



# Journal of Applied Sciences

ISSN 1812-5654

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## Study of the Influential Factors for the Development of Public Sector Information Value-added Exploitation Industry on the Diamond Model

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**Abstract:** The huge economic value of Public Sector Information (PSI) has been accounted by people gradually, while related industry is still in its infancy. In order to solve the bottleneck and promote the industrial growth, the key factors and restrictions for industry development should be found. The article establishes an influential factor model for the development of PSI value-added exploitation industry with the help of 'diamond model' and analysis of industry characteristics. Then 22 specific observed variables are chosen to make a quantitative analysis according to survey data from China. The study adopts the method of Principal component analysis and correlation analysis. The results show that 'factor conditions', 'demand conditions', 'related and supporting industry', 'rivalry and 'government' are the key factors influencing the development of China's PSI value-added exploitation industry. In these five factors, 'factor conditions' have the greatest influence. Besides the direct influence on the industrial development, government policy can also generate the indirect influence by affecting factor conditions and 'rivalry'. Furthermore, there is a positive correlation between 'factor conditions and 'rivalry' in the model. Therefore, China's government should implement the proper legal guarantee to ensure the access to PSI. Meanwhile, government should also adopt some preferential policies such as establishing the Foster Fund, increasing financial input, cutting taxes, etc., to support industrial development.

**Key words:** Public sector information, value-added exploitation, diamond model, factor analysis

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### INTRODUCTION

As early as the year 1999, the European Commission pointed out 'Public Sector Information (PSI) plays a fundamental role in the proper functioning of the internal market and the free circulation of goods, services and people. Commission European (2013) ever since then, the huge economic value of PSI has been accounted by people gradually and related industries develop rapidly. Meanwhile, the theoretical study of PSI value-added exploitation industry has also been deepened gradually. Throughout the domestic and foreign studies over the past decade, the contents mainly focused on five aspects. Firstly, evaluate the scale of PSI industry (European Commission, 2000). Secondly, assess the contribution to the economy of PSI industry (OFT, 2000). Thirdly, find out the commercial exploitation model for PSI (OECD, 2006). Fourthly, remark on the effects of PSI re-use laws (European Commission, 2005; SEC, 2009). Finally, figure out Information and Communication Technologies' (ICTs) function on the industrial development (OECD, 2006).

It had been discovered through literature review that there were few domestic and foreign studies on the

development of PSI value-added exploitation industry at present and even no one analyzed the influential factors in the empirical perspective. However, the research on the key factors and restrictions for industry development has a great importance in solving the bottleneck and promoting the industrial growth. Therefore, on the basis of former studies, the influential factor model for the development of PSI value-added exploitation industry was proposed by using Porter's 'diamond model'. Furthermore, empirical studies had been carried out by integrating China's background. Through the empirical results, the article tries to find out a way to promote the development of PSI value-added exploitation industry in today's China.

### METHODOLOGY

**PSI value-added exploitation and related industry:** PSI value-added exploitation refers that individuals or legal entities (including the public sector) produce the value-added products by deep exploitation for PSI and provide them to the society on the basis of purposes excluding common tasks (no matter it is out of commercial

purpose or non-commercial purpose). In foreign countries, such a concept is often stated as PSI re-use. PSI will realize the adding of value during a series of information processing, such as screening, classification, sorting, concentration, etc. (Cisco and Strong, 2009). Figure 1 shows the details of this process.

In the above process, the enterprises engaged in developing and exploring PSI are named as the PSI value-added exploitation industry. According to the different contents of PSI, PSI industry can be divided as geographic information industry, meteorology information industry, economic information industry, traffic information industry, legal information industry, socio-culture information industry, etc. In America, such industry is usually called the information intensive industry.

