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Study on Relevance between Social Economic Environment and Resistance to Disasters

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Abstract: Social, life and belongings lost in natural disasters are caused by the disaster itself and the ability of resistance to it. The loss extent caused by the same disaster is obviously different in different social economic environment. Based on data of 1991-2010, relationship between social economic environment and resistance to natural disasters is studied by panel data regression models. Furthermore, the social economic environmental factors which are likely to influence loss extent of natural disasters are analyzed. It is empirically shown that increase of Real GDP per capita, rural per capita net income, population of tertiary industry in GDP and number of doctors per thousand people all can decrease loss extent of natural disasters notably. However, increase of social fixed asset investment and increment speed of GDP cannot influence the loss extent prominently. Increase of disposable income decreases the death toll and the number of people affected by the disasters but enhances direct economic losses. Therefore, the influence of disposable income on the loss is not certain.

Keywords: Empirical models, influence, loss extent, natural disasters, panel data analysis

INTRODUCTION

Recently, all kinds of natural disasters have caused tremendous loss of life and possessions. According to recent data released by United Nations International Strategy for Disaster Reduction (UNISDR) and Center for Research on Environment Decisions (CRED) in January 28, 2010 in Geneva, about 780 thousand persons died and economic losses amounted to 960 billion dollars in 3852 of natural disasters from 2000 to 2009 all over the world. In recent 30 years, there are three natural disasters in China from the most disastrous top ten according to Emergency Disasters Database (EM-DAT). The three calamities are Wenchuan Earthquake, the Flood in 1996 and in 1998. Additionally, according to the direct economic losses data released from Ministry of Civil Affairs of the People's Republic of China, the average loss caused by natural disasters in every year is 267 billion Yuan RMB in China and the loss is increasing continuously. Therefore, it is important to investigate natural disasters and find new ways of disaster prevention and reduction.

The loss extent in a disaster is codetermined by the disaster itself and the resistance to it. The loss extent caused by the same disaster is obviously different in different social economic and social environment. Since 1969 many researches have focus on such questions as whether there is internal relation between natural disasters and social economic development level. What is the degree of the influence on loss of the disasters by social economic environment? How to adjust the regional economy to reduce the loss from natural disasters? Since 1969 many researches have focused on how to resolve the above questions by taking into account the social economic factors, e.g. economic development level, population, education, opening degree, development level of financial market, etc. However, the existing empirical researches have not considered that different social political system and culture would have different effects on loss in natural disasters. Furthermore, the sample nations in existing empirical investigations are the same in statistical index. Thus the investigation results and policy recommendations can only use in nations of the same kind but the typical nation China has not been the sample in such investigations.

Since 1950s disaster economy has been studied in western nations. Dacy and Kunreuther (1969) firstly put forward the relevance between social economy and loss of natural disasters. Many researches have been done on the relevance from then on and the researches are divided into two phases.

The first phase is before the end of the 20 century. Most of the researches then were theoretically carried out from the angle of management science and sociology. For example, Wildavsky considered that with the increase of income people need more safety. Moreover, increase of income not only supplies safety guard but also enhance the resistance to natural disasters. Albala-Bertrand (2000) analyzed factors of institution and management in comparative study of man-power disaster and natural disaster. He considered the development level of a country depended on per capital income, allocation of revenue, economic

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diversity, level of social security and education, health condition of people, etc. The higher the development level of a country was, the less the loss in a disaster was engendered. Horwich (2000) also considered that the key potential factor in a disaster is wealth and the richer the safer.

