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How Natural Resource-Based Industry Affect Sustainable Development? An Evolutionary Study of China

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Abstract: The effects of natural resources on regional sustainable development is widely discussed by scholars and policymakers. However, most of the researchers concentrated on economic growth and technical development; evidence of how natural resources affect the soft environment is relatively lacking. Different from the neo-classical economics perspective of resource allocation, we used the evolutionary economics scope of factor creation and historical evolution to explore the effect on China's regional entrepreneurship laid by the natural resource distribution on the early stage of China. The resource curse is explained from the aspect of regional entrepreneurship development in China. Based on the provincial panel data from China, in China's industrial statistical yearbook and China's statistical yearbook, we applied PLS-SEM (Partial Least Squares Structural Equation Model) to explore the path from natural resources to regional entrepreneurship. We also examined the mediating effect at the organizational scale, industry structure, the degree of regional openness, and the quality of human capital in the path between natural resource and entrepreneurship. The result shows that natural resources in the early-stage has negative effects on the growth of the entrepreneurship. Besides, industry structure and organizational scale are significant in terms of mediation effect in the path of the resource curse. An in-depth analysis is provided, and implications are discussed based on the results with the aim of revealing the mechanism and path-dependence of China's regional development. The implications of this research include the suggestion of adapt the industry structure and motivate start-ups.

Keywords: entrepreneurship; natural resource; regional development; evolution; path dependence

1. Introduction

Sustainable development of natural resource-based regions is an emerging research topic, which attracts increasing attention from different fields. Economies are characterized by agglomeration [1], after the 19th century, many enterprises gathered together in a specific area, and the main driving force is a natural resource. The single pattern of development with consumption of natural resource left many crises to such regions, such as the damage of environment, waste of resources, as well as brain drain. With the case studies concerning the sustainable development in natural resource-based regions such as Manchester, the UK, the Ruhr district, German (coal), and Pittsburgh, PA, USA (iron), many scholars find the barriers which disturb the sustainable development of such regions are not restricted in the fields of environmental problems and resource exhausting problems, the potential crisis which could induce lock-in effect include organizational culture, innovation environment as well as entrepreneurship [2–4]. Among all the factors, entrepreneurship is dynamically correlated with sustainable development, which contains innovation and start-ups; it would bring

competitive advantages to the natural resource-based regions with less consumption of energy and less damage of the focal environment [5]. According to Gast et al. (2017), sustainable entrepreneurship could motivate economy activities to create a more balanced relationship between development and ecology [6]. Moreover, as the traditional dimensions of entrepreneurship, in regard to the regions agglomerated with natural density resource-based industries, the start-up and self-employee could support sustainable development through industrial upgrading [7]. However, most of the natural resource-based regions have suffered from resource curse and become increasingly rely on the natural resource industry and induce bad sustainability problems. From the perspective of the resource curse which occurs in sustainable development, entrepreneurship's role is explored relatively less. With the rapid development of evolutionary economics, the outcomes from the resource curse have transformed from economic development to the shifting of the institutional environment and entrepreneurship. Erixon and Johannesson applied the peak-end theory to explain why decision-makers become the status quo during innovation decision-making with the consideration of sustainable development [8]. Chinitz conducted an in-depth comparison of the development paths of New York and Pittsburgh (USA) in the last century and found the advantages of natural resource in the early stage led Pittsburgh to large-scale companies and a hierarchy management system that negatively affected the regional entrepreneurship [9].

With the case study of the adaption of the natural resource-based regions, some cities gradually overcome the resource curse and realize the sustainable development. The key issue is to adapt entrepreneurship and institutional environment [10]. However, the process of adaption is evolutionary, and many postpone that the over-reliance on natural resources would curse the development of entrepreneurship. On the background of China, Northeast China was China's industrial center in the 1950s due to the abundant fossil fuel and iron. With the emergence of the three economic centers (Yangzi River delta, Pearl River delta, and Bohai), Northeast China stepped into a lock-in situation that reflected the poor economic, technological, and social development. What's more, according to GEM (Global Entrepreneurship Monitor) on the specific background of China, why natural resource-based regions always have a relatively lower start-up rate than any other region in China. How could the natural resource-based industry affect entrepreneurship's evolution? This research topic could uncover the resource curse at a deeper level and find implications for these regions, which have the tendency to decline.

We analyzed the resource curse of sustainable development and lock-in in China using an empirical study. Compared with the previous studies, we provide the following contributions: Firstly, we discuss the relationship between sustainable development and entrepreneurship; secondly, from the perspective of dynamic evolution, we explain the lock-in effect in resource-based cities through entrepreneurship; thirdly, we add several different paths that could affect regional entrepreneurship; lastly, we provide policy suggestions for emerging countries to enhance regional entrepreneurship. The remainder of the paper is organized as follows: Section 2 outlines the hypothesis formed after reviewing the literature, Section 3 introduces the methodology and research design, Section 4 presents and discusses the results; and the final section provides the implications and conclusion to our study.

