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The Decline of National Innovation and Its Implication

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Abstract. Based on the Annual Global Innovation Index (GII) reports, this paper found that many countries in the world have experienced a decline in national innovation capacity in different years, which has restricted the development of the country to some extent. Presently, the global economic growth is sluggish, the development uncertainty is huge, and the understanding of innovation decline is of great significance to the development of a country. This paper made a definition of innovation decline and analyzed its influencing factors. Finally, the result of this paper showed that the improvement of infrastructure quality will promote the occurrence of innovation decline. However, the institutional environment and R&D expenditure of government cannot affect innovation decline significantly.

1. Introduction and literature review

Because of the pioneering introduction of economic innovation theory put forward by Schumpeter[1], people have paid more and more attention to the innovation researches, such as the connotation and extension of innovation, the role and importance of innovation, the influencing factors of innovation, the reasons for lacking of innovation and the countermeasures. Moreover, the main body of innovation is not limited to individuals, but also the institution, organization, industry, region, or even the country. Freeman[2] pioneered the concept of the National Innovation System (NIS) by studying the miracle of Japan's economic growth and the important role of the government. Lundvall[3], Nelson[4], and the OECD[5] also studied this issue deeply and emphasized the role of the government, who was the system supplier and market corrector in the overall national innovation system for national innovation. Furthermore, under the premise of recognizing the market as the main body of innovation, Howells[6], Curtis[7], and Block[8] believed that innovation was not only a matter of the market and the government should participate in national innovation actively and selectively. Smith[9] even believed that government was the core of national innovation. Additionally, Fromhold-Eisebith[10] highlighted the function of the innovation systems approach for policy conceptualization. Based on the experience of the European Union and the United States, Kravchenko[11] analyzed the problems of assessing and measuring national innovation systems. At present, the combination of technological innovation and institutional innovation, management innovation, business innovation and cultural innovation are tight increasingly, and the national development mode is gradually shifting from factor-driven to innovation-driven. This process is reshaping the world's competitive landscape and changing the power of country. The innovation drive has become a core strategy for more and more countries to seek competitive advantages, such as, "America's Innovation Strategy: Ensuring Our Economic Growth and Prosperity" and "National Strategic Plan for Advanced Manufacturing" (America), " Basic Plan of Science and Technology" (Japan), "Germany 2020 High Technology Strategy" (Germany), "Chinese Manufacturing in 2025" (China). On one hand, the importance of innovation is unquestionable so that it has become the focus of many countries. The one who can lead innovation can also lead the global development process. On the other hand, the decline in the growth rate of total factor growth (TFP), which is significantly positively correlated with national innovation capabilities, explains 85% economic slowdown in more than 130 countries around the world [12]. At the same time, according to the annual national innovation index's scores and rankings released by Cornell University, the World Intellectual Property Organization (WIPO) and other institutions, the country's absolute innovation ability and relative ranking is neither static, nor

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continuously improving. Whether it is in developed countries or developing countries, the phenomenon of decline in innovation capacity, has generally occurred, and the emergence of innovation decline is not a small probability event (more details are shown in section 3). Because of this, the decline of innovation has become one of the major risks of the national development. Presently, the global economic growth is sluggish, the development uncertainty is huge. The understanding of innovation decline and the role of the government are of great significance to the development of the country. At present, there are few scholars who regard "innovation decline" as a direct research object. Therefore, this paper used the global innovation index to define "innovation decline" and tried to use the panel Logit model to explore the influencing factors of the "innovation decline" and the government's role in preventing this risk.

2. Identification of innovation decline

2.1 Definition of innovation decline

Referring to Barry Eichengreen, Donghyun Park, Kwanho Shin [12] for the definition of the dummy variable "economic slowdown", and according to the value of the global innovation index and its ranking, "absolute innovation decline" and "relative innovation decline" can be defined. Among them, "absolute innovation decline" refers to the decline of the innovation output index, and "relative innovation decline" refers to the decline in the ranking of the innovation output index. Specifically, if a country's innovation output index declines in a certain year, its corresponding "absolute innovation decline" is assigned a value of "1". Otherwise, it is assigned a value of "0". Similarly, if a country's rank of the innovation output index declines in a certain year, its corresponding "relative innovation decline" is assigned a value of "1", and vice versa is assigned a value of "0". By doing the above operations for all the individuals in the sample, two dummy variables were obtained, which were called "innovation decline".

