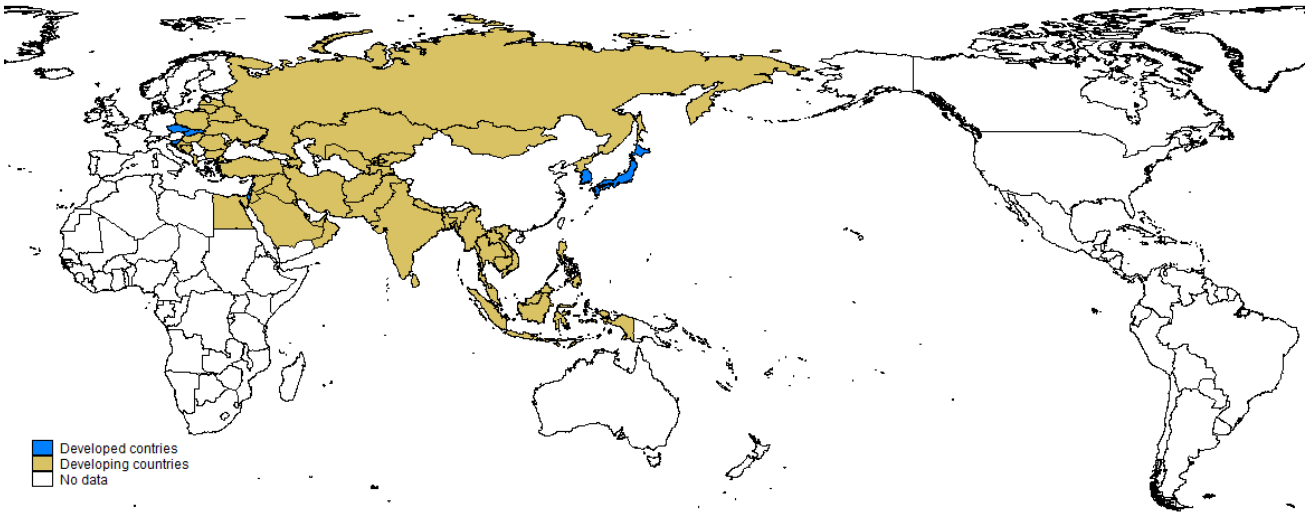

Figure 1. Locations of Chinese listed enterprises' Outward Foreign Direct Investments in Belt & Road Initiative (nominal, 2017)

[3] Although Japan is not formally a part of the B&R Initiative, it is considered to be a B&R country in this study. Under the "Third-party Market Cooperation" framework, Japan has played an important role in the B&R Initiative and China Central Television has offered guidance on investing in Japan as part of the B&R Initiative. This is in overall accord with the ancient Silk Road and the database employed in this study.

According to the above research questions, a theoretical framework is proposed for the mechanism by which B&R implementation affects the R&D outcome of Chinese firms having affiliates in B&R countries (**Figure 2)**. With reference to extant theory, the following hypotheses are proposed. For firms having affiliates in B&R countries, B&R implementation may have positive effect on their R&D outcome in general. Such an influence, on the one hand, might be mediated by an increase in R&D expenditure, which is driven by promotion in asset-exploitation along with established OFDIs (*H1*). Conversely, such an influence may also be a direct effect, which is a result of improvement in knowledge transfer related to established OFDIs (*H2*). Finally, there may be a difference of such influence among firms having affiliates in developed countries and only in developing countries, primarily because of the conflict between former theory and policy practice (*H3a* and *H3b*). The Propensity Score Matching - Difference-In-Differences (PSM-DID) method is used to identify the policy effect rigorously and test these hypotheses. By constructing a counterfactual framework based on the sample of Chinese listed firms in the manufacturing sector, the approach can identify all paths proposed in **Figure 2**.

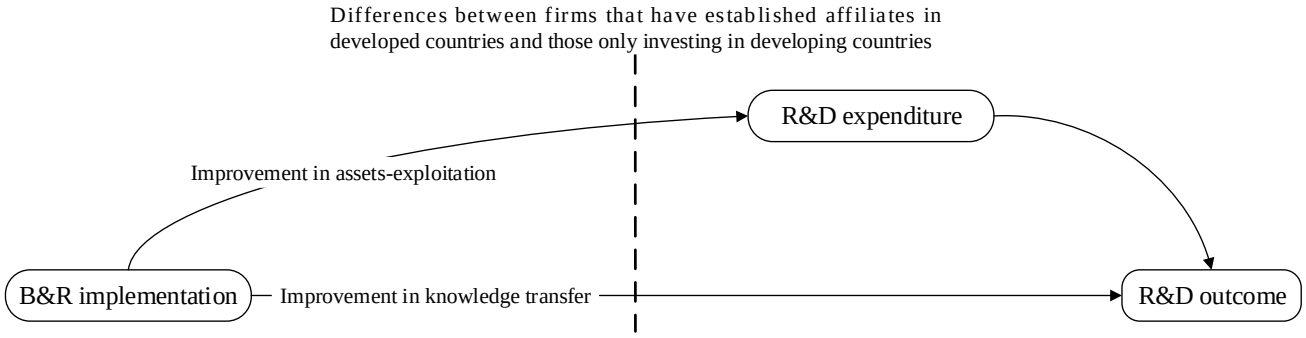

Figure 2. Mechanisms by which Belt & Road implementation affects the R&D outcome of Chinese firms having established affiliates in B&R countries

This study contributes to the literature in three ways. First, by employing the casual inference method at the firm level, this study concludes that there is a positive effect of B&R implementation on the R&D outcome of Chinese firms having established affiliates in B&R countries. This result verifies the existence of influence of an OFDI promotion policy on R&D activities besides the motivation of new OFDI entries. Second, this study finds that the above positive effect is mainly caused by an increase in R&D expenditure in addition to a weak direct effect, as a result of B&R implementation. This reveals an explicit understanding of the mechanisms by which B&R implementation influences Chinese firms' R&D outcomes, and also provides a pattern to study the effect of OFDI promotion policies on R&D activities at the firm level. Third, the empirical results indicate that the positive direct effect of B&R implementation on the R&D outcomes is a weak short-term shock with a large deviation, and all the influence paths mentioned above do not show a

significant difference between firms having affiliates in developed countries and those having affiliates only in developing countries. These results shed light on the motivations of Chinese firms' investments in B&R countries. Also, to some extent, such results reveal the nature of knowledge transfer led by B&R implementation, and may relieve, in part, concerns associated the B&R Initiative, such as intellectual property theft.

Following this introduction, the remainder of this paper is organized in the following sections. Section 2 presents background for this study. Section 3 evolves the hypotheses with reference to extant theory and practice. Section 4 constructs an empirical framework to test these hypotheses. Results are presented and analyzed in Section 5. Section 6 discusses the findings and implications. Finally, conclusion and future perspectives are provided in Section 7.