2. Literature Review

2.1. Entrepreneurship and Sustainable Development

There are three-hundred definitions of sustainable development, the Brundtland Commission defines sustainable development as "development that meets the present without compromising the ability of future generations to meet their own needs (World Development Commission on Environment and Development)". In this way, sustainable development is to coordinate the relationship between ecology, society, and economics through the mechanism of the market [11]. With the consideration of a limited resource [12], how to reduce the exploitation becomes the main mission of sustainable development [13]. To achieve the goal of sustainable, many scholars mentioned entrepreneurship

in their research, and the main mechanisms are various. Entrepreneurship is generally accepted as the motivation of opportunity discovery, creation, and exploitation. Through establishing a small and medium enterprise (SME), and engaging an economic activity, entrepreneurship could improve regional economic performance and social capital which are two main aspects of sustainable development [14]. As to the third part, ecology, some research asserted that entrepreneurship is an innovative process, which would reduce the consumption of natural resources [15]; moreover, regions with high entrepreneurship could reduce the environmental problem through entrepreneurial activities [16]. The high start-up rate and entrepreneurial activities' motivation awake decision-makers' awareness of sustainable development.

2.2. Natural Resources and Entrepreneurship

During the industrial revolution, Marshall found that the endowment of natural resources could be the driving force of industrial agglomeration; the high cost of transportation pushed the resource-based cities to be the frontier of industrial development via large-scale factories [17]. However, since the introduction of modern technology, resource-based cities have lost their competitive advantages, such as the Netherlands' economic recession after finding North Sea oilfields. This phenomenon has occurred in many different areas, which raised the issue of the resource curse. Scholars have attempted to explain the resource curse from various perspectives. Xu and Wang attributed China's natural resource curse to imbalanced industry and labor distribution, the outcome of which was the declining of economic efficiency as measured by total factor production [18]. Gylfason indicated the natural resource industry would induce policymakers to ignore education and cause a lock-in of regional development [19]. Fu and Wang empirically explored the resource-based cities in China and found the natural resource industry leads to the crowding-out effect of manufacturing development and environmental crises [20]. Along with the transition of research orientation from resource distribution to resource creation, scholars have applied an evolutionary perspective, the heterogeneity of organizations, and historical inheritance to express the mechanism of the resource curse. As such, entrepreneurship is regarded as a causal factor of the resource curse due to its natural ties to the institutional and cultural environment. According to Schumpeter, entrepreneurship is the motivation of business activities that leads to positive organizational decisions as well as regional innovation and economic developments [21]. Therefore, scholars attempted to determine the dynamic relationship between resource-based industry and entrepreneurship during a specific period. After Chinitz's research about the connection between business model and regional natural resources, Glaeser et al. set the distribution of iron and coal as causal variable and regional innovation ability as the outcome variable and determined the deficiency in entrepreneurship and start-up rate are caused by the agglomeration of natural-resource-based industry during the early stage of development. According to the literature, we formed the following hypothesis:

Hypothesis 1 (H1). *The agglomeration of the natural-resource-based industry during the early development stage results in deficiency in regional entrepreneurship.*

2.3. Mediating Factors Between Natural-Resource-Based Industry and Entrepreneurship

2.3.1. Organizational Scale

The accessibility of natural resources used to be the foremost factor driving industry agglomeration, which also determined the scale of the regional enterprise. Stuetzerd et al. found that the U.K.'s organizations' average scale in different regions was dependent on the distance to natural resources in the 1890s [22], meaning large-scale organizations are inherited from the giant factories, whereas the SMEs (small and medium enterprise) are located far from natural resources. How does the organizational scale affect entrepreneurship? Different from Schumpeter's argument that large companies perform better in innovation (Schumpeter II), researchers of evolutionary economics tend to accept that regions

with more SMEs have better regional innovation efficiency [23]. To explain this phenomenon, besides externalities, knowledge transfer, and competition pressure, Baumol identified that entrepreneurship connected with organizational innovation might be affected by the regional organizations' scales [24]. A large company's hierarchy model would limit the staff's creativity. A large company would set barriers for emerging companies to retain its market share, which would decrease the regional start-up rate and innovation efficiency [25]. Conversely, SMEs have more flexible management systems, which provide opportunities for their staff to engage in different assignments. As such, SMEs would provide different working experiences to their staff, which promotes regional start-up [26]. Thus, the average size of local firms may negatively affect entrepreneurship. Based on the literature, we formed the following hypotheses:

Hypothesis 2a (H2a). *The agglomeration of the natural-resource-based industry during early-stage development positively affects regional average sized firms.*

Hypothesis 2b (H2b). *Regional average-sized firms negatively affect regional entrepreneurship.*

2.3.2. Industry Structure

Industry structure is a reflection of a region's industrial composition. The diversity and concentration of industries are important indexes reflecting industry clustering because they are directly associated with economic performance. In recent years, researchers proved that regions with low industry diversity more easily sink into path-dependence than regions with high industry diversity [27]. Cities that rely on natural resources face many problems when increasing their industry diversity due to the lock-in of foundational facilities, human resources, and the institutional environment. Most resource-based cities heavily rely on a single industry, which directly connects the model of economic growth to the production of local natural resources. Based on the theory of Jacobs externalities, many researchers proved that industry diversity would increase the spillover of knowledge, which increases the opportunities for start-up [28]. Conversely, high industry concentration would decrease regional knowledge spillover between firms [29]. As a consequence, entrepreneurship is lower with fewer intra-firm connections. Based on the above, we hypothesized:

Hypothesis 3a (H3a). *The agglomeration of the natural-resource-based industry in the early stage of development negatively affects regional industry diversity.*

Hypothesis 3b (H3b). *Industry diversity positively affects regional entrepreneurship.*

2.3.3. Degree of Openness

Given increasing globalization, embedded into the global value chain, increasing the degree of openness is an important approach for a nation to achieve and retain competitive advantages and raise the position of its industries in the world [30]. Many emerging and developing countries have room for improvement, both in terms of openness and entrepreneurship. Regional entrepreneurship and openness appear to have some relationship. From the macro scope, the degree of openness could encourage entrepreneurship in a region through spillover from outward foreign direct investment (OFDI) and subsidiaries from multi-national enterprises [31]. At the organizational scale, high regional openness would provide potential entrepreneurs with more experience and technical skills to help them start their own businesses [32]. In resource-based regions, they have an obvious tendency to be self-sufficient with weaker relationships with the outer world as the sufficient natural resources enable vertical integration division and distribution in a region [33]. In this way, the region's industry would become independent and isolated. Given the above argument, we formed the following hypothesis:

Hypothesis 4a (H4a). *The agglomeration of natural-resource-based industry in early-stage development negatively affects the regional degree of openness.*

Hypothesis 4b (H4b). *The regional degree of openness positively affects regional entrepreneurship.*

2.3.4. Human Capital

Human capital has formative effects on regional development and industry upgrading development. The degree of industrial development also affects human capital by optimizing the education environment and absorbing foreign talent [34]. As a primary industry, the natural-resource-based industries have a comparatively low demand for high-end human capital than other industries. Therefore, the agglomeration of natural-resource-based industry in a region would lead to the lack of development of human capital due to the low attraction of high-end talent [35]. According to research, the quality of human capital and entrepreneurship have several relationships. Firstly, knowledge and skills are dimensions of dynamic entrepreneurship that motivate entrepreneurs to start-up and innovate [36]. Secondly, human capital is a critical resource required to fulfill their missions and sustain their business [37]. We then formed Hypotheses 5a and 5b:

Hypothesis 5a (H5a). *The agglomeration of the natural-resource-based industry in the early stages of development negatively affects the quality of regional human capital.*

Hypothesis 5b (H5b). *The quality of regional human capital positively affects regional entrepreneurship.*

The research framework and the hypothesis are listed in Figure 1.

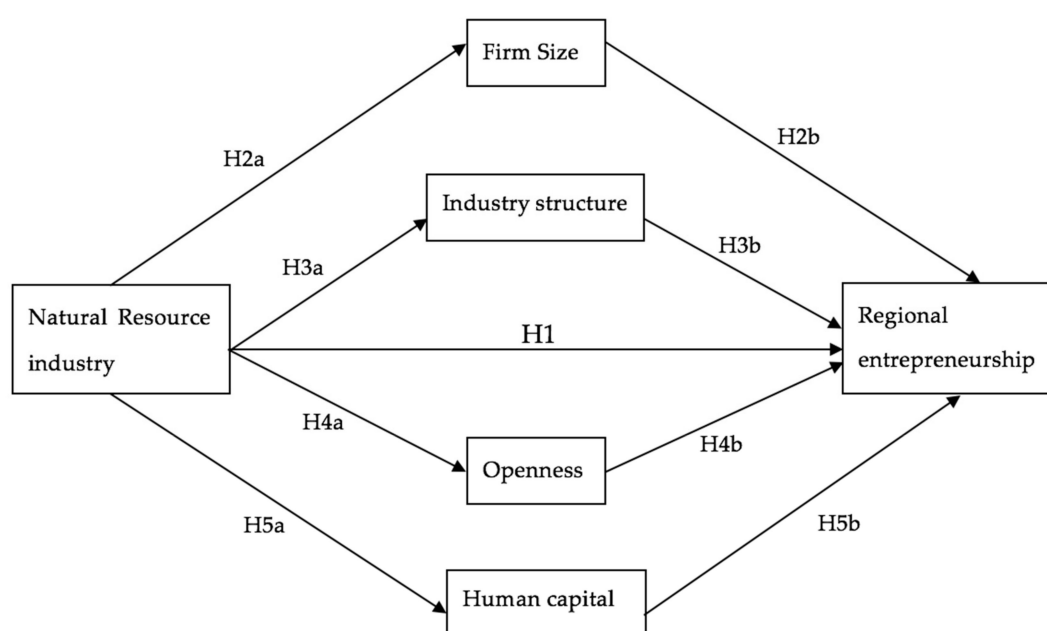


Figure 1. Research Framework.

3. Methodology

3.1. Variables Design

China is an emerging country and has various natural resources. In the 40 years, since the introduction of the reform and opening-up policy, China displayed an unbalanced development pattern in terms of economic, industrial, and entrepreneurship performance. We selected the provincial units as the research objects and investigated the path between natural resources in early-stage

development and regional entrepreneurship. Before the People's Republic of China (PRC) was founded in 1949, the distribution of traditional industries changed very slowly. As such, we selected 1952 to 2016 as the period of study, as these 64 years have witnessed almost the complete transition of China from a state-owned dominated country to a start-up country and almost the whole process of entrepreneurship growth in this eastern country.