However, there are some problems with "innovation decline" defined by the above method. There, the decline of the innovation output index was taken as an example. For a country, if the value of the innovation output index of a certain year is less than that of last year, but the difference is very small, it is not appropriate to define the year as "innovation decline". For example, the scores of Algeria were 16.74 and 16.68 in 2014 and 2015 respectively. The difference between the two was only 0.06. It is not appropriate to identify Algeria in 2015 as "innovation decline". In addition, due to small changes year by year in the annual output of the Innovation Output Index (refer to the GII report appendix for detail), the smaller differences might not be due to the differences in real innovation capabilities rather than the statistical methods or statistical errors. To alleviate this problem, it can be judged as "innovation decline" only when the innovation index falls by 5% and above (or 10% and above). In terms of "relative innovation decline", it can be judged as "innovation decline" to alleviate this problem only when the ranking declines by 3 and above (or 5 and above). Additionally, the one-year ranking decline sometimes might be accidental, but the probability of accidental decline for two consecutive years will be reduced greatly. Therefore, it can be judged as "relative innovation decline" when the rank of innovation output index has fallen by three or five units in two consecutive years.The above definitions are summarized as follows:

1. Absolute innovation decline – based on the innovation output index score

(a) Score（T）-Score（T-1）<=0；

(b) (Score（T）-Score（T-1）)/ Score（T-1）>=-0.05；

(c) (Score（T）-Score（T-1）)/ Score（T-1）>=-0.10；

2. Relative innovation decline - based on the rank of innovation output index

(a) Rank（T）- Rank（T-1）>=1；

(b) Rank（T）- Rank（T-1）>=3；

(c) Rank（T）- Rank（T-1）>=5；

(d) Rank（T）- Rank（T-1）>=1 and Rank（T-1）- Rank（T-2）>=1；

(e) Rank（T）- Rank（T-1）>=3 and Rank（T-1）- Rank（T-2）>=3；

(f) Rank（T）- Rank（T-1）>=5 and Rank（T-1）- Rank（T-2）>=5；

2.2 Performance of innovation decline

According to the definition of "innovation decline" in 2.1, Table 1 can be obtained according to the GII index and its ranking data. According to the TFP data in Penn World Table 9.0, Table 2 can be obtained. From Table 1, Table 2, we can get the following facts. (1) "Innovation decline" is not a small probability phenomenon: From the perspective of "absolute innovation decline", in the period of 2012-2017, the number of innovation decline defined by falling, falling more than 5%, and falling more than 10% are respectively 323, 186, 98 and the corresponding decline frequency are respectively 0.55, 0.31, 0.17; from the perspective of "relative innovation decline", in the period of 2012-2017, the number of rank declining, declining 3 units or more, and declining 5 units or more are 291, 206, and 167, respectively, and the corresponding decline frequencies are 0.49, 0.35, and 0.28, respectively. What is more, the number of rank declining, declining 3 units or more, and declining 5 units or more for two consecutive years are respectively 119. 57, 38, and the corresponding sliding frequencies are 0.20, 0.10, 0.06. (2) "Innovation decline" is widespread, but to a different extent: in 2012-2017, almost all countries suffered from "innovation decline", but countries with different income levels suffered from different "innovation decline". The difference is that from the perspective of "absolute innovation decline", the decline rate of low-income countries, lower-middle countries, upper-middle countries, and high-income countries is 0.51, 0.34, 0.32, and 0.24, respectively. In countries with higher per capita income, the lower the probability of decline in their ability to innovate, the fact that the scores fall by 10% or more also supports the above judgment; From the perspective of "relative innovation decline", taking de1_3 as an example, the decline frequencies of low-income countries, lower-middle countries, upper-middle countries, and high-income countries were 0.46, 0.34, 0.40, and 0.29, respectively (see table 2). It seems that the probability of a substantial decline in the ranking of innovation in high-income countries is smaller, and the decline in other ranking methods also supports this judgment. (3) The absence of "absolute innovation decline" does not mean that "relative innovation decline" will not happen, and vice versa is not true: in the United States, for example, in 2014 and 2015, the GII output scores of US were 52.27 and 52.89 respectively, but its ranking slipped from 7 to 9. What is more, the scores of the United States in 2016 and 2017 were 54.08 and 53.93 respectively, but the ranking rose from 7 to 5. (4) The score of innovation ability is positively correlated with TFP and GDP per capita: After eliminating the petroleum country (economic structures of those countries are quite unique), the author drew the scatter plot of the innovation output score and TFP (see figure 1) and finds that the innovation output score has strong positive correlations with TFP. Countries with stronger innovation capabilities, in general, have higher total factor productivity, which also implies the negative impact of "innovation decline" on TFP. This finding is in line with the findings of many other scholars. Based on the research of Solow [13] and Barro [14], TFP was considered to represent the generalized technology. The TFP growth rate was considered as a generalized technological advancement, and this generalized technique was considered to include three factors: narrow technical level, resource allocation efficiency, scale effect [15]. Furthermore, Zhang Lijun [16] believed that innovation capability was an important part of TFP and verified that regional innovation capability has a significant positive impact on TFP growth rate through production function method. In addition, as can be seen from figure 2, samples with bigger innovation scores than average have higher TFP, while TFPs with lower innovation rankings are also slightly lower than those without decline. It can also be seen from figures 3 and 4 that both TFP and innovation output scores are significantly positively correlated with per capita income. At the same time, the TFP of the sample with a decline in innovation ranking is also slightly lower than the sample with no decline. Finally, it can also be seen from figures 3 and 4 that both TFP and innovation output scores are significantly positively correlated with income per capita.