**Diamond model:** Porter (1990) has proposed the ‘diamond model’ when referring to the theory of competitive advantage in the book *The Competitive Advantage of Nations*. In his theory, it is believed that a country’s international competitiveness is mainly determined by four factors, that is factor conditions,

demand conditions, related and supporting industry as well as firm strategy structure and rivalry. In addition, chance and government play the supplementary role as sub-elements. These six factors will not only be dependent but also influence each other, forming a perfect diamond system, as shown in Fig. 2. In this system, each factor displays different significances depending on the type of industries.

**RESEARCH MODEL**

**Factor conditions:** According to Porter (1990), factor conditions are the reflection of the country’s production in specific industrial competition, including human resources, physical resources, knowledge resources, capital resources and infrastructure. Combining with the characteristics of industry, the factor conditions influencing the PSI value-added exploitation industry can be divided into five categories: PSI, information processing technology (IPT), capital resources, human resources and information communication technology (ICT) infrastructure in this study:

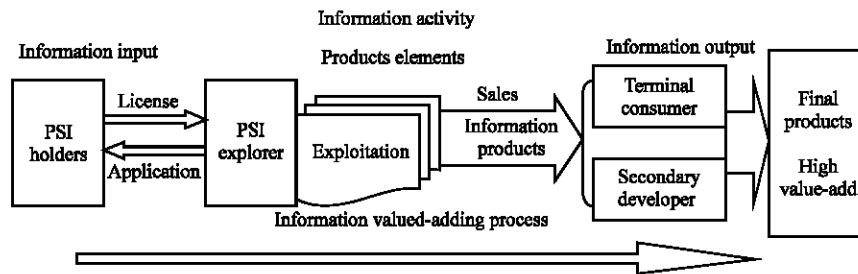


Fig. 1: The flow chart of the PSI value-added process

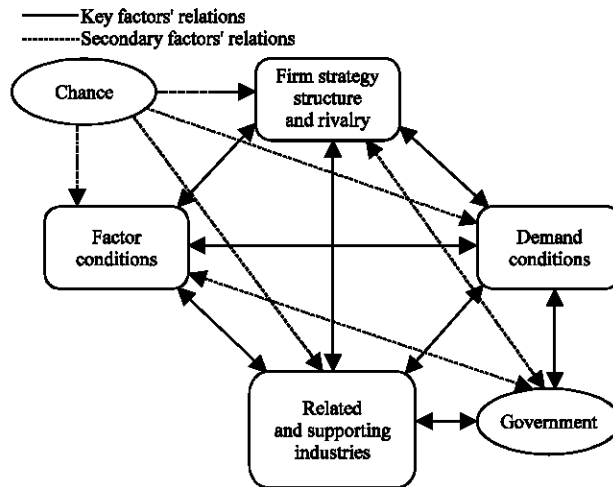


Fig. 2: Porter’s diamond model for the competitive advantage of nations

- **PSI:** The value will be added through developing and exploiting PSI. Therefore, as for this industry, PSI is not only the subject of labor but also the most important means of production (Chen and Wang, 2010). The access to information, authority conditions, acquisition cost and quality are the significant basis for evaluating PSI
- **Information processing technology (IPT):** As for PSI value-added exploitation industry, IPT including the ordinary technology and the core technology is a significant instrument of labor which generates the value-added information products and services through the combination with PSI. Moreover, IPT will also influence the industrial structure. Higher value added producers have often taken the place of previous intermediary distributors in the production value chain (OPSI, 2010)
- **Capital resources:** The realization of PSI value-added exploitation requires the access of information resources, the establishment of ICTs platform as well as the R and D of IPT. Therefore, the early stage of industrial development requires a huge capital investment
- **Human resources:** As for PSI value-added exploitation industry, skilled labor can deepen the industrial division and promote the industry to develop in depth and breadth. In addition, human resources can also accelerate the industry innovation
- **Infrastructure:** ICTs Infrastructure mainly includes the fundamental communication network, platform and terminal of information service, etc. ICTs Infrastructure innovation including the development of mobile networks open up further markets for PSI-based services and better data quality and e.g., increased interoperability open up cross-border services

**Demand conditions:** In the ‘diamond model’, expected demand of market will strengthen the industrial competition and promote the development of industry. As for the specific PSI value-added exploitation industry, the demand conditions mainly include the consumer demands and trust.

