Research Digest

Research Digest is a clear and concise summary of main points and issues with policy implications that have been raised in RIETI discussion papers.

The Economic Impacts of Natural and Man-made Disasters and the Effectiveness of Insurance Mechanisms

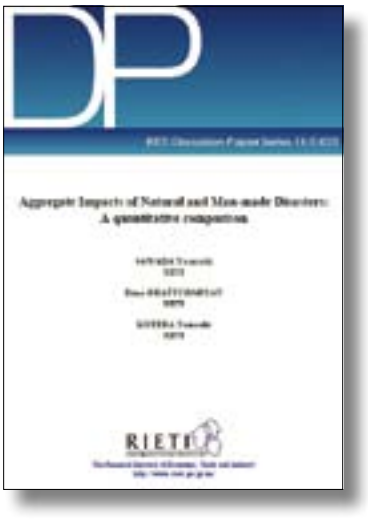
Natural disasters, such as earthquakes, tsunamis, typhoons, and floods, and man-made disasters, such as wars and economic crises, significantly affect the lives of every individual and society in general. The limited resources used for dealing with these disasters must be distributed appropriately based on scientific evidence. To help achieve this, Faculty Fellow SAWADA Yasuyuki undertook a comparative study of the economic effects of a broad range of disasters, using data available for comparing results from countries around the world over a long time frame starting from 1960. Professor Sawada also examined the effectiveness of risk sharing mechanisms against disasters in developing nations, where natural disasters produce more serious effects, using data from Vietnam. Through these studies, Professor Sawada found that although all disasters produce short-term negative effects on the economy, with natural disasters and wars having particularly adverse effects, in the long run, natural disasters and wars produce positive economic effects, while economic crises have continuous negative effects. Professor Sawada argues that comprehensive short-term policy interventions are needed for dealing with natural disasters, while long-term measures are essential for addressing economic crises. A policy should take into account the effective allocation of limited resources across different disasters.

Has the Number of Disasters Risen Sharply in Recent Years?

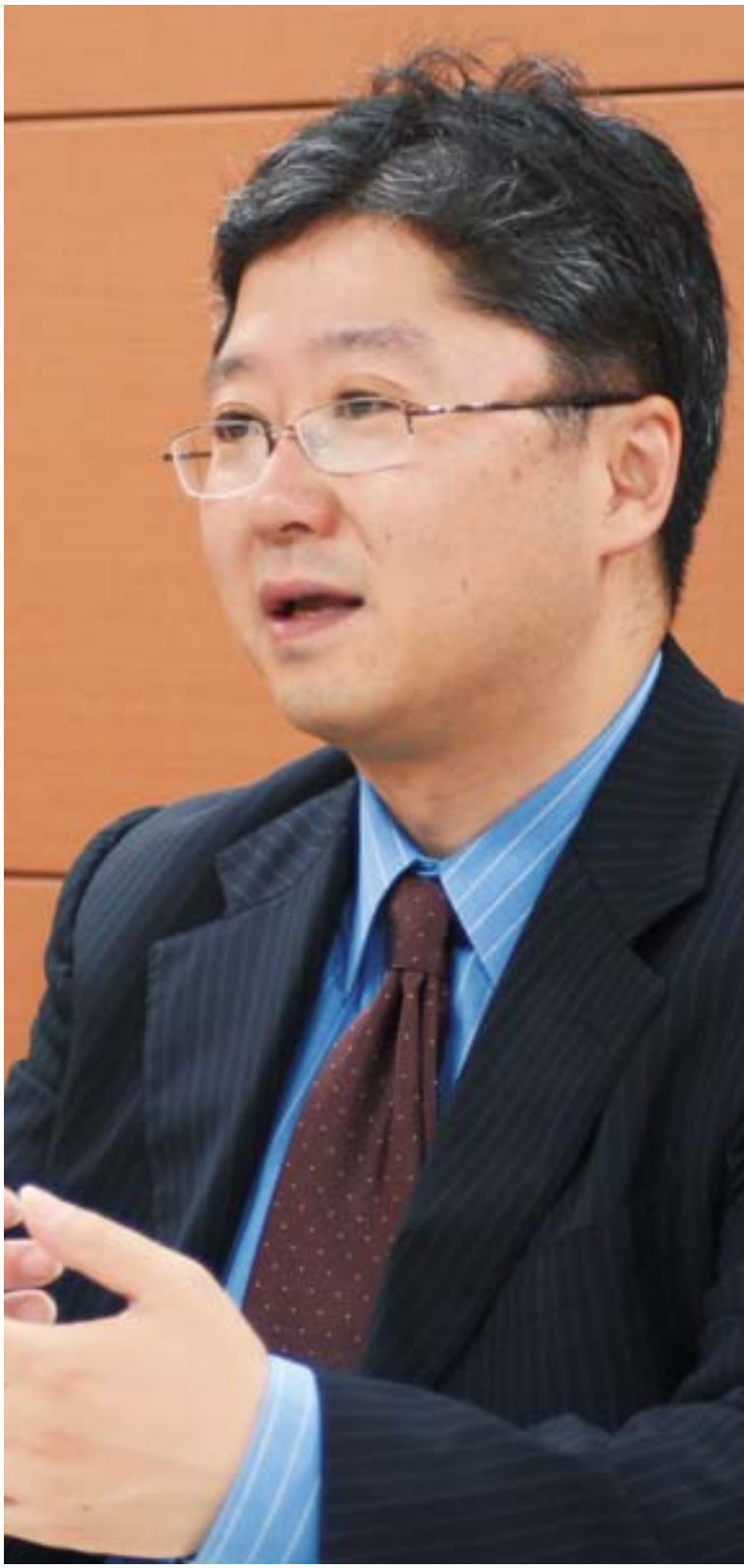
——Professor Sawada, you published two papers on disasters in succession. Tell us first about the motive for your research titled, "Aggregate Impacts of Natural and Man-made Disasters: A quantitative comparison."