Table 1 Innovation decline statistics I

	sde1	sde1_5	sde1_10	de1	de1_3	de1_5	de2	de2_3	de2_5	observations
low-income	40	35	19	30	31	26	10	11	8	68
lower-middle income	72	42	26	66	42	36	30	9	4	124
upper-middle income	87	50	30	76	62	54	34	20	15	154
high-income	124	59	23	119	71	51	45	17	11	245
sum	323	186	98	291	206	167	119	57	38	591
decline frequency	0.55	0.31	0.17	0.49	0.35	0.28	0.2	0.1	0.06	

Note: sde1, sde1_5, and sde1_10 respectively represent the decline in innovation output, decline 5% and above, and decline 10% or more. de1, de1_3, and de1_5 respectively represent the rank of innovation output declines, declines at least 3 units, and declines at least 5 units. de2, de2_3, and de_5 respectively represent the rank of innovation output declines, declines at least 3 units, and declines at least 5 units for two consecutive years. A country in a year is regarded as an observation here.

Table 2 Innovation decline statistics II

	sde1	sde1_5	sde1_10	de1	de1_3	de1_5	de2	de2_3	de2_5	observations
low-income	0.59	0.51	0.28	0.44	0.46	0.38	0.2	0.16	0.12	68
lower-middle income	0.58	0.34	0.21	0.53	0.34	0.29	0.2	0.07	0.03	124
upper-middle income	0.56	0.32	0.19	0.49	0.4	0.35	0.2	0.13	0.1	154
high-income	0.51	0.24	0.09	0.49	0.29	0.21	0.2	0.07	0.04	245
sum	0.55	0.31	0.17	0.49	0.35	0.28	0.2	0.1	0.06	591