2. BRIEF HISTORY OF THE B&R INITIATIVE

2.1 Timeline of implementation

The "Belt & Road Initiative" comprises both the "*Silk Road economic belt*" and "*the 21st-Century Maritime Silk Road*" initiatives, which were proposed by Chinese President Xi Jinping and Chinese Premier Li Keqiang in 2013, respectively. In 2015, these proposed initiatives were formally implemented as a government policy. While the public announcement by Xi Jinping and Li Keqiang in 2013 is well-documented, the official policies related to the B&R Initiative were enacted at the beginning of 2015 when the "*Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road*" was issued by the National Development and Reform Commission, the Ministry of Foreign Affairs, and the Ministry of Commerce of the People's Republic of China, with State Council authorization. Thus, the analysis of policy effects in this study commence with B&R implementation at the beginning of 2015 rather than the public B&R announcement in 2013.

2.2 Vision and content

In retrospect, the concept behind the Silk Road economic belt originates from historical trade routes, which were established by Zhang Qian during the Han Dynasty[4]. The concept behind the 21st-Century Maritime Silk Road originates from the maritime trade route, which was spontaneously explored by merchant traders during the Qin or Han Dynasty[5]. With these historical trade routes and trading partners serving as geographical boundaries, the Chinese government established a centuries-old foundation for their outward-facing OFDI strategy (NDRC et al., 2015).

[4] 2nd century B.C.
[5] Before 1st Century A.D.

As for the specific content, the B&R Initiative is a comprehensive policy with various policy instruments on politics, economics, and culture. It looks to foster "policy coordination, facility connectivity, unimpeded trade, financial integration, and people-to-people bonds." Nevertheless, at the firm level, the B&R Initiative is usually considered to be a policy that is intended to support cross-border investments and trade targeted at certain countries and regions, especially for Chinese OFDI (e.g., Huang, 2016; Yu, 2017). These intentions can be seen in the ways the B&R Initiative has been implemented. Among the policy documents and regulations related to B&R, more than 70% of these concern FDI of Chinese enterprises. Specifically, for Chinese firms that invest in B&R countries, the Chinese government coordinates some intergovernmental policies and regulations, and sets cross-border financial service mechanisms. Further, the Chinese government provides information about the investment environment, such as taxation and regulations. In sum, the B&R Initiative is intended to improve the business environment for Chinese OFDI (NDRC et al., 2015; Cheng, 2018) in addition to, but not specifically focused on, improving the R&D outcomes of Chinese firms.

2.3 Importance in Chinese policy system

Today, the Chinese government regards the B&R Initiative as the country's general program to spur out-ward facing economic investment in the coming years. It is widely believed that Chinese government grants the B&R Initiative special status when economic growth in China slows. To some extent, it can be observed that the B&R Initiative garners the highest importance when considering the various economic policies issued by the Chinese government since B&R was enacted as policy. For example;

- Among Leading Groups within the Chinese government designated to promote various economic policies, only the director of the Leading Group for Promoting the "Belt and Road" Construction is the member of the Standing Committee of the Political Bureau of the CPC Central Committee;
- Since its announcement, the B&R Initiative has been mentioned many times in the annual government work report;
- The Belt and Road Forum for International Cooperation organized by the Chinese government has the features of a *de facto* conference of heads of state.

3. HYPOTHESES

Recognizing that the majority of B&R countries are developing countries, it is supposed that B&R implementation may influence the R&D outcome of Chinese firms having established affiliates in B&R countries mainly by initiating changes to R&D activities associated with their established OFDIs in developing countries. In general, developing countries are usually considered to have location advantages such as natural resources, low-wage labor, and large market potential (Mallampally and Sauvant, 1999). Based

on advantages already owned, multinational corporations (MNCs) are able to acquire such location advantages and develop competitive advantages in host countries (Caves, 1971; Hymer, 1976). Hence, MNCs need to make efforts to develop new products or adjust previous operations according to the environment of host countries, which is summarized as the asset-exploitation process (Kotabe et al., 2002; Makino et al., 2002). Investing in R&D to make operations more applicable to a host country is an important part of this process (Kotabe et al., 2002; Fagerberg et al., 2005; Buckley et al., 2016). Usually, developing countries have location advantages that could be exploited[6], but the relatively weak legal system and high political risk in such countries limit foreign firms' exploitation (Buckley et al., 2007). After B&R implementation, the Chinese government has taken measures to alleviate the institutional barriers of the subsidiaries' operation and cooperation with local companies, and provides financial resources for overseas activities in B&R countries (Gabusi, 2017). Thus, Chinese firms having established affiliates in B&R countries may be stimulated to expand their original operations such that, following the logic of asset-exploitation, R&D investments may be required to further integrate their own capabilities with the host country location advantages to develop competitive advantages in B&R countries.

Of course, the increase in R&D investments related to established OFDIs could also lead to a decrease in R&D investments at the whole-firm level. It is a well-known argument that the expansion of overseas operations usually causes MNCs to relocate R&D investments using cost-benefit analyses that consider resource constraints (Chuang and Lin,1999). Thus, the increase in R&D investments related to established OFDIs may crowd out original R&D investments of MNCs (Huang, 2013). Such a crowding out effect, however, may be small with respect to the policy effects of B&R implementation. Except for infrastructure investments[7], the scale of OFDIs in B&R countries are small compared with the assets of Chinese firms that have established such OFDIs (MOFCOM, 2017). This implies that the changes in such firms' operations in B&R countries does not significantly distract the firms from their domestic operations and the overall demand of R&D investment. Moreover, in the context of B&R implementation, financial support for commercial activities in B&R countries provided by the Chinese government, including low interest loans and direct financing, is earmarked for specific purposes and leads to little cash outflow in the short term (Gabusi, 2017). Hence, the cash flow that supports the original R&D investments may not be crowded out (Brown et al., 2009). Taken together, it is reasonable to expect that the policy effect of B&R implementation on R&D investments

[6] In B&R countries, the potential of low wage labor and market scale are still attractive for further exploitation (Zhang, 2019).

[7] Due to externalities, infrastructure investments are usually initiated or done in cooperation with the government, a scenario that is outside the scope of understanding the behavior of ordinary firms (Yang et al., 2020). Thus, this paper focuses on Chinese firms participating in OFDIs along with B&R implementation, except for infrastructure investments.

of Chinese firms having established affiliates in B&R countries is, in part, a net increase. If other conditions are controlled, the R&D outcomes of such firms will increase due to the increase in R&D investments. Hence, the following first hypothesis is proposed;

H1: Mediated by the increase in the R&D expenditure, B&R implementation has a positive effect on the R&D outcomes of Chinese firms that have affiliates in B&R countries.

In addition to the indirect policy effect on R&D outcomes through R&D investments, the policy may also directly impact R&D outcomes of Chinese firms having established affiliates in B&R countries by promoting knowledge transfer with established OFDIs. Knowledge transfer is defined as a process of transmitting knowledge among individuals or organizations. Specifically, because some B&R countries are developed countries, asset-seeking is usually considered to be the prominent motivation for investments from developing countries like China (Buckley et al., 2007). Associated with this type of OFDI, strategic assets, especially technology, are transferred from external sources in host countries to MNCs, which may result in a direct increase in their R&D outcomes (Ikeda and Marshall, 2016; Osabutey and Jin, 2016). In addition to technology transfer, other types of knowledge may be transferred. Such knowledge is more tacit and less transferable than technology, but also benefits R&D and innovation (Schulz, 2003; Gopalakrishnan and Santoro, 2004). Such knowledge transfer happens from both developed countries and developing countries (Ismail et al., 2018), thus including all of the B&R countries.

