Healthcare and Development: Based on Principal Component Analysis

Jing Chen and Chiping Yuan
Institute of Guangdong, Hong Kong and Macao Development Studies, Sun Yat-sen University, Xingang West Road, Guangzhou, China

Keywords: Public Health Emergency Management Capability, Nighttime Light, China.

Abstract: Governments are paying increasing attention to public health emergency management, which is a cruel part of sustainable development and a form of public goods, in that various public health emergencies can bring serious threats to local economic growth. This paper proposes a framework to assess local public health emergency management capability using principal component analysis method and investigates its relationship with regional economic development. Through econometric analysis, we found apparent regional gap regarding public health emergency management capacity in China, which is highly related to economic development. However, the relationship of this capacity with regional economic development varies due to regional differences.

1 INTRODUCTION

Seventeen sustainable development goals have been put forward in the "Transforming our World: The 2030 Agenda for Sustainable Development" issued by the United Nations, the eleventh of which is to "Make cities and human settlements inclusive, safe, resilient and sustainable". There's no doubt that emergency management has become a part of sustainable development that cannot be ignored. From SARS to H1N1 to COVID-19 pandemic, public health events continue to threaten local economic development, local governments have to increase public health emergency management capacity to effectively prepare for and respond to such emergencies. According to the State Overall Emergency Response Plan for Public Emergencies, the research on the classification of emergencies in China is based on the occurrence mechanism of emergencies, which divides public emergencies into four categories: natural disasters, accident disasters, public health events and social security events. Early in 2003, Beijing has started constructing a comprehensive governments' emergency management system with "one case, three systems" as the core. It was further strengthened in 2009 during the H1N1 epidemic. In 2020, the outbreak of COVID-19 has brought severe challenge to China's emergency public health emergency management system, and China has undoubtedly handed over a satisfactory answer. We have seen that China's emergency management capacity has made great progress in the past decades. Therefore, we hope to make a proper quantitative analysis of this changing process and evaluate it scientifically.

Whereas from the experience of COVID-19 pandemic, we see that fighting against such emergency is so complex that it is not only a case of government management, but also a systematic project involving the joint efforts of every aspect of society including all kinds of social organizations. This cross-sector collaboration in emergency response is defined by Mojir (2019) as a process in which different autonomous actors from different societal sectors attempt to create a new setting by establishing new ways of sharing information, resources and capabilities and by performing joint response operations in order to achieve common goals, including saving lives and minimising environmental damages (Mojir et al. 2019). Cross-sector collaboration is essential in addressing public health (Johnston and Finegood 2015), dealing with climate change (Ingold and Fischer 2014), improving traffic quality (Bryson et al. 2009), fighting against poverty by securing food management (Hamann et al 2011) and so on. Thus, we must take these resource

Chen, J. and Yuan, C.
Healthcare And Development: Based on Principal Component Analysis.
DOI: 10.5220/0011188600003444
In *Proceedings of the 2nd Conference on Artificial Intelligence and Healthcare (CAIH 2021)*, pages 109-116
ISBN: 978-989-758-594-4

endowments into account when measuring local public health emergency management capability.

Specifically, for the evaluation of emergency management system, some scholars establish an evaluation system from the perspective of crisis response process. Zhang et al. (2003) believe that the urban emergency management system should cover three systems, namely, emergency warning preparation, emergency response and crisis recovery and reconstruction. Dong (2005) further proposed that the guarantee system of emergency management mechanism includes twelve aspects: information guarantee, communication guarantee, command technology guarantee, engineering guarantee, command technology guarantee, team guarantee, transportation guarantee, medical rescue guarantee, public security guarantee, material guarantee, fund guarantee, scientific research guarantee and legislative guarantee. With the outbreak of COVID-19, the number of articles discussing on the management of public health emergencies has increased, and research methods have become increasingly complex, digital, and multidisciplinary. On the one hand, however, an important shortcoming of these methods is their cruel requirement on data, which makes it difficult to form a long-term evaluation system. On the other hand, there are many articles about the impact of public health emergencies on economy, and most of them take specific epidemic situations as research objects, while there are few literatures concentrate on the relationship between the public health emergency management capability and economic development.

Our most related literature is by chen et al. (2021) which evaluates capability of rural public health emergency management in China, and draws one conclusion that the level of rural public health emergency management capability is strongly correlated to economic development. Following this paper, we set up a similar evaluation system to further expand the study of rural areas to urban and rural areas by using provincial panel data, and further explore the relationship of public health emergency management capacity and economic development through econometric analysis.

