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How can the combination of entrepreneurship policies activate regional innovation capability? A comparative study of Chinese provinces based on fsQCA

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ABSTRACT

The global innovation environment is undergoing major changes. Driven by its entrepreneurship policy, China's innovation level has gradually improved, but the regional gap remains large. As previous studies mainly focused on the net impact of entrepreneurship policy on innovation, knowledge on the combination of entrepreneurship policies to improve regional innovation capability is still lacking. To fill this gap in the literature, this study uses fuzzy set qualitative comparative analysis (fsQCA) on data from 31 provinces in China to explore how five entrepreneurship policies (i.e., technology transfer, fiscal and tax, digital transformation, talent, and government innovation management policy) jointly affect regional innovation capability. The results show that these five entrepreneurship policies are sufficient conditions for high regional innovation capability, and three paths can produce high innovation capability. Therefore, local governments need to formulate appropriate entrepreneurship policies to address the actual situation. This study has important management significance for formulating entrepreneurship policies worldwide, especially in developing countries.

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Introduction

Innovation, entrepreneurship, and knowledge are regarded as the main bases of economic growth (Piñeiro-Chousa, López-Cabarcos, Romero-Castro & Pérez-Pico, 2020). The concept of knowledge intensive innovation and entrepreneurship (KIE) is a combination of the above three concepts and is considered to be the most important type of entrepreneurship in the modern knowledge economy. It emphasizes the role of "transformation of technology and ideas to innovation" in regional economic growth (Malerba & McKelvey, 2018). In regional economies, entrepreneurial firms transform existing knowledge into economic knowledge and, thus, have higher innovation performance with a higher level of entrepreneurship in the process of knowledge commercialization (Audretsch & Keilbach, 2004). In other words, entrepreneurship, especially high-tech entrepreneurship, is a key factor driving innovation (Chung, Jung & Lee, 2022). However, entrepreneurship is the missing component of the government-led East Asian regional innovation system (Su & Hung, 2009), which is also ignored in the literature on East Asian regional innovation systems (Yoon, Yun, Lee & Phillips, 2015). Here, weak institutions and organizations are the determinants of low regional innovation capability (Huggins & Johnston, 2009). In China, which is an East Asian economy, the government plays an important role as it undertakes the task of promoting regional knowledge flow, improving enterprise entrepreneurship, and realizing sustainable innovation. The entrepreneurship policy provides convenience for participants in the regional innovation system, including universities, enterprises, and the government. Additionally, providing fiscal and tax facilities for enterprises and encouraging talent innovation are also important parts of an entrepreneurship policy. Regional policies should be revised to ensure adequate absorptive capacity and human capital for start-ups (Giuliani, 2005), which are crucial for improving regional innovation capability.

When analyzing the important role of innovation in economic growth, researchers must consider that unbalanced development is a common problem worldwide (Zhu et al., 2021) and that China is no exception. China's achievements in terms of scientific and technological innovation have gradually become more prominent. In 2021, China ranked 12th in the Global Innovation Index and was the only middle-income economy among the top 30 countries. While China's

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innovation and development are generally improving, when focusing on China's regional innovation system, researchers find an obvious imbalance among regional innovation capability, mainly manifested through the imbalance within and between regions. According to the Evaluation Report of China's Regional Innovation Capability (2021), taking the Bohai Rim Economic Zone as an example, the innovation capability within the region varies greatly: Beijing's comprehensive score is 57.99, while Tianjin, Hebei, and Liaoning only score 26.94, 26.48, and 25.26, respectively(China Science and technology development strategy research group & China Innovation and Entrepreneurship Management Research Center, University of Chinese Academy of Sciences 2021). Additionally, the gaps between the eastern and western, and between the northern and southern regions are also large. There are also differences in the development of China's regional innovation system. Promoting regional innovation capability through the entrepreneurship policies is an effort toward developing a mature regional innovation system based on a government-led regional innovation system in East Asia. Therefore, it is necessary to add to the research on entrepreneurship policy.