As a type of learning, knowledge transfer will follow the path of least cost. The lower the cost, the easier the knowledge transfer (Levinthal and March, 1993). Along these lines, B&R implementation can improve the efficiency of knowledge transfer in two ways. First, due to worries of losing competitive advantage, when transferring knowledge, external knowledge sources usually bear additional costs to prevent leaking of knowledge that they are not willing to share, thus limiting the willingness and speed of knowledge transferring from external knowledge sources to MNCs (Cabrera and Cabrera, 2002). As a part of B&R implementation, the Chinese government has cooperated with B&R countries to reduce knowledge protection costs (Ali and Gen, 2019). Second, to transfer knowledge successfully MNCs must understand and absorb knowledge (Hansen, 1999; Reagans and McEvily, 2003). Communication between knowledge sources and MNCs is one of the main ways to transfer knowledge (Roberts, 2000; Nezu, 2007). B&R implementation includes a series of measures to promote cooperation and interaction between local companies and Chinese subsidiaries, thus reducing the cost to communicate between subsidiaries and local companies. Both of these efforts within B&R implementation lower the cost of knowledge transfer. Hence, if other conditions are controlled, as knowledge transfer becomes easier as a result of B&R implementation, it is reasonable to propose that an increase in R&D outcomes may be induced. Thus, the following second hypothesis is proposed;

H2: B&R implementation has a direct positive effect on R&D outcomes of Chinese firms that have affiliates in B&R countries.

As discussed previously, both developed and developing countries are covered by B&R Initiative. Differences of R&D activities related to established OFDIs across developed and developing countries may lead to differences in the policy effects of B&R implementation. Specifically, as asset-exploitation mainly exists in developing country (Buckley et al., 2007), it can be hypothesized that the indirect policy effect of B&R implementation on R&D outcomes through R&D investments only concerns Chinese firms that have established affiliates in B&R developing countries. At the same time, as technology transfer usually occurs when MNCs invest in developed countries, with other knowledge transfer occurring in both developed and developing countries (Ismail et al., 2018), the direct increase in R&D outcomes caused by B&R implementation may be lower for Chinese firms that only have affiliates in B&R developing countries.

While these potential differences in policy effects may seem obvious, it is important to carefully consider the background of B&R implementation. Firstly, it should be noted again that the effect of OFDI promotion policy is not equivalent to the effect of the OFDI. The B&R Initiative is a general OFDI promotion policy such that it will improve the environment of OFDIs in general, rather than motivate Chinese firms to acquire more strategic assets (Zhang et al., 2018). Thus, whether technology transfer has been promoted by B&R is ambiguous in terms of the content of the B&R Initiative. Further, some B&R developed countries, such as Greece and Hungary, are not highly developed, and thus Chinese firms may be investing primarily for asset-exploitation purposes (e.g., Dumitrescu, 2015; Herrero and Xu, 2017). Such phenomena will lessen the ability to observe differences in policy effects. Thus, two hypotheses are proposed, with alternative formations;

Among Chinese firms having affiliates in B&R developed countries and those investing only in developing countries,

H3a: the effects of the B&R implementation on their R&D outcomes are different.

H3b: the effects of the B&R implementation on their R&D outcomes are not significantly different.

4. DATA AND METHODS

4.1 Data and sample

Data was obtained from the China Listed Firm's R&D Innovation Database (GTA_LCPT), and the Chinese Listed Firms' Outward Foreign Direct Investment Research Database (GTA_OFDI). GTA_LCPT is the source of patent application data for this study. GTA_OFDI was used as a source of basic information regarding Chinese listed firms' overseas affiliates such as host country, main business and time of entry and exit; some

information related to OFDI, for example, directors' overseas background and ownership structure, are also included. Both of the databases were collected and maintained as part of the GTA CSMAR Database. The WIND Database was also used to access financial data derived from annual reports, including R&D expenditures, advertising cost, income, total assets, asset-liability ratio, and return on equity.

Given that it would be difficult to compare the R&D outcomes of firms belonging to different industries, this study is based on data from firms belonging to one industry as a sample based on feasibility and representativity[8]. In this study, observations of manufacturing firms were used. R&D activities (investment and outcome) of manufacturing firms are often easier to measure when compared to firms belonging to other sectors (Hall and Rosenberg, 2010), which adds to the feasibility of this research. Regarding representativity, among valid observations of Chinese listed firms from 2013 to 2017, over 50% of the observations are manufacturing firms, with the manufacturing industry also receiving attention with regard to innovation aspects of the B&R Initiative (NDRC et al., 2015). Therefore, the focus on manufacturing firms is appropriate for this study. Ultimately, a set with 5,113 observations of 1,326 firms from 2013 to 2017, was used as the initial sample[9]. It should be noted that firms making OFDIs solely in *tax havens and offshore financial centers* (THOFCs)[10] have been excluded from the sample in line with former studies. This exclusion is due to the fact that most of Chinese firms' affiliates in THOFCs are only established for tax avoidance or other financial aims. The including of such investment activities by firms would skew the findings of the study (Sutherland and Anderson, 2015).

4.2 Models

In order to test whether B&R implementation is a cause of change in R&D activities, causal inference should be conducted. Difference-In-Differences (DID) is a widely used econometric method to identify causality in economic studies. To estimate the effect of a certain intervention, such as B&R implementation, on some individuals (denoted by subscript "tr" as "treated" in this study) rigorously, the DID method adopts the occurrence of *controlled experiments* for study. By observing "untreated" individuals (denoted by subscript "untr" in this study), which are similar to "tr" individuals in all aspects except for the intervention, as a control group, the effect of intervention can be identified as shown in **Figure 3** (Imbens and Wooldridge, 2009).

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[8] In this way, selection bias is controlled. Consider a random sampling from several industries. The probability that one industry is chosen will never be less than the probability that more industries are chosen.

[9] Because of the omitted data of some variables, the number of observations actually used in empirical analysis is 5,093.

[10] In this study, THOFCs include Hong Kong SAR, Cayman Islands, the British Virgin Islands, the United States Virgin Islands, American Samoa, Bermuda, Jersey, Marshall Islands, the Independent State of Samoa, the Northern Mariana Islands.