(☞ http://www.rieti.go.jp/jp/publications/dp/11e023.pdf)

I began this study about two years ago. It started with my impression that the occurrences of natural disasters might be increasing. The great earthquake in Sichuan Province, China (2008), the great tsunami in the Indian Ocean (2004), Hurricane Katrina (2005), and the Great Hanshin-Awaji Earthquake (1995) are still fresh in our memories. And, of course, the Great East Japan Earthquake, the



devastating earthquake in Haiti, and volcanic eruptions in Iceland have taken place in more recent years. These natural disasters, which have significant adverse effects on people's lives, have been occurring around the globe at a rapidly rising frequency in the last 20 years or so. Data suggests that floods and other hydro-meteorological disasters, such as typhoons and hurricanes, have strikingly increased. Besides those natural catastrophes, there are other disasters—the Lehman Brothers collapse, the Asian currency crises, the economic crises in Mexico and Argentina, wars, civil wars, terrorist attacks, other violent disasters, the nuclear power plant accidents that accompanied the Great East Japan Earthquake, the Japan Railway Company (JR) Takarazuka Line derailment,



SAWADA Yasuyuki

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Profile

SAWADA Yasuyuki has been a professor of Economics at the University of Tokyo since 2012. He was previously an associate professor in Faculty of Arts and Sciences and Faculty of Economics at the University of Tokyo since 1999. His fields of research are Development Economics, International Economics, and Applied Micro-econometrics. He holds a Ph.D. in Economics from Stanford University, an M.A. in International Development Policy from Stanford University, and an M.A. in International Relations from the University of Tokyo.

Recent works include: "Did the Financial Crisis in Japan Affect Household Welfare Seriously?" *Journal of Money, Credit, and Banking* 43 (2-3), 297-324, 2011 (co-authored with NAWATA Kazumitsu, II Masako, and Mark J. LEE); "How do People Cope with Natural Disasters? Evidence from the Great Hanshin-Awaji (Kobe) Earthquake," *Journal of Money, Credit, and Banking* 40 (2-3), 463-488, 2008 (co-authored with SHIMIZUTANI Satoshi)

and airplane crashes—which could be called "technological disasters." We can lump economic crises, violent disasters, and technological disasters together and call them "man-made disasters." Disasters tremendously affect the lives of all individuals and society as a whole. For that reason, people intensely focus their attention on major disasters as they occur. However, interest in the disasters weakens rapidly, the media scales down its coverage, and relief donations shrink over time. These are the so-called "cognitive biases." As for policy response to disasters, while correcting the bias that results from "cognitive biases" and distinguishing a short-term axis from medium- and long-term axes, distributing limited resources appropriately will be a critical issue. Building upon this, as a premise for developing responses, I came up with the idea of comparatively analyzing the effects caused by various disasters from an empirical standpoint.