- **Consumer demands:** It refers to the consumer’s acceptance level for contents quality of value-added products. According to the consumer, the fact that the value-added products can satisfy their demands is usually the main basis for determining their adoption. In addition, the quality will also influence the consumer’s choiceto a large degree
- **Trust:** It refers to the customer’s trust degree to the authenticity and effectiveness of products provided by the value-added service provider

**Related and supporting industry:** According to Porter (1990), an industry can only develop its competitive advantages sustainably by forming the effective industrial clusters and the benign interaction between upstream and downstream industries. Here, the related and supporting industry mainly refers to the information industry. The development of information industry, especially the mobile communication technology’s entering into the 3G age, makes the individualized information service possible (Saxb, 2002). The good fusion with information industry can expand the space of PSI value-added exploitation industry.

**Rivalry:** In the diamond model, Porter (1990) believed that the maximum factor associated with creating the sustainable industry competitive advantage was the presence of a strong market competitor. The successful industry would certainly experience the market struggle for improvement and innovation. PSI value-added exploitation was primarily carried out by the public sector. But with the industrial development, the public and private sectors gradually occupied the equal position in the market to access and make use of the public data. The participation of the private sector in the market competition made changes in the industrial structure. As a result, the roles of the public and private bodies are changing now which maximizes the economic and other values of PSI and promotes the development of industry ultimately (McMullen, 2007).

**Government:** According to Porter (1990), the government’s role it to provide the needed resources and create the development environment for enterprises, rather than direct involvement. As for PSI value-added exploitation industry, the focus of government policy should include the legal guarantee, market supervision and economic regulation.

- **Legal guarantee:** Information access, intellectual property protection and personal data protection in the process of PSI value-added exploitation present a huge challenge to the development of this industry. Government should balance the interest of each part through legislation to promote the healthy and orderly development of industry
- **Market supervision:** The government will supervise and administrate the behavior of market entity, creating a fair and orderly competitive environment for guaranteeing the industrial development
- **Economic regulation:** It mainly refers that the government’s support policies, including establishing the Foster Fund, increasing financial input, reducing taxes, etc.

**Chance:** In the diamond model, Chance usually has nothing to do with the national environment. It is not the internal capability for an enterprise, even cannot be influenced by the government. However, once the event triggering the chances occur, it is quite important to seize these chances to form or improve the industry competitive advantage. Chance does not play a decisive role. For industry, chance cannot be sought, whether it can be seized is decided by other five factors.

**RESEARCH METHOD**

**Influential factor model for the development of PSI value-added exploitation industry:** According to the above analysis, factors for the development of PSI value-added exploitation industry have been concluded but they play different roles. Therefore with the help of ‘diamond model and the above analysis, an influential factor model has been established, as shown in Fig. 3. The article ties to testify the applicability of this model and illustrate each factor’s function on the industrial development as well as their internal relations through the empirical study based on background of China’s PSI value-added exploitation industry.

**Empirical study**

**Variable definition:** In this study, the model has been testified with questionnaire method. There are two parts in the questionnaire: Demographic questions including gender, age, vocation and education background etc., Measure scale for all variables based on previous

researches. Since, the ‘opportunity’ factor be expected and observed, it will be deleted during the investigation, as shown in Table 1. Besides, to ensure the data accuracy and convenience to analyze relationship within the variables, we took Likert 7 point scale, following a format of strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree, strongly agree, with 1, 2, 3, 4, 5, 6, 7 points.