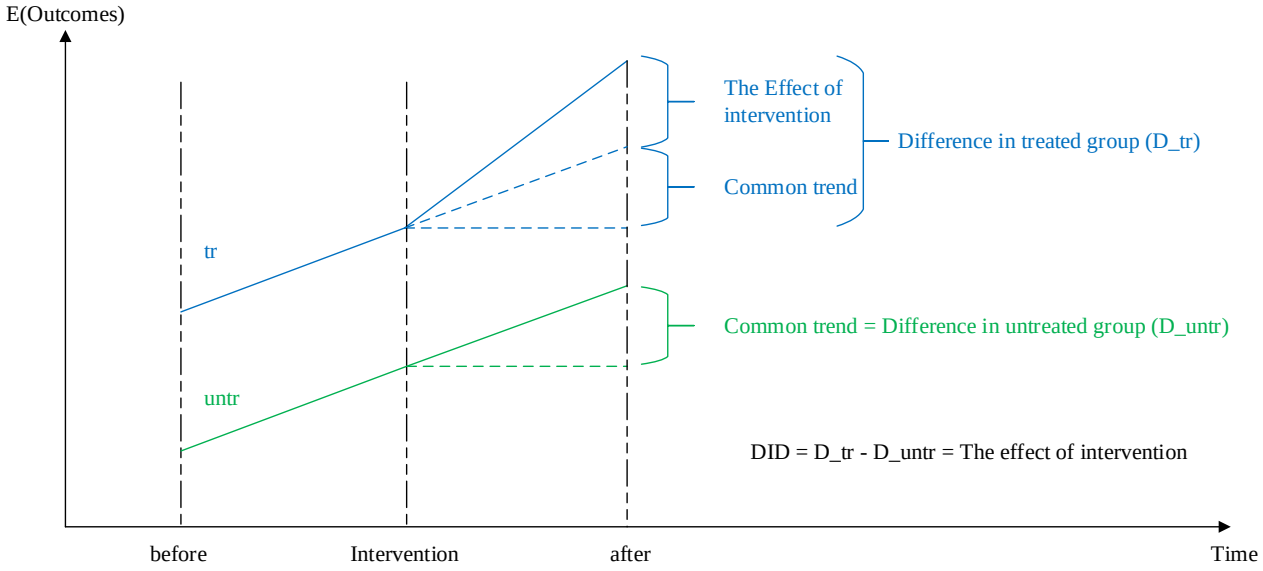

Figure 3. A diagram of Difference-In-Differences

In accordance with the study hypotheses, the objective of the empirical analysis was to examine the effect of B&R implementation on the R&D outcome of firms that have established affiliates in B&R countries, and the potential mediating effect by R&D expenditure. For this purpose, firms that have affiliates in B&R countries were assigned to the treated group, while the remaining observations were assigned to the control group. With this treatment classification, it was possible to assign an observation to the treated group (investing in B&R countries) endogenously, when the investment decision was as a result of B&R implementation. Thus, Propensity Score Matching (PSM) was used to process the data. Using *Logit* regression on some *covariates* correlated to the treatment classification, but uncorrelated with the intervention, a propensity score was estimated for each observation. By eliminating observations that have a high propensity for misclassification as "treated" or "untreated", the endogeneity of intervention in treatment classification can be controlled (Heckman et al., 1997). In this paper, if the pre-determinants of OFDI entries are employed as covariates in PSM, the disturbance of endogenous influence of B&R implementation on new OFDI entries is eliminated to some extent.

By integrating the framework of PSM-DID and the *Causal Steps Approach* (CSA) proposed by Baron and Kenny (1986), the main DID analysis model is formulated as **Eqs. (1)** through **(3)**.

$$R\&D\ Outcome_{it} = \alpha + \beta_1 DID_{it} + \beta_2 DID\_Group_{it} + \delta_1 AfterB\&R_{it} + \delta_2 IsB\&R_{it} + \boldsymbol{\gamma}^{T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (1)$$

$$R\&D\ Expend_{it} = \alpha + \beta_3 DID_{it} + \beta_4 DID\_Group_{it} + \delta_1 AfterB\&R_{it} + \delta_2 IsB\&R_{it} + \boldsymbol{\gamma}^{T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (2)$$

$$R\&D\ Outcome_{it} = \alpha + \beta_1 DID_{it} + \beta_2 DID\_Group_{it} + \beta_0 R\&D\ Expend_{it} + \delta_1 AfterB\&R_{it} + \delta_2 IsB\&R_{it} + \boldsymbol{\gamma^T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (3)$$

In **Eqs. (1)** through **(3)**, $IsB\&R_{it}$ is a dummy treatment variable, and is assigned a value of 1 when the propensity score is larger than 0.5. $AfterB\&R_{it}$ is a dummy policy variable, and is assigned a value of 1 when the B&R Initiative has been implemented ($t > 2014$). DID_{it} is an interaction term of $AfterB\&R_{it}$ and $IsB\&R_{it}$. According to the DID methodology, the coefficient of DID_{it} is the policy effect of B&R implementation which is equivalent to the DID shown schematically in **Figure 3**. DID_Group_{it} is an interaction term of $AfterB\&R_{it}$ and a dummy variable which assumes a value of 1 if firm i has affiliates in B&R developed countries at year t. The coefficient of DID_Group_{it} represents the policy effect on firms that have overseas affiliates only in B&R developed countries. According to the CSA methodology, these three models are to be taken in succession. If the estimates of β_3 and β_4 in **Eq. (2)** and β_0 in **Eq. (3)** are significant, and the significance of β_1 and β_2 in **Eq. (3)** are lower than those in **Eq. (1)**, it can be concluded that the effect of B&R implementation on R&D outcomes of treated firms is mediated by R&D expenditure, to some extent. Finally, all covariates used in PSM were controlled in these regressions as a column vector $\mathbf{ControlVar_{it}}$, and the two-way fixed effects were contained in the variable "c" in **Eqs. (1)** through **(3)**[11].

4.3 Variable Treatment

To alleviate the challenge posed by endogeneity, the covariates used in the PSM should be correlated to the treatment classification, but uncorrelated with the intervention as far as possible. With reference to extant literature, there following variables were selected.

$IsRelatedInd_{it}$ is a dummy variable that represents whether the firm i belongs to the CSI OBOR (One Belt One Road) Index[12]. CSI OBOR is an industry-based securities index, and a firm in the selected industries is more likely to have affiliates in B&R countries. At the same time, the industry classification of a firm should not vary based on a policy intervention, so that this covariate remains uncorrelated to B&R implementation in theory.

$OverseaBack_{it}$ represents the number of directors with an overseas background. $R\&DInten_{it}$ represents the firm's R&D intensity. $ADInten_{it}$ represents the firm's advertising intensity. These three variables are popular representatives for FDI determinants at the firm-level in extant writings (Reuber and Fischer, 1997; Blonigen, 2005). Considering their importance, these variables, and their quadratic terms, have

[11] By employing two-way fixed effects, the potential influence of variables which are constant across firms or periods, such as firm age and ownership, can be controlled (Woodridge, 2002).

[12] CSI OBOR Index and CSI China Manufacture 2025 Index used in robustness check are official indices for A-share market compiled by China Securities Index Co., Ltd, a joint venture between the Shanghai Stock Exchange and the Shenzhen Stock Exchange.

been incorporated into PSM. In general, R&D expenditure and advertising expenditure are sticky over the short-term (Anderson et al., 2003), while the membership of the board of directors is not easily change, thus making these variables unlikely to be influenced by B&R implementation.

Total assets, $Asset_{it}$, asset-liability ratio, DA_{it}, and return on equity, ROE_{it} are adopted as representatives of basic financial performance. Ownership by institutional investors, $InsOwn_{it}$, and ownership by the government, $StateOwn_{it}$ are also taken into account in the PSM to control for any potential influence of corporate governance (e.g., Ramasamy et al., 2012).

All covariates and outcome variables employed in the main DID analysis are described in **Table 1**. Of note in the model, a time-lag between $R\&D\ Expend_{it}$ and $R\&D\ Outcome_{it}$ was not set. In recent years, the development cycle of patents has curtailed gradually, and near simultaneous development and application for patents has become more prevalent (Gan et al., 2018). For this reason, a time-lag was not deemed necessary.

