Journal of Organizational and End User Computing
Volume 35 • Issue 3

Research on the Impact of Enterprise Innovation and Government Organization Innovation on Regional Collaborative Innovation

Yingjing Chu, Zhengzhou University, China*
Liyuan Pang, Zhengzhou University, China
Fairtown Zhou Ayoungman, Zhengzhou University, China

ABSTRACT

Improving the regional innovation system and developing new organizational innovations to continuously enhance regional innovation capabilities are key measures for building a regional innovation hub and achieving high-quality economic development. This study first theoretically elucidates the impact mechanism of enterprise innovation agglomeration and government policy uncertainty on regional innovation capability, and thus clarifies such impact on regional organizational innovation. Based on urban panel data, this article empirically analyzes their impact on regional innovation. Based on the research results, the agglomeration of manufacturing industry in cities can significantly improve regional innovation capabilities. The policy uncertainty brought about by the mobility of municipal party secretaries has a restraining effect on the enhancement of regional innovation capabilities. The higher the degree of marketization in a city, the more significant the role of manufacturing agglomeration in enhancing regional innovation capabilities, thereby weakening the inhibitory effect of policies.

KEYWORDS

degree of marketization, industrial agglomeration, policy uncertainty, regional innovation

1. INTRODUCTION

The report of the 19th National Congress of the Communist Party of China (CPC) pointed out that innovation is the primary driving force for development and provides the strategic support for building a modern economic system. Over the past 70 years since the founding of the People's Republic of China, China's research and development (R&D) investment has maintained rapid growth, with the scale of investment consistently ranking second in the world, and scientific and technological

DOI: 10.4018/JOEUC.328073
*Corresponding Author

innovations have produced remarkable results, but there are still outstanding challenges, such as the low level of innovation and the lack of optimization of the innovation environment. Currently, regional innovation capacity, as an important component of national innovation capacity, is a key means for realizing regional industrial restructuring and upgrading and the main driving force for the high-quality development of the regional economy. How to accelerate improvements in regional innovation capacity and realize the transformation to innovation-driven economic growth will be urgent issues for local officials in the future. The investment, environment, talent, policies, and carriers of innovation are key factors that affect innovation-driven regional development (Li et al., 2016; Furman and Hayes, 2004). Industrial agglomeration is a form of spatial organization formed based on the deepening of the division of labor. It has the dual advantages of market and enterprise and can enhance industrial competitiveness and optimize resource allocation (Xie and Yuan, 2016), thereby becoming an important carrier to enhance regional innovation capacity. Regional industrial agglomeration is not only the increase in capital and the number of enterprises but also, more importantly, the collection of technology, knowledge, and talent. The convergence and flow of innovation resources within the industry provide a good foundation and environment for enterprises to engage in innovation activities, inject diverse impetus into enhancing regional innovation capacity, and improve state power and discretion (Zhou, 2007). Currently, the government provides support by encouraging and guiding enterprises to engage in innovation activities and consolidating regional innovation systems. Therefore, exploring a pathway for enhancing regional innovation capacity at the level of industrial agglomeration has become a focal issue for academics and local government decision makers.

Under China's existing political system, local officials play important roles in technological innovation. The various preferential policies for innovation introduced by local officials are often the focus of attention of innovation actors in a region, and policy changes often affect their innovation behavior. The turnover of key local officials is often accompanied by changes in funds, policies, and management styles, and the arrival of new officials reinforces the uncertainty of relevant regional policies, increasing the crowding-out effect of corporate financial asset allocation on innovation investment (Ya et al., 2018; Bhattacharya et al., 2017; Huseyin and Mihai, 2013; Pástor et al., 2013). Therefore, avoiding and reducing the impact of policy uncertainty on regional innovation activities caused by the turnover of key local officials has important practical significance for addressing the existing barriers facing regional innovation activities and enhancing regional innovation capacity.

On this basis, this study uses empirical tests with micro-city panel data from China to examine the impact of industrial agglomeration and policy uncertainty on regional innovation capabilities. Existing literature extensively explores the impact of industrial agglomeration on regional innovation, but seldom considers the influence of policy uncertainty on regional innovation capabilities. There is minimal research on the policy impacts within government organizational behavior, which is an essential research focus of this paper, investigating its influence on regional collaborative innovation. Therefore, this study primarily probes into the mechanisms of how policy uncertainty, brought about by major city officials' turnover, affects regional innovation capabilities, providing empirical evidence for exploring and understanding the influence of local governments on regional innovation capabilities. Additionally, this study investigates the role of market forces in the impact of industrial agglomeration and policy uncertainty on regional innovation capabilities, serving as a reference for local governments to improve market environments, promote regional innovation, and achieve high-level innovation for the high-quality development of regional economies.