The research used fuzzy-set qualitative comparative analysis (fsQCA) to analyze entrepreneurship policies and regarded entrepreneurship policy as a single antecedent condition (Castaño, Méndez & Galindo, 2016; Jiao, Zhang & Tang, 2020), while, in fact, the entrepreneurship policy system is complex. The links between policies are intricate (Bakir, Akkunay & Coban, 2021) and there are differences in the implementation of entrepreneurship policies among regions (Sancton, 1983). To better understand the differences in China's regional innovation capability, it is necessary to analyze the synergistic effects of entrepreneurship policy combinations on the overall regional innovation capability.

Based on this perspective, the question addressed by this study is "how does the combination of entrepreneurship policies activate regional innovation capability"? To this end, this study explores the configuration of five entrepreneurship policies (i.e., the technology transfer policy, fiscal and tax policy, digital transformation policy, talent policy, and government innovation management policy) and how they jointly affect China's regional innovation capability. It thus provides a complex dynamic perspective for examining the role of entrepreneurship policy in regional innovation capability and clarifying the combination of various conditions leading to high regional innovation capability. These results are an important reference for policymakers in developing countries, especially those countries or regions undergoing industrial transformation.

The rest of this paper is organized as follows. In the following section, this study reviews the literature on entrepreneurship policies that affect innovation. Then, fsQCA is used to analyze the portfolio allocation of entrepreneurship policies that lead to high regional innovation capability. Finally, this study discusses the significance of theory and practice, analyzes the study's limitations, and suggests directions for future research.

Literature review

Entrepreneurial regional innovation system

Innovation is an important means of regional economic growth (Huggins, Waite, & Munday, 2018), its core lying in the knowledge flow between regions (Huggins & Thompson, 2015). The literature on regional innovation system(RIS) discusses the participants (Su, Jiang & Lin, 2021), innovation networks (Piazza, Mazzola, Abbate & Perrone, 2019), and regional innovation abilities (Lau & Lo, 2015). Further, Cooke and Leydesdorff (2006) proposed an entrepreneurial RIS, which is an innovation system focused on supporting the private sector and developing innovation by stimulating the entrepreneurial spirit of individual actors. Compared with the mature British and American entrepreneurial RIS, the East Asian entrepreneurial RIS is dominated by the government and is still immature (Yoon et al., 2015). However, with the advent of the knowledge economy, the emerging knowledge-based technology sector is expanding rapidly through small enterprises and scalable start-ups, which makes people realize that small enterprises and entrepreneurship are important sources of innovation in a RIS (Jacobides, Cennamo & Gawer, 2018). Therefore, East Asian economies are trying to change the tradition of government-led innovation, learn from the more mature western entrepreneurial RIS, revitalize the entrepreneurial spirit of individual actors, and accelerate the sustainable flow and innovation of knowledge in the system.

Regional innovation capability

Rogers and Larsen (1984) considered innovation capability at the regional level. Regional innovation capability (RIC) is the ability to transform new knowledge into products and realize economic development by integrating existing production factors (Chen, Wang & Li, 2020). It also reflects the comprehensive ability of regional enterprise innovation, basic research innovation, and achievement transformation. Its core lies in the knowledge flow between regions (Huggins & Thompson, 2015). The complexity of evaluating RIC depends on the systematicity of the innovation process (Cooke, 2001). Therefore, cooperation among innovation subjects in a region is the key driving factor for the development of RIC (Bøllingtoft & Ulhøi, 2005).

Entrepreneurship policy

Lundstrom and Stevenson (2001) first focused on the entrepreneurship policy, believing that its purpose is to promote individual entrepreneurship and improve the start-up vitality of small and medium-sized enterprises in a region. It is generally believed that entrepreneurship makes an important contribution to regional development (Piñeiro-Chousa, López-Cabarcos, Romero-Castro & Vázquez-Rodríguez, 2021). In East Asian economies, as the main actor of institutional change, the government needs to take the main responsibility for regional economic competitiveness and activating the entrepreneurial spirit of small and medium-sized enterprises in the knowledge economy era (Yoon et al., 2015). This purpose can be achieved by implementing suitable policies (OECD, 2010). The key to the entrepreneurship of small and medium-sized enterprises lies in the knowledge flow between innovation networks (Lin & Ha, 2015). The government needs to formulate convenient policies for the main participants of RIS to improve the initiative of each innovation subject to absorb knowledge and its ability to transform this knowledge (Huggins & Thompson, 2015).