The dependent variable in this research was entrepreneurship. Measure entrepreneurship using a single variable is difficult. According to Audrestch et al., entrepreneurship can be split into static entrepreneurship and dynamic entrepreneurship [38]. Dynamic entrepreneurship is a motivation-orientated dimension of entrepreneurship that includes knowledge and skills, perception of the environment, enthusiasm for the job, and preference for adventure [39]. Dynamic entrepreneurship is usually applied to measure individual performance, so to evaluate regional entrepreneurship, we used the indicator of static entrepreneurship as a status-orientated measurement [40]. Static entrepreneurship can be used to measure the status of regional entrepreneurship, which is more intuitive for comparison. Considering the research concerning regional entrepreneurship, we applied the start-up rate (Sur) and self-employee rate (Ser) to measure regional entrepreneurship using the data available from the statistical yearbooks of each province.

In terms of the independent variables, for the early stages of the natural-resource-based industry, we applied the percentage of wood (Logotp) and coal (Coatp) in each province to determine the total output in 1952. These data were obtained from China's industrial statistical yearbooks, which are published by China's National Statistics Bureau. Wood and coal are the most common natural resources in China that support many industries, so they reflect the distribution of the natural-resource-based industry. To measure a province's dependency on natural resources, we used the numbers of the natural resource-based cities (Rcn) as an index, which is an official indicator defined by China's State Council.

We selected four mediating variables between natural resources and entrepreneurship. The first variable is the average scale of the focal enterprise (Escale), which is the ratio between the amount of total working people and companies in each region. The second variable, industry diversity, combines the methods of industry concentration ratio and the Herfindahl–Hirschman Index (HHI). We quantified the employees in different industries in a region and divided them into employees in the top-five regional industries and other industries. We then calculated the HHI as the ratio between the other employees and the total employees to provide an index of industry diversity. The larger the HHI index, the higher the regional industry diversity. For the degree of regional openness, we used the ratio between export and domestic production [41]. Notably, we used the exchange rate between U.S. dollars and China's yuan in the year 2015. To measure the quality of human capital, Barro and Lee used the average years of education in China [42]; Li and Liu set the years of the primary, middle, and high school education, and college education as 6, 9, 12, and 16 years, respectively [43]. Du and Lin differentiated undergraduate and junior college education by education years [44]. To accurately evaluate the quality of human capital, we added the postgraduate degree and removed primary and middle school. The formula we used is as follows:

$$HR = 12a+15b+16c+19d \quad (1)$$

where HR is human resource(capital), a is the percentage of people with a high school (included technical school) degree, b is the percentage of those with a junior college degree, c is the proportion of those with an undergraduate degree, and d is those with a postgraduate degree. The data were obtained from the statistical yearbooks of each province. Table 1 lists the descriptions of the variables.

Table 1. Descriptions of the variables.

Variable (Abbreviations)	Type	Measurement
Natural Resource (NR)	Independent variable	Percentage of wood, coal, resource-based cities
Entrepreneurship (Ent)	Dependent variable	Start-up rate(sur) and self-employee rate(ser)
Firm size (Escale)	Mediating variable	Average employees in each enterprise
Industry diversity (HHI)	Mediating variable	ratio of employees in the industries out of top-five
Openness (OP)	Mediating variable	Ratio of the value of export in the total regional production
Human Capital (HR)	Mediating variable	Weight of educational years

3.2. Research Method

To analyze the path, we applied the PLS-SEM method. As an explorative analysis, the sample size was relatively small. PLS-SEM (Partial Least Square Structural Equation Model) uses the nonparametric interference approach, and the research was not normally distributed [45]. Table 2 indicates the descriptive analysis of all the variables. To eliminate dimension differences, the authors standardized the variable industry diversity and average firm size. The path analysis included the examination of nine connections. The coefficient of determination (R^2) was 0.68, which indicates acceptable goodness of fit. The coefficients and significance of path were calculated using PLS-Algorithm and Bootstrapping program in Smart-Plus 3.2.7(GmbH, Ahornstr, Germany).

Table 2. Descriptive analysis.

Variable	Mean	Median	Min	Max	Std. Dev
Coal	3.67	1.7	0	17.7	4.96
Wood	3.57	0.5	0	35.8	7.21
resource city	8.86	10	0	17	4.94
star-up	13.94	12.9	−11	29.4	8.16
self-employee	23.04	20	9.3	71.6	14.97
firm size(log)	4.59	4.33	2.92	5.68	0.63
HHI(log)	3.76	3.68	2.57	4.12	0.36
Openness	18.41	12.63	2.2	73.5	18.05
human capital	4.21	4.02	1.8	9.02	1.47

4. Results and Discussion

We used ArcGIS (Geographic Information System, Environmental Systems Research Institute, Redlands, CAL, US) to describe the distribution of variables of the natural resources and entrepreneurship. Figure 2 shows that natural resource industry agglomerated in Northeast and Southwest China in 1952. Figure 3 depicts the density of resource-based cities, with a distribution covering most areas. As it can be seen, Northeast and Southwest China had larger natural industry density in the early stage of China's industrialization process.