2. LITERATURE REVIEW AND RESEARCH HYPOTHESES

The theory of industrial agglomeration can be traced back to Marshall, after whom relevant economists and new economic geographers have also systematically elucidated the phenomenon of industrial agglomeration. The self-agglomeration of industries in a given space can improve the living standards of residents in the agglomeration area, promote regional technological progress, and enhance regional industrial competitiveness (Chen and Hu, 2008; Syverson, 2004) and can also significantly enhance the quality of exported products by Chinese enterprises (Su et al., 2018). Additionally, industrial agglomeration in the form of a specialized economy can have a positive and significant influence on total factor productivity growth (Fan et al., 2014; Baldwin et al., 2010; Brandt et al., 2012). In addition, industrial agglomeration can increase the probability and intensity of enterprises engaging in innovation activities while alleviating their financing constraints (Mao, 2015). A number of researchers have studied industrial agglomeration and regional innovation capacity. Carlino et al. (2007) noted that, in the United States, the agglomeration economy is highly correlated with regional innovation capacity and that, when the degree of agglomeration (measured by employment density) in a region is twice as high as that in another region, the number of patents per capita in the former region is 20% higher than that in the latter region. Peng and Jiang (2011) argued that both MAR and Jacobs externalities can significantly promote regional innovation. In terms of specific industries, Ni and Li (2017) concluded that manufacturing industry agglomeration can effectively interact with local human capital and enhance regional innovation capacity (Toulemonde, 2006). Yang et al. (2016, 2013) proposed that high-tech industrial agglomeration can promote technological innovation. Productive service industry agglomeration can significantly contribute to technological innovation, and manufacturing industry agglomeration shows an inverted U-shaped relationship with technological innovation (Yuan and Guo, 2018; Zhao and Zheng, 2012; Overman et al., 2001). Han et al. (2017) carried out an empirical analysis using a spatial econometric model, concluding that industrial agglomeration has a positive effect on innovation output. The influence of industrial agglomeration on regional innovation capacity mainly manifests as the influence of industrial agglomeration on the technological innovation capacity of enterprises in the cluster (Du et al., 2018; Bruelhart and Mathys, 2008; Andersson et al., 2005). At the micro level, industrial agglomeration plays a significant role in promoting enterprise innovation decision making and new product output (Du and Li, 2015; Zhang, 2015). Industrial agglomeration refers to a high concentration of a large amount of production factors, such as capital, human resources, and technology; these factors that are considered micro actors of an enterprise, along with different innovation actors in the agglomeration area gradually form a regional innovation network through the flow of innovation factors such as resources, information, and technology, thus enhancing the regional innovation capacity. There are two main paths for industrial agglomeration to enhance regional innovation capacity. One is the external effect path. The agglomeration of similar industries in a certain region can facilitate, at low transaction costs, the flow and sharing of innovation factors such as technology, knowledge, and information within the industries, forming an innovation network and platform among the industries and generating a positive external effect, represented by technology and knowledge spillovers. This external effect can stimulate innovation actors within the industries to increase R&D investment, improve the innovation level, and ultimately enhance the innovation capacity of the entire region. The other is the competitive effect path. The spatial agglomeration of industries intensifies competition among enterprises. To gain an advantageous position and increase profit margins, enterprises will increase investment in technological innovation, improve their overall innovation capacity, and thereby enhance the innovation capacity of the region where the industries are located. Based on the above literature and theoretical analysis, the first hypothesis is proposed:

H1: With all other conditions unchanged, industrial agglomeration improves the overall regional innovation capacity.

Currently, China's market system is still imperfect, and the "visible hand" of the government still plays an important role as a resource coordinator, directly or indirectly affecting the normal business and investment activities of enterprises (Luo et al., 2016; Durnev, 2010). Enterprises often make choices based on existing policies, and thus, policy uncertainty can cause unexpected losses

(Deng, 2018; MN Jucá and Fishlow, 2020; Liu et al., 2017). Shi et al. (2020) found that the rotation of officials significantly promotes enterprise innovation, including the innovation investment, quantity, and quality of enterprises. Julio and Yook (2012) argued that the political uncertainty caused in election years can affect the investment expenditure of enterprises. Policy uncertainty due to local officials can significantly exacerbate the market risks faced by local enterprises (Luo and Shi, 2018). Hao et al. (2016) noted that economic policy uncertainty affects enterprises' R&D inputs through investment mechanisms and thus influences enterprises' innovation behavior. The policy uncertainty due to the turnover of local officials can reduce the innovation efficiency of enterprises (Chen et al., 2016). Johnstone et al. (2011) argued that the environmental policy uncertainty due to the turnover of local officials reduces the incentives of enterprises to identify innovative technologies. In addition, researchers have also investigated the relationship between policy uncertainty and regional innovation. Huang and Yuan (2018) carried out an empirical analysis using a GMM, finding that the turnover of local officials weakens the promoting effect of regional industry-university-research collaborative innovation. In addition, Wu (2015) used provincial panel data to empirically reveal that the turnover of provincial party secretaries has a negative impact on regional innovation capacity. Therefore, the policy uncertainty caused by the turnover of local officials can disrupt enterprises' expectations for innovation activities, in addition to investments in, and choice of such activities, thus affecting the motivation of micro-innovation actors, and in turn inhibiting the enhancement of regional innovation capacity. "Primary leaders" often exist in local parties and governments within China's political system, with municipal party secretaries often controlling the major policies in cities; hence, the turnover of municipal party secretaries in a region often has an enormous impact on various policies in the region. Therefore, the turnover of regional municipal party secretaries is used in this study as a proxy variable for policy uncertainty. Based on the above literature and theoretical analysis, the second hypothesis is proposed:

H2: With all other conditions unchanged, the policy uncertainty caused by the turnover of municipal party secretaries inhibits the regional innovation capacity.