Many scholars have examined the role of policies in stimulating RIC (Doloreux & Parto, 2005; Levén, Holmström & Mathiassen, 2014). Some of these studies examined how policymakers can improve RIC by focusing on the roles of specific actors in regional innovation, such as universities, small and medium-sized enterprises, start-ups, and technology transfer institutions (Asheim, Isaksen, Nauwelaers & Tödtling, 2003).

To explore the impact of policies on RIC, this study classifies entrepreneurship policies and considers them as the most important parts of RIS. When formulating entrepreneurship policies, the government should consider the three spiral subjects of innovation proposed by Etzkowitz (2002), namely universities, enterprises, and the government. Since the entrepreneurship of small and medium-sized enterprises in East Asia depends on the entrepreneurial capital support provided by the government (Sternberg & Müller, 2005), the former needs fiscal and tax investment. Further, human capital is one of the important driving factors for the development of RIC (Asheim, Smith & Oughton, 2011). Therefore, this study includes the fiscal and tax policies as well as the talent policies into the government's guarantee policies for innovation subjects and identifies five types of entrepreneurship policies.

Influence of the technology transfer policy on regional innovation capability

The ability to transform scientific and technological achievements into productivity is an important indicator of the level of scientific and technological development of a country or region (Gong, Duan, Wang, Wang & Zhou, 2019). In practice, enterprises, universities, and research institutions have formed strategic alliances to jointly promote the transformation of scientific and technological achievements, which has a positive impact on innovation capability (Peng, Wang, Wang, Shang & Zhang, 2020). As many scientific and technological achievements have been rapidly accomplished, technology has improved exponentially, resulting in a large number of high-tech enterprises, industrial clusters, and an effective improvement of RIC (Lin, Xie, Hao & Wang, 2020). Therefore, this study puts forward the following proposition:

Proposition 1. The existence of a technology transfer policy leads to high RIC.

Influence of the fiscal and tax policy on regional innovation capability

A fiscal and tax policy, mainly in the form of financial subsidies and tax incentives, promotes innovation and productivity growth by encouraging start-ups to enter the market (Aghion, Cai, Dewatripont, Du, Harrison & Legros, 2015). The interaction between tax incentives and enterprise R&D investment is conducive to improving enterprise innovation performance (Dai & Chapman, 2022). Enterprise financing policies can also improve RIC, and an appropriate fiscal and tax policy can stimulate enterprises to produce invention patents and provides a favorable environment for independent innovation (Qi, Peng & Xiong, 2020). In general, fiscal and tax policies can directly support enterprise innovation activities, where the enterprise innovation index is an important reflection of RIC (Fan, Lian & Wang, 2020). Therefore, this study puts forward the following proposition.

Proposition 2. The existence of a fiscal and tax policy leads to high RIC.

Influence of the digital transformation policy on regional innovation capability

The transformation of the real economy, including a digital transformation policy, affects the competitiveness of innovation systems, especially the changes related to resource demand, network processes, and communication mechanisms in entrepreneurial activities (Satalkina & Steiner, 2020). Enterprise digital transformation has thus become an inevitable development trend. However, due to obstacles such as the large financial burden, technical obstacles, and talent shortage, innovative small and medium-sized enterprises now face an arduous task (Gamache, Abdul-Nour & Baril, 2019). In response, the government should launch a series of digital transformation policies to help enterprises cope with the complexity of transformation and realize the sharing of information, knowledge, data, and technology to enhance the cooperation ability of RIS and effectively improve RIC (Hao & Zhang, 2021). Therefore, this study puts forward the following proposition:

Proposition 3. The existence of a digital transformation policy leads to high RIC.