Figures 4 and 5 indicate the regional start-up rate and self-employment rate in 2016, respectively. The eastern coastal area shows a high level of entrepreneurship. Conversely, the start-up rate and self-employment rate in Northeast, Northwest, and Southwest China were relatively low as the areas heavily rely on the natural-resource-based industry. The areas with low levels of entrepreneurship coincide with the areas with natural-resource-based industry. In terms of the self-employee rate, the eastern coastal area, which has a low proportion of the natural resource industry, has a higher self-employee rate than other places in China. The resource curse becomes more prominent after a period of evolution.

Table 3 is the internal consistency reliability, and validity test. In terms of validity, all the variables' AVE (Average Variance Extracted) is more than 0.5; that is to say, the sample has good validity. As to the reliability, each variable's Cronbach α is above 0.7, which reflects good international consistency and reliability. The composite reliability is also above 0.7. The last but not the least, the VIF also indicates the multicollinearity is acceptable.

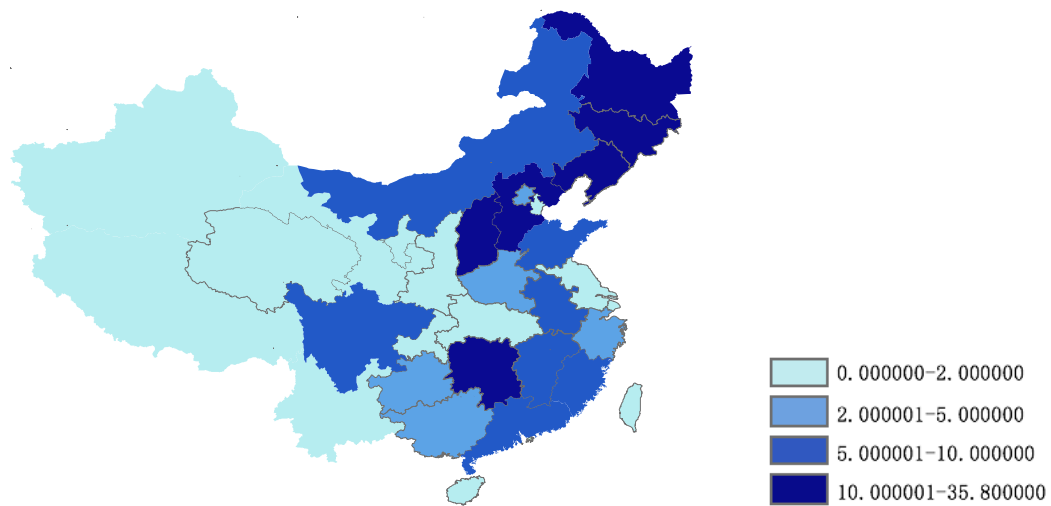


Figure 2. Distribution of the natural-resource-based industry in 1952.

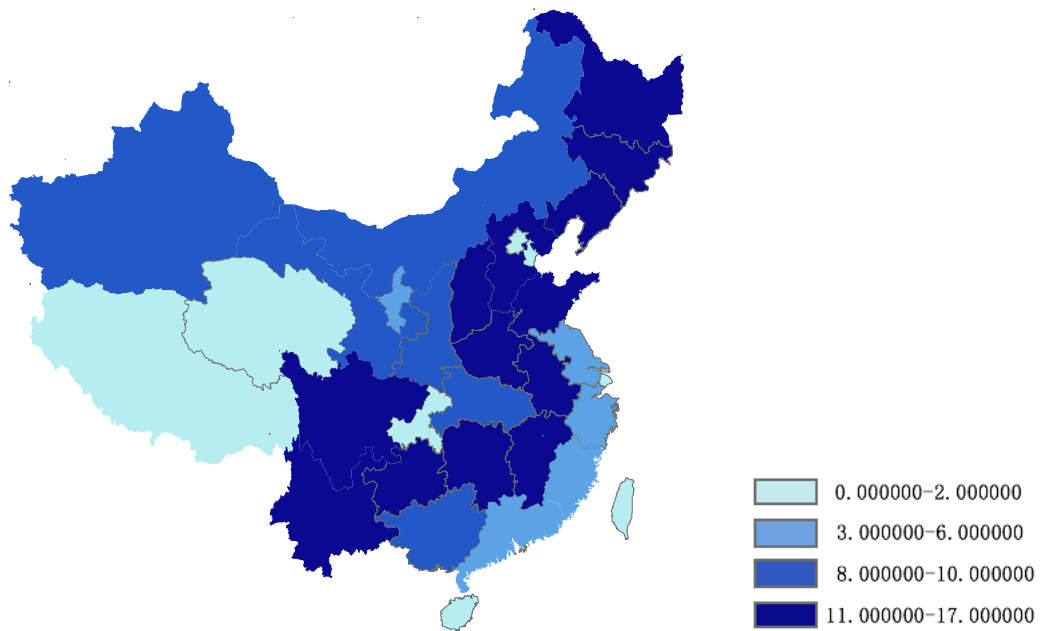


Figure 3. Distribution of the natural-resourced-based cities in 2016.

Table 3. Test of Validity and Reliability.