**Data collection and reliability, validity test:** The investigation is launched among the employees in the government, universities and scientific research institutes, information resources developing enterprises, public information sectors like libraries, public service sectors like banks and telecommunications, etc. With 228 participants, the effective feedback rate is 76%. The survey sample is aging mainly from 25-40 (63.0%) and 72.1% of the participants earned junior degree or higher degree.

Firstly, we should make a reliability and validity test for all variables. We measure the reliability through Cronbach  $\alpha$ . In general, if Cronbach  $\alpha$  is bigger than 0.7, the data is considered as highly reliable. In our survey, the whole Cronbach  $\alpha$  of variables is 0.902, bigger than 0.7 which shows high reliability.

Besides, KMO and Bartlett’s sphericity test are used to testify the relevance between the variables. Generally, the KMO above 0.6 is applicable for factor analysis and it shall not be lower than 0.5. When Bartlett’s sphericity test is lower than 0.05 (sig. <0.05), the observed variables are suitable for factor analysis. In this study, the KMO is

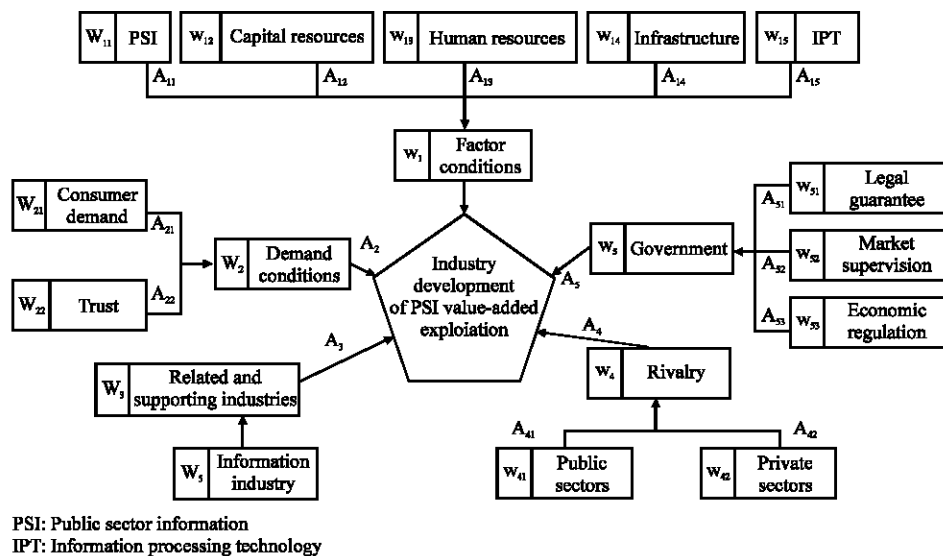


Fig. 3: Influential factor model for the development of PSI value-added exploitation industry

**Table 1: Variable definition for the influential factor model**

Item	Sub-item	Observable variable
Factor conditions (W <sub>1</sub> )	PSI <sup>1</sup> resources W <sub>11</sub>	Access channel X <sub>1</sub>
		License X <sub>2</sub>
		Acquisition cost X <sub>3</sub>
		Quality X <sub>4</sub>
		Capital input X <sub>5</sub>
Capital resources W <sub>12</sub>	Human resources W <sub>13</sub>	Skilled labor X <sub>6</sub>
		ICT's <sup>2</sup> infrastructure X <sub>7</sub>
		Ordinary technology X <sub>8</sub>
Infrastructure W <sub>14</sub>	IPT <sup>3</sup> W <sub>15</sub>	Core technology X <sub>9</sub>
		The consumer's satisfaction with contents X <sub>10</sub>
Demand conditions (W <sub>2</sub> )	Consumer demand W <sub>21</sub>	The consumer's satisfaction with quality X <sub>11</sub>
	Trust W <sub>22</sub>	The customer's trust degree of the information product and service X <sub>12</sub>
Related and supporting industry (W <sub>3</sub> )	Information industry W <sub>31</sub>	Supportive degree of information industry X <sub>13</sub>
		The fusion degree with such information industries as the communication, broadcast, television, etc. X <sub>14</sub>
Competition within the industry (W <sub>4</sub> )	Public sector W <sub>41</sub>	Equality of the market position X <sub>15</sub>
	Private sector W <sub>42</sub>	Competition status X <sub>16</sub>
Governmental (W <sub>5</sub> )	Legal guarantee W <sub>51</sub>	Legislation for Value-add use of PSI X <sub>17</sub>
		Intellectual property protection X <sub>18</sub>
	Market supervision W <sub>52</sub>	Standard for the information resources development X <sub>19</sub>
		Standard of pricing X <sub>20</sub>
Economic regulation W <sub>53</sub>	Foster fund X <sub>21</sub>	
	Fiscal taxation policy X <sub>22</sub>	