3. EMPIRICAL DESIGN

3.1 Samples and Data Sources

To test the above research hypothesis, enterprises in the China Industry Business Performance Data from 2004 to 2013 were selected as the sample to measure manufacturing industry agglomeration. This is an annual database established under the National Bureau of Statistics and includes the basic information and financial data of enterprises. However, Nie et al. (2012) have noted that this database has problems such as sample mismatching, missing indicators, and abnormal indicators. Based on the approach described by Du and Li (2015), the original data were adjusted as follows: (1) observations with missing indicators (e.g., number of employees, gross industrial output value, and sales) were excluded; (2) observations that did not meet the "above-scale" criterion, i.e., net value of fixed assets less than 5 million yuan or sales less than 5 million yuan, were excluded; and (3) some observations that clearly did not conform to accounting principles (e.g., total assets less than net fixed assets) were excluded. In view of the city matching and research needs of the China Industry Business Performance Data, 47 large and medium-sized cities were selected as the research objects. The policy uncertainty variable used for each city was the turnover of the municipal party secretary of that city, with relevant data mainly obtained through Internet searches and information retrieval. The data for regional innovation capacity were primarily obtained from the local science and technology statistical yearbooks of the provinces where the cities are located and the website of the Intellectual Property Office from 2004 to 2013. Partially missing data were completed using the moving weighted average method.

3.2 Variable Selection

(1) Explained variables. There are diverse indicators for measuring regional innovation capacity, including number of patents, new product sales revenue, and volume of technology transaction contracts. In particular, patents contain a large amount of innovation and technology information, are subjected to stringent audit criteria, and can scientifically reflect the innovation capacity of a region. Therefore, this study selected number of patents granted as the basic indicator to measure regional innovation. Patents include invention patents, utility patents, and design patents. Based on the approach described by Bai and Jiang (2015), weights of 0.5, 0.3 and 0.2 were assigned to the three types of patents based on their respective degrees of innovation, and the weighted average was used as the final patent indicator, denoted as *Innovation*.
(2) Explanatory variables. The main explanatory variables in this study are industrial agglomeration and policy uncertainty. There are various methods for measuring industrial agglomeration. In this study, location entropy is used to measure the industrial agglomeration level of each city, consistent with the approach described by Fan et al. (2014) and Su et al. (2018). Using the micro data of manufacturing enterprises in the China Industry Business Performance Data, the location entropy index was constructed based on the total industrial output value and the average annual number of employees at the above-scale manufacturing enterprises, as calculated below:

$$LQ = \frac{X_{ij} / X_j}{X_i / X}$$

Where LQ is the location entropy level of manufacturing industry i in city j, and X_{ij} is the total output value and average annual number of employees at manufacturing industry i in city j, with the data obtained from the sum of the relevant data for the above-scale micro manufacturing enterprises selected from the China Industry Business Performance Data based on double-digit national economy industries. X_j is the total output value or number of employees at all industries in city j, X_i is the total output value or number of employees at manufacturing industry i in China, and X is the total output value or number of employees at all industries in China. X_j X_i, and X are the sum of the relevant data from the China Industry Statistical Yearbook based on the classification of manufacturing industries in the national economy.

The explanatory variables of policy uncertainty were considered and analyzed from the perspective of the turnover of municipal party secretaries in respective cities. Drawing on the approach described by Chen and Chen (2018) for local policy uncertainty, the turnover of municipal party secretaries in each of the 47 cities during the 2004-2013 period is used as a measure of policy uncertainty, denoted as *Policyuncertainty*, with a value of 1 for the current year if the turnover of the municipal party secretary occurred in that year and 0 otherwise. Furthermore, the source of the turnover of the municipal party secretary also has an important influence on the continuity and stability of regional policies. Specifically, if the new municipal party secretary is promoted from a pool of local cadres, he or she is more familiar with and understands the local situation, and the policies adopted after his or her appointment tend to be more consistent and stable. In contrast, if the successor is transferred to the city from a different area, time is needed for him or her to become familiar with and explore the specific local conditions; therefore, the policies adopted after his or her appointment may exhibit poor continuity and stability. Therefore, for the year in which the turnover of the municipal party secretary occurred, a value of 1 is assigned for a local promotion and 2 for a nonlocal transfer.

(3) Control variables. Based on the above review and existing research results, the control variables selected for this study include the level of urban economic development (*pergdp*), industrial structure (*seco-thir*), level of financial development (*finance*), level of openness to the outside world (*fdi*), human capital (*human*), and intensity of science and technology expenditures (*tech*). The variables are defined in Table 1.

(4)Descriptive statistics for the variables

The descriptive statistics of the main variables in the regression model are shown in Table 2. There is a considerable difference in the total number of granted patents for the three categories between different cities and different years, with a variance difference of 6.6687 after taking the natural logarithm. This suggests that there are individual characteristics of innovation capabilities

Table 1. Definitions of the variables and their calculation methods

Category	Name	Calculation Method
Explained variable Explanatory variable Control variable	Innovation LQ Policyuncertainty pergdp seco-thir finance fdi human tech	ln (weighted total number of three patents granted in the city) Construction of location entropy based on the manufacturing industry (total output value, number of employees) in the city 1 = turnover of municipal party secretary; 0 = otherwise 1 = local promotion; 2 = nonlocal transfer ln (actual total GDP of the city in the current year / total population of the city in the current year) Proportion of the secondary industry in GDP of the city / proportion of the tertiary industry in GDP of the city Balance of various deposits and loans of financial institutions in the city at the end of the current year / total GDP of the city in the current year Education expenditure of the city in the current year / total fiscal expenditure in the current year Science and technology expenditures of the city in the current year / total fiscal expenditure in the current year