Table 1. Description of variables used in the Propensity Score Matching-Difference-In-Differences models along with summary statistics

Symbol	Variable description	Type	Obs	Mean	S.D.
Outcome variables					
$R\&D\ Outcome_{it}$	Number of patent applications	Ratio	5,113	118.513	614.992
$R\&D\ Expend_{it}$	Total R&D expenditure (in 100 million yuan)	Ratio	5,113	2.044	6.806
Covariates in PSM					
$IsRelatedInd_{it}$	Does the firm belong to CSI OBOR industries: yes=1, no=0	Nominal	5,113	-	-
$OverseaBack_{it}$	Number of directors with and overseas background	Ratio	5,113	1.549	1.784
$R\&DInten_{it}$	The ratio of R&D expenditure to income	Ratio	5,113	0.043	0.047
$ADInten_{it}$	The ratio of advertising cost to income	Ratio	5,113	0.013	0.044
$Asset_{it}$	Total assets (in 100 million yuan)	Ratio	5,113	103.390	286.993
DA_{it}	The ratio of total liabilities to total assets	Ratio	5,113	0.421	0.671
ROE_{it}	Return on equity	Ratio	5,093	0.056	0.551
$InsOwn_{it}$	The stock share that institutional investors hold	Ratio	5,113	0.044	0.048
$StateOwn_{it}$	The stock share that the government holds	Ratio	5,113	0.036	0.121

5. EMPIRICAL ANALYSIS

5.1 Results of Propensity Score Matching

For empirical analysis, PSM was conducted for the initial sample as described in Section 4. Neighbor matching was done using a 0.5 caliper to account for the fact that the number of observations in the control group is larger than that in the treated group. The results of the balance test for PSM analysis are shown in **Table 2**. After propensity score matching, the differences between the treated and control groups becomes insignificant, and the biases over all covariates used in PSM are reduced to less than 10%.

Table 2. Result of the balance test for Propensity Score Matching

Variable	Unmatched / Matched	Mean: Treated	Mean: Control	Bias (%)	Bias ↓ (%)	T-test
$IsRelatedInd_{it}$	U	0.067	0.044	10.0	64.3	3.46 ***
	M	0.067	0.059	3.6		0.95
$OverseaBack_{it}$	U	1.934	1.377	30.0	96.7	10.47 ***
	M	1.913	1.895	1.0		0.25
$OverseaBack_{it}^2$	U	8.121	4.433	26.0	99.1	9.41 ***
	M	7.920	7.886	0.2		0.06
$R\&DInten_{it}$	U	0.043	0.043	0.2	-519.9	0.05
	M	0.043	0.044	-1.0		-0.30
$R\&DInten_{it}^2$	U	0.003	0.004	-3.2	73.7	-0.93
	M	0.003	0.004	-0.8		-0.64
$ADInten_{it}$	U	0.006	0.016	-23.5	99.9	-6.92 ***
	M	0.006	0.006	0.0		0.02
$ADInten_{it}^2$	U	0.000	0.003	-15.8	98.7	-4.52 ***
	M	0.000	0.000	-0.2		-0.23
$Asset_{it}$	U	194.240	61.937	39.3	96.2	15.63 ***
	M	160.780	155.720	1.5		0.49
DA_{it}	U	0.460	0.387	37.1	86.5	12.26 ***
	M	0.459	0.469	-5.0		-1.32
ROE_{it}	U	0.069	0.050	3.8	-1.4	1.11
	M	0.068	0.087	-3.8		-0.93
$InsOwn_{it}$	U	0.049	0.042	14.3	75.8	4.90 ***
	M	0.049	0.051	-3.5		-0.88
$StateOwn_{it}$	U	0.042	0.034	6.3	85.2	2.15 **
	M	0.041	0.042	-0.9		-0.26

Note: $***p < 0.01$, $**p < 0.05$, $*p < 0.10$.

The propensity score distribution shown in **Figure 4** indicates a similar distribution between the treated and control groups following PSM. In light of this, observations which are not supported (called "off support" in **Figure 4**) by the PSM analysis are excluded from further DID analysis. The number of these excluded observations is 36, which accounts for less than 1% of the total empirical analysis sample set, suggesting that the treated and untreated group in the DID analysis are statistically similar.

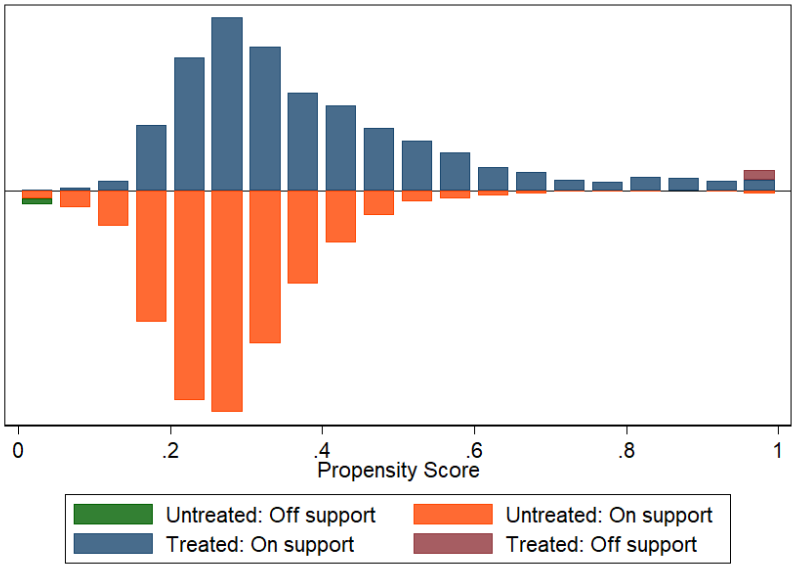

Figure 4. Propensity score histogram by treatment status

5.2 Difference-In-Differences Analysis

Based on the result of the PSM analysis, DID analysis, as detailed in **Eq. (1)** to **Eq. (3),** was performed on the remaining sample set. To control for the potential disturbance of heterogeneity and serial correlation, heteroskedasticity-robust standard error was applied to the regressions. Results are presented in **Table 3**.

Table 3. Result of Difference-In-Differences analysis

Outcome		Eq. (1) *R&D Output*	Eq. (2) *R&D Expend*	Eq. (3) *R&D Output*
Policy effects	DID	63.952**	0.490**	42.513*
		(27.900)	(0.234)	(23.677)
	$DID \times Group$	-20.084	-0.028	-18.849
		(50.797)	(0.260)	(44.943)
Mediating variable	*R&D Expend*			43.711**
				(19.158)
Overall difference over whether the policy has been adopted		Y	Y	Y
Initial difference across treatment classifications		Y	Y	Y
Control variables		Y	Y	Y
Year fixed effects		Y	Y	Y
Firm fixed effects		Y	Y	Y
Observations		5057	5057	5057
Individuals		1321	1321	1321

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

With regard to the effect of B&R implementation on R&D outcomes, the policy effect is positive and

significant (For **Eq. (1)**, $\beta_1 = 63.951,\ p < 0.05$). Thus, B&R implementation is shown to improve the R&D outcomes of Chinese firms having affiliates in B&R countries. Compared to the results of **Eq. (1)**, both the value and significance of the direct policy effect diminish in the results of **Eq. (3)** (For **Eq. (3)**, $\beta_1 = 42.513$, $p < 0.10$). Given both a positive effect of B&R implementation on R&D expenditure and a positive effect of R&D expenditure on R&D outcome with high significance (For **Eq. (2)**, $\beta_3 = 0.490,\ p < 0.05$; For **Eq. (3)**, $\beta_0 = 43.711,\ p < 0.05$), it can be concluded that the positive policy effect of B&R implementation on R&D outcome of firms having affiliates in B&R countries is significantly mediated by R&D expenditure, while the direct policy effect still weakly exists. Hence, both Hypotheses 1 and 2 are supported.