<sup>1</sup>PSI: Public sectors information, <sup>2</sup>ICT's: Information communication technology's, <sup>3</sup>IPT: Information processing technology

**Table 2: Initial, extracted and varimax variance explained**

Factor	Initial statistics			Factor extracted statistics			Factor extracted statistics after the varimax rotation		
	Characteristic root	Contribution rate	Accumulated contribution rate	Characteristic root	Contribution rate	Accumulated contribution rate	Characteristic root	Contribution rate	Accumulated contribution rate
Factor W <sub>1</sub>	9.353	42.515	42.515	9.353	42.515	42.515	7.135	32.434	32.434
Factor W <sub>5</sub>	3.182	14.465	56.980	3.182	14.465	56.980	3.750	17.047	49.481
Factor W <sub>2</sub>	2.908	13.217	70.196	2.908	13.217	70.196	3.087	14.034	63.515
Factor W <sub>3</sub>	1.937	8.803	78.999	1.937	8.803	78.999	2.842	12.920	76.434
Factor W <sub>4</sub>	1.086	4.935	83.934	1.086	4.935	83.934	1.650	7.499	83.934

Factor W<sub>1</sub>: Factor conditions, Factor W<sub>5</sub>: Governmental, Factor W<sub>2</sub>: Demand conditions, Factor W<sub>3</sub>: Relating and supporting industry, Factor W<sub>4</sub>: Competition within the industry

0.883 which is greater than 0.6 and the Bartlett's sphericity is notable in  $p = 0.000$ . So, it is believed that the observed variables are suitable for factor analysis.

**Model test:** The article took Exploratory Factor Analysis (EFA) to testify the influential factor model for the development of the above PSI value-added exploitation industry.

In the process of factor analysis, the Principal Factor Analysis method is adopted. We conducted the factor rotation with Varimax and the factor whose characteristics root is greater than 1 is extracted. The results shows that the factor loading of each variable is greater than 0.5, thus all of them should be reserved. Meanwhile, there are 5 public factors whose characteristic roots are greater than 1 and the total variance explained rate is 83.934% which is greater than 80%, suggesting that the five common factors cover most variables. Please refer to the details in Table 2.

The difference, meaning and practical value between the factor-loadings obtained from the primary transformation are not so, great. Therefore, the maximum

variance rotation method is adopted to obtain the factor loading after rotation, as shown in Table 3. It has been discovered that the loading coefficients between the observable variables and corresponding common factor are relatively large. While, according to the statistic analysis, ICT's Infrastructure X<sub>7</sub> should be fallen into the factor W<sub>1</sub> because the technical progress of ICT'S infrastructure is consistent with the development of information industry. But general speaking, it can be believed that the statistical data has supported the applicability of 'diamond model' in the influential factor analysis for the PSI value-added exploitation industry.

In addition, according to the Table 2, the 'factor conditions' have the largest influence on the industrial development with the contribution rate of 32.434%, for the PSI value-added exploitation industry in China. Besides, the 'government and 'demand conditions' also have a huge impact and the contribution rates are 17.047% and 14.034%, respectively.