Table 2. Descriptive statistics for the variables

Variable	Mean	Maximum	Minimum	Standard deviation
Innovation	6.8456	9.7774	3.1087	1.3843
LQ_1 (output value)	1.1047	2.3128	0.5274	0.2652
LQ_2 (number of employees)	1.2395	1.9337	0.5833	0.2155
$Policyuncertainty_1$ (presence of turnover)	0.2372	1	0	0.4258
$Policyuncertainty_2$ (presence of a change in source)	0.5580	2	0	0.8360
pergdp	10.7459	12.7434	9.1454	0.7080
seco-thir	1.1474	2.0231	0.3197	0.3886
finance	3.1883	6.6100	1.1934	1.2660
fdi	0.0388	0.1234	0.0009	0.2740
human	0.0292	0.4454	0.0034	0.6201
tech	0.0193	0.0720	0.0011	0.0158

in different cities, demonstrating significant spatial differentiation. Such differentiation can create a certain spatial spillover effect in space, which provides new content for subsequent research. Data from Table 2 suggests that the regression model needs to consider regional fixed effects.

3.3 Model Setting

Based on the above theory and variable analysis, both industrial agglomeration and policy uncertainty affect regional innovation capacity to varying degrees.

$$Innovation_{it} = \beta_0 + \beta_1 LQ_{it} + \beta_2 Policyuncertainty_{it} + \beta_3 control\,variables + \delta_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where i represents the region, t represents the year of the selected sample, β_0 is a constant term, LQ is the location entropy (measures industrial agglomeration), $Policyuncertainty$ is the policy uncertainty index, $control\,variables$ represents the set of selected control variables, and δ_i and γ_t represent the individual effect and time effect of the panel data, respectively. This study focuses on the values of β_1 and β_2. A positive value for β_1 indicates that industrial agglomeration enhances regional innovation capacity, and a negative value for β_2 indicates that policy uncertainty caused by the turnover of local officials inhibits the enhancement of regional innovation capacity.

4. EMPIRICAL RESULTS AND DISCUSSION

For the model estimation of panel data, various factors and econometric tests need to be considered before determining whether a fixed-effects model or a random-effects model should be selected. The sample data in this study are standard short panel data. First, the sample data were winsorized at the 1% level to exclude the influence of extreme values on the regression results. In addition, the Hausman test was performed on the sample data, and the results indicate that the fixed-effects model is more suitable for the sample data in this study (Prob > chi^2 = 0.0091).

4.1 Overall Regression Results

First, the overall regression was conducted using all samples; the results are provided in Table 3. Models 1 and 2 are used to analyze the influence of manufacturing industry agglomeration on the innovation capacity of the city in the absence of policy uncertainty variables; Models 3 and 4 are used to analyze the influence of policy uncertainty caused by the turnover of local officials on the innovation capacity of the city in the absence of industrial agglomeration variables; and Model 5 includes both industrial agglomeration and policy uncertainty variables. As seen in Table 3, the industrial agglomeration variables constructed based on the manufacturing output value (LQ_1) and the number of employees (LQ_2) both pass the test at the 1% level and are significantly positive, indicating that manufacturing industry agglomeration in a city can significantly enhance regional innovation capacity through the flow of innovation factors and competitive pressure, thus supporting Hypothesis 1. As seen from the regression results for Model 3, the regression coefficient of policy uncertainty (presence of turnover) is significantly negative at the 10% level, indicating that the policy uncertainty caused by the turnover of the municipal party secretary of a city has an inhibitory effect on regional innovation capacity, thus verifying Hypothesis 2. The regression coefficient for the source of turnover in Model 4 is significantly negative at the 1% level, indicating that in the year of turnover, the transfer of officials from outside the city cause local policy uncertainty to be greater, thus inhibiting the enhancement of regional innovation capacity and thus confirming Hypothesis 3. The regression results for Model 5 indicate that the regression coefficients for industrial agglomeration are positive and all pass the significance test, while the regression coefficients for policy uncertainty caused by the turnover of city officials are negative and pass the significance test, again verifying hypotheses 1 and 2. Regarding the regression coefficients for the control variables, the variables *pergdp* and *finance* in Models 1 to 5 are all significantly positive at the 1% level, indicating that continuous improvements in the economic level and financial development level of cities can play a role in enhancing regional innovation capacity. The human capital level of cities has a similar effect. Likewise, the intensity of science and technology expenditures also passes the test at different significance levels and thus improves regional innovation capacity.

4.2 Robustness Test

There are diverse indexes for identifying and measuring regional innovation capacity, among which the number of patent applications is notable. The larger the number of annual patent applications in a city, the higher is the innovation activity and the stronger is the innovation capacity of the region. Therefore, the number of patent applications in a city was selected to replace the number of patents granted. Li et al. (2017) argued that the volume contract transactions in the regional technology market per capita reflects the ability of technology to transform into economic benefits in the market and indicates the economic output capacity of regional innovation. In addition, based on the approach described Wan and Hu (2018), the number of manufacturing enterprises in the China Industry Business Performance Data was divided by the area of the administrative region of the city to construct a geographic density variable for industrial agglomeration to replace LQ_1 and LQ_2. The following