The remainder of the paper will proceed as follows. Section 2 will set up our evaluation system and compare the capacity of public health emergency management horizontally and vertically. Section 3 will specify the empirical models and present the econometric results and heterogeneity analysis. Section 4 will provide conclusion.

2 EVALUATION OF PUBLIC HEALTH EMERGENCY MANAGEMENT CAPABILITY

2.1 Construction of Evaluation System

As an aspect of sustainable development, responding to major public health emergencies is also a reflection of the regional ability to integrate and dispatch resources. Public health emergency management is a complex systematic project which needs cross-sector cooperation involving transportation, information and communication, grassroots organizations, social stability, medical security and other aspects. In order to measure local public health emergency management capability as comprehensively as possible, we established an index system from the four levels of multi-agent cooperation, medical and health security, social and economic stability, and infrastructure construction, covering 24 secondary indicators in total.

Table 1: Evaluation indexes for public health emergency management.

Targert layer	Criteria layer	Index layer	Unit
capacity of public health emergency management	Multi-agent cooperation	Leadership of grassroots organizations	person/unit
		Student-full-time teacher ratio	-
		Number of employed persons	10,000 person
		Gross dependency ratio	%
		population	10,000 person
	Medical and health care	Number of beds in health institutions per 10000 persons	bed/person
		Number of medical technical personnel per 10000 persons	person
		Number of health care institutions	unit
		Number of beds in health care institutions	bed
		Persons in pension insurance	10,000 person

		Persons in health programs	10,000 person
	Social and economic stability	General public budget revenue	100 million yuan
		Public budgetary expenditure	100 million yuan
		Per capita disposable income	yuan
		Tertiary industry-GDP ratio	%
		Numbers of traffic accidents	case
		registered unemployment rate	%
	Infrastructure constructions	Population density	person/sq.m
		Ratio of sewage treatment	%
		Per capita area of roads	sq.m
		Water penetration rate	%
		Ratio of garbage harmlessly treatment	%
		Viewer-coverage rate	%
		Listener-coverage rate	%
		Popularization rate of telephone	sets/100 person

2.2 Data Resources

To make a horizontal and vertical comparison of local public health emergency management capacity in China, we use panel data covering 29 provinces and regions from 2005 to 2019. The data in this paper are mainly from the national statistical yearbook and CEInet statistics database released by the National Bureau of Statistics, some regional data are from local statistical bulletin, and a few incomplete values are filled using Conditional Mean Completer method.

2.3 Health Emergency Management Capability Assessment

Principal Component Analysis (PCA) is applied to create a public health emergency management capability index for rural regions for each year in the study period (2005-2019). The original data are standardized as observed variables are in different dimensions, positive indicators are normalized on the interval [0,1] according to equation (1).

$$x_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_i) - \min(X_i)} \quad (1)$$

While negative indicators are normalized according to equation (2).

$$x_{ij} = \frac{\max(X_i) - X_{ij}}{\max(X_i) - \min(X_i)} \quad (2)$$

KMO and Bartlett's test of sphericity are conducted, the value of former is 0.831 and both confirmed the suitability of PCA. According to the factor analysis result, 5 common factors whose characteristic root is greater than 1 are extracted, with contribution rate of cumulative variance being 77.89%. Factor 1 mainly explains the information of six indicators: the number of persons in pension insurance, general public budget revenue, the number of health care institutions, population, the ratio of sewage treatment, and the number employed persons. Factor 2 mainly explained four indicators: popularization rate of telephone, per capita disposable income, Tertiary industry-GDP ratio, and the number of medical technical personnel per 10000 persons. Factor 3 mainly explains five indicators: listener-coverage rate, gross dependency ratio, leadership of grassroots organizations, viewer-coverage rate, and registered unemployment rate. Factor 4 explained per capita area of roads, student-full-time teacher ratio, water penetration rate and ratio of garbage harmlessly treatment. Factor 5 explained the number of traffic accidents, the number of beds in health institutions per 10000 persons, public budgetary expenditure, the number of persons in health programs, and population density.

Table 2: Factor load matrix after rotation.

	Factor1	Factor2	Factor3	Factor4	Factor5	Index
x1	-0.1129	0.1147	-0.0549	-0.0749	0.3092	Numbers of traffic accidents
x2	-0.0573	0.1224	0.032	0.0635	0.1418	Number of beds in health institutions per 10000 persons
x3	-0.030	-0.0066	0.2885	0.1182	-0.0342	Listener-coverage rate
x4	-0.0081	-0.0033	0.3514	-0.1961	-0.0628	Gross dependency ratio
x5	0.1714	-0.0126	-0.0175	-0.0888	-0.0288	Persons in pension insurance

x6	0.1016	0.0536	-0.0866	0.0065	0.1591	Public budgetary expenditure
x7	0.1361	0.0595	-0.0703	-0.0899	0.0335	General public budget revenue
x8	0.0108	0.1037	-0.3973	0.0158	-0.0905	Leadership of grassroots organizations
x9	0.0592	-0.0475	-0.0501	0.1541	0.2484	Persons in health programs
x10	0.1676	-0.0022	0.0089	-0.1263	-0.0036	Number of health care institutions
x11	-0.0149	-0.0013	-0.0077	0.1915	-0.6127	Population density
x12	0.0034	0.1379	0.0562	-0.0647	-0.0578	Popularization rate of telephone
x13	0.0128	0.14705	-0.06007	-0.01077	0.06410	Per capita disposable income
x14	0.15524	-0.1144	-0.0253	0.0598	0.0481	population
x15	-0.056	-0.0327	0.0036	0.4891	-0.2384	Per capita area of roads
x16	-0.0045	0.2059	-0.1399	-0.1454	-0.0539	Tertiary industry-GDP ratio
x17	0.1555	-0.0144	-0.0223	-0.0312	-0.0822	Ratio of sewage treatment
x18	-0.0363	-0.0751	0.1064	0.2153	0.1958	Student-full-time teacher ratio
x19	-0.0282	0.1536	0.0550	-0.0808	-0.0098	Number of medical technical personnel per 10000 persons
x20	-0.0388	0.1219	-0.1497	0.2447	-0.0444	Ratio of garbage harmlessly treatment
x21	-0.0366	0.0129	0.2501	0.135	-0.0175	Viewer-coverage rate
x22	0.0241	0.1334	-0.1543	0.0097	-0.1024	registered unemployment rate
x23	-0.0458	0.0947	-0.0151	0.1735	-0.0573	Water penetration rate
x24	0.1696	-0.0310	0.0015	-0.0726	0.0007	Number of employed persons

The values of five common factors were calculated according to the component score coefficient matrix of factor analysis, and the score regression equation of comprehensive factor F was constructed by combining the variance contribution rate and cumulative variance contribution rate of each component factor:

$$F = \sum_{i=1}^{5} f_i W_i \quad (3)$$

Where $W_i = \frac{P_i}{C}$, and W_i is the ratio of the variance contribution rate of factor i to the cumulative variance contribution rate of the five common factors. Now we get the scores of public health emergency management mechanism in 29 regions of mainland China in the past 15 years (Xinjiang and Tibet excluded).

Table 3: Index score of 29 regions in 2005 and 2019.

region	2019			2005		
	F-value	ranking	GDP ranking	F-value	ranking	GDP ranking
Shanghai	0.930093	6	10	-0.02443	2	7
Yunnan	0.372891	16	18	-0.79152	24	23
Neimenggu	0.276175	23	20	-0.80677	25	19
Beijing	1.087905	4	12	0.259063	1	10
Jilin	0.198572	25	25	-0.60617	15	22
Sichuan	0.877105	7	6	-0.53519	12	9
Tianjin	0.323722	20	23	-0.2888	6	21
Ningxia	0.015994	28	28	-1.06179	29	29
Anhui	0.463785	14	11	-0.70065	18	15
Shandong	1.065953	5	3	-0.37225	9	2
Shanxi	0.355786	17	21	-0.6867	17	18
Guangdong	1.920924	1	1	-0.0724	3	1
Guangxi	0.300613	22	19	-0.84313	26	17
Jiangsu	1.314929	2	2	-0.09225	4	3
Jiangxi	0.337264	19	16	-0.71013	19	16
Hebei	0.645215	9	13	-0.38037	10	6
Henan	0.827317	8	5	-0.36702	8	5
Zhejiang	1.124411	3	4	-0.19255	5	4
Hainan	0.039474	27	27	-0.73328	20	27
Hubei	0.601304	11	7	-0.56932	13	13
Hunan	0.635282	10	9	-0.78122	23	12
Gansu	0.164195	26	26	-0.76491	21	26
Fujian	0.409762	15	8	-0.45402	11	11
Guizhou	0.208629	24	22	-1.03386	28	25

Liaoning	0.533621	12	15	-0.33313	7	8
Chongqing	0.350023	18	17	-0.77314	22	24
Shaanxi	0.495465	13	14	-0.67268	16	20
Qinghai	-0.01875	29	29	-0.85483	27	28
Heilongjiang	0.313462	21	24	-0.5748	14	14

Great improvement has been seen in the past decades regarding to the public health emergency management capability in China, which is apparently consistent with economic fact. In terms of the overall spatial layout, the overall emergency management capability in southeast China has always been in the leading level, with Guangdong and Shanghai leading the way. Among East, Central and Western Regions, the Central region has the fastest growth rate, represented by Hunan Province. Specifically, the ranking of public health emergency management capability in some regions, such as Tianjin, Jilin, Hainan and Heilongjiang, declined significantly. Another fact worth noticing is that, the capacity of public health emergency management is somewhat not positively correlated with local economic development as we expected. Some regions possess a relatively high economic development speed but a relatively decreasing emergency management capacity. In cases like Tianjin, a steady GDP ranking can also be accompanied by a rapidly dropping capacity ranking. This raises our interest in how this capability reacts with economic growth.

3 ECONOMETRIC MODEL AND RESULTS

From the discussion above, relatively developed areas generally possess a high level of emergency management capacity, but a high speed of GDP development does not guarantee a huge increase in health emergency management capability. On the one hand, high management level is conducive to attracting more investment and talents, and providing a stable environment for economic development, so as to enhance economic development. On the other hand, for regions with limited resources, great difficult in crisis management may occupy public resources originally used for other economic construction, thus inhibiting economic development. However, which kind of power is stronger may depends, therefore the relationship between the two needs further empirical verification.

3.1 Basic Analysis

Since there is an obvious causal relationship between the level of local public health emergency management and the level of regional economic development, the endogenous problem is not alleviated. Thus, we use nighttime lights datasets as the proxy measure for economic activity. We set the model as follow:

$$light_{it} = \beta f_{it} + \theta \ln X_{it} + c_t + \epsilon \qquad (4)$$

Where light_it is nighttime light of province i at period t, f_{it} is its index score, X represents other control variables, and ϵ is random error. According to Solow model, human capital and social capital stock are important components of economic growth. Urbanization level, industrial structure and foreign trade are also major factors affecting regional economic growth (LYU 2015). Variables above are included in X with all original data from the National Bureau of Statistics. Capital stock (cap) is calculated according to Shan (2008) using fixed capital formation, investment price index, base capital stock, depreciation rate data from the national statistical yearbook. Human capital (hr) is calculated according to Peng (2005), we calculate the average number of years of schooling in each province over the years and convert it into human capital, combined with the return on education. The urbanization rate (urb) is expressed by the proportion of urban population in the total population. Variable serv and eo represent the proportion of tertiary industry in GDP and Total import and export respectively.

Table 4: Effects of public health emergency management capacity on regional economic development.

Dependent variable: nighttime light							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	FE	OLS	FE
L.light						0.023	-0.005
						(1.50)	(-0.64)
f	2.301***	2.233***	3.948***	1.373*	0.494	2.127***	3.960***
	(5.14)	(4.51)	(7.31)	(1.90)	(0.69)	(3.16)	(7.26)

lncap			-0.895***	-1.084***	0.161	-1.233***	-0.060
			(-2.95)	(-3.51)	(0.46)	(-4.26)	(-0.16)
lneo			-0.076	0.042	-0.106	0.388**	-0.115
			(-0.59)	(0.31)	(-0.85)	(2.34)	(-0.86)
lnhr			0.234	1.102***	0.728	0.124	0.147
			(0.60)	(2.69)	(1.56)	(0.35)	(0.28)
lnserv			0.883	-0.111	-0.060	4.870***	0.509
			(1.23)	(-0.15)	(-0.08)	(5.08)	(0.69)
lnurb			0.227	-0.757	-6.432***	0.800*	-3.582**
			(0.29)	(-0.96)	(-4.86)	(1.79)	(-2.26)
_cons	1.764***	1.737***	7.239	6.981	-6.090	-10.195*	-1.256
	(6.89)	(4.20)	(1.41)	(1.32)	(-1.00)	(-1.74)	(-0.19)
N	174	174	174	174	174	174	174
Time FE	NO	YES	NO	YES	YES	NO	NO

NOTE: The sample includes mainland of China except Tibet and Xizang due to lack of dataset, since the statistical caliber of lighting data has changed since 2013, so data of this table covers only from 2014 to 2019. Time FEs are years. FEs are location FEs. All controlling variables are logged. * p<0.1 ** p<0.05 *** p<0.01

It seems that public health emergency management capacity does have a positive effect on local economic development, and it is not weakened as we adding more controlling variables. Further, we add in one-period lagged values of the dependent variables in (6) and (7), and the conclusion still holds. To directly investigate the relationship between public health crisis management capacity and regional economic development, we use GDP data and introduce the lagging term of regional economic development indicators into the model as an explanatory variable:

$$\ln gdp_{it} = \alpha \ln gdp_{it-1} + \beta f_{it} + \theta \ln X_{it} + \epsilon \quad (5)$$

All control variables remain unchanged.

Table 5: Effects of public health emergency management capacity on GDP growth.

	Dependent variable: log (GDP)			
	(1)	(2)	(3)	(4)
	OLS	FE	GMM	FD-GMM
L.lngdp	1.023***	0.842***	0.610***	
	(81.56)	(30.06)	(10.48)	
L2.lngdp				0.629***
				(6.66)
ff	-0.052***	0.065***	0.330***	0.203***
	(-4.60)	(3.02)	(5.01)	(3.01)
X	√	√	√	√
N	406	406	377	348

NOTE: The sample includes mainland of China from 2005 to 2019, with Tibet and Xizang excluded due to lack of data. In column (1) and (2) we simply applied an OLS and FE regression. In column (3) GMM model is applied and in column (4) we applied a first-difference GMM and added two-period lagged values of the dependent variable in. All controlling variables are logged.
*** p<0.1 ** p<0.05 *** p<0.01**

In order to solve the endogeneity problem of dynamic panel model, since the OLS regression of first-order difference data cannot get consistent estimation, we adopt the generalized moment estimation (GMM) method for regression on the basis of first-order difference. The results show that there is a significant positive correlation between public health emergency management capacity and regional economic growth rate.

3.2 Heterogeneity Analysis

As we discussed before, the relationship between the level of public health emergency management capacity and economic development may not be simply same positive through all regions in China, so we come up with further analysis to see how it differs through different regions.

Table 6: Heterogeneity analysis.

Region	East		West		Central	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	light	Log(gdp)	light	Log(gdp)	light	Log(gdp)
L.light	-0.004		0.040		0.034	
	(-0.30)		(0.61)		(1.23)	
L2.lngdp		0.720***		0.427***		0.465***
		(14.01)		(5.84)		(4.34)
ff	2.428*	0.080**	2.825***	0.421***	1.577	-0.076
	(1.93)	(2.52)	(3.18)	(5.98)	(1.24)	(-0.87)
X	√	√	√	√	√	√
N	66	132	54	108	54	108
Hansenp		1.000		1.000		1.000
sarganp		0.000		0.001		0.000
ar1p		0.328		0.032		0.887
ar2p		0.005		0.013		0.160

NOTE: We performed regression on the eastern, central and western regions respectively, and took GDP and nighttime light data as explained variables to ensure the robustness of conclusion. The dependent variable of column (1), (3), (5) are nighttime light data, which is regressed with FE model, with study period from 2014 to 2019. The dependent variable of column (2), (4), (6) are log of GDP, which is regressed in FD-GMM model, with data from 2005 to 2019. All controlling variables are logged. * p<0.1 ** p<0.05 *** p<0.01

We were surprised to find that there was a statistically significant positive correlation between the capacity of public health emergency management and regional economic development for the eastern and western regions, while for the central region, this economic driving effect was not significant. This difference is mainly related to the characteristics of each region. With concentrated resources and large population density, the eastern region has sufficient manpower and material resources to carry out the capacity construction of public health emergency management, and the improvement of such capacity can promote the regional economic growth by attracting funds, attracting talents and providing a stable environment for economic development. The western region is relatively undeveloped, with a smaller population density, and facing less pressure from public health crisis management, so dealing with public health events is far less a pressure of the government, meanwhile the western region with a relatively higher emergency management capacity will also attract more funds and talents. For the central region, due to the scarcity of resources, the construction of public health emergency management capacity may run counter to the regional economic development in the short term, which means that the government may have to give up some economic benefits when investing in improving its capability of emergency management.

4 CONCLUSIONS

Based on our research, the conclusions are obtained as below:

(1) There exists great regional gap of public health emergency management capacity in China, showing the spatial distribution characteristics that the southeast is the best, the northwest worst.

(2) The more developed one region is, the better able it is to build a better public health crisis management system. However, as a part of public services, public health emergency management ability can enhance the regional economic vitality to a certain extent though, it may also be a burden in some areas, so we see that its relationship with regional economic development varies due to regional differences.

Though we hope to promote sustainable development through crisis management capacity-building, we cannot ignore the fact that in short term, such construction may require sacrificing part of economic growth.

ACKNOWLEDGEMENTS

This work was funded by the "Public Management" Construction Project of Characteristic Key Discipline from Guangdong Province, China in 2016(F2017STSZD01).

REFERENCES

Anderson, T., and C. Hsiao. (1981) Estimation of Dynamic Models with Error Components. In: Journal of American Statistical Association, 76: 598-606.

Bryson, J., Crosby, B. C., Stone, M., and Saunoi-Sandgren, E. (2009). Designing and Managing Cross-Sector Collaboration: A Case Study in Reducing Traffic Congestion. Washington, DC: IBM Center for the Business of Government. Available at: http://www.businessofgovernment.org/sites/default/files/Designing and Managing.pdf (accessed October 2017).

Cao Guangxi, Gao Sheng, Zhou Ling. Emergency Industrial Agglomeration, Emergency Fiscal Expenditure and China's Economic Growth: Based on Provincial Panel Data[J/OL]. Journal of Audit & Economics. https://kns.cnki.net/kcms/detail/32.1317.F.20210709.1739.004.html.

Chen Peibin, Wang Danfeng, Zhong Minhua, Zhu Chaozhi. (2021) Evaluation on Capability of Rural Public Health Emergency Management[J]. Statistics & Decision, 15:156-161.

COLES J B, ZHANG J, ZHUANG J. (2019) Scalable simulation of a Disaster Response Agent-based network Management and Adaptation System (DRAMAS). Journal of Risk Research, 2019: 1-26.

Dong Ruihua, Dong Youhong. (2005) On Mechanisms and Structures of Crisis Management of Shanghai. Journal of Shanghai Administration Institute, 5:33-42.

Guo zhenzhong. (2003) Establishment of Crisis Management System of Our Governments. Journal of Liaoning University (Philosophy and Social Sciences Edition), 6 :11-14.

Haibo Zhang, Xiaosu Zhang, Louise K. Comfort, et al. The Emergence of an Adaptive Response Network: The April 20, 2013 Lushan, China Earthquake. Safety Science, 2016, (90).

Hamann, R., Giamporcaro, S., Johnston, D. and Yachkaschi, S. (2011). The role of business and cross-sector collaboration in addressing the "wicked problem" of food insecurity. Development Southern Africa,Vol. 28 No. 4, pp. 579–594.

Hu Guoqing, Rao Keqin, Sun Zhenqiu, Yu Renhe. (2008) Development and Testing of a Preparedness and Response Capacity Questionnaire in Public Health Emergency for Chinese Provincial and Municipal Governments. Journal of Central South University (Medical Science),12:1142-1147.

Ingold, K. and Fischer, M. (2014). Drivers of Collaboration to Mitigate Climate Change: An Illustration of Swiss Cimate Policy over 15 Years. Global Environmental Change, 24: 88–98.

Johnston LM, Finegood DT. (2015) Cross-Sector Partnerships and Public Health: Challenges and Opportunities for Addressing Obesity and Noncommunicable Diseases Through Engagement with the Private Sector. Annu Rev Public Health 36:255–71.

Lyu Jian. (2015) Analysis of Impact of Local Government Debt on Economic Growth—Based on the Perspective of Liquidity, 11:16-31.

Mojir K Y, Pilemalm S, Granberg T A. (2019) Semi-professionals: emergency response as an additional task in current occupations. International Journal of Emergency Services, 2(8): 86-107.

PARK C H, JOHNSTON E, PEART A, et al. (2019) Determinants of collaboration between digital volunteer networks and formal response organizations in catastrophic disasters. International Journal of Organization Theory and Behavior, 2(22):155-173.

Peng Guohua. (2005) The Disparity of Income, TFP and the Convergence Hypothesis in Chinese Provinces. Economic Research Journal, 9:19-29.

Shan Haojie. (2008) Reestimating the Capital Stock of China:1952-2006. The Journal of Quantitative & Technical Economics,10:17-31.

Zhang Haibo, Tao Zhigang. (2021) The Change of Interagency Networks in the Emergency Management of Public Health Incidents. Wuhan University Journal (Philosophy and Social Sciences Edition),4:114-126.

Zhang Jie, Guo Zhenzhong. (2003) Establishment of Crisis Management System of Our Governments. Journal of Liaoning University (Philosophy and Social Sciences Edition),6:92-96.