——What kind of data did you use for your analysis?

I chose data that would allow me to compare results over a long time frame starting from 1960, based on macro data obtained from more than 100 countries. I made sure to show clear scientific evidence of disasters that have had large impacts on people's lives, using gross domestic product (GDP) and consumption levels as indicators.

Natural Disasters and Wars Produce Positive Effects in the Long Run

——What did your analysis reveal?

The analysis showed that the effects of disasters on a given country's economy differ depending on factors such as the length of time post-disaster, disaster type, and the size of the country's GDP. Let me first talk about the differences caused by time. When we look at global averages in short-term periods of one to three years, natural disasters produce the largest downward effects on per capita GDP. A single natural disaster can lower per capita GDP by an annual rate of about 1%. Conflicts and wars cause the second largest effect on per capita GDP. Both lower the figure by an annual rate of 0.4 to 0.5%. Economic crises follow conflicts and wars, but their downward effect on per capita GDP is limited possibly to 0.2% per year.

Table: Effects of Disasters on Per Capita GDP (Annual Rate)

	Short term (1 year)	Long term (20 years)
Natural disasters	−1 to −0.7%	+0.6 to +1.2%
Conflicts and wars	−0.5 to −0.4%	+0.4 to +0.9%
Economic crises	−0.7 to −0.2%	−0.5 to 0%

In contrast, I found that natural disasters, conflicts, and wars work in the opposite direction over the long term and can push up per capita GDP. Based on my analysis of their effects over 20 years, natural disasters increase per capita GDP by 0.6 to 1.2% per year, while conflicts and wars produce upward effects of 0.4 to 0.9%. However, the effects of economic crises remain negative at minus 0.5 to 0% even over the long term (as shown in the table).

Next, let me explain the differences attributable to the size of GDP. Natural disasters cause extremely large short-

term adverse effects on countries with low per capita GDP. In contrast, wars create a significant negative impact on countries with large per capita GDP. Previous studies proved similar results that the effects of natural disasters and wars switch from negative to positive over the long term. To give an example, there is a research paper showing that Japan recovered surprisingly quickly from its serious loss of domestic capital stock, a negative repercussion of World War II.

As a cause of the positive long-term effects that the given disasters produce, previous studies suggested the amplification of economic activities caused by accelerated moves toward shakeout of firms, in other words, as a result of the forced withdrawal of relatively unproductive companies and the survival and growth of highly productive companies under the effects of the disasters. This is the process Joseph A. Schumpeter called "creative destruction," although when attributable to disasters, "creative destruction" may not be an appropriate expression from the standpoint of companies and households that have suffered unexpected, severe property and human damages.

In the meantime, concerning the negative effects that economic crises have on both short- and long-term bases, we can assume the following possibility. Natural disasters cause visible physical damage. The processes of recovery and reconstruction also become visible. Political agreements on recovery and reconstruction investments are assumed to be straightforward for that reason. On the other hand, as economic crises are largely intangible, decision making may take extra time, and sometimes effective prescriptions may not be known. As for the differences attributable to economic scale, because natural disasters generally cover geographically-limited areas, they greatly affect small nations but have limited effects on large nations.

Economic Crises Require Long-Term Involvement

——What kinds of policy implications can you draw from your study?

We must take comprehensive measures in the immediate wake of natural disasters because they produce extremely large adverse effects within short periods of time. In the meantime, we must involve governments in initiatives against economic crises for extended periods because their adverse effects continue over the long term.

——What future research are you planning?

Many catastrophes occur concurrently. An economic crisis occurred immediately after the Great Kanto Earthquake. In Africa, there were cases in which natural disasters caused economic crises, which further led to conflict. In the latest Great East Japan Earthquake, natural disasters also caused technological disasters, such as the nuclear power plant accident, which led to a major catastrophe. I must study the "mechanisms" behind these "combined" disasters more closely.