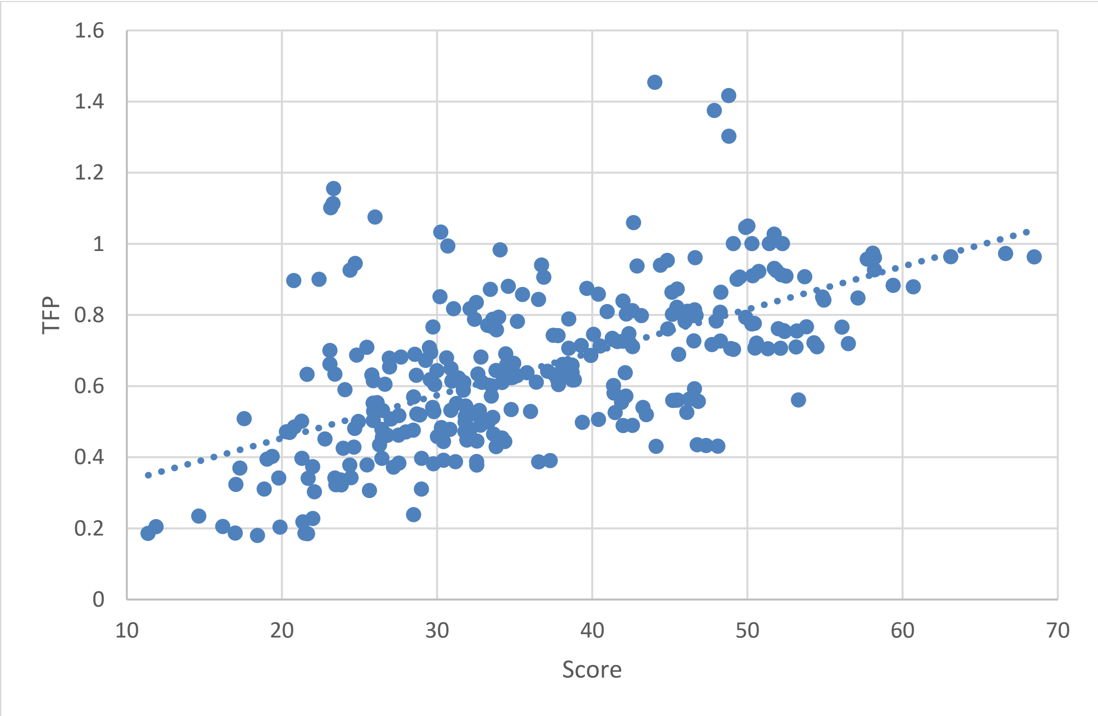

Fig. 1. Innovation and TFP I

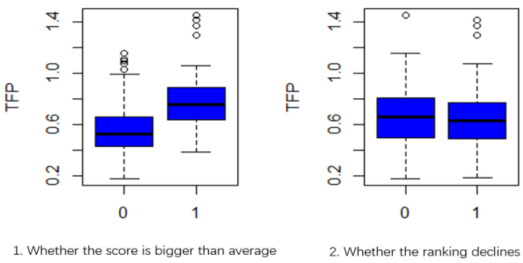

Fig. 2. Innovation and TFP II

Note: "1" means yes, "0" means no.

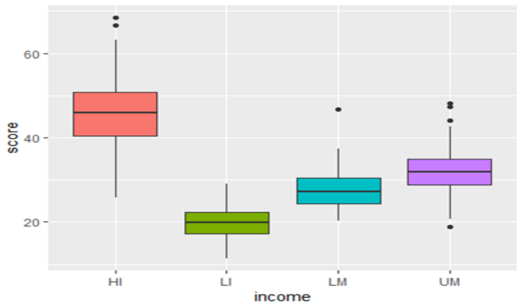

Fig. 3. Income and innovation score

Note: LI、LM、UM、HI respectively represent low-income countries, lower-middle income countries, upper-middle income countries, and high-income countries.

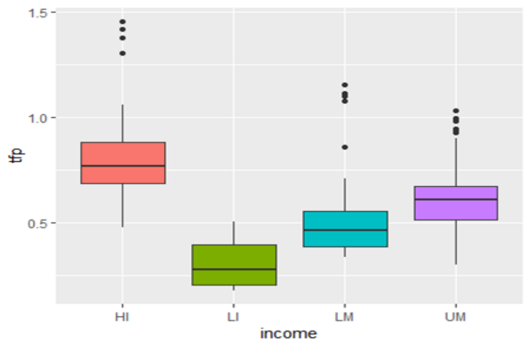

Fig. 4. Income and TFP

Note: LI、LM、UM、HI respectively represent low-income countries, lower-middle income countries, upper-middle income countries, and high-income countries.

3. Factors behind the innovation decline

3.1 About the composition of the innovation index

In order to more fully and comprehensively describe the country's ability to innovate, the GII report does not adopt a single indicator, but constructs a comprehensive index of innovation that is weighted in some way by the innovation input index and the innovation output index. Among them, there are five pillars in the input index of innovation capability, namely Institution, Human capital and research, Infrastructure, Market sophistication, Business sophistication. More information can be seen in figure 5.