Influence of the talent policy on regional innovation capability

Talent is the foundation and core of innovation activities (Bajwa et al., 2017). Facing a talent shortage and difficulties in introducing high-quality talent, Guangdong, Hong Kong, and the Macao Dawan district have issued a series of policies such as housing subsidies for high-level talent (Chen & Tao, 2020). Cities with better employment opportunities and more convenient lifestyles may attract more innovative talent than cities with strong economic growth (Wang, 2020). Therefore, the government can retain high-quality talent by creating employment opportunities and a good living environment. As a talent policy plays an important role in attracting talent and promoting innovation, this study puts forward the following proposition:

Proposition 4. The existence of a talent policy leads to high RIC.

Influence of the government innovation management policy on regional innovation capability

The government can transform the management mode and enhance RIC by improving government efficiency and supervision quality (Oluwatobi, Efobi, Olurinola & Alege, 2015). Another study found that fewer entrepreneurial procedures and wider cultural awareness can increase the possibility of entrepreneurial success (Urbano & Alvarez, 2014). E-government services launched by the government can simplify the processes and steps required for entrepreneurship, reduce entrepreneurs' time and money costs, and promote enterprise innovation (Das & Das, 2021). Further, entrepreneurial activities and publicity by the government can be conducive to the construction of entrepreneurial culture and encourage entrepreneurship. Therefore, this study puts forward the following proposition:

Proposition 5. The existence of a government innovation management policy leads to high RIC.

Research methodology

Method selection

This study used fsQCA to study how the entrepreneurship policies of 31 provinces in China jointly affect innovation capability. QCA can fully compare and analyze cases using Boolean logic and algebra, it can explore the joint effect of the interaction of multiple antecedents on specific phenomena (Ragin, 2008). QCA studies involve learning about unknown facts by using what information people do know (Thomann & Maggetti, 2020); the present study follows this logic. According to the types of variables, QCA can be divided into three types: crisp-set QCA (csQCA), multi-value QCA (mvQCA), and fuzzy-set QCA (fsQCA). The reasons for choosing fsQCA are as follows. First, compared with csQCA and mvQCA, it adopts a higher consistency standard and has more stringent results (Rihoux & Ragin, 2008). In other words, fsQCA can better preserve the richness of the original data in a case (Herrmann & Cronqvist, 2009) and make the research results reproducible and transparent. Second, fsQCA is rarely used in social science, and existing studies (López-Cabarcos, Vázquez-Rodríguez & Piñeiro-Chousa, 2016) show that fsQCA is feasible when analyzing causal complexity in social science. It is consistent with the analytical logic of this study. Third, it is suitable for small sample research (Fiss, 2011; López-Cabarcos, Vázquez-Rodríguez & Quiñoá-Piñeiro, 2022), especially when using countries or regions as the analysis unit (Beynon, Jones & Pickernell, 2020), which is again suitable for this study's purpose. The following steps are followed in fsQCA: calibration, necessity analysis, and sufficiency analysis (Schneider & Wagemann, 2010).

Previous studies have used fsQCA to analyze the impact of entrepreneurship policy on innovation activities (Jabeur, Mefteh-Wali & Carmona, 2021; Xie, Wang, Xie, Dun & Li, 2021), but viewed entrepreneurship policy as a single antecedent. Different from previous studies, this study focuses on the interaction of various entrepreneurship policies and discusses how the combination of entrepreneurship policies affects RIC, which is an innovative approach.

Data collection

Taking 31 provinces in China as the sample, this study used Python3, a data capture software, to retrieve data from the websites of provincial governments. The study collected continuous and effective entrepreneurship policies from July 27, 2017, to December 11, 2021 (from the date of document release to the date of obtaining the result variable data).