Finally, the coefficients of $DID \times Group$ are shown to be insignificant in all the three models (For **Eq. (1)**, $\beta_2 = -20.084,\ p > 0.10$; For **Eq. (2)**, $\beta_4 = -0.028,\ p > 0.10$; For **Eq. (3)**, $\beta_2 = -18.849,\ p > 0.10$). Thus, Hypothesis 3b is supported. The effects of B&R implementation on R&D activities of firms having affiliates in B&R countries are similar, regardless of whether such firms have affiliates only in developing countries.

5.3 Further analysis and robustness check

5.3.1 Common trend test and policy dynamics

To ensure that the differences in policy effects between treated and control groups are not driven by preexisting differences, a *common trend* test was performed as part of the DID analysis. This test assesses whether trends in the outcome variable are similar in treated and control groups before enacting a policy. If similar, it can be concluded that policy effects between treated and control groups are, in fact, not driven by preexisting differences. Additionally, this analysis can provide more details about the policy dynamics following enactment of the policy. An event-study analysis was conducted using the models shown in **Eqs. (4)** through **(6)** (Tanaka, 2015).

$$R\&D\ Outcome_{it} = \alpha + \sum_{t=2013}^{2017} \beta_t IsB\&R_{it} \times I_t + \boldsymbol{\gamma^T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (4)$$

$$R\&D\ Expend_{it} = \alpha + \sum_{t=2013}^{2017} \beta_t IsB\&R_{it} \times I_t + \boldsymbol{\gamma^T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (5)$$

$$R\&D\ Outcome_{it} = \alpha + \sum_{t=2013}^{2017} \beta_t IsB\&R_{it} \times I_t + \beta_0 R\&D\ Expend_{it} + \boldsymbol{\gamma^T}\mathbf{ControlVar_{it}} + c + \varepsilon_{it} \quad (6)$$

In these models, I_t is an indicator variable that assumes a value of 1 in year t. By interacting these year dummy variables with the treatment variable, the annual effect of B&R implementation can be determined, as shown in **Figure5**.

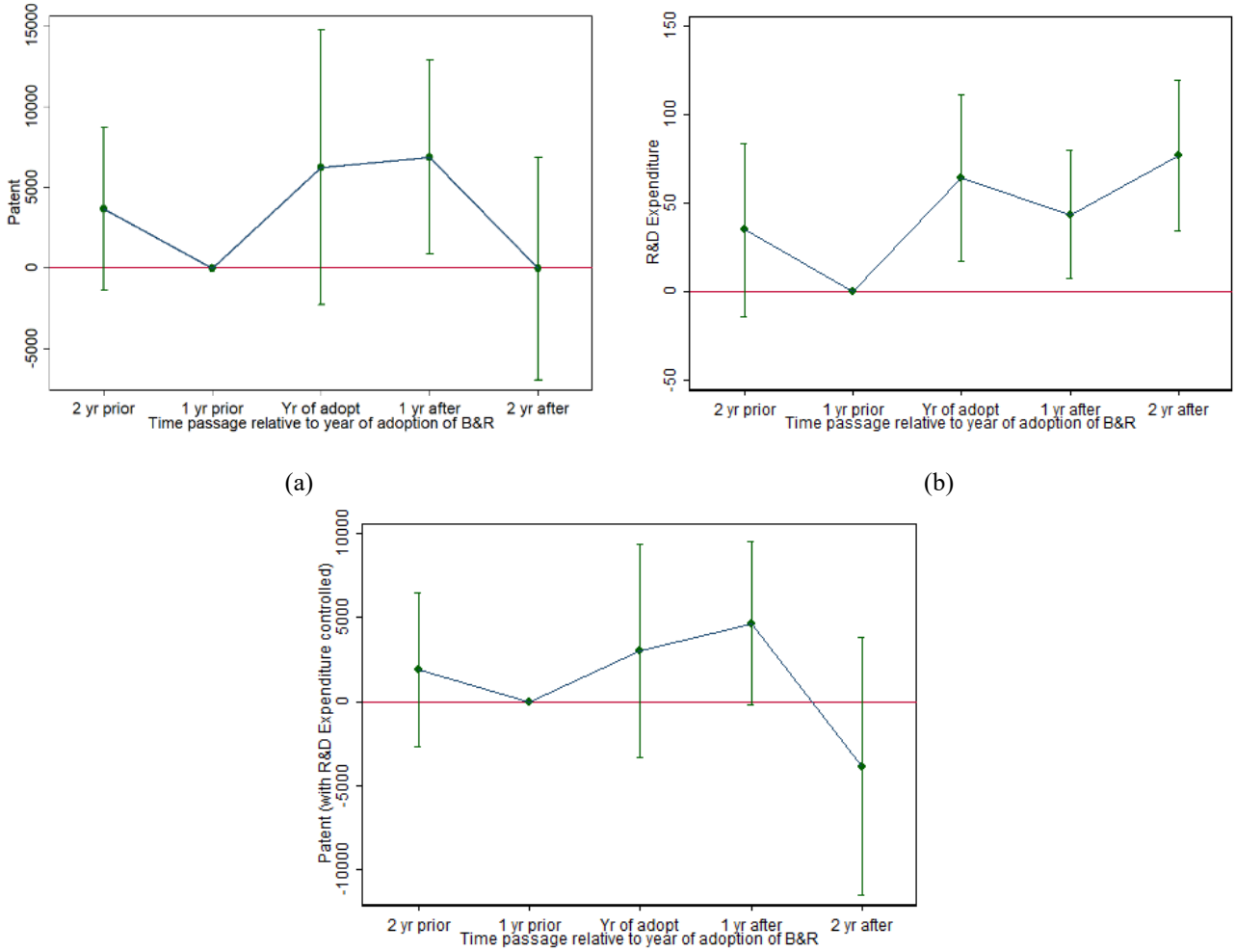

Figure 5. The annual effect of B&R implementation on (a) number of patents, (b) R&D expenditure, and (c) number of patents with R&D expenditure controlled[13]

For all three models the test reveals no systematic differences in trends prior to policy enactment across treated and control groups. With regard to policy dynamics, the effect of B&R implementation on R&D expenditure of firms that have affiliates in B&R countries remains significantly positive after 2014, meaning this effect, and the induced effect on R&D outcomes, is stable over time. However, the direct effect of B&R implementation on the R&D outcomes of firms that have affiliates in B&R countries is weak and variant across individuals and periods. As shown in **Figure 5(a, c)**, with large deviation, the average effect increases in 2015 (the year of policy enactment), reaches a crest in 2016, and sharply decreases to zero in 2017. This dynamic pattern indicates that the direct effect of B&R implementation on R&D outcomes may be an instantaneously weak shock, and some unique circumstances that occurred in 2017 had a mitigating effect on the R&D outcomes of the treated group.