Insurance Markets in Developing Countries are Undeveloped

——Please tell us about your second paper, "Self-production, Friction, and Risk Sharing against Disasters: Evidence from a developing country." What were your motives for studying the relationship between disasters and the economy of a developing country in the paper?

(☞ http://www.rieti.go.jp/jp/publications/dp/11e017.pdf)

The Economic Impacts of Natural and Man-made Disasters and the Effectiveness of Insurance Mechanisms **SAWADA Yasuyuki**

A number of problems associated with risks have emerged in developing countries because of their undeveloped markets. These problems include the weak functioning of valid market mechanisms against "weather risks," or the risks of weather affecting the harvest of agricultural products that comprise a key industry in developing countries; "health risks," or the higher risks of infectious diseases and other health problems in tropical regions; and "contractual risks" attributable to weak legal foundations for contract enforcement in various economic transactions. Among these risks, natural disasters are particularly serious. Data for natural disasters by country show that the probability of an occurrence is the same for advanced and developing countries. Compared to developed countries, developing countries have insufficient central government policies and market functions, and these cause disasters to produce greater human and economic damage. To approach this problem, I wanted to study how disasters are related to economic welfare in developing countries on a micro level, in other words, from the perspectives of citizens and households.

——Why did you focus on risk sharing in self-production and consumption?

A significant number of studies had been conducted on whether consumption risk sharing is achieved by exchanging daily necessities such as food in a community; in other words, whether people living in a village actually help each other. Many papers on this subject have been published in leading economic journals. However, these studies did not set apart self-consumption that is essential in the farming regions of developing countries from total consumption. I thought that an explicit analysis of self-consumption through this research would significantly contribute to the prior studies because it is assumed to be a key factor for addressing risks independently in the farming regions of developing countries. In addition, very little prior research had analyzed risk sharing against natural disasters. I picked Vietnam for this study for several reasons. First, an outbreak of avian influenza, a serious natural disaster, caused enormous damage to the country. Second, Vietnam suffers from floods almost every year. The risks of natural disasters in general are high as indicated by its classification as Level 4, the second-highest risk group among the five natural disaster risk categories established by the United Nations International Strategy for Disaster Reduction (UNISDR), the UN agency responsible for disaster prevention programs.

——What are the characteristics of the data you used for analysis?

In selecting data, I felt that it must be representative of Vietnamese households. As such, I tried to expand on multi-purpose household survey data from the Vietnam Household Living Standard Survey 2006 (VHLSS 2006), which the General Statistics Office of Vietnam (GSO) conducted as a nationwide survey that year. For this study, we selected about 2,000 households, or all subject households in four representative regions of Vietnam, from those studied in the VHLSS 2006, surveyed them on items related to our study objectives at the beginning of 2008, and constructed panel data by matching the results with the VHLSS data. As our four survey regions, we chose one area that sustained serious damage from both avian influenza and flooding, one area each which sustained serious damage from avian influenza or flooding, and one

area which was lightly damaged by both. The ratio of self-consumption to total consumption averaged 40% in these regions, which are dominated by farming villages. We also distinguished self-consumption from consumer expenditure in both the VHLSS panel data and our self-procured data. With these steps, we prepared household panel data that showed how disasters affected consumption and income from 2006 to 2007. In preparing questions for the follow-up survey, we devised a way to show people's subjective probabilities of avian influenza outbreaks and floods, the amount they are willing to pay for buying and staying in a hypothetical disaster insurance program, and their risk tolerances, aiming to develop an understanding of contentions such as "people think natural disasters will not befall them before they occur," which are often discussed in behavioral economics.

Sharing Does Not Function in Geographically Extensive Disasters

——What did you find through your analysis?