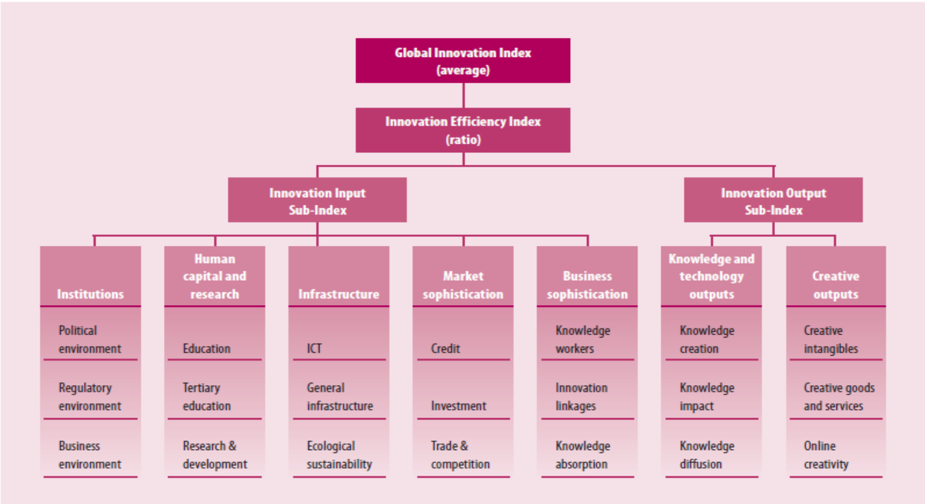

Fig. 5. GII indicator framework

In conclusion, the innovation input index comprehensively measures the investment of country's innovation in a certain year (including institutional environment, market organization, human capital, physical capital and other dimensions), while the innovation output index measures the innovative outcomes of a country's innovation in a given year. In this paper, the author used the innovation output as the measure of the country's ability to innovate. Undoubtedly, the output of innovation results will be affected by inputs inevitably , which include the role of the government and market. The government's role in innovation can be broadly divided into three categories: the first is the provision of public goods such as infrastructure; the second is to create an innovative institutional environment, and the third is government innovation-related expenditures (such as R&D expenditures). In the next section, the panel Logit model will be used to explore the role of these three factors.

3.2 Empirical model and variable description statistics

Since the dependent variable is a "0-1" dummy variable, it is not suitable to use the linear regression model. Therefore, the binary regression model is selected. Since the selected data is panel data and the Probit model does not support it, the panel Logit model is used. The specific structure is as follows:

$$y_{it}^{*} = x_{it}^{\prime}\beta + u_i + \varepsilon_{it} \quad (\mathrm{i} = 1, \ldots \mathrm{n}; \mathrm{t} = 1, \ldots \mathrm{T}) \tag{1}$$

$$y_{it} = \begin{cases} 1, y_{it}^{*} > 0 \\ 0, y_{it}^{*} \leq 0 \end{cases} \tag{2}$$

$$\begin{aligned} \mathrm{P}((y_{it} = 1 | x_{it}, \beta, u_i) &= \mathrm{P}((y_{it}^{*} > 0 | x_{it}, \beta, u_i) \\ &= \mathrm{P}\,((\varepsilon_{it} < u_l + x_{it}^{\prime}\beta | x_{it}, \beta, u_i) \\ &= \mathrm{F}\,(u_i + x_{it}^{\prime}\beta) \end{aligned} \tag{3}$$

Where y_{it}^{*} is the unobservable latent variable, u_i measures the individual effect，**F** is the cumulative distribution function of ε_{it}. If ε_{it} obeys the logical distribution, the above regression model is the Logit model.

$$\mathrm{P}((y_{it} = 1 | x_{it}, \beta, u_i) = \Lambda(u_2^{\prime} + x_{it}^{\prime}\beta) = \frac{e^{u_i + x_{it}^{\prime}\beta}}{1 + e^{u_i + x_i^{\prime} t\beta}} \tag{4}$$

$$\ln \frac{P}{1-p} = u_i + x_{it}^{\prime}\beta \tag{5}$$

In this article, y_{it} means innovation decline and "1" indicates occurrence. In part 2.1, "innovation decline" is divided into "absolute innovation decline" and "relative innovation decline", but in the next section "innovation decline" only refers to "absolute innovation weakness". x_{it} stands for the various factors that affect innovation decline , see Table 3. u_i is an unobservable, non-observable individual effect, that is, a unique factor that affects a country's "innovation decline". Since the GII report has a large difference in calculation methods around 2011, only the data of the Innovation Index of 2012-2017 is used here, and the description of the variables is shown in Table 3. Among them, sd1_5 and sd1_10 represent the innovation decline calculated on the basis of 5% and 10% decreasing of the scores; inf, ins, hcr, msof and bsof are the five pillars of the GII index, representing infrastructure, institutional environment, human capital and R&D, market sophistication, business sophistication; ps, qe are political stability, government efficiency, measuring the national political environment; rq, rl are the quality of supervision and legal rules, measuring the state's regulatory environment; esb, ept, and eri measure the ease to start a business, ease to pay tax, and ease of bankruptcy insolvency, measuring the business environment of the country. rd and acrd respectively are accumulate R&D expenditures per capita and government R&D expenditures, measuring the government's R&D expenditure stock. The above data are from the GII reports or the World Bank WDI database.