Table 3. Overall sample regression results

	Model 1	Model 2	Model 3	Model 4	Model 5
LQ1(output value)	1.291*** (0.225)				0.72*** (0.127)
LQ2(number of employees)		1.381*** (0.265)			0.85*** (0.145)
Policyuncertainty1(presence of turnover)			-0.099* (0.066)		-0.095* (0.063)
Policyuncertainty2(presence of a change in source)				-0.195*** (0.031)	-0.157*** (0.039)
Pergdp	1.352*** (0.092)	1.357*** (0.087)	1.356*** (0.086)	1.375*** (0.088)	1.461*** (0.096)
Secothir	-0.427** (0.208)	-0.426** (0.301)	-0.415* (0.206)	-0.431** (0.209)	-0.556** (0.224)
Finance	0.179*** (0.044)	0.177*** (0.040)	0.178*** (0.045)	0.173*** (0.043)	0.161*** (0.042)
Fdi	-0.012 (1.558)	-0.019 (1.561)	-0.054* (1.556)	-0.107** (1.522)	-0.143*** (1.123)
Human	0.518* (0.258)	0.540** (0.264)	0.556** (0.251)	0.533** (0.256)	0.198*** (0.116)
Tech	0.855*** (0.124)	0.858*** (0.121)	0.867*** (0.115)	0.873** (0.111)	0.292*** (0.221)
Year&city	Control	Control	Control	Control	Control
N	470	470	470	470	470
R2	0.528	0.527	0.530	0.525	0.520

Note: ***, **, and * denote that the parameter estimate passes the significance test at the 1%, 5%, or 10% level, respectively; standard errors are in parentheses.

robustness tests were conducted. First, number of patents granted was replaced. The number of patent applications and volume of technology market contracts per capita replaced the number of patents granted, and a regression analysis of the replaced variables with industrial agglomeration,policy uncertainty and control variables was conducted. Second, the industrial agglomeration variables were replaced. The constructed geographic density index for industrial agglomeration replaced the agglomeration variables industrial output value and number of employees, after which regression was performed with the explained variables. Third, Yu (2019) noted that the administrative levels of and promotion incentives for local officials in municipalities directly under the central government are significantly different from those in other cities. For this reason, samples from four municipalities directly under the central government, Beijing, Shanghai, Tianjin, and Chongqing were taken,and then regression analysis was conducted using the remaining samples. The results of all three robustness tests verify the theoretical hypotheses.

4.3 Expansion Analysis

(1) The inhibitory effect of policy uncertainty

It was verified above that the industrial agglomeration variables significantly enhance regional innovation capacity and that the turnover of officials inhibits the enhancement of regional innovation capacity. The turnover of local officials is inevitably accompanied by the transfer of political power and certain changes in policy direction (Huang and Yuan, 2018). The turnover of old and new officials brings about changes in industrial policies, affecting the innovation decisions of enterprises within the industrial agglomeration as well as the competitiveness and technological innovation inputs of the industrial agglomeration. Therefore, the influence of the interaction between policy uncertainty and industrial agglomeration on regional innovation capacity was assessed using Model 2, as follows:

$$Innovation_{it} = \beta_0 + \beta_2 LQ_{it} + \beta_3 \left(LQ_{it} \times Policyuncertain\,\mathrm{t}\,y_{it} \right) + \Theta X_{it} + \delta_i + \gamma_t + \varepsilon_{it} \qquad (2)$$

The regression results after adding the interaction terms industrial agglomeration and policy uncertainty are shown in Table 4; the results demonstrate the influence of policy uncertainty caused by the turnover of municipal party secretaries on improvements in regional innovation capacity via industrial agglomeration. Model 6 represents the influence of industrial agglomeration on regional innovation capacity in the presence of the LQ_1-based multiplicative interaction term; Model 7 represents the influence of industrial agglomeration on regional innovation capacity in the presence of the LQ_2-based multiplicative interaction term; and Model 8 represents the influence of industrial agglomeration on regional innovation capacity in the presence of all multiplicative interaction terms in the regression. The regression results for the control variables are not shown due to space limitations (the same below).

As seen in Table 4, after the interaction term is added to the model, the regression coefficients of the industrial agglomeration variables pass the significance test, and the signs of the regression coefficient values do not change, indicating that industrial agglomeration still has an enhancing effect on regional innovation capacity. Therefore, Hypothesis 1 is again confirmed. The regression coefficients of LQ_1 and LQ_2-based interaction terms are both negative and pass the significance test at different levels, indicating that the turnover of the municipal party secretary has an inhibitory effect on improving regional innovation capacity via industrial agglomeration. In addition, the regression coefficients of industrial agglomeration variables are reduced to different degrees compared with the results of the earlier full-sample regression, once again confirming the inhibitory effect of policy uncertainty caused by the turnover of municipal party secretaries.

(2) Role of market forces

In general, the more prominent the absence of market mechanisms, the more reasonable and justified is an intervention by government forces (Han et al., 2017). The turnover of officials causes changes in policy measures regarding industry and technological innovation, and cities with well-developed market mechanisms enable the optimal allocation of regional innovation resources. If new officials are committed to promoting local economic growth and enhancing the innovation capacity of their jurisdictions, they need to use market forces to optimize the allocation of resources to industries and enterprises with higher innovation efficiency. On this basis, empirical Models 3 and 4 were used to examine the influence of the multiplicative interaction term between industrial agglomeration and market forces and the multiplicative interaction term between policy uncertainty and market forces, respectively, on regional innovation capacity.