We found that no mechanism of pooling risks for consumption risk sharing was present within the broad framework of a province, which comprised a subject area of our research. In other words, we can say that mutual assistance mechanisms are unlikely to form in response to geographically extensive disasters. However, risk sharing mechanisms appear to function well in units called communes, which are groups of smaller territories such as villages. Many of the earlier studies in India and Pakistan showed that sharing mechanisms do not function completely even within villages in developing countries. Through this study, we found the possibility that sharing may function within villages in a way that is supplemented by self-help, when a self-help approach to dealing with risks by adjusting self-consumption is taken into consideration. Our research also showed that the analysis results from the earlier studies arose from omitted variable biases of self-consumption variables. The second point is the substance of sharing mechanisms. We can think of various modes of sharing, including direct exchanges of actual goods, such as money and rice, and labor exchanges, in which another person performs agricultural work in place of a person unable to work. Through our analysis, we learned that the mechanism of risk diversification by means of money lending and borrowing is particularly important in Vietnam. The third point is a "commitment" to sharing. There is the theoretical possibility that spontaneous sharing mechanisms will not function when personal conditions are favorable, because under those conditions, a latent incentive for leaving mutual assistance mechanisms and offering no help to other people arises. However, our study found no support for this hypothesis in communes in Vietnam. I believe a strong relationship of trust that exists among people is one of the factors behind the effective operation of sharing mechanisms there.

——What kind of policy implications can you draw from the results of your second study?

Through this research, we found that sharing mechanisms worked well at the commune level, but they did not function over a broader space. Thinking about it, this is quite natural. We must support formal insurance market transactions to ensure that risk sharing functions properly across broader areas. A scheme called crop insurance, in which compensation is paid for crop failures, is one possible approach. However, traditional indemnity-based crop insurance is known to work poorly in developing countries because damage verification is difficult and costly. To deal with this problem, new "index-based" insurance programs have been designed with schemes such as insurance payment for total rainfall below a pre-fixed

threshold, using indicators outside human control, such as rainfall, as "indices." The World Bank and other international agencies are using these "index-type insurance programs" in pilot experimental programs around the world. The programs are also used in commercial insurance contracts in places like India. This kind of fresh thinking will be required going forward. Natural disasters cause incomes to shift dramatically. Yet it is difficult for people to build an informal pooling and sharing scheme against very significant risks that negatively affect large areas, such as avian influenza outbreaks and floods. For that reason, in the future, we must design schemes against natural disasters, such as index insurance. For some time now, a number of international organizations have been experimenting in collaboration with partners such as global reinsurance companies in an attempt to develop these schemes.

——What future research are you planning?

I would like to pursue projects designing actual insurance contracts with non-life insurance companies. I also hope to undertake carefully-designed experiments and econometric investigations to verify the effectiveness of insurance mechanisms.

Recovery and Reconstruction from the Great East Japan Earthquake Will Take a Long Time

——What policy implications can you draw on the economic effects of the Great East Japan Earthquake and reconstruction of quake-stricken areas in the future, based on the findings of your two studies?

I can say three things. First, natural disasters produce negative effects in the short term, but the effects prove positive in the long run. This is what we found through our first study. However, a closer investigation of the results caused by the type of natural disaster reveals that quake and tsunami damages make no contribution to economic growth over the long term. In the Great East Japan Earthquake, a tsunami destroyed entire towns. The adverse effects of this major quake will remain for an extended period because the physical damage will be so persistent. For that reason, recovery and reconstruction will require patient efforts over a very long time, in addition to short-term assistance.

Second, we must distribute our limited funds and resources to implement various policies in a level-headed way in order to keep the negative effects of this disaster to a minimum. We should always bear in mind the "biases" that may arise in the course of recovery and reconstruction, such as resource distribution limited to the political limelight and policy issues easily tackled. We need policy debate based on scientific evidence to achieve a "efficient and well-balanced distribution" of limited state resources. Gathering data that can serve as a basis for this debate is indispensable. Studies should prevent the debate from being too heavily influenced by political dynamics, playing the role of a "compass" for designing and executing policies.

Third, actively articulating the knowledge we created, sharing it within Japan and overseas, and turning it into an "global public good" are all extremely important. The damage to Japan from the recent earthquake was enormous. If too many people fall into a condition known in psychiatry as "disorientation," calm judgment becomes difficult, panic occurs, and society is thrown into turmoil. We must accumulate and share quality evidence to prepare ourselves for these situations and to draft better policies in the future.