Table 3 Variable description statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
sde1_5	0.315	0.465	0.000	1.000	N = 448
sde1_10	0.170	0.376	0.000	1.000	N = 448
inf	40.334	13.213	11.400	69.800	N = 448
ins	63.984	16.533	25.400	95.400	N = 448
hcr	35.162	15.062	0.700	68.300	N = 448
msof	48.798	12.449	19.000	87.100	N = 448
bsof	36.333	11.251	12.600	76.900	N = 448
ps	-0.011	0.851	-2.700	1.490	N = 450
ge	0.332	0.908	-1.280	2.250	N = 449
rq	0.402	0.931	-1.290	8.000	N = 449
rl	0.209	0.983	-1.290	2.090	N = 450
esb	67.325	34.516	0.070	100.000	N = 450
ept	55.666	31.095	0.010	97.190	N = 449
eri	41.444	28.552	0.120	98.310	N = 450
rd	927.075	959.345	34.323	6047.472	N = 208
acrd	50.372	123.768	0.184	803.147	N = 208

3.3 Empirical results

3.3.1 Infrastructure

In order to measure the impact of general infrastructure on "innovation decline", the author used the infrastructure index in the GII input index to measure the quality of the infrastructure, which is represented by "inf" in the model. The regression results are shown in Table 4, and column (1) is the base regression, which measures the impact of infrastructure on innovation decline without considering other factors. Columns (2) through (4) measure the impact of infrastructure on innovation decline under other factors. In order to further increase the robustness of the results, this paper reports in the column (5) the regression results of the 10% based innovation decline. The results of columns (1) through (5) show that inf is statistically significant and its coefficient is positive, which means that the higher the score of the infrastructure, the greater the probability of innovation decline, while other influencing factors remain the same. This is easy to understand, although in terms of the function of the infrastructure, its improvement can provide a good material basis for innovation. However, from the perspective of its implementation process, infrastructure investment may squeeze private investment by squeezing out limited credits, raising market interest rates, increasing government debt, and distorting economic structure. Because private investment is the mainstay of innovation, this process will inhibit market innovation and the development of national innovation. Especially when the supply of infrastructure exceeds normal levels, the continued increase in infrastructure investment may have a greater inhibitory effect on innovation.

Table 4 Infrastructure

	(1)	(2)	(3)	(4)	(5)
	inf1_5	inf2_5	inf3_5	inf4_5	inf_10
main					
inf	0.134^{***}	0.131^{***}	0.133^{***}	0.135^{***}	0.152^{***}
	(0.0312)	(0.0314)	(0.0322)	(0.0327)	(0.0426)
ins		0.0333		-0.0368	-0.0374
		(0.0453)		(0.0539)	(0.0651)
hcr		-0.0355		-0.0141	-0.0873^{*}

		(0.0350)		(0.0369)	(0.0520)
msof			0.0460*	0.0498*	0.0419
			(0.0259)	(0.0281)	(0.0332)
bsof			-0.0643**	-0.0707**	-0.0655
			(0.0317)	(0.0342)	(0.0407)
N	363	363	363	363	244
R^2					

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: "_5" means decreasing 5% or above, "_10" means decreasing 10% or above.