The second phase is after the beginning of 21 century and this is the empirical phase. By analyzing cross-section data of many countries Rasmussen (2004) found that income level of a country was in negative correlation with the number of people injured in disasters, increase of income level could protect the country from disasters. Kahn (2005) found in 2005 that people died less if the country owned better social system, democracy and revenue allocation. By using annual data of many countries all over the world Toya and Skidmore testified the influence of the underlying economic variables on loss of disasters? The variables are income, education background, open degree, development degree of financial market, government scale, etc. They found economic development and loss of disasters are in negative correlation. A country with higher educational level and commercial open degree had higher resistance ability to disasters. A country with more powerful financial department and smaller government size was able to reduce the number of people died in disasters (Toya and Skidmore, 2005). In 2008, Raschky investigated 2792 disasters from 1984 to 2004 and found economic development level measured by GDP is the key factor in treating with disasters. The number of people died in a disaster was less in a country with higher income that the country with lower income. Secondly, a country with better social system, e.g., more steady politics and better investment environment, was able to reduce the loss of people and wealth in a disaster (Raschky, 2008). Noy (2009) considered a country with higher literacy rate, better social system, higher per capital income, higher commercial open degree and higher government expenditure was able to resist disasters and prevented disasters from impacting on production area and macro economy better.

To sum up, social economic environment is important to resist regional disasters and influence the number of death people, the number of people injured and the magnitude of loss in disasters. The less the loss is, the better the resistance is. Different from natural factors, social economic environment that can be improved artificially should gain more attention. In the present study, relationship between the social economic environment and loss extent of natural disasters is studied. The social economic environment is characterized by Real GDP per capita, disposable income per capita, rural per capita net income, population of tertiary industry in GDP, social fixed asset investment, increment speed of GDP and number of doctors per thousand people.

EMPIRICAL MODELS

Rasehky considered that it was difficult for the direct economic loss to describe the overall loss in disasters. So he added the number of people died to describe the loss. In the present work, the number of people injured in a disaster is used to characterize the impulse on social life and the indirect economic loss caused by disasters to describe the overall loss. “Death” and “People” refer to the number of people died and injured in disasters. Direct economic loss means after a natural disaster the loss of value of the suffer object. The basic computational method is to multiply the real value of the suffer object before the disaster and damaged rate. Direct economic loss includes loss of agriculture, industry and mining, public facilities, family property, etc.

Data of loss in disasters are derived from Emergency Disaster Database (EM-DAT). EM-DAT is the most influential and widely used disaster database. It is free and convenience and supply many data to international project and scientific research.

To describe the regional social economic environment exactly, social economic comprehensive evaluation index system put forward by Academy of Macroeconomic Research, NDRC in 2008 is adopted in the present work. Real GDP per capita, disposable income per capita, rural per capita net income, population of tertiary industry in GDP, social fixed asset investment, increment speed of GDP, population of educational fund in GDP and number of doctors per thousand people are adopted as the research variables. The above eight variables present the achievements of economic development, quality of life of people, rationality of regional economic structure and rationality of social structure from different angles. Different from former research, the choice of variables in the present work is more suitable for China and more operational and is helpful to investigate comprehensively the relevance between loss extent of disasters and regional social economic environment.

In the present work China is divided into the east, the middle and the west, Chongqing is included in Sichuan Province. Additionally, Tibet Autonomous Region and Hainan Province are not included into the sample for many data lost. Accordingly, the data sample contains 28 provinces, cities and autonomous regions. The above eight social economic environment variables are derived from the annual statistic yearbook.

Table 1: Results of empirical parameters estimation

Explained variables			
Explanatory variables	Death	People	Loss
C	-22.813	-58.661	-23.715
Rgdp	-1.145 (0.725)	-3.477** (2.641)	-1.723** (4.622)
Pcdi	-4.027** (3.931)	-10.310** (2.667)	2.952**(2.792)
Pcni	-6.613** (2.112)	-20.858** (2.724)	-7.392** (1.9970
Sfai	0.723 (1.012)	3.019 (0.858)	0.885** (2.760)
Gdpg	1.422 (1.153)	2.757 (0.974)	1.379 (0.892)
Tior	-0.013** (2.892)	-0.037** (4.579)	-0.011** (2.088)
Efr	-0.068** (2.163)	-0.171** (3.039)	-0.073**(2.643)
Ndp	-0.233** (3.813)	-0.557** (3.166)	-0.311** (3.055)
Hensen test	0.917	0.903	0.899
AR(1) test	0.022	0.019	0.023
AR(2) test	0.511	0.468	0.487