	AVE	VIF	Cronbach α	Composite Reliability
Coal	0.67	1.65	0.86	0.92
Wood	0.58	1.58	0.92	0.81
resource city	0.58	2.98	0.76	0.74
star-up	0.68	2.33	0.77	0.84
self-employee	0.65	1.58	0.79	0.88
firm size	0.59	2.93	0.86	0.86
Industry diversity	0.56	2.21	0.79	0.87
Openness	0.57	1.53	0.81	0.73
human capital	0.61	2.42	0.84	0.76

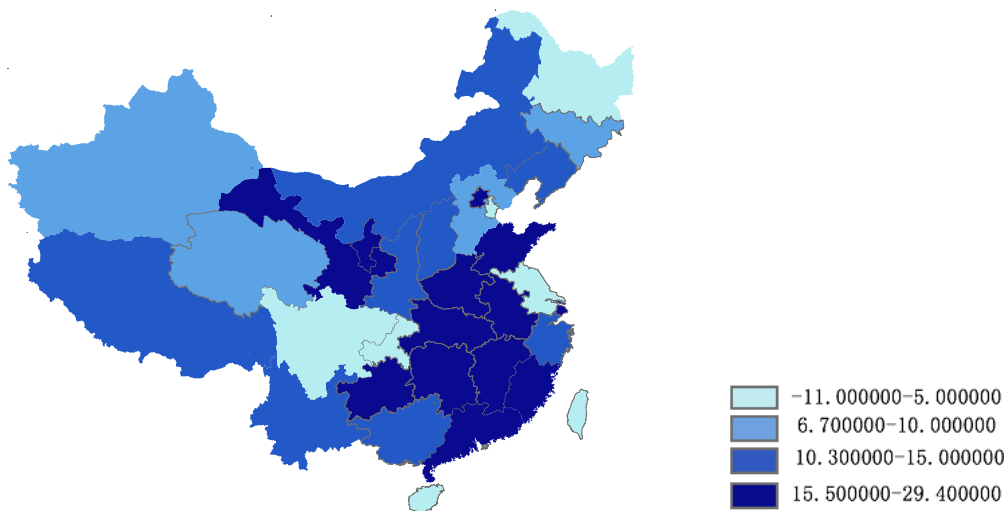


Figure 4. Distribution of the start-up rate in 2016.

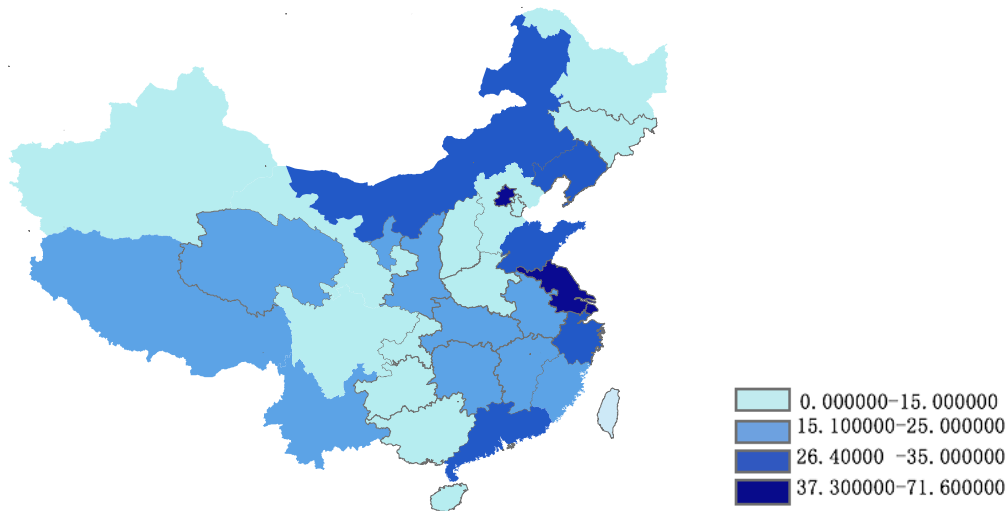


Figure 5. Distribution of the self-employee rate in 2016.

Table 4 provides PLS-SEM results. In Smart-PLS, the correlation coefficients ranging from 0.02 to 0.15 indicate a weak connection, 0.15 to 0.35 indicates a medium connection, and coefficients above 0.35 indicate a strong connection. We tested the significance of the connections using a two-tailed test. According to the results, among all nine connections, seven were found to be significant. Firstly, the natural-resource-based industry in the early development stage of the direct effect on entrepreneurship was significantly negative, with a coefficient of -0.348 ($T\text{-value} = 2.098$). The result means the resource curse exists in China, and the hypothesis 1 is supported. In terms of the mediating effects, the average size of the focal enterprise was positively affected by the independent variable (coefficient = 0.58, $T\text{-value} = 2.19$) and negatively affected by entrepreneurship (coefficient = -0.27 , $T\text{-value} = 1.998$), which support hypotheses 2a and 2b. In China, large enterprises used to promote the efficiency of natural resource-based industries, but they restricted employees from starting their own businesses. Natural resources negatively influenced regional industry diversity (coefficient = -0.45 , $T\text{-value} = 2.46$), and industry diversity promoted regional entrepreneurship (coefficient = 0.38, $T\text{-value} = 2.14$). As such, hypotheses 3a and 3b are supported. Low regional industry diversity characterizes resource-based cities around the world, negatively affecting the development of entrepreneurship because the intra-industry spillover is relatively low compared to other regions [40]. In terms of the last two mediator variables in the path, the regional degree of openness was negatively