3.3.2 Institutional environment

In order to study the impact of different institutional environments on "innovation decline", the author selected a series of indicators to measure the institutional environment. It can be seen from column (4) and column (5) of Table 4 that the influence of institutional environment ins on innovation decline is not statistically significant under other factors. Of course, the selection of composite index may have an impact on the results. In order to more closely measure the impact of different institutional environments, it is necessary to use subdivided indicators instead of composite indices. In order to measure the political environment, the author selected political stability and safety and government effectiveness. In order to measure the regulatory environment, the author selected regulatory quality and rule of law; In order to measure the business environment, the author chose the cost to start a business, the cost of resolving insolvency, and the time to prepare and pay taxes. In the regression models, the above variables are represented by "ps", "ge", "rq", "rl", "csb", "ric", "tppt", respectively. It can be seen from Table 5 that whether or not to consider the influence of other factors, the political stability and security level of the political environment and the impact of government efficiency on the lack of innovation are not statistically significant; as can be seen from Table 6, although the regulatory quality and rule of law have negative coefficients, which means the improvement of regulatory quality tends to reduce the probability of "innovation decline", they are not statistically significant. In addition, as can be seen from Table 7, the indicators for measuring the business environment, whether it is the cost of starting a business, the cost of resolving the bankruptcy problem or the time of tax payment is not statistically significant. All in all, this shows that the institutional environment itself does not affect the occurrence of innovation decline.

Table 5 Political environment

	(1)	(2)	(3)	(4)	(5)	(6)
	ps1_5	ps2_5	ps3_5	ge_5	ps_10	ge_10
main						
ps	-0.0756	0.0120	0.195		0.291	
	(0.348)	(0.372)	(0.383)		(0.457)	
inf		0.133***	0.134***	0.137***	0.151***	0.149***
		(0.0315)	(0.0323)	(0.0326)	(0.0421)	(0.0423)
hcr		-0.0407	-0.0120	-0.0156	-0.0851*	-0.0845
		(0.0342)	(0.0369)	(0.0370)	(0.0516)	(0.0517)
msof			0.0450*	0.0510*	0.0413	0.0353
			(0.0268)	(0.0277)	(0.0329)	(0.0332)

bsof			-0.0648**	-0.0624*	-0.0620	-0.0579
			(0.0322)	(0.0320)	(0.0388)	(0.0386)
ge				0.741		-0.211
				(0.605)		(0.874)
N	363	363	363	362	244	243
R^2						

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: "_5" means decreasing 5% or above, "_10" means decreasing 10% or above.

Table 6 Regulatory environment

	(1) rq1_5	(2) rq2_5	(3) rq3_5	(4) rq_10	(5) rl_5	(6) rl_10
main						
rq	-0.404	-0.370	-0.431	-1.072		
	(0.473)	(0.463)	(0.489)	(0.824)		
inf		0.132***	0.132***	0.152***	0.126***	0.150***
		(0.0314)	(0.0321)	(0.0420)	(0.0324)	(0.0420)
hcr		-0.0399	-0.0109	-0.0805	-0.00865	-0.0842
		(0.0343)	(0.0369)	(0.0517)	(0.0370)	(0.0518)
msof			0.0428	0.0377	0.0521*	0.0415
			(0.0267)	(0.0326)	(0.0280)	(0.0340)
bsof			-0.0659**	-0.0622	-0.0617*	-0.0591
			(0.0322)	(0.0393)	(0.0318)	(0.0384)
rl					1.550	0.643
					(1.417)	(1.729)
N	362	362	362	243	363	244
R^2						

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: "_5" means decreasing 5% or above, "_10" means decreasing 10% or above.

Table 7 Business environment

	(1) csb1_5	(2) csb2_5	(3) csb3_5	(4) tppt1_5	(5) tppt2_5	(6) ric1_5	(7) ric_10	(8) ric2_5
main								
csb	-0.0347**	-0.0165	-0.0183					
	(0.0164)	(0.0162)	(0.0168)					
tppt				0.00135	0.00202			
				(0.00233)	(0.00235)			

ric						-0.137	-27.75	-0.188
						(0.359)	(3221.1)	(0.390)
inf		0.124^{***}	0.122^{***}	0.145^{***}	0.140^{***}	0.141^{***}	0.170^{***}	0.134^{***}
		(0.0328)	(0.0338)	(0.0335)	(0.0336)	(0.0322)	(0.0446)	(0.0323)
hcr		-0.0422	-0.0132	-0.0211	-0.0112	-0.0211	-0.101^{*}	-0.0117
		(0.0344)	(0.0370)	(0.0358)	(0.0369)	(0.0358)	(0.0538)	(0.0369)
msof			0.0409	0.0543^{**}	0.0453^{*}	0.0531^{**}	0.0389	0.0441^{*}
			(0.0271)	(0.0260)	(0.0268)	(0.0259)	(0.0323)	(0.0267)
bsof			-0.0678^{**}		-0.0669^{**}			-0.0639^{**}
			(0.0326)		(0.0325)			(0.0321)
N	363	363	363	363	363	363	244	363
R^2								

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: "_5" means decreasing 5% or above, "_10" means decreasing 10% or above.