The conditional variable of this study comes from the idea of "strengthening the implementation of innovation driven development strategy and further promoting the in-depth development of mass entrepreneurship and innovation" issued by the State Council of China in 2017. Five antecedent conditions are set for the five policies: technology transfer policy (TTP), fiscal and tax policy (FTP), digital transformation policy (DTP), talent policy (TP), and government innovation management policy (GIMP). This study takes the specific policy terms as the basic analysis unit and encodes them according to the five entrepreneurship policies. After excluding invalid clauses, the policy clauses are counted.

The RIC index used in this study comes from China's regional development evaluation report, titled "Evaluation Report of China's Regional Innovation Capability in 2021". With the support of the Ministry of Science and Technology of China, the report was prepared by the China Science and Technology Development Strategy Research Group in conjunction with the University of the Chinese Academy of Sciences. The report establishes a four-level index system as the main evaluation method. The first level index includes knowledge creation, knowledge acquisition, enterprise innovation, innovation environment, and innovation performance, reflecting enterprise innovation, basic research and original innovation, achievement transformation, etc. in all regions of China. Table 1 provides more details on the outcome and conditions.

Calibration and measurement

Under fsQCA, calibration is the process of assigning collective membership to cases, where the calibrated collective membership is between 0 and 1 (Ragin, 2008). Commonly used calibration methods may be either direct or indirect (Pappas & Woodside, 2021). For direct calibration, exactly three qualitative breakpoints are needed to define the membership levels of full input, intermediate, and full output in the fuzzy set. For indirect calibration, there is the need to rescale the measurement range accordingly. Studies usually use three thresholds of 0.95, 0.5, and 0.05 for direct calibration (Ragin, 2008). However, the setting of a threshold should be adjusted according to the situation and should not be selected mechanically (Pappas & Woodside, 2021). Because the data in this study do not completely follow a normal distribution and are slightly skewed, if calibrated according to the above threshold, the effectiveness of the configuration will be reduced. Referring to existing studies (Fiss, 2011; Romero-Castro, López-Cabarcos & Piñeiro-Chousa, 2022), this study sets the full membership points of five antecedents and one result variable as the upper quartile (75%) of the case data, the intersection points as the median (50%) of the case data, and the complete non-membership points as the lower quartile (25%). See Table 2 below for the anchor point calibration.

Table 1
Description and format of the outcome and conditions.

Type	Name	Description	Format
Outcome	RIC	China's regional innovation capability	Fuzzy value
Condition	TTP	number of technology transfer policies	Fuzzy value
Condition	FTP	number of fiscal and tax policies	Fuzzy value
Condition	DTP	number of digital transformation policies	Fuzzy value
Condition	TP	number of talent policies	Fuzzy value
Condition	GIMP	number of government innovation management policies	Fuzzy value

Table 2
Calibration of variables

Variable classification	Variable name	Fully in	Crossover	Fully out
outcome variable	RIC	31.955	26.750	23.640
antecedent condition	TTP	22.000	15.000	10.000
	FTP	19.500	14.000	8.000
	DTP	20.500	14.000	6.500
	TP	33.000	20.000	16.000
	GIMP	40.500	31.000	14.500

Results

Necessity analysis

The fsQCA software was used to detect the necessary conditions, and the results are shown in Table 3. The necessary condition facilitates the occurrence of an event. According to the literature (Amara, Rhaiem, & Halilem, 2020; Beynon et al., 2020), the consistency threshold of the necessity analysis is set at 0.9. Table 3 lists the results of the necessity analysis. The necessary consistency of the single antecedent condition on high or low RIC is below 0.9, indicating that no single policy type is necessary for high or low RIC. In other words, a single policy category has insufficient explanatory power for high RIC. Therefore, it is necessary to further analyze the combined effect of antecedent conditions.