affected by the natural-resource-based industry (coefficient = -0.34 , T-value = 2.202), but it did not promote regional start-ups. The reason for this finding is that even though the degree of openness increases the motivation to run a business, it also increases the competitiveness of and challenges to start-up. As such, the relationship is unclear. However, previous studies confirmed that the degree of openness increases emerging countries' competitive advantage, which includes innovation, technical achievement, commercialization, as well as cultural environment [46]. The quality of regional human capital can positively affect entrepreneurship (coefficient = 0.35, T-value = 1.99); however, the relationship with the early stages of natural resource development was not significant. In China, the areas with low levels of entrepreneurship have suffered from loss of human capital, mainly due to the imbalanced distribution of social welfare and job opportunities rather than the natural-resource-based industries in their early stages of development. The natural resource curse path is demonstrated in Figure 6.

Table 4. Coefficient and T-values of each relationship.

Relationship	NR-Escale	NR-HIH	NR-OP	NR-HR	NR-Ent
Coefficient	0.58 ***	-0.451 ***	-0.342 ***	-0.249	-0.348 ***
T-value	2.185	2.464	2.202	0.930	2.098
Relationship	Escale-Ent	HIH-Ent	OP-Ent	HR-Ent	
Coefficient	-0.27 ***	0.376 ***	-0.180	0.349 ***	
T-value	1.998	2.136	1.396	1.986	

Note: ***, significant at the 1% level (two-tailed).

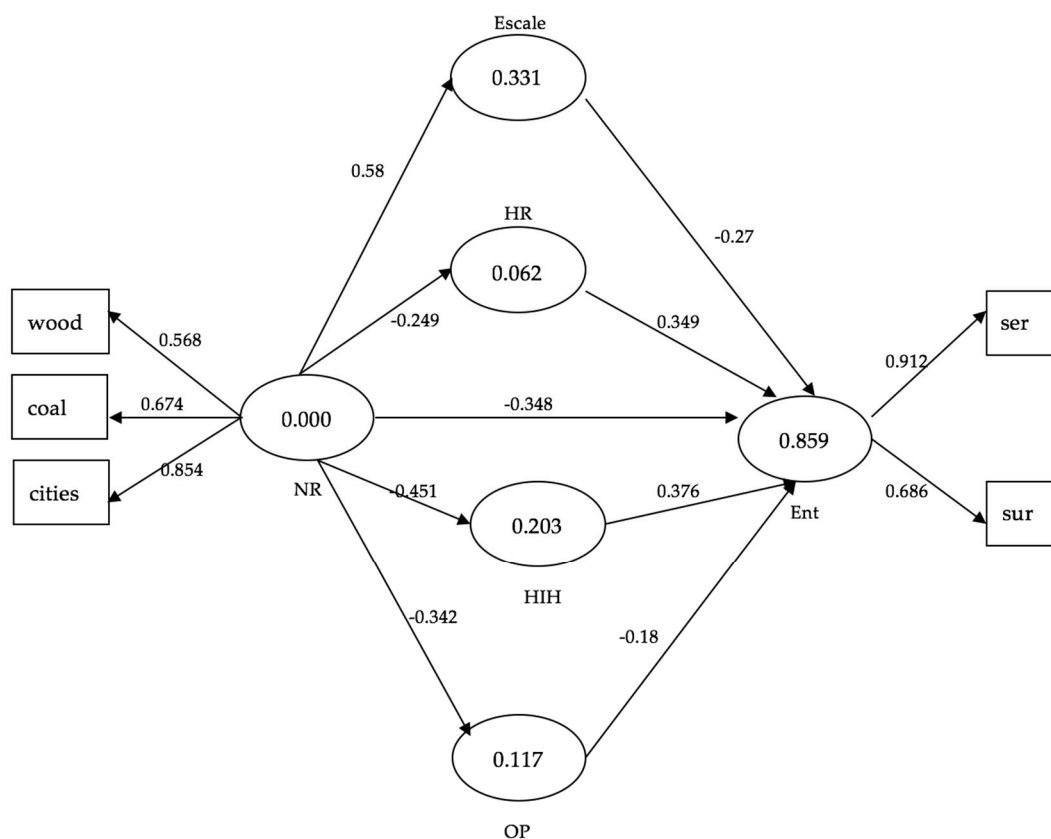


Figure 6. Path diagram.

To avoid the error from the process of sample selection and measurement, the authors applied the hierarchical regression to test the mediating effect of firm size and industry diversity. The robustness

check added human density, financial environment (measured by the loan balance's ratio in GDP), and institutional environment (measured by the logarithm of crime by taking advantage of duty). Table 5 indicates the full mediating effect of firm size in the relationship of natural resources (significant and positive in wood and resource-based cities) and entrepreneurship (start-up and self-employee). Moreover, Table 6 tested high industry diversity, which negatively affected by the natural resource-based industry that could improve regional entrepreneurship. The robustness check indicates the same research result.