3.3.3 Government research and development expenditure

In theory, government expenditures such as R&D spending have a certain impact on national innovation capabilities. For example, CY Lee [17] believes that public R&D has four potential channels for enterprise innovation: technological capability enhancement effect, demand creation effect, and R&D cost reduction effect, and project overlap effects. He also said that due to the existence of multiple channels, it is difficult to assess the overall effect of public R&D. In addition, Isabel Busom [18], PA David, BH Hall and AA Toole [19], AM Domínguez [20], E Taymaz and Y Ucdogruk[21] also studied the impact of government R&D expenditure on corporate innovation. But none of them reached a consistent conclusion. Here, the author examines the impact of the government's cumulative R&D expenditure per capita and the government's total accumulated R&D expenditure on "innovation decline" when other factors keep constant. As the results shown in table 8, the coefficients of R&D expenditure are not statistically significant, which means there is insufficient evidence to prove that government R&D expenditure can affect the probability of "innovation decline".

Table 8 Government R&D expenditures

	(1) rd1_5	(2) rd2_5	(3) rd3_5	(4) rd_10	(5) acrd_5	(6) acrd_10
main						
rd	0.000863	-0.00247	-0.00354	-0.00348		
	(0.00308)	(0.00353)	(0.00469)	(0.00702)		
ins		0.171^{*}	0.0161	-0.0806	-0.0320	-0.108
		(0.0959)	(0.124)	(0.148)	(0.126)	(0.154)
inf		0.0475	0.0449	0.0305	0.00314	0.00906
		(0.0647)	(0.0693)	(0.0984)	(0.0678)	(0.0986)
msof			0.170^{*}	0.182	0.190^{**}	0.219^{*}
			(0.0901)	(0.136)	(0.0894)	(0.133)

bsof			-0.0841	-0.0364	-0.0539	0.00460
			(0.0823)	(0.136)	(0.0769)	(0.126)
acrd					0.0653	0.0307
					(0.0652)	(0.0565)
N	127	127	127	60	127	60
R^2						

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: "_5" means decreasing 5% or above, "_10" means decreasing 10% or above.

In this part, the author studied the role of the government affecting "innovation decline" from three aspects. The results show that the higher the quality of infrastructure, the higher the probability of innovation decline. When other conditions remain unchanged, the institutional environment, whether as a whole or a separate sub-item, has no statistically significant impact on the decline of innovation. The government's R&D expenditures, whether per capita or total, will not affect the occurrence of innovation decline.

4. Conclusion and policy implication

This paper defined the "innovation decline" through the global innovation index jointly released by Cornell University, the European Business School, and the World Intellectual Property Organization (WIPO). Moreover, this paper described the innovation decline and attempted to explore the factors of "innovation decline" by using the Logit model. It turns out that the lack of innovation is a common phenomenon on the global scale. Almost all countries, regardless of their level of economic development and social systems, have experienced the innovation decline. Additionally, this phenomenon is not a small probability event. Many countries have experienced varying degrees of innovation decline, which is undoubtedly a huge risk for national development. Through further in-depth study of the factors affecting innovation decline, this paper also found that,, the improvement of infrastructure quality would promote the occurrence of innovation decline, which was contrary to our intuition. The reason behind this might be the squeezing-out effect of public investment on private investment and other innovative activities. At the same time, although the institutional environment and government R&D expenditure are beneficial to the improvement of national innovation, there is insufficient evidence to prove that these two factors can affect innovation decline.

Based on the conclusions above, this paper has the following policy implications: the government must be highly cautious about increasing the infrastructure investment, especially when the country's infrastructure exceeds normal levels. The reason for this is that excessive infrastructure investment might squeeze out market innovation and promote innovation decline.

However, there are still some shortcomings in this article. Due to the huge differences in the connotation and extension of national innovation capabilities and the complexity of its measurement, it is difficult for the author to obtain completely reliable numerical values to describe the country's absolute innovation ability. Although the GII index is a good measurement of innovation capacity, it is not equal to the real innovation ability, and its method of index construction is still controversial. Although this paper uses a variety of methods to identify the innovation to alleviate the problem of the data itself, it cannot be eradicated. Therefore, it is necessary to use more and more scientific data to measure the country's innovation ability to verify the robustness of the results.

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