$$Innovation_{it} = \beta_0 + \beta_1 LQ_{it} + \beta_2 \left(LQ_{it} \times Market_{it}\right) + \Theta X_{it} + \delta_i + \gamma_t + \varepsilon_{it} \tag{3}$$

$$Innovation_{it} = \beta_0 + \beta_1 Policyuncertain\,\mathrm{t}\,y_{it} + \beta_2 \left(Policyuncertain\,\mathrm{t}\,y_{it} \times Market_{it}\right) + \Theta X_{it} + \delta_i + \gamma_{it} \tag{4}$$

The marketization index of China's provinces compiled by Wang et al. (2017) was selected as a proxy variable for market forces. X_{it} represents a set of selected control variables. The regression results are shown in Table 5 and demonstrate, which demonstrates the influence of the interaction of the marketization index with industrial agglomeration and with policy uncertainty on regional innovation capacity. The regression results are noteworthy for the following two reasons. First, the regression results for both the interaction of the marketization index and industrial agglomeration and the interaction of marketization index and policy uncertainty are positive and pass the test at least at the 5% level, indicating that the combination of regional marketization and industrial agglomeration (*LQ* × *Market*) significantly enhances regional innovation capacity and that the combination of regional

Table 4. Regression results and the interaction between industrial agglomeration and policy uncertainty

	Model 6	Model 7	Model 8
LQ_1	0.933*** (0.135)		0.267*** (0.089)
$LQ_1 \times Policyuncertianty_1$	-0.098* (0.053)		-0.426*** (0.221)
$LQ_1 \times Policyuncertianty_2$	-0.480*** (0.200)		-0.130** (0.109)
LQ_2		0.674*** (0.105)	0.516*** (0.102)
$LQ_2 \times Policyuncertianty_1$		-0.164*** (0.099)	-0.364*** (0.225)
$LQ_2 \times Policyuncertianty_2$		-0.132** (0.074)	-0.080 (0.113)
Control variable	—	—	—
Year&city	Control	Control	Control
N	470	470	470
R^2	0.519	0.520	0.517

Note: ***, **, and * denote that the parameter estimate of a variable passes the significance test at the 1%, 5%, or 10% level, respectively; standard errors are in parentheses.

marketization and policy uncertainty (*Policyuncertainty1×Market*) effectively reduces the inhibitory effect of the turnover of officials on regional innovation capacity. Second, after the introduction of the marketization index, the significance and sign of the regression coefficients for industrial agglomeration and policy uncertainty remained unchanged, and both pass the test, again confirming the proposed hypothesis. In addition, the value of the regression coefficient for industrial agglomeration based on the number of employees increased, indicating that industrial agglomeration plays a strong role in enhancing regional innovation capacity in regions with a high degree of marketization.

5. CONCLUSION AND COUNTERMEASURES

This study first identified variables to measure industrial agglomeration, policy uncertainty, and regional innovation capacity, and then empirically tested and analyzed the mechanism of their effects on regional innovation capacity using city panel data. The results show that industrial agglomeration in the manufacturing industry of cities can significantly enhance regional innovation capacity, while the policy uncertainty brought about by the turnover of municipal party secretaries inhibits regional innovation capacity. This is a significant innovation point of this paper. Moreover, the policy uncertainty caused by the turnover of municipal party secretaries weakens the enhancing effect of industrial agglomeration on regional innovation capacity, thus it is necessary to consider the risks brought about by officials' turnover in regional collaborative innovation. After considering the degree of regional marketization, the higher the degree of marketization, the stronger the enhancing effect of industrial agglomeration on regional innovation capacity, effectively reducing the inhibitory effect of the turnover of municipal party secretaries on regional innovation capacity.

Table 5. Tests of the effects of the market on industrial agglomeration and policy uncertainty

	Model 9	Model 10	Model 11	Model 12
LQ_1	0.749*** (0.198)			
LQ_2		1.730*** (0.322)		
$LQ_1 \times Market$	0.082*** (0.022)			
$LQ_2 \times Market$		0.037** (0.011)		
$Policyuncertainty_1$			-0.326*** (0.109)	
$Policyuncertainty_2$				-1.137*** (0.140)
$Policyuncertainty_1 \times Market$			0.045*** (0.012)	
$Policyuncertainty_2 \times Market$				0.120*** (0.016)
Control variable	—	—	—	—
Year&city	Control	Control	Control	Control
N	470	470	470	470
R^2	0.603	0.517	0.531	0.519

Note: ***, **, and * denote that the parameter estimate of a variable passes the significance test at the 1%, 5%, or 10% level, respectively; standard errors are in parentheses.

Based on the above conclusions from the empirical analysis, countermeasures are proposed to enhance regional innovation capacity, along with suggestions and future research prospects. First, industrial agglomeration should be planned and guided to improve innovation. Specifically, enterprises in agglomerations should be selected based on diversified criteria, a platform for technology exchange and cooperation among enterprises should be built, the orderly flow of innovation resource factors should be promoted, the protection of intellectual property of agglomeration enterprises should be improved, and a good innovation environment for industrial agglomeration should be created to enhance the innovation and efficiency of regional industrial agglomerations. Second, relevant institutional mechanisms should be improved to ensure the continuity of regional innovation policies and stabilize the policy expectations of the innovation actors in the region. During turnover periods, it is necessary to focus on maintaining the continuity of policies regarding industrial and technological innovation and to avoid the blind introduction of various innovation policies and measures by officials due to their pursuit of political assessments and promotion. Third, administrative system reform should continue so as to stimulate innovation and give full play to the role of the market in optimizing the allocation of regional innovation factors. The government reform "streamline administration and delegate power, improve regulation, and upgrade services" should be expanded, innovation factors should be standardized, the transaction system should be improved, the innovation costs for innovation actors should be reduced, market forces should be used to address the obstacles and difficulties encountered by innovation actors such as enterprises and research institutes in the innovation process, and relevant factors should be maximally mobilized to enhance regional innovation capacity. In subsequent research, the author will expand the research area and quantitatively analyze the uncertainty brought about by the turnover of government officials to provide a more reasonable and scientific explanation.