Table 5. Robustness check (firm size as mediator).

	First Step Model 1 (Escale)	Model 2 (Escale)	Second Step Model 3 (Sur)	Model 4 (Ser)
wood	0.34 **	0.32 ***		
coal	−0.18	−0.13		
resource cities	0.61 **	0.55 **		
Escale			−0.2 *	−0.41 **
human		−0.54 **	0.38 *	0.38 **
financial		−0.16	−0.23	0.21 **
institutional		−0.06	−0.41 *	0.4 ***
constant	3.9 **	5.67 ***	41.83 *	73.86 ***
R square	0.444	0.783	0.544	0.872

Note: *** $p < 0.01$, ** $0.01 < p < 0.05$, * $0.05 < p < 0.1$.

Table 6. Robustness check (industry structure as mediator).

	First Step Model 1 (HIH)	Model 2 (HIH)	Second Step Model 3 (Sur)	Model 4 (Ser)
wood	−0.01	−0.02 *		
coal	−0.09	−0.27 *		
resource cities	−0.03 **	−0.02		
HIH			0.528 **	0.21 **
human		0.82 ***	0.32	0.62 **
institutional		0.14	0.216 **	−0.58 **
financial		−2.23 **	−0.51	2.84 ***
constant	3.6 ***	2.85 ***	12.22	12.72
R square	0.476	0.845	0.448	0.806

Note: *** $p < 0.01$, ** $0.01 < p < 0.05$, * $0.05 < p < 0.1$.

5. Policy Implications

Overreliance on natural resources rather than human capital and technological innovation is a typical feature of developing countries, and this reliance on natural resources is not sustainable in such regions. Some natural-resource-based cities in developed countries that have suffered from the resource curse have transformed their industry policy and institutional environment to encourage regional start-ups. However, sustainable development in emerging economies would face many challenges due to urban citizens and public welfare; the challenges include improving the industry structure and regional lock-in effect. To overcome the negative effects of the resource curse on entrepreneurship, we examined the relationship between industry and entrepreneurship in this study, and we provide the following policy suggestions:

Firstly, regional industry diversity should be increased through bolstering related industries. The largest obstacle to industry development in resource-based cities in China is the poor environment and infrastructure. Ruhr's model of development is hard to copy, as regional governments in China could not afford the cost of reconstructing the industry's structure and distribution. Therefore, industry upgrading should be based on existing industries and focus on the related industries [47]. The equipment manufacturing industry and services could promote the breakthrough of industry

upgrading in such regions. Local governments should increase the support provided to regional SMEs to increase vitality and competition in the focal industry.

Secondly, the regional collaboration of multiple participants should be improved. The triple helix is an important collaboration mode that includes the government, industry, and universities. This mode would increase local development, which includes technical innovation, industry upgrading, and entrepreneurship. The government of natural-resource-based cities could build industrial parks to promote regional entrepreneurship through spillover of agglomeration [48]. Industrial parks act as incubators to accelerate start-ups by enabling the collaboration of multiple participants. Due to the lack of regional collaboration and start-ups, China's government should boost triple helix collaboration through a combination of administrative intervention and encouragement, such as subsidies and regulations.

Finally, local governments need to increase the paths to start up a business for potential entrepreneurs. In many regions in China, venture capital is hard to access, and start-ups often require too many administrative tasks [49]. The poor institutional environment negatively affects the resources' promotion of entrepreneurship. To address this problem, policymakers should improve the institutional environment through credit republishing and structural reform. Via adopting the investment environment, entrepreneurship would be supported by venture capital, incubators, and universities, enabling the transformation of start-up motivation into action.

6. Conclusions

Sustainable development is still an emerging topic on the background of China. In China's natural resource-based cities, entrepreneurship tends to be survival entrepreneurship, and the economic motivation would outweigh the social and environmental motivation; the reason is mainly because of the lock-in effect of these cities. In the process of evolution of entrepreneurship, the sufficient natural resource offered the entrepreneur more opportunities to establish their business at first, but the overdependence on the natural resource has been criticized as the main barrier of regional sustainable development. Return to the main theme of introduction, natural resource-based regions that suffered resource curse in terms of sustainable development is attributed to the shortage of regional entrepreneurship. This paper explored why the natural resource industry negatively affects regional entrepreneurship; many resource-based regions have common situations, such as low industry diversity, large-scale enterprises, and self-reliance development. These typical features may benefit the regions at the beginning; however, after a period of evolution, these features restricted the development of entrepreneurship. As a consequence, the innovation and start-up environment would be restricted. With the low productivity as well as regional multiple-participant collaboration, the pressure of economic growth and social development induce the excessive exploitation of natural resources. The series of problems consist of the natural resource curse and proved by this paper.

This research has three limitations. Firstly, we could not capture the influence of every natural resource on regional development; the second limitation is that entrepreneurship may be affected by some aspects of the soft environment, which could not be evaluated using quantitative research. The last but not least, this paper applied provincial data of China, and some provinces are too large, which would have different situations. Compared to the previous researches, applying the prefectural-level is a better choice, but the data is unavailable in China. Future work should focus on analyzing cultural factors, following trends as well as the inheritance effect. The approach could include a case analysis in China.

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