Finally in order to explore the correlation between the five influential factors of PSI value-added exploitation

industry further, the correlation analysis is adopted to analyze the data, as shown in Table 4. From which it can be discovered that the correlation coefficient between factor W1 and factor W4, factor W1 and factor W5, factor W4 and factor W5 is 0.634, 0.599 and 0.321, respectively. The corresponding P is smaller than 0.01 with notable statistical significance, suggesting that there is a notable positive correlation between ‘factor conditions and

‘rivalry’, between ‘factor conditions and government’ and between ‘rivalry and government’. The correlation between the rest dimensions is not notable (the corresponding p is greater than 0.05).

**DISCUSSION AND CONCLUSION**

With ‘diamond model’, the article analyzed the influencing factors of PSI value-added exploitation industry. Combining with the current situation in China, the empirical study is adopted to testify the model. The study results have indicated the following four points.

Firstly, though the proposal of ‘diamond model’ aims to study the problems about the competitive advantage of nations, it is applicable for the influential factor analysis for the PSI value-added exploitation industry. It shows the influence of the macro-environment, such as the economy, society, policies and laws of a country, on the industrial development.

Secondly, the key factors influencing the development of PSI value-added exploitation industry in China include factor conditions, demand conditions, related and supporting industry, rivalry and government. In these four factors, ‘factor conditions’ have the greatest influence which suggests that China’s PSI value-added exploitation industry is still in its infancy. As a result, the supply of production factor is the significant support to the industrial development in this period. Therefore, the input guarantee of the production factors, including PSI, capital resources, IPT, human resources etc. is the priority to promote the industrial development. This result is consistent with the conclusion from OECD (OECD, 2006). In addition, the influence of ‘demand condition’ and ‘government’ is also huge, suggesting that in the primary stage of industry, the market demand has a distinct pulling effect while the government policies play an important role in promoting the industrial development. Such result is consistent with the results from European Commission (2005).

**Table 3: Rotated component matrix for all observable variables**

Observable variables	Component				
	Factor W <sub>1</sub>	Factor W <sub>2</sub>	Factor W <sub>3</sub>	Factor W <sub>4</sub>	Factor W <sub>5</sub>
X <sub>1</sub>	0.846	0.047	0.009	0.275	0.309
X <sub>2</sub>	0.807	0.043	0.027	0.291	0.307
X <sub>3</sub>	0.845	0.031	0.033	0.279	0.324
X <sub>4</sub>	0.822	0.119	0.045	0.242	0.258
X <sub>5</sub>	0.883	0.009	-0.070	-0.003	0.200
X <sub>6</sub>	0.903	-0.016	-0.038	-0.008	0.223
X <sub>7</sub>	0.014	-0.026	0.970	0.023	-0.070
X <sub>8</sub>	0.914	0.002	0.013	0.024	0.201
X <sub>9</sub>	0.913	0.004	0.005	0.129	0.116
X <sub>10</sub>	0.002	0.955	-0.047	0.100	0.014
X <sub>11</sub>	0.026	0.980	-0.019	0.035	-0.005
X <sub>12</sub>	0.052	0.963	-0.032	0.038	0.006
X <sub>13</sub>	-0.013	-0.056	0.971	-0.004	-0.074
X <sub>14</sub>	0.006	-0.020	0.952	0.042	-0.065
X <sub>15</sub>	0.442	0.103	0.068	0.742	-0.033
X <sub>16</sub>	0.590	0.089	0.026	0.617	0.105
X <sub>17</sub>	0.286	-0.162	-0.088	-0.115	0.721
X <sub>18</sub>	0.499	-0.070	-0.135	-0.070	0.717
X <sub>19</sub>	0.145	0.456	-0.037	-0.213	0.628
X <sub>20</sub>	0.364	0.049	-0.038	-0.107	0.683
X <sub>21</sub>	0.195	0.014	-0.051	0.387	0.824
X <sub>22</sub>	0.216	0.067	-0.030	0.406	0.803