[13] From left to right, this figure plots the coefficients of annual effect of the B&R implementation and their associated 90% confidence interval based on **Eq. (4)** to **Eq. (6)**, using 2014 as the baseline.

5.3.2 Placebo test for DID analysis

To ensure robustness of the findings, a *placebo test* was conducted as part of the DID analysis. This test assumes the existence of alternative mechanism that may similarly influence outcomes, rather than the original policy being studied. By repeating the DID analysis with this alternative mechanism, and observing for any changes in the significance of effects attributed to the original policy, the plausibility of any alternative mechanisms can be assessed.

Recent studies have conducted a placebo test using a bootstrap method. In those studies, observations are randomly placed into a treated or control group, a new interaction term with the policy variable is introduced, and DID analysis is run. By repeating this process many times, most of the possible *placebo effects* can be assessed (e.g., La Ferrara et al., 2012). While acceptable in econometrics, this method was not adopted in this study since the bootstrap method may needlessly focus on some placebo effects, while ignoring the real placebos. More generally, regardless of how many times the bootstrap is conducted, some specific effects that may be the most plausible placebos cannot be definitively ruled out.

As discussed previously, the B&R Initiative, to some extent, is the most important strategy for China in recent decades. Thus, potential placebo policies must be those whose importance approaches the scale of B&R implementation. In this case, the effects of the "*Made in China 2025"* policy and the first declaration of the B&R Initiative are considered as placebos to B&R implementation. The latter is defined as the first declaration of the B&R Initiative by president Xi Jinping in late 2013, whose influence should not be observed in the treated firms prior to 2014. The "*Made in China 2025"* policy may be the second-most substantial policy simultaneously implemented in early 2015, which could have effect on R&D activities of a separate treated group[14]. The plausibility of the placebo effect is assessed by generating a new policy variable which equals 1 for every year after 2013, and a new treatment variable that denotes whether firms belong to industry sectors included in CSI China Manufacture 2025 Index. The two variables are then multiplied by the original treatment variable and policy variable, respectively, to represent the effect of the B&R declaration and the policy effect of Made in China 2025. These two interaction terms, $DID\_Pre2014$ and DID_CM2025, are added to the model in Eq. (2) through (4) in turn to verify the robustness of the original policy effect of B&R implementation. These results are shown in **Table 4**.

[14] *Internet Plus* was also carried out in early 2015. However, this policy mainly focuses on service industry, which covers few observations in the sample of this study. In view of this, the Internet Plus policy is not taken into account in the placebo test.

Table 4. Results of the placebo test for the uniqueness of the original policy effect of B&R declaration.

Outcome		Placebo: declaration of the B&R			Placebo: Made in China 2025		
		Eq. (1)	Eq. (2)	Eq. (3)	Eq. (1)	Eq. (2)	Eq. (3)
		R&D Output	*R&D Expend*	*R&D Output*	*R&D Output*	*R&D Expend*	*R&D Output*
Policy effects	DID	57.695**	0.374*	41.333*	64.001**	0.491**	42.549*
		(24.539)	(0.208)	(21.273)	(27.909)	(0.234)	(23.694)
	$DID \times Group$	-19.876	-0.024	-18.810	-20.091	-0.028	-18.852
		(50.807)	(0.260)	(44.908)	(50.798)	(0.260)	(44.949)
Mediating variable	$R\&D\ Expend$			43.704**			43.665**
				(19.168)			(19.115)
Placebo effects	$DID\_Pre2014$	13.576	0.252	2.567			
		(14.531)	(0.181)	(14.096)			
	DID_CM2025				19.360	0.322**	5.307
					(17.699)	(0.127)	(12.238)
Overall difference over whether the policy has been adopted		Y	Y	Y	Y	Y	Y
Initial difference across treatment classifications		Y	Y	Y	Y	Y	Y
Control variables		Y	Y	Y	Y	Y	Y
Year fixed effects		Y	Y	Y	Y	Y	Y
Firm fixed effects		Y	Y	Y	Y	Y	Y
Observations		5057	5057	5057	5057	5057	5057
Individual		1321	1321	1321	1321	1321	1321

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

Overall, results show no significant changes in the originally determined policy effect of B&R implementation. With regard to the placebo effect associated with the declaration of the B&R Initiative, coefficients of $DID\_Pre2014$ are insignificant in all three models, meaning that the effect of the B&R declaration on R&D activities of firms that have overseas affiliates in B&R countries is very little relative to the effect of the B&R enactment on R&D activities of firms that have overseas affiliates in B&R countries. For the potential policy effect of the Made in China 2025 placebo, coefficients of DID_CM2025 are not significant, except for the coefficient modeling R&D expenditure (**Eq. (2)**). This significant coefficient indicates that the implementation of Made in China 2025 may have a positive effect on the R&D expenditure of high-end manufacturing firms, while also implying that it may also induce an increase in R&D outcomes. Ultimately, the original policy effect of enacting the B&R Initiative remains virtually unchanged relative to those effects measured in the original DID analysis. Thus, the effect of the Made in China 2025 policy on R&D activities is independent with regard to the original B&R Initiative policy effect of interest.

In addition to testing for the uniqueness of the original policy effect, another type of placebo effect that must be tested is the potential effect of the original policy on the control group. This test determines whether

B&R implementation has generic effect on R&D activities of firms that have made OFDIs in any country. Thus, a new DID interaction term is introduced into the model in **Eq. (1)** through **Eq. (3)**. The interaction term, DID_IsOFDI, is the product of the original policy variable and a new treatment variable which shifts the firms that have made OFDIs in any country into treated group. Results of this test are shown in **Table 5**.

Table 5. Results of the placebo test for B&R policy implementation on the control group

Outcome		Eq. (1) $R\&D\ Output$	Eq. (2) $R\&D\ Expend$	Eq. (3) $R\&D\ Output$
Policy effects	DID	67.513**	0.542**	43.829*
		(29.645)	(0.249)	(24.621)
	$DID \times Group$	-20.171	-0.030	-18.881
		(50.789)	(0.260)	(44.948)
Mediating variable	$R\&D\ Expend$			43.704**
				(19.157)
Placebo effects	DID_IsOFDI	-6.725	-0.097	-2.478
		(7.986)	(0.085)	(6.707)
Overall difference over whether the policy has been adopted		Y	Y	Y
Initial difference across treatment classifications		Y	Y	Y
Control variables		Y	Y	Y
Year fixed effects		Y	Y	Y
Firm fixed effects		Y	Y	Y
Observations		5057	5057	5057
Individuals		1321	1321	1321

Note: $***p < 0.01$, $**p < 0.05$, $*p < 0.10$.

Results from this test show that coefficients of DID_IsOFDI are insignificant in all three models, confirming that B&R implementation has an effect on the R&D activities of firms that have overseas affiliates specifically in B&R countries, rather than those only investing in countries outside of the B&R Initiative.