Sufficiency analysis

After determining that a single antecedent condition does not constitute a necessary condition for high RIC, the study further analyzes the conditional combination of the five conditional variables to obtain the entrepreneurship policy combination path. This study adopts the consistency threshold in the range of 0.75–0.85, as established by Ragin (2006), or the natural discontinuity value of consistency score for truncation (Crilly, Zollo & Hansen, 2012). Based on Ragin (2006), this study sets the consistency threshold to 0.75 and the case frequency threshold to 1 to obtain the truth table. The core solution is generally used to determine the number of configurations and antecedents, while the reduced solution is used to determine the intermediate conditions. According to Fiss (2011), the condition appearing in the reduced solution is the core condition, indicating a strong causal relationship with the result variable. The condition that appears in the core solution, but not in the reduced solution, is the peripheral condition, which has a weak relationship with the result variable. Additionally, some definitions need to be provided as follows. Consistency refers to the degree to which a case corresponds to

Table 3
Necessity analysis of variables

antecedent condition	high RIC		low RIC	
	Consistency	Coverage	Consistency	Coverage
TTP	0.695	0.776	0.370	0.341
~TTP	0.410	0.440	0.757	0.673
FTP	0.710	0.761	0.408	0.361
~FTP	0.404	0.452	0.730	0.675
DTP	0.655	0.719	0.404	0.367
~DTP	0.423	0.462	0.691	0.624
TP	0.679	0.754	0.420	0.386
~TP	0.447	0.483	0.733	0.654
GIMP	0.700	0.759	0.354	0.318
~GIMP	0.371	0.410	0.731	0.668

Table 4
Configuration of high RIC

	H1		H2	H3
	H1a	H1b		
TTP	●	●		●
FTP	•	•	•	○
DTP	•		•	○
TP		•	•	○
GIMP	●	●	●	○
Consistency	0.815	0.850	0.826	0.918
Raw coverage	0.503	0.503	0.517	0.105
Unique coverage	0.036	0.040	0.054	0.055
Solution consistency	0.822			
Coverage of solution	0.652			

Notes: black circles indicate the presence of the condition; ○ white circles indicate the absence of the condition; ● large circles indicate a core condition; • ○ small circles indicate peripheral solution; and blank cells indicate that the condition is not relevant within that configuration.

the set-theoretic relationship expressed in the solution (Fiss, 2011). It is an important indicator to measure the necessary conditions. Coverage indicates how many cases have high membership in the outcome condition (Skarmeas, Leonidou & Saridakis, 2014). Coverage measures the degree to which the subset covers the target set and is used to measure the empirical correlation of the necessary conditions. Coverage includes raw coverage, unique coverage, and solution coverage (Ragin, 2008). Raw coverage refers to the proportion of cases covered by a given configuration; unique coverage refers to the degree to which a single configuration explains the results after excluding the common parts with other configurations; solution coverage refers to the proportion of cases in the outcome that is explained by the complete solution. The results show that there are three configurations (see Table 4) that can produce high RIC, namely H1, H2, and H3. Since the core conditions of H1a and H1b are the same, they constitute a second-order equivalent configuration. Additionally, the coverage of the solution is 0.652, indicating that the solution covers most cases with high RIC.

Configurations H1a, H1b, H2, and H3 are the combinations that yield high RIC. Configurations H1a and H1b are second-order equivalent configurations. According to Configuration 1a, 50.3% of the cases suggest that RIC is high when a region has a large amount of TTPs, FTPs, DTPs, and GIMPs. Among them, TTP and GIMP are the core conditions, and they play the most important roles. FTP and DTP are peripheral conditions that also affect high RIC. In Configuration H1a, TP has no effect on the outcome. The consistency score is 81.5%. According to Configuration 1b, 50.3% of the cases indicate that high RIC is achieved when there is a large number of TTPs, FTPs, TPs, and GIMPs. TTP and GIMP are core conditions, and they are most important for high RIC. FTP and TP are peripheral conditions and do not play a major role. DTP has no effect on the outcome. The consistency score is 85%.

According to Configuration H2, 51.7% of the cases show that RIC is high when there is a large number of FTPs, DTPs, TPs, and GIMPs. GIMP is the core condition, and it plays the most important role. FTP, DTP, and TP are peripheral conditions and do not play a major role. TTP is not significant for the results. The consistency score is 82.6%.