Factor W<sub>1</sub>: Factor condition, Factor W<sub>2</sub>: Demand conditions, Factor W<sub>3</sub>: Related and supporting industry, Factor W<sub>4</sub>: Competition within the industry, Factor W<sub>5</sub>: Governmental, X<sub>1</sub>: Access channel, X<sub>2</sub>: License, X<sub>3</sub>: Acquisition cost, X<sub>4</sub> Quality, X<sub>5</sub>: Capital input, X<sub>6</sub>: Skilled labor, X<sub>7</sub>: Information Communication Technology (ICT) infrastructure, X<sub>8</sub>: Ordinary technology, X<sub>9</sub>: Core technology, X<sub>10</sub>: Consumer’s satisfaction with contents, X<sub>11</sub>: Consumer’s satisfaction with quality, X<sub>12</sub>: Customer’s trust degree of the information product and service, X<sub>13</sub>: Supportive degree of information industry, X<sub>14</sub>: Fusion degree with such information industries as the communication, broadcast, television, etc., X<sub>15</sub>: Equality of the market position, X<sub>16</sub>: Competition status, X<sub>17</sub>: Legislation for value-add use of public sector information, X<sub>18</sub>: Intellectual property protection, X<sub>19</sub>: Standard for the information resources development, X<sub>20</sub>: Standard of pricing, X<sub>21</sub>: Foster fund, X<sub>22</sub>: Fiscal taxation policy.

**Table 4: Pearson correlation between five influential factors and their significance**

Factors		Factor W <sub>1</sub>	Factor W <sub>2</sub>	Factor W <sub>3</sub>	Factor W <sub>4</sub>	Factor W <sub>5</sub>
W <sub>1</sub>	Pearson correlation	1	0.073	-0.010	0.634**	0.599**
	Sig. (2-tailed)		0.377	0.900	0.000	0.000
	N	150	150	150	150	150
W <sub>2</sub>	Pearson correlation	0.073	1	-0.065	0.146	0.094
	Sig. (2-tailed)	0.377		0.429	0.074	0.251
	N	150	150	150	150	150
W <sub>3</sub>	Pearson correlation	-0.010	-0.065	1	0.062	0.144
	Sig. (2-tailed)	0.900	0.429		0.454	0.078
	N	150	150	150	150	150
W <sub>4</sub>	Pearson correlation	0.634**	0.146	0.062	1	0.321**
	Sig. (2-tailed)	0.000	0.074	0.454		0.000
	N	150	150	150	150	150
W <sub>5</sub>	Pearson correlation	0.599**	0.094	-0.144	0.321**	1
	Sig. (2-tailed)	0.000	0.251	0.078	0.000	
	N	150	150	150	150	150

Factor W<sub>1</sub>: Factor conditions, Factor W<sub>2</sub>: Demand conditions, Factor W<sub>3</sub>: Related and supporting industry, Factor W<sub>4</sub>: Competition within the industry, Factor W<sub>5</sub>: Governmental

Thirdly, there is a positive correlation between 'factor conditions' and 'rivalry' in the model which means that China's PSI value-added exploitation industry is still in the production factor driving stage. In this stage, the major competitive strategy is to struggle for production factors such as PSI, capital, IPT and talents.

Finally, besides the direct influence on the industrial development, government policy can also generate the indirect influence by affecting 'factor conditions and rivalry'. Therefore, the government's industrial policy has a great significance on the development of PSI value-added exploitation industry in China. On one hand, the government should make related laws for PSI value-added exploitation and take various preferential policies to guide the flowing of PSI, capital resources, human resources and technology towards this industry and improve resource allocation efficiency. On the other hand, the government should further fulfill its market regulation function to make the public and private sectors as the fair market competitors for preventing the information monopolization and creating a healthy and orderly market environment for the industrial development.

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