REFERENCES

Andersson, R., Quigley, J. M., & Wilhelmsson, M. (2005). Agglomeration and the spatial distribution of creativity [J]. *Papers in Regional Science*, *84*(3), 84. doi:10.1111/j.1435-5957.2005.00049.x

Bai, J., & Jiang, F. (2015). Collaborative innovation, spatial correlation and regional innovation performance [J]. *Economic Research Journal*, *50*(07), 174–187.

Baldwin, J. R., Brown, W. M., & Rigby, D. L. (2010). Agglomeration Economies: Microdata Panel Estimates from Canadian Manufacturing [J]. *Journal of Regional Science*, *50*(5), 915–934. doi:10.1111/j.1467-9787.2010.00675.x

Bhattacharya, U., Hsu, P. H., Tian, X., & Xu, Y. (2017). What Affects Innovation More: Policy or Policy Uncertainty? [J]. *Journal of Financial and Quantitative Analysis*, *52*(5), 1869–1901. doi:10.1017/S0022109017000540

Brandt, L., Biesebroeck, J. V., & Zhang, Y. (2012). Creative Accounting or Creative Destruction? Firm-level Productivity Growth in Chinese Manufacturing [J]. *Journal of Development Economics*, *97*(2), 339–351. doi:10.1016/j.jdeveco.2011.02.002

Bruelhart, M., & Mathys, N. A. (2008). Sectoral Agglomeration Economies in a Panel of European Regions [J]. *Regional Science and Urban Economics*, *38*(4), 348–362. doi:10.1016/j.regsciurbeco.2008.03.003

Carlino, G. A., Chatterjee, S., & Hunt, R. M. (2007). Urban density and the rate of invention [J]. *Journal of Urban Economics*, *61*(3), 389–419. doi:10.1016/j.jue.2006.08.003

Chen, D., & Chen, Y. (2018). Policy Uncertainty and Earnings Management by Listed Companies [J]. *Economic Research Journal*, *53*(06), 97–111.

Chen, D., Jin, Y., & Dong, Z. (2016). Policy Uncertainty, Political Connection and Firms' Innovation Efficiency [J]. *Nankai Business Review*, *19*(04), 27–35.

Chen, J., & Hu, C. (2008). The Agglomeration Effect of Industrial Agglomeration——Theoretical and Empirical Analysis of the Yangtze River Delta Sub-region [J]. *Guanli Shijie*, (06), 68–83.

Deng, S., & University, S. J. (2018). *Will Political Uncertainty Affect the Cash Holding Decisions of Chinese Listed Companies?* [J]. China Economic Studies.

Du Shuang, F. J. (2018). Du Chuanzhong. The Role of Industrial Agglomeration and Market Concentration on Regional Innovation Capability——Comparison of Manufacturing Industries Based on Two Economic Circles of Beijing-Tianjin-Hebei and Yangtze River Delta [J]. *Research on Economics and Management*, *39*(07), 48–57.

Durnev, A. (2010). *The Real Effects of Political Uncertainty: Elections and Investment Sensitivity to Stock Prices* [J]. Social Science Electronic Publishing.

Fan, J., Meng, F., & Li, F. (2014). Industrial Agglomeration and Enterprise Total Factor Productivity [J]. *Japan and the World Economy*, *37*(05), 51–73.

Furman, J. L., & Hayes, R. (2004). Catching up or standing still?: National innovative productivity among 'follower' countries, 1978–1999 [J]. *Research Policy*, *33*(9), 1329–1354. doi:10.1016/j.respol.2004.09.006

Han, Y., Huang, L., & Wang, X. (2017). Do Industrial Policies Promote Industrial Structure Upgrading? Theory and Evidence from China's Development-oriented Local Government [J]. *Economic Research Journal*, *52*(08), 33–48.

Hao, W., Wei, W., & Jun, W. (2016). How Does Policy Uncertainty Influence Firm Innovation?An Effect Mechanism based on the Real Option Theory [J]. *Economic Management*, *38*(10), 40–54.

Huang, J. (2018). Yuan yijun. Collaborative innovation, local governors' turnover and technology upgrading [J]. *Studies in Science of Science*, *36*(06), 1143–1152.

Huseyin, G., & Mihai, I. Policy Uncertainty and Corporate Investment[J]. Ssrn Electronic Journal, 2013, 29.

Jian, H., Fei, T., Wu, S., & Duan, J. (2017). Industrial Agglomeration, Spatial Effect and Regional Innovation [J]. *Public Finance Review*, (08), 90–100.

Johnstone, N., Haščič, I., & Poirier, J. (2011). *Environmental policy stringency and technological innovation: evidence from survey data and patent counts* [J]. Post-Print.

Jucá, M. N., & Fishlow, A. (2020). *Political uncertainty of impeachment upon corporate investment decisions* [J]. Borsa Istanbul Review.