According to Configuration H3, 10.5% of the cases in this study suggest that RIC is high even if it lacks FTPs, DTPs, TPs, and GIMPs, as long as it has enough TTPs. The consistency score is 91.8%.

Robustness check

There are three common robustness tests: changing calibration, changing the consistency threshold, and adding and deleting cases (Schneider & Wagemann, 2012). In this study, the consistency threshold is increased to 0.8, the frequency threshold is still 1, and the configuration obtained from the analysis remains unchanged, which shows that the analysis results are reliable.

Discussion

Comparing the results with the previous literature

Many studies cited in this paper showed an obvious positive correlation between the transformation of scientific and technological achievements and regional innovation capability (Gong et al., 2019; Lin et al., 2020; Peng et al., 2020). This study builds on these studies by investigating the impact of TTP on RIC and how TTP relates to other types of entrepreneurship policies. Specifically, the intellectual property and marketization policies of scientific and technological achievements in TTP promote the transformation of scientific and technological achievements of enterprises into real productivity. This corroborates previous research (Guan, Mok, Yam, Chin & Pun, 2006) in that technology transfer is a key factor in innovation performance and economics. Chinese enterprises should focus on technology absorptive capacity (Cohen & Levinthal, 1989), and the government should introduce more policies to improve the ability of enterprises in this regard.

According to some studies (Dai & Chapman, 2022), tax incentives for high-tech enterprises stimulate their R&D and help emerging economies achieve innovation-led economic growth. The results also suggest that FTP is related to RIC as it helped companies stimulate more aggressive and substantive innovation activities, especially small and medium-sized enterprises that have been hit by the COVID-19 pandemic.

Some studies have used panel measurement models to examine the relationship between digital transformation and firm performance (Peng & Tao, 2022). They believed that digital transformation could stimulate business innovation. Our results agree with them. The results show that high RIC can be produced when DTP is combined with TTP, FTP, and GIMP. Therefore, the results support propositions 1, 2, and 3. These conditions positively affect RIC.

According to the literature cited in this paper, talent plays an important role in innovation activities (Bajwa et al., 2017; Chen et al., 2020; Wang, 2020). As the results of this study show, provinces with a large amount of TP have high RIC. In addition, research on corporate green innovation (Lian, Xu & Zhu, 2022) showed that, limited by factors such as talent, compared to large companies, it was more difficult for small companies to conduct green innovation. Therefore, the government can retain high-quality talent by creating employment opportunities and a good living environment and help small and medium-sized enterprises to gather talent to improve regional innovation capability. Therefore, proposition 4 is supported.

Government innovation management is related to RIC (Oluwatobi et al., 2015). Research pointed out that the construction of digital government promotes enterprise innovation, allowing firms to interact with the government on digital innovation issues (Wang, Li, Tian & Hou, 2022). This study agrees with this view. The results show that provinces with a large number of GIMPs have high RIC. The government facilitates enterprise innovation by simplifying government approval procedures and building a digital government. Therefore, proposition 5 is supported.

Theoretical implications

The findings of this study enrich theoretical research on RIC. Specifically, this study examines how a mix of entrepreneurship policies affects Chinese RIC. Consistent with previous research that entrepreneurship policies can drive innovation (Oluwatobi et al., 2015; Guo & Niu, 2021; Hao & Zhang, 2021; Liu & Bai, 2021; Liu, Xu, Zhao, Xiao & Li, 2021), this study clearly identifies three entrepreneurship policy combinations. Inspired by research on RIS in East Asian

economies (Yoon et al., 2015), this study explores the entrepreneurship policy mix that promotes RIS entrepreneurship in East Asian economies, and uses data to confirm the transition of RIS to mature RIS in China, thus further refining previous research findings. Finally, this study confirms the important role of TTP and GIMP on RIC enhancement. In conclusion, this study echoes previous research related to the intersection of innovation and entrepreneurship concepts, that is, further research on the intersection of innovation, entrepreneurship and knowledge (IEK) will help policymakers to develop more effective policy measures to promote regional growth (Piñeiro-Chousa et al., 2020).

Another important contribution of this study is related to the research method and the scope of the research object. From a methodological point of view, previous research regards entrepreneurship policy as a single antecedent condition and does not consider the combined effect of different policies. This has imposed certain limitations on our understanding of the role of policies. This study uses fsQCA to study the comprehensive effects of five types of entrepreneurship policies and reveals the role of different entrepreneurship policy combinations in promoting knowledge flow and improving innovation capability. As an extension of previous research, it especially emphasizes the important role of GIMP. In terms of the scope of research objects, previous studies on China's regional innovation capability are confined to some regions (He, Li, Zhang & Wang, 2018; Li, He & Zhao, 2020). This study takes policy texts from 31 provinces in China as the research object, covering both economically developed and underdeveloped regions, and the results are therefore more comprehensive.

Managerial implications

This study has practical management significance for multiple regional policy makers. First, economically developed provinces (e.g., Guangdong and Hubei) or underdeveloped provinces (e.g., Shaanxi and Anhui) can achieve high RIC through different paths. When formulating entrepreneurship policies, policymakers should fine-tune the policies in line with the local economic and technological level to narrow the regional innovation gap and build an innovative country.

Second, in economically underdeveloped areas, policymakers should formulate policies to transform scientific and technological achievements, including the transformation of achievements, and the protection of intellectual property rights, to prevent the loss of innovation resources to other areas. In economically underdeveloped areas, the market demand and interest drive are insufficient, and the accumulation of innovation is weak (Xu, Qiu, Jin, Cheng & Zhu, 2022). TTP can alleviate the loss of innovation resources and promote new innovations. Third, policymakers should not ignore the role of GIMP, especially in East Asian economies that are deeply influenced by government efficiency and decision-making. Such countries should strive to simplify government processes and create a culture of innovation, which is conducive to creating an effective and transparent innovation environment.

Limitations and directions for future study

This study has some limitations. First, the policies captured in this study are not comprehensive enough. Some entrepreneurship policies may only be available offline or deleted due to expiration, and researchers may not be able to access all entrepreneurial policy texts. This is a reminder for future researchers to fully consider various obstacles before obtaining policy samples and to try to overcome them to obtain comprehensive samples.

Second, in terms of research methodology, due to the lack of time contingency factors in fsQCA (Beynon et al., 2020), this study only discusses the static impact of entrepreneurship policy on RIC. Future studies could include time-varying factors to explore the dynamics of RIC. This study uses fsQCA to confirm the synergistic effect of entrepreneurship policies on high RIC, but the results do not show the strength of the impact of each policy. This could be measured by other methods in future studies. This study focuses on configurations that produce high RIC and does not present configurations that produce low RIC. However, the results related to low RIC configuration can also provide lessons for policymakers. Therefore, studying the entrepreneurship policy configuration of low RIC in the future could have practical significance.

Third, the role of other factors is not carefully considered in this study. Therefore, for a more in-depth analysis of RIC, future research should fully consider the relationship between various factors such as culture, institutional background, educational policy, and regional development.

Conclusion

This study explores the complex causal mechanism of multiple entrepreneurship policies on RIC, including TTP, FTP, DTP, TP, and GIMP. A single entrepreneurship policy does not necessarily lead to high RIC, but a combination of multiple entrepreneurship policies can lead to high RIC. The results of this study show that among the five entrepreneurship policies, TTP and GIMP have a more pronounced impact on RIC and play a more vital role in entrepreneurial RIS. This observation helps us understand the relationship between entrepreneurship and innovation concepts. There are three paths through which high RIC can be achieved: (1) driven by the transformation of scientific and technological achievements and government services; (2) driven by government services; (3) driven by the transformation of scientific and technological achievements. The results of these paths will help decision-makers better understand the decision-making mechanisms. In the context of different countries, IEK is a topic worthy of constant exploration. The results of this study greatly contribute to understanding this valuable topic.

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