6. DISCUSSION

6.1 Findings and implications

The first question proposed in this study was whether B&R implementation has caused any change in R&D outcomes of Chinese firms. In support of Hypotheses 1 and 2, empirical results prove the existence of a positive overall effect. Through the application of a counterfactual analysis framework, the potential influence of other factors motivating new OFDI entries has been excluded, and other unobserved factors (i.e., events, other policies, and time trends) that may undermine the validity of these results have proven insignificant in a robustness check. Such findings lend credibility to identification of B&R implementation as a cause for this

positive effect. Among extant writings, the influence of an OFDI promotion policy on R&D activities is often simply connected with the relationship between OFDI entries and R&D activities (e.g., Branstetter, 2006; Pradhan and Singh, 2017). Such thinking provides an avenue to understand the issue with regard to policy effects, but is potentially too narrow in perspective. Most OFDI promotion policies cannot only motivate new investments, but also improve the operations of established OFDIs (Luo et al., 2010). The findings of this study show that the latter also makes sense with respect to R&D activities at the firm level. Such a mechanism should be taken into consideration when policy-makers and scholars assess the effect on R&D from OFDI promotion policies like the B&R Initiative.

With regard to the specific effect of B&R implementation on R&D outcomes of Chinese firms that have affiliates in B&R countries, this study reveals the mechanism behind a simple increase. The findings highlight the continuous mediating effect that R&D expenditure has on the positive relationship between B&R implementation and the R&D outcome of treated firms. Investing for asset-exploitation may be the goal of most Chinese firms having affiliates in B&R countries. Along with the asset-exploitation process, R&D investments are usually regarded as necessary to develop competitive advantages in B&R countries (Kotabe et al., 2002; Fagerberg et al., 2005; Buckley et al., 2016). The B&R implementation can stimulate Chinese firms to expand their operations in B&R countries by alleviating the institutional barriers and providing financial support (Du and Zhang, 2018). Under this condition, further R&D investments may be needed and may induce sustainable increases in R&D outcomes, as a result of continuous improvement in B&R implementation. At the same time, knowledge transfer also plays an important role in the policy effect of B&R implementation on R&D outcomes of Chinese firms that have affiliates in B&R countries. As an instantaneous weak-shock in empirical results, findings indicate that B&R implementation may mainly improve knowledge transfer except for technology transfer, such as informal institutions in host countries, which is more likely a one-time insignificant benefit. Combining the above effects, this study partly describes the behavioral pattern of Chinese firms in light of the policy effects of B&R implementation, and thus may provide a novel perspective to analyze the effects of OFDI promotion policy on R&D.

Finally, with regard to the instantaneously weak-positive direct effect of B&R implementation on R&D outcomes, the empirical results indicate no difference among Chinese firms having affiliates in developed countries and only in developing countries, and the deviation of such a policy effect is larger than the policy effect mediated by R&D expenditure. Considering that strategic assets are usually located in developed countries (Piperopoulos et al, 2018) and the learning and integration of these assets is a progressive process (Wu et al., 2017), such a result further implies an understanding that Chinese firms have gained few technological advantages directly as a function of B&R implementation. Because the positive effect of B&R

implementation on R&D outcomes exhibits no difference across developing and developed countries when mediated by the increase in R&D expenditure, the established OFDIs of Chinese firms in B&R countries are more likely to seek asset-exploitation (e.g., Alon and McIntyre, 2008; Schüler-Zhou et al., 2012). Under such conditions, the pursuit of strategic assets, such as technologies, is typically not considered. At the same time, the core of the B&R Initiative is not innovation, meaning that such a policy might not provide special support for acquiring strategic assets (Zhang et al., 2018). In general, this understanding can be regarded as a response to the fear that the B&R Initiative is motivating "intellectual property theft". Results show that for Chinese firms that already have established affiliates in B&R countries, such fear is unfounded.

6.2 Limitation

Although this study provides insight into implications of OFDI promotion policy for R&D activities at firm level, a number of limitations exist. Firstly, only selected listed firms were included in the sample set. To some extent, this problem constrains the application of the conclusion of this paper, in particular for small and medium enterprises (SMEs) that are unlisted. In reality, among the firms initiating OFDI, SMEs comprise a proportion that should be considered. But as the size of SMEs is different than listed firms, the R&D activities and overseas operation may also differ making the results inconclusive.

Besides, for the sample employed, because a majority of Chinese firms that invested B&R countries are non-state-owned enterprises (non-SOEs), and the distribution of firms investing in B&R countries with respect to ownership is similar to the distribution of all Chinese listed firms with respect to ownership[15], this study does not consider the influence of ownership heterogeneity on the policy effects of B&R implementation on R&D activities. However, while the conclusions of this study can applied to most industries without consideration of ownership heterogeneity, further care should be taken when applying the conclusions of this study to the policy effect of B&R implementation in the field of infrastructure investments, which are more heavily dominated by state-owned enterprises (SOEs) (Du & Zhang, 2018).

7. CONCLUSION

Through the application of Propensity Score Matching (PSM) on a sample of Chinese listed manufacturing firms from 2013 to 2017, a set of firms that have established affiliates in B&R countries were classified as a treated group, while the remaining firms with similar decision patterns regarding OFDI were classified as a

[15] For the sample employed in this study, among 1,611 observations recorded affiliates in B&R countries from 2013 to 2017, 452 observations are of SOEs. The distribution of firms investing in B&R countries with respect to ownership (about 25% are SOEs) is similar to the distribution of all Chinese-listed firms with respect to ownership (about 30% are SOEs). Under this condition, it is difficult and unnecessary to examine the influence of ownership heterogeneity on the policy effects of B&R implementation due to collinearity.

control group. A Difference-in-Differences (DID) approach was used to evaluate the treatment effect of B&R implementation on the treated firms. Empirical results indicate that, for Chinese firms that have established affiliates in B&R countries, B&R implementation not only leads to an increase in R&D outcomes mediated by the overall increase in R&D expenditure along with the improvement of asset-exploitation, but also results in another directly weak-positive effect on R&D outcomes as a result of the increase in knowledge transfer. Policy dynamics showed that the former is a continuous effect, while the latter is a one-time shock with large deviation. All of these mechanisms for positive effects were similarly observed among firms that have B&R affiliates in developed countries and those only investing in B&R developing countries. These results contribute to the theoretical understanding of the effect that an OFDI promotion policy has on R&D activities related to established OFDIs, and help policy-makers to assess the policy effects of B&R implementation in a more detailed fashion while also better explaining these effects to the public.

For future research, several new gaps have emerged from this study. First, the framework employed in this study can also be applied to better understand how firms from other B&R countries participate in the science-technology cooperation accompanied by B&R implementation. Second, interacting the extant policy effects with other factors, such as the heterogeneity on absorptive capacity or firm scale and the political connection in some industries (Cohen and Levinthal, 1990; Gassmann and Zedtwitz,1999; Du and Zhang, 2018), may help to researchers comprehend firms' behavior in R&D management more deeply within the context of B&R implementation. Finally, this type of empirical research illustrates the need for scholars to have access to high-quality data in order to more comprehensively view former OFDI promotion policies in retrospect.

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