Julio, B., & Yook, Y. (2012). Political Uncertainty and Corporate Investment Cycles [J]. *The Journal of Finance*, *67*(1), 45–83. doi:10.1111/j.1540-6261.2011.01707.x

Kun, Y., Luo, F., & Li, Q. (2018). Economic Policy Uncertainty, Financial Asset Allocation and Innovation Investment [J]. *Finance & Trade Economics*, *39*(12), 95–110.

(2017). Liu haiyang, lin Lingtao, Huang Shunwu. Official Turnover and the Rise and Fall of Local Enterprises——An Evidence from China's Prefecture-level Cities [J]. *China Industrial Economics*, (01), 62–80.

Luo, D., Junping, L., & Yu, W. (2016). Change of Local Officials and Corporate Risks——Based on the Empirical Evidence of Chinese Listed Companies [J]. *Economic Research Journal*, *51*(05), 130–142.

Luo, D., & Shi, Y. (2018). Market Order, System Loophole and the Development of the New Three Board Market [J]. *Journal of Zhengzhou University of Aeronautics*, *36*(03), 65–81.

Nan, L., Gong, H., & Chao, Z. (2016). The Research on Regional Innovation Driven Development Key Factors [J]. *Science & Technology Progress and Policy*, *33*(12), 41–46.

Ni, J., & Hua, L. (2017). Industrial Agglomeration, Human Capital and Regional Innovation: An Empirical Study Based on the Perspective of Heterogeneous Industrial Agglomeration and Synergistic Agglomeration [J]. *Inquiry into Economic Issues*, (12), 156–162.

Nie, H., Ting, J., & Yang, R. (2012). Current Status and Potential Problems of the Use of Databases in Chinese Industrial Enterprises [J]. *Japan and the World Economy*, *35*(05), 142–158.

Pastor, L. (2013). Political uncertainty and risk premia [J]. *Journal of Financial Economics*, 110.

Zhou, L. (2007). Research on the Promotion Championship Model of Local Officials in China [J]. *Economic Research Journal*, (07), 36–50.

Rui, M. (2015). Industrial agglomeration and financing constraints of enterprises [J]. *Guanli Shijie*, (02), 58–71.

Shi, X., Bu, D., & Zhang, C. (2020). Official rotation and corporate innovation: Evidence from the governor rotation[J]. *China Journal of Accounting Research*.

Su, D., Bin, S., & Shao, C. (2018). Industrial Agglomeration and Firms' Export Product Quality Upgrading [J]. *China Industrial Economics*, (11), 117–135.

Syverson, C. (2004). *Prices, Spatial Competition, and Heterogeneous Producers: An Empirical Test[J].* (Working Papers).

Toulemonde, E. (2006). Acquisition of skills, labor subsidies, and agglomeration of firms [J]. *Journal of Urban Economics*, *59*(3), 420–439. doi:10.1016/j.jue.2005.12.002

Wan, D., & Bin, H. (2018). Industrial agglomeration, financial development and"innovation inertia"of enterprises [J]. *Industrial Economics Research*, (01), 28–38.

Wang, X., Gang, F., & Yu, J. (2017). *MARKETIZATION INDEX OF CHINA'S PROVINCES: NERI REPORT 2016* [M]. Social Sciences Academic Press.

du Weijian, L. M. (2015). Does Industrial Gathering Promote Enterprise Product Innovation?——An Empirical Study Based on the Chinese Industrial Enterprise Database[J]. *Industrial Economics Research*.

Wu, X. (2015). Does Local Leaders' Replacement Affect Regional Innovation Ability? [J]. *Finance & Economics*, (04), 107–119.

Xiang, P., & Jiang, C. (2011). Industrial Agglomeration, Technological Spillovers and Regional Innovation:Evidences from China [J]. *China Economic Quarterly*, *10*(03), 913–934.

Xie, R., & Yuan, Y. (2016). Research on the Pollution Abatement Effect of Industrial Agglomeration's Evolution [J]. *Economic Review (Kansas City, Mo.)*, (02), 11.

Yang, C. H., Lin, H. L., & Li, H. Y. (2013). Influences of production and R&D agglomeration on productivity:Evidence from Chinese electronics firms [J]. *China Economic Review*, *27*, 162–178. doi:10.1016/j.chieco.2013.09.005

Yang, H. C., Lian-Shui, L. I., & Liu, J. (2016). Impact of high-tech industrial agglomeration on technological innovation and its regional comparison[J]. *Studies in Science of Science*.

Yu, W. (2019). How does the restructuring of the relationship between government and enterprise affect enterprise innovation? [J]. *Economic Review (Kansas City, Mo.)*, (01), 33–45.

Yuan, Y., & Ran, G. (2018). Productive Service Industry Agglomeration, Manufacturing Industry Agglomeration and Technological Innovation——An Empirical Study Based on Provincial Panel Data [J]. *Economist*, (05), 23–31.

Zhang, H. (2015). How does agglomeration promote the product innovation of Chinese firms? - ScienceDirect [J]. *China Economic Review*, *35*, 105–120. doi:10.1016/j.chieco.2015.06.003

Zhao, W. (2012). *Producers' Service Improvements and Manufacturing Agglomeration When Taking Trade Costs as a Mediator Variable: Mechanism and evidence from China*. (Discussion papers)

Zheng, L., Yang, S., & Bin, H. (2017). Does FDI Inhibit or Promote China's Regional Innovation Efficiency?——Analysis of 30 Provinces Based on Spatial Panel Model [J]. *Business Management Journal*, *39*(04), 6–19.