To testify the influence of the social economic environment variables on regional loss extent of disasters, data of 28 provinces from 1991 to 2010 are collected to carry parameter estimation on the following panel models:

$$Death_{it} = \alpha_0 + \alpha_1 Rgdp_{it} + \alpha_2 Pcdi_{it} + \alpha_3 Pcni_{it} + \alpha_4 Sfai_{it} + \alpha_5 Gdpg_{it} + \alpha_6 Tior_{it} + \alpha_7 Efr_{it} + \alpha_8 Ndp_{it} + f_i + \varepsilon_{it} \quad (1)$$

$$People_{it} = \alpha_0 + \alpha_1 Rgdp_{it} + \alpha_2 Pcdi_{it} + \alpha_3 Pcni_{it} + \alpha_4 Sfai_{it} + \alpha_5 Gdpg_{it} + \alpha_6 Tior_{it} + \alpha_7 Efr_{it} + \alpha_8 Ndp_{it} + f_i + \varepsilon_{it} \quad (2)$$

$$Loss_{it} = \alpha_0 + \alpha_1 Rgdp_{it} + \alpha_2 Pcdi_{it} + \alpha_3 Pcni_{it} + \alpha_4 Sfai_{it} + \alpha_5 Gdpg_{it} + \alpha_6 Tior_{it} + \alpha_7 Efr_{it} + \alpha_8 Ndp_{it} + f_i + \varepsilon_{it} \quad (3)$$

In the above models:

i = A certain region, t is a certain year
$Death_{it}$ = The number of people died in a disaster in region i in year t,
People = The number of people injured
Loss = The direct economic loss
Rgdp = Real GDP per capita
Pcdi = Disposable income per capita
Pcni = Rural per capita net income
Sfai = Social fixed asset investment
Gdpg = Increment speed of GDP
Tior = Population of tertiary industry in GDP
Efr = Population of educational fund in GDP
Ndp = Number of doctors per thousand people
f_i = The effect which can not be detected
ε_{it} = Residual error. Some explanatory variables are included in ε_{it} and assumed $\varepsilon_{it} \sim \text{iid}(0,\delta^2)$.

Such explanatory variables are unable to be quantified but may impact on the loss in disasters.

Panel data analysis is used in the present study. Provincial data in different time are used as sample observations to construct and testify the model. Additionally, panel data analysis supply more data points, increase degree of freedom, decrease the collinearity among explanatory variables and improve the validity of estimation.

Empirical parameters estimation

Considering on the evolutive continuity of social economic environment and resistance to disasters, explanatory variables lagged one period or several periods in models (1) to (3) may have influences on resistance to regional disasters. However, the variables are not introduced into the models as explanatory variables. The influence of them on explained variables is included into perturbation term. Thus the endogenous character of explanatory variables in models (1) to (2) is inevitable. Hereby, if fixed effects or random effects of general panel data are adopted models (1) to (3) result in biased estimation. To avoid the endogenous character of explanatory variables systematic GMM method designed by Arellano is adopted in parameter estimation (Arellano, 1995). This method is suitable for short time and large sample panel data. Results of empirical parameters estimation are shown in Table 1.

Validity tests of instrumental variables in GMM are shown in the bottom of Table 1. It is found that the instrumental variables in the three models pass second order correlation test and over identifying restriction test. So the instrumental variables are valid.

RESULTS

Difference of loss extent of disasters in different regions in China can be explained by difference in development level of different social economic environment to some degree. In the present work it is shown that real GDP per capita, rural per capita net income, population of tertiary industry in GDP,

population of educational fund in GDP and number of doctors per thousand people have opposite effects on loss extent of disasters. Social fixed asset investment and increment speed of GDP have no influence on the loss. Disposable income per capita has remarkably negative influence on and the number of died and injured people and the influence on direct economic loss in disasters is opposite. So the effects of disposable income per capita on resistance to disasters are uncertain.

All kinds of natural disasters that frequently happened not only destroy the basis of economic development but also ruin the achieved fruits of economic development. In all sectors of national economy natural disasters have the most serious effects on agriculture. The main income of rural people comes from agricultural production. The object of agricultural production is animals and plants which must live harmoniously with the environment. Natural condition is the key factor of agriculture production. Thereby, rural people are the most susceptible persons of different social strata in disasters in China. For a long time, lower income has made it difficult for rural people to equip facilities for disaster prevention and difficult to receive better general knowledge of disaster prevention. Moreover, most natural disasters happen in countryside which causes serious loss of life and belongings. It is important to increase net income of rural people and increase the resistance ability to disasters for most people are in countryside in China.

From the empirical results death people, number of people injured and direct economic loss are small in the province with large number of doctors per thousand people. Number of doctors per thousand people which is widely used by U.N. and World Bank to evaluate the quality of medical care and life evaluates the development status of medical human resources. In 2000, WHO pointed out that number of doctors per thousand people should be one? American socialist Alex Inkeles considered the number should be 1.25 in modern society. In U.K. and U.S.A the number has amounted to 2.2 and 2.4. However, it still needs 25 to 30 years for China to level with the world average level. Medical reformation is essential for China to increase its resistance ability to disasters and decrease the loss.

Population of educational fund in GDP is important in educational development strategy. It is an important parameter to measure educational modernization in a region. The guideline of International Decade for Natural Disaster Reduction is that education is the focus and knowledge is the key of disaster reduction program. By means of education it is possible to improve national moral quality, form correct ethic and attitude for environment, explore and make rational use of resources and reduce natural inducement of disasters. On the other hand, sufficient knowledge and skills of disaster prevention are essential to prevent the man-power disaster. It is verified in the present work increase of educational fund plays important role in reduction of loss in disasters and maintaining social stability.

Population of tertiary industry in GDP reflects the stage and the average level of economic development of a region. Tertiary industry is the industry which consumes less energy sources. For reduction of loss in disasters it is feasible to optimize regional industrial conformation, speed up development of tertiary industry, especially develop modern service industry, strengthen ecological construction, economize resources, decrease dependence of regional economic development on industrial increment, support actively low carbon and green industry, improve inter industry competition, boost high-tech industry and phase out older and more polluting industries.

Regional social fixed asset investment and increment speed of GDP have almost no influence on the loss extent of disasters. Increase of regional social fixed asset investment possibly results in increment of economic loss in disasters, mostly because population of investment in disaster prevention facilities in social fixed asset investment is too low to resist the impact of natural disaster. China is a big developing country. It is essential for maintaining economic growth to enhance national strength and welfare of people. Whereas, the way “aiming high and go all out” of local government does not suit for social economic and natural environmental change. Thus it is momentous for China in economic transition to consider comprehensively harmonious coexist of nature and human beings in investment of social fixed assets.

Furthermore, except for improvement of self knowledge and physical quality most increased income of city resident is used in purchase high-grade consumer goods. Hence the loss increases instead in natural disasters. Increase of regional GDP per capita means more expenditure in disasters in the region and it is helpful to reduce the negative influence of disasters.

CONCLUSION

Panel data from 1991 to 2010 are collected from 28 provinces to study social environment factors that influence on loss extent of disasters. The factors are characterized by real GDP per capita, disposable income per capita, rural per capita net income, population of tertiary industry in GDP, social fixed asset investment, increment speed of GDP, population

of educational fund in GDP and number of doctors per thousand people. It is shown that rural per capita net income, population of tertiary industry in GDP, population of educational fund in GDP and number of doctors per thousand people have prominent impact on the loss and number of people injured in disasters but increment of disposable income per capita reduces the number. Secondly, high increment speed of GDP and increase of social fixed asset investment seemly can not reduce the loss in disasters effectively. Furthermore, unsuitable economic development system decreases the attention of people to disasters and results in increment of loss. China is in the stage of industrial development, so it is essential to keep a high speed of economic increment but still it is more important to enhance welfare of people.

Low per capita net income of resident's especially rural residents increases the loss in disasters. The current status is that high income of the government but low income of the rural net income. Therefore, it is important to increase rural per capita net income to reduce the loss. Additionally, increment of educational and medical investment is another way to reduce the loss in disasters. Moreover, it is also important to readjust industrial structure, increase the population of tertiary industry in GDP, choose rational economic development mode, exploit and use natural resources and energy and invest in social fixed